Linking Water Science to Policy: Wastewater Treatment for Small Communities

A CCME sponsored workshop

February 11 and 12, 2003

Burlington, Ontario

CCME Linking Water Science to Policy Workshop Series: Wastewater Treatment for Small Communities

A workshop sponsored by the Canadian Council of Ministers of the Environment

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Workshop Context and Overview

The Canadian Council of Ministers of the Environment (CCME) provides a forum for federal, provincial and territorial governments to cooperate on priority environmental issues. Because of concerns about water quality and the value placed on water by Canadians, CCME has made water quality one of its top priorities.

One active CCME initiative is directed at ensuring that CCME members, and policy and decision makers in particular, are up-to-date on the latest science with respect to various water quality issues. CCME also wanted to provide an opportunity for its members to give input to the scientific community on water quality-related research priorities.

CCME identified an initial list of three priority areas for information exchange:

1. water quality impacts of agricultural practices;
2. groundwater quality; and
3. water quality issues related to water reuse and recycling.

A fourth priority area was subsequently identified in the theme of wastewater treatment for small communities.

It was agreed that Environment Canada's National Water Research Institute (NWRI), on behalf of CCME, would organize a series of workshops where leading scientists would be invited to present the latest science related to the above issues. The targeted audience would include CCME members' representatives, and other federal, provincial and territorial departments, as well as key municipal and industry stakeholders. The meetings would be designed to foster a two-way dialogue where policy and program personnel could get the recent science to help them make better decisions, and allow them an opportunity to help shape the research agenda based on their needs and priorities.

This is the report from the fourth workshop, held February 11 and 12, 2003, and co-chaired by Environment Canada's NWRI and Great Lakes Sustainability Fund, and the Ontario Ministry of the Environment. The workshop was attended by about 70 science and policy experts from provincial, territorial and federal departments, municipal government, universities, and professional and industry organisations. A tremendous success, these workshops have set the standard as a ground-breaking enterprise in building a substantive, much-needed and ongoing dialogue between the scientific and policy-making communities.

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In addition to the Canadian Council of Ministers of the Environment, Dr. John Carey of the National Water Research Institute, John Shaw of the Great Lakes Sustainability Fund, Claude Fortin of the Environmental Technologies Advancement Directorate, and the Standards Development Branch of the Ontario Ministry of the Environment were instrumental in providing supplemental funding to allow the workshop to proceed. Finally, no workshop would succeed without a cast of well-prepared, enthusiastic and knowledgeable speakers and panellists, and we are extremely grateful to them for their clear, concise and thoughtful presentations. We have attempted to capture the salient points of these presentations and the fruitful discussion that followed. Any errors or omissions are due to our oversight and not that of the workshop presenters or discussants.

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Executive Summary

Small communities across Canada are faced with difficult and often expensive decisions regarding the treatment and management of wastewater in their communities. This issue was one of four key issues identified by the Canadian Council of Ministers of the Environment (CCME) in their setting of nation-wide priorities for environmental issues.

To help focus attention on this issue and begin a dialogue, the CCME sponsored a two-day workshop in Burlington, Ontario on February 11 and 12, 2003. This workshop was co-chaired by the Ontario Ministry of the Environment and Environment Canada's National Water Research Institute and Great Lakes Sustainability Fund, and brought together a select group of invited professionals from across Canada and from abroad. The focus was on small communities with populations of less than 2000 and how they might provide effective wastewater treatment services. The target audience was not only CCME members but also the various federal, provincial, territorial, and local governments responsible for delivering, managing and regulating these services, as well as other stakeholders.

The key goals of the workshop were to:

- strengthen the linkage between policy decision makers and researchers or technology experts by:
  - providing federal, provincial, municipal and other decision-makers with the latest scientific knowledge and technical tools to shape their own program, policy and regulatory needs;
  - providing feedback to the science and research community on policy needs; and
  - identifying opportunities to sustain dialogue between these groups
- gain an understanding of problems with respect to wastewater treatment for small communities;
- learn about recent advances on treatment technologies, management and financial options;
- become aware of initiatives in other jurisdictions; and
- provide a forum and opportunity to exchange information, network and make contacts.

Water quality problems of small communities are amply illustrated by the large number of communities with failing or inadequate wastewater treatment systems. This situation arises for both communities with decentralized systems, as well as those with communal or central systems. Management of either of these scenarios is often a challenge either because existing regulations do not provide for the ability to manage them (e.g. on-site systems), or the community lacks the expertise. While many communities may consider or are encouraged to go to traditional central systems with extensive sewer networks and large treatment facilities, this is often prohibitively expensive.

Workshop participants identified seven key areas of need for small communities. These included:

- technologies
- management
- regulations
- financing
- training and education
- research
- coordination and maintaining dialogue

Technology Needs

Generally, there are many options for communities when it comes to appropriate and cost effective technologies for the treatment of wastewater. These range from simple on-site septic systems for individual homes to highly advanced treatment units for whole communities. While some systems are simply scaled-down ver-

sions of large city facilities, they are not always cost-effective solutions and technologies for smaller towns. System failure was generally due to poor design, lack of maintenance or inappropriate management. Given the remote nature of many small communities and the lack of local expertise, the need for solutions that were simple and with low operation and maintenance requirements was emphasised. Many new and innovative Canadian technologies with successful applications were discussed (e.g. ones that incorporated water reuse or used innovative materials). However, significant barriers to new technologies were recognized and should be overcome before these technologies become generally available.

To address these barriers, workshop participants identified the following small community needs:

- a consistent certification and approvals process for new technologies both within provinces and between provinces,
- continued effort in developing simple, low cost, low maintenance technologies,
- continued decentralized system awareness and education campaigns that highlight successes,
- improved information sharing on new available technologies,
- improved training of local wastewater practitioners in the installation, operation and maintenance of technologies,
- better guidance on the applicability of new technologies to their specific circumstances, and
- more testing and field pilot studies to demonstrate economically sound, environmentally responsible examples of decentralized wastewater systems to gain support and interest.

Management Needs

The importance of appropriate management of small community systems was identified as perhaps the greatest need. This was particularly true for individual on-site systems where management is generally left up to the individual homeowner. Although Nova Scotia (which has had wastewater management district legislation for over 20 years which some communities have used to manage private systems within their jurisdiction) and more recently Quebec, have enacted regulatory changes to address this particular problem, this was the exception. Problems also exist for larger systems, particularly those with more complex operational systems.

Probably the most important observation from this workshop was that if appropriate management systems are in place, in many instances traditional passive and low maintenance technologies will provide cost- and environmentally-effective service. Without effective management, both simple and complex technologies will usually lead to more failures and higher remedial costs.

To provide better management of decentralized wastewater systems in small communities, it is necessary to:

1. have management systems that are simple and effective; and
2. make better use of existing model management frameworks for on-site systems (e.g. Walsh *et al.*, 2001; USEPA, 2003) and ensure these are better disseminated and shared.

Some of the key features of these model frameworks include:

- encouragement of public consultation in implementing decentralized systems,
- involvement of the community throughout the process,
- long-term management strategies and financing, and
- responsibility for small systems taken by a central agency.

Regulatory Needs

Monitoring for compliance for both decentralized and central systems was identified as a key regulatory need. Regulation of on-site systems after construction is a significant problem in many areas because the present regulatory environment relies on the individual owner to be responsible for this. Homeowners often have an

"out of sight, out of mind" attitude and do no maintenance at all. Current regulations often discourage acceptance of new technologies, and changes are required if new technologies are to reach the marketplace sooner.

To accommodate the unique issues and needs faced by small communities, the following actions could be taken on the regulatory side:

- regulatory authorities give a higher priority to the needs of small communities, recognizing that they have fewer resources and less financial support,
- regulatory authorities consider giving small communities some flexibility in the application of regulations and standards, recognizing the site specific risk factors to human health and environmental quality,
- more emphasis be placed on performance requirements rather than prescriptive design/codes,
- regulatory authorities recognize decentralized systems and be willing to further explore and consider new technologies with limited performance data,
- implementation of effective enforcement of existing rules that seek compliance, not penalties, and
- regulatory authorities be given more authority to oversee system maintenance to ensure continued operation and maintenance of decentralized systems,.

Financing Needs

Current trends of fiscal restraint at all levels of government have led to the drying up of funds and grants for financing of new systems. This has led to neglect for capital upgrades of small systems and reluctance to try new technologies that may, eventually, save communities money.

Some delegates advocated the need to adapt infrastructure funding programs for small communities to make funding available for operation, maintenance and training. In order to finance small systems, options identified include:

- financial planning based on political, financial and social objectives,
- grants from senior levels of government,
- revolving funds,
- amalgamation of operations under regional operating authorities,
- contracting out of capital and/or operating activities to third parties (e.g. wastewater utilities), and
- developing public-private partnerships.

Research Needs

Canada benefits from a significant pool of highly qualified researchers focussing on wastewater issues for all sizes of systems. Key areas of research for small communities are:

- bio-solids management (including septage),
- pathogen removal from small and communal systems,
- economical and reliable methods for nutrient reductions in discharges to the environment,
- fate of pharmaceuticals and endocrine disruptors
- viable grey water and black water systems,
- waterless technologies,
- risks and causes of failure of traditional and advanced decentralized wastewater systems, and
- development and application of risk based performance codes.

Training and Education Needs

Training and education are key to the success of any program to improve wastewater treatment opportunities in smaller communities. Although organizations like the Centre for Water Resource Studies in Halifax and the Ontario Rural Wastewater Centre in Guelph offer a number of programs aimed at training and education in the on-site area, more is needed across the country and for all audiences. Specific needs include:

- consultants need to be trained to design low technology systems for small communities,
- public and regulators must be educated on the effectiveness of various new technologies,
- local operators have to be educated and trained on how to operate and maintain the systems such that they will not fall into disrepair once the consultants are gone, and
- funding is needed to finance education programs.

Coordination and Maintaining Dialogue Needs

Workshop participants started an important dialogue on the need for stronger coordination in the areas of research, alternative technology selection, evaluation, design, operation, maintenance and regulation, as it pertains to small wastewater systems in Canada. Improved coordination and sustained dialogue are critical for moving the industry forward. Specific needs in this area include:

- establishing a national forum to identify research needs and problems,
- developing a national protocol for evaluation and acceptance of new technology,
- improving linkages between provincial legislation and standards,
- creating a national infrastructure guide for best management practices,
- having one of the already existing national organizations whose focus is water quality take the lead in coordination efforts,
- follow up workshops and sessions at conferences for these groups, and
- use of electronic networking to sustain dialogue

Dialogue can be maintained in Canada through the establishment of an organisation similar to the U.S. EPA's National Small Flows Clearinghouse and the National Environmental Training Centres for Small Communities.

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Introduction

A major challenge facing small Canadian communities is provision of effective wastewater treatment services. Treatment facilities may range from individual septic systems loosely regulated by local or provincial/territorial government, to simple collection systems with a direct discharge to a surface water body, to municipal lagoons with seasonal discharge, to advanced tertiary treatment systems.

Recent events in North Battleford, SK and Walkerton, ON have heightened public awareness of the risks of contaminating drinking water sources. These tragedies have propelled a move toward more stringent environmental protection across Canada. Examples include the recent addition of ammonia to the Canadian Environmental Protection Act list of toxic substances, changes to the Ontario Safe Drinking Water Act, and changes to Quebec regulations of on-site systems, instituting, for example, mandatory tank pumping intervals. These evolving regulatory initiatives all place considerable responsibility and challenges upon small communities, who will be responsible for their implementation. Appropriate technologies that can be managed and maintained by the local community are required to meet these challenges.

This workshop was sponsored by the Canadian Council of the Ministers of the Environment (CCME) to allow government decision makers and industry stakeholders to discuss the latest scientific and policy issues related to wastewater treatment for small communities. It was intended that the workshop participants would:

- gain and contribute to an understanding of the problems and issues associated with wastewater treatment for small communities,
- share knowledge on recent advances in treatment technology, management and financing,
- share information on ongoing initiatives across Canada and in other jurisdictions, and
- provide feedback to the research community on policy needs.

To accomplish this, a select group of professionals were invited from across Canada, the US and Europe. This report is a summary of that workshop.

For the purposes of the workshop a small community was considered to be any community that could benefit from decentralised wastewater treatment options. This includes rural communities, cottage/fishing communities, isolated communities and fringe areas of urban centres where, due to geography or housing density, a local treatment option is most effective. The workshop began by defining a small community as one with a population less than 2000.

This report is a compilation of the presentations and subsequent discussions that took place over the two-day workshop. After a brief background of the general issues, specific issues and concerns for small systems are addressed. Topics range from community needs to research needs and how to sustain the important dialog begun here at the workshop. Case studies are highlighted throughout the text. The report concludes with initiatives in Canada and elsewhere.

Background

Two recent national surveys have identified over 400 small communities in Canada with central wastewater treatment facilities (MUD 1999; NPRI 2001). Although the definitions of small communities differed between these studies (1-3000 for MUD and 20-3000 for NPRI) and from the definition used at the workshop (<2000), they do provide a valuable background, demonstrating that the facultative lagoon is the predominant technology in use.

There are many small communities located in areas of Canada where it is impractical to have a large centralized treatment system with an extensive sewer network. Communal or individual on-site treatment systems are common in areas where large centralized treatment systems with extensive sewer networks are not available. Over time, due to lack of maintenance, poor design and old age, many of these systems start to fail - posing a threat to public health and the environment. These communities, which include both rural and northern communities, face a serious challenge when a failing system needs to be upgraded, expanded or replaced. A classic example is a small community developed on individual on-site (e.g. septic) systems that over time has expanded. With age, increasing water use in the home and increasingly restrictive codes governing the use of on-site systems, the wastewater treatment in the community fails to keep pace with such demands which can then present a threat to human health and environmental quality. The community is thus faced with an unenviable set of options to correct the problem.

In addition to the above situations, there are many instances of new developments located on the edge of

urban centres where it is not economically feasible to connect to large centralized treatment systems. At the other end of the spectrum are communities with no wastewater treatment facilities at all, and whose untreated wastewater discharges directly to ground or surface waters. These areas also need local, decentralized solutions for wastewater treatment.

To make the correct decisions that will lead to long-term solutions for wastewater treatment, many of these small communities require guidance on current trends in wastewater treatment technologies and on adoption of innovative management strategies. This is especially true now, as many are considering new or upgrading existing small communal treatment systems.

Objectives

The workshop addressed issues related to wastewater treatment technology options (system design, operation and maintenance requirements) and institutional issues and challenges (policy, regulation, financing and administration) for small communal wastewater systems. The broad-based objectives included:

- improve environmental protection and promote sustainable government,
- determine what is required to make small community systems run effectively and efficiently, and
- make use of the CCME as a forum for developing long-term strategies for small community wastewater treatment.

More specifically, the key goals of the workshop were to:

- strengthen the linkage between policy decision makers and researchers or technology experts in priority areas,
- provide a forum and opportunity to exchange information, network and make contacts,
- gain an understanding of problems with respect to wastewater treatment for small communities,
- learn about recent advances on treatment technologies, management and financial options,
- become aware of initiatives in other jurisdictions,
- provide feedback to the science and research community on policy needs, and
- provide federal, provincial and municipal decision-makers with the latest scientific knowledge and technical tools to shape their own program needs.

Issues and concerns for small systems in Canada

Small Community Needs

Small Canadian communities face serious barriers and challenges associated with wastewater treatment. Many factors contribute to inhibiting the capacities of small communities to develop, operate and maintain wastewater treatment systems. These include social issues and community buy-in, small local economies and tax bases, lack of sufficient knowledge, trained personnel and local servicing expertise.

To overcome these challenges and make wastewater treatment systems sustainable in small communities, it is necessary to be able to accommodate their unique needs.

Small community needs as identified at the workshop included:

- appropriate **technologies** that are simple to operate and maintain, involve residents and take cultural needs into consideration,
- consistent and simple **management** approaches,
- clear **regulations**, the capacity and flexibility to meet regulations, and a willingness on the part of the regulatory bodies to accept new technologies,
- assistance to help overcome **financing** problems,
- improved **public awareness** of the threats of inadequate wastewater treatment on the environment and quality of life,
- proper **training** for operators, installers and other industry professionals to maintain the systems,
- **research** needs,
- **coordination** between parties including communities, consultants, regulatory authorities, and
- **dialogue** to be maintained between scientists and policy/program managers.

All of these needs are interdependent and need to be dealt with in an integrated manner. For example, one key observation was that if appropriate management systems are in place, in many instances traditional passive and low maintenance technologies will provide cost- and environmentally-effective service. Without effective management, both simple and complex technologies will usually lead to more failures and higher remedial costs.

Each of the above items is discussed in further detail in this report.

Technologies

Throughout the world various decentralised system technologies are commonly used to treat wastewater. These technologies can be divided into two broad categories: mechanical and natural treatment systems. Examples of these systems include: aerobic treatment units, trickling filters, lagoons and constructed wetlands, activated sludge plants and membrane separation plants. **Aerobic treatment units** pump air through the wastewater to feed a consortia of bacteria of which the majority are aerobic. These systems include rotating biological contactors (RBCs) as well as a series of proprietary on-site wastewater technologies. **Trickling filter** systems use a variety of media to support aerobic bacteria. Wastewater trickles through an unsaturated media and is degraded by aerobic bacteria existing on the media surface. The traditional leaching bed is the classic example of a trickling filter; however, there are many other technologies including recirculating sand filters, alternative media filters (i.e. Waterloo Biofilter®), and peat filters. **Lagoons** are generally earthen reservoirs in which effluent is stored and treated for various periods of up to one year. They are a common technology to treat wastewater from small communities. Constructed wetlands are being used as a polishing step for lagoons to improve the effluent quality by the action of natural aeration, plant evapotranspiration, increased microbial degradation of pollutants and soil interactions. **Activated sludge** is the common treatment option in which sludge is recycled back to the aeration tank with the incoming wastewater. More commonly used for large municipalities, it can be scaled down for small communities. Upcoming technological developments include the use of membrane separation to optimise treatment processes and to increase capacity at existing facilities (e.g., ZENON Environmental Inc.).

Recent Austrian experience has shown that **sequencing batch reactors (SBRs)** (also used in North America and increasingly used for small communities), which are fill-and-draw type reactor systems involving one or more reactors, can provide one of the best options for small communities compared with the more traditional lagoon and soil filter technologies. It was found that the major operating costs of SBRs were labour costs (more than 50%). Sludge management and disposal costs were also reduced.

In general, small Canadian communities do not have the expertise and resources to operate complex wastewater treatment systems (e.g., mechanical activated sludge systems). More often that not, complex wastewater treatment systems and on-site systems implemented in these communities end up failing or falling into a state of disrepair due to factors such as inappropriate management, poor design and lack of maintenance. This results in small communities being left with little to no infrastructure to deal with their wastewater problems. Due to so many failed on-site systems, regulatory agencies are reluctant to accept new, innovative designs and technologies. In some cases, regulatory reluctance to accept unproven technologies, it may be argued, has shaped public perception that decentralized technologies fail to treat wastewater sufficiently to protect public health and the environment.

Small Community Wastewater Systems Defined

On-site Systems: One of many types of technologies in which the wastewater is treated and returned to the environment at the location where it is generated (i.e., without use of community-wide sewers or centralised treatment). Most commonly a septic system for a single home but can be a more advanced treatment facility.

Cluster and Communal Systems: Small systems connecting small neighbourhoods of homes (typically less than 100) using alternative collection systems (e.g., STEP, small diameter sewers, pressure and/or vacuum systems) with a central facility to treat wastewater. Effluent disposal may be sub-surface or direct surface discharge after treatment.

Decentralized Systems: An on-site or cluster system that is used to treat and dispose of relatively small volumes of wastewater, generally from individual or groups of dwellings and businesses that are located relatively close together.

Central System: Collection, treatment and disposal systems for entire communities. Typically use large diameter gravity sewers and after treatment discharge to surface waters.

To ensure proper wastewater treatment, thereby reducing the potential threat improperly maintained systems pose to human health and the environment, appropriate, simple systems with low operation and maintenance requirements/costs are needed. For these technologies to be sustainable, they have to be site specific to receiving environments and communities, involve residents in their design and operation, and consider cultural needs of the communities.

There are a growing number of treatment technologies, some of which are new and innovative, that can be applied towards decentralized wastewater treatment in small communities. These wastewater treatment systems have been proven to suit small rural

communities due to their ability to produce high effluent quality, requirement of low operation and maintenance costs and need for a low level of service expertise. These technologies include re-circulating sand filters, lagoons, synthetic medium filters, and peat systems. In order for innovative, new technologies to be implemented it is also vital that treatment performance data be sufficient to demonstrate the consistent long-term performance to convince regulatory authorities that the treatment systems are protective of public health and the environment.

Alternative sewage collection systems (not a primary focus of this workshop) should also be considered in remote or low population density areas, particularly where there are low temperatures, frost heave, rocky conditions close to the surface (e.g. in the Canadian Shield) or permafrost. One such system recommended by Ontario, for its greater affordability under the above adverse conditions, is the STEP (Septic Tank Effluent Pumping) System. The STEP system is a type of low pressure and small diameter (also known as "small bore") sewage collection system using the on-site septic tank and a grinder pump to convey sewage to a central treatment system. Design details for the use of this system can be found in OMOE (1985).

Barriers to the use of new technologies in small communities mainly revolve around a lack of awareness of new or proven technologies, limited financing, regulatory bodies not being convinced as to the long term performance of new technologies and a lack of guidance and expertise to help small communities select appropriate technologies.

To address these barriers, small communities need:

- a consistent certification and approvals process for new technologies both within provinces and between provinces,
- continued effort in developing simple, low cost, low maintenance technologies,
- continued decentralized system awareness and education campaigns that highlight successes,
- improved information sharing on new available technologies,
- improved training of local wastewater practitioners in the installation, operation and maintenance of technologies,
- better guidance on the applicability of new technologies to their specific circumstances, and
- more testing and field pilot studies to demonstrate economically sound, environmentally responsible examples of innovative decentralized wastewater systems to gain support and interest.

All of the above are directed at providing small communities with wastewater systems that provide satisfactory performance: that is, systems providing a long-term achievement of the specified performance criteria with suitable redundancy/backup systems and are supported by reliable system testing.

CASE STUDY - Lagoon systems

Lagoon systems are long term storage basins relying on sedimentation and facultative degradation of wastewater. Their use was first practiced in China roughly 1000 years ago, and in Canada in the 1940s. Today, roughly 80% of treatment facilities in Alberta are lagoon systems.

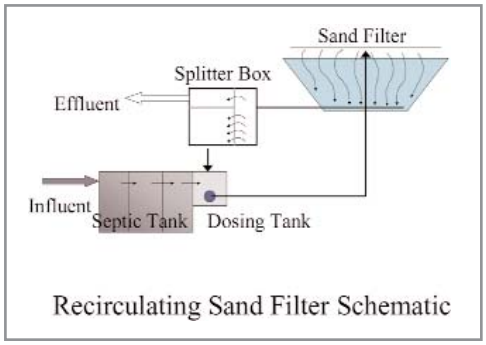
Shallow lagoons (<1.5 m) may be used for primary treatment (6-20 days) while deep lagoons (3 m or more) provide long-term storage and facultative treatment (6 months - 1 year. Lagoons have substantially larger area requirements but can produce effluents equivalent to (in some cases) mechanical treatment plants with substantially lower operation and maintenance costs. The construction costs (land, excavation, soil clay content) as well as sludge removal and treatment will determine the cost effectiveness of lagoon system technologies. For many rural areas with low land costs, lagoon systems are likely to be the most cost effective option.

Management Issues

Decentralized wastewater management often involves the planning, implementation and operation of a variety of wastewater systems (collection, treatment, reuse and/or disposal) to most effectively manage wastewater flows as close as practical to where the wastewater is generated. This can include residential on-site systems, cluster or communal systems as well as areas connected to the centralised sewer system. The USEPA noted in its Response to Congress on Use of Decentralized Wastewater Treatment Systems (1997), "Few communities have developed organizational structures for managing decentralized wastewater systems, although such programs are required for centralized wastewater

CASE STUDY - Recirculating Sand Filters

Filters are often used in areas where the soil is too shallow or too permeable to allow the use of conventional septic tank + leach bed systems. In a filter system, effluent is typically pre-treated in a septic tank and then flows, or is pumped, over a bed of sand under which is a drainpipe collection system. Recirculating systems are those in which the septic tank effluent is discharged to a recirculation tank, in which the raw septic tank effluent mixes with the recycled filtrate from the sand filter. A portion of the return filtrate discharges to the disposal system, while the majority is pumped back up to run through the system for further treatment.



Recirculating Sand Filter Schematic

The experience in Wisconsin suggests that small communities successfully achieve high levels of treatment and nitrify wastewater during treatment with recirculating sand filters (RSF) under both summer and winter conditions. Experience with the RSF has proven that it is a low maintenance, trouble-free wastewater treatment technology ideally suited for small, rural communities. Design elements such as pumping cycles, recirculation rate, media gradation and distribution schemes are critical to final performance. Experience over the past 20 years in Wisconsin proves the popularity of the RSF with local governments and regulatory agencies, and it is argued its application will only increase in the future.

facilities and for other services (e.g., electric, telephone, water, etc.)." Decentralized systems, when effectively managed, have been demonstrated to protect public health and the environment and provide long-term solutions to wastewater needs in small communities.

Management of wastewater treatment infrastructure is critical to reliable system performance, no matter how simple or advanced the technology. Unfortunately, there has been little management of residential on-site systems which are typically governed by prescriptive codes defining design and installation standards. Ongoing inspection and maintenance are typically left to the homeowner, who often fails to inspect the system or have the tank pumped. This has resulted in a high failure rate of residential on-site systems and has often forced communities to subsequently construct costly centralised sewer systems.

Small communities in Canada were, until recently, able to construct centralized systems with large grants from senior levels of government, often up to 80% of the capital costs. Costs can exceed $50,000 per connection. However, many small communities lack both the revenues to operate and maintain these facilities once they are constructed and the expertise to manage the treatment operations properly. Effective management would enable small communities to be aware of their alternatives, make educated decisions, select suitable options and ensure long term operation and maintenance of the systems.

The North American Onsite Wastewater Recycling Association (NOWRA) has developed a model framework for management of decentralised systems. The seven essential items include (Walsh *et al.*, 2001):

- performance requirements, as opposed to prescriptive codes, that protect human health and the environment,
- system management to maintain performance,
- compliance monitoring and enforcement,
- technical guidelines,
- education and training,
- certification and licensing for all practitioners, and
- program reviews.

The items in the model framework have generally not been applied to residential decentralized systems in Canada and there is often a lack of sufficient financial resources and expertise to manage communal systems in many remote communities properly.

Some jurisdictions are developing initiatives in this area, but generally these examples are few. For example, the management of residential decentralized systems in jurisdictions across Canada has been, until recently, left in the hands of the homeowners. Nova Scotia is working with the septic system industry, municipalities and communities to explore management options for on-site systems and is investigating, among other options, a program to correct malfunctioning on-site systems, the cost of which has been

estimated at $81M. Some jurisdictions in Ontario (Township of Archipelago, Lake of Bays Township, Town of Gravenhurst) have also established on-site system inspection and mandatory tank pumpout regulations (MMAH, 2001) while the Province of Quebec has regulated a mandatory septic tank pumpout every 2 years. Other jurisdictions such as the Township of Langley, B.C. have instituted discharge levies for on-site systems to assist in management of these systems as well as to finance education and source water protection programs in those areas with high risk factors (Stjepovic *et al.* 2003).

Unexpected management issues relating to wastewater treatment for small communities can be created by spin offs from other, seemingly unrelated, decisions. An example cited by one participant is a program providing support to First Nations families to encourage "traditional" activities. In the case of the James Bay and Northern Quebec Agreement (1975) this takes the form of support for family units that remain outside their communities for extended periods, typically six to nine months. This is usually spent at a traditional hunting camp with only rudimentary sanitary sewage facilities – typically a pit privy. When these were used by small numbers of people for limited periods in the year, the systems adequately protected the environment. With extended use, and in some cases use by large numbers (over a hundred individuals), during times when the ground is still frozen, the systems clearly cannot work and represent a significant health hazard.

Capital funds to construct new systems have traditionally been easier to secure than operational funding, particularly in isolated communities with eroding tax bases due to the rural exodus. In addition to securing adequate operating funds, finding qualified system operators is a common problem faced by small communities. Hence, besides residential on-site systems, lagoon systems are the prevalent wastewater treatment technology across rural Canada because of low operating and maintenance requirements. In smaller communities in Alberta, wastewater lagoons were found to produce consistently excellent effluent quality in a cost efficient manner. In Nunavut, almost all systems are lagoons built in permafrost.

Mechanical systems in small communities which require high levels of expertise to operate have tended to fail. There is no proven mechanical technology for the North where extremely cold weather and lack of communication makes the operation and maintenance of mechanical systems extremely difficult. Problems with the operation of small mechanical systems have been widely experienced in Newfoundland. Relatively passive systems would seem to offer a better alternative. For example, peat filter / constructed wetland systems were found to be an appropriate low cost / low maintenance system for coastal communities in Labrador

The key barriers to suitable, consistent management include public perception of decentralized systems, mistrust of engineers and authorities that exists in

CASE STUDY - Colchester County

This case study was particularly illustrative of the planning challenges (management, technical and regulatory decisions) facing small towns that have to decide between developing small, individual, communal wastewater systems and piping effluent to a larger municipality's central treatment system.

The Municipality of the County of Colchester, Nova Scotia owns and operates four wastewater collection and treatment systems. The Central Colchester system was upgraded in 1995 and eliminated four small STPs and 11 outfalls that once discharged raw sewage directly into Salmon River and the Cobequid Estuary.

Three other small systems are located in the communities of Brookfield, Great Village and Village of Tatamagouche. These systems are currently overloaded and upgrading or replacement has become a high priority. The Brookfield STP has recently been replaced by a new facility that utilized an innovative design-build approach for construction that provided various design options to the Muncipality with minimal engineering costs. The STP servicing Great Village is under construction now and will incorporate components of the decommissioned Brookfield plant. Finally, complete replacement of the Tatamagouche STP is expected to occur during 2004. It is interesting to note that the planning process for the Municipality's new STPs also examined the viability of extending sewer services to areas where failing on-site septic systems was probable. Prior to the design of these STPs the Municipality went through a planning exercise and determined that it was too expensive to extend the central sewer system to Brookfield and it was more economical to use the old Brookfield plant for Great Village without expanding the sewer boundaries since the on-site systems in Great Village are functioning well. The Municipality is in the process of expanding its sewer services in Brookfield because of failing on-site systems.

many of these communities, low level of expertise, lack of long-term performance data of decentralized technologies to convince regulators, and limited financing, which favours traditional systems.

To provide better management of decentralized wastewater systems in small communities, it is necessary to:

- have management systems that are simple and effective; and
- make better use of existing model frameworks for decentralized systems such as those developed by the North American Onsite Wastewater Recycling Association (Walsh *et al.*, 2001) and the U.S. EPA's Voluntary National Guidelines for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems (USEPA, 2003) and ensure these are better disseminated and shared.

Some of the key features of these model frameworks include:

- encouragement of public consultation in implementing decentralized systems,
- involvement of the community throughout the process,
- long-term management strategies and financing, and
- having a central agency take responsibility for small systems.

Regulatory Issues

Regulatory oversight is divided between the province for larger systems (greater than 10,000 L/day in Ontario for example) and the municipality (e.g. through the building code or public health department) for residential on-site systems. Typically, residential on-site systems have been regulated by prescriptive codes that seek to ensure a compliant system is installed, but actual performance monitoring is neglected. In some provinces/territories, regulatory bodies do not have the capacity or authority to oversee system performance or operation and maintenance of residential on-site systems. There also seems to exist reticence on the part of the regulatory bodies to recognize decentralized systems and to accept new technologies, in part due to the lack of sufficient long-term performance data. Larger systems using conventional technologies typically have more modest, monitoring requirements to demonstrate compliance with regulations in comparison to smaller systems using newer technologies.

With few resources and finances available, many small communities frequently do not have the capacity or expertise to meet new or existing provincial/territorial wastewater standards and regulations.

There is a general feeling from remote parts of the country that discharge regulations are not achievable due to financial constraints and that the regulations, which may be appropriate for densely populated areas, are not always appropriate for remote, sparsely populated areas. For example, in Newfoundland, $4 billion (equivalent to the entire Provincial budget) would be required to install secondary sewage treatment plants. Some participants felt that current regulations are too strict and do not properly account for risk considering the use and attenuation capacity of the receiving water body. Traditionally, discharge criteria for communal systems have been based on end of pipe concentration limits, while it might be more appropriate to base them on total maximum daily loads (TMDLs). Outfall concentrations ranging from 20-120 mg/L BOD_5 have been suggested depending on the receiving body (stream, lake, and ocean) and water uses (aquaculture, fishing, recreation, drinking water intake). In Newfoundland, a policy of decommissioning sewage lagoons and increasing the length and depth of sewage outfalls into the ocean is viewed as a reasonable management strategy for isolated small coastal communities.

In the Northwest Territories, a major issue is the native right to self government and the implications upon ownership and management of wastewater treatment facilities. Cost, consequences and seriousness of non-compliance to effluent discharge limits often do not reflect the low level of risk associated with the discharge to human health or to the environment. A similar view was held in Nunavut. Enforcement of stringent discharge requirements for lagoon systems when there is little perceived risk to the environment and human health has been a source of disagreement between the various regulatory authorities.

In Ontario, private developers must sign a responsibility agreement with the municipality in order to install a communal system. This has the advantage that the municipality can stipulate appropriate bonds, reserve funds, and management of the system and guarantees the province that the system will not be abandoned should the developer run into financial difficulties. However, this policy also discourages the implementation of communal systems in cases where the municipality is not willing to take on the risk.

The inclusion of ammonia into the Canadian Environmental Protection Act list of toxic substances will affect wastewater treatment plants

CASE STUDY - Wastewater Reuse

An example of innovation in small-scale systems is the concept of wastewater reuse. Wastewater recycling systems may reuse up to 55% of the wastewater stream for non-potable uses such as toilets and laundry and may reduce capital costs by 30 - 40 %.

Immediate reuse of treated sewage for toilet flushing occurs in several Canadian Arctic communities where water supply is expensive, in a large Ontario truck stop where groundwater supplies are limited, and in a Vancouver condominium, which halves the water load on the sewer. In a common system, sewage passes through a septic tank, Waterloo Biofilter, sand filter and ozone disinfection and then to the storage tank for reuse.

Although approval status for residential applications has not been obtained, trial operations in N'Dilo, NWT and Iqualuit are progressing towards approved operational status. Although the major feature of this system is the ability to reuse water in a water scarce environment, the ability to manufacture the bulk of the system in a central facility before being installed in remote locations is a highly desirable characteristic. It also demonstrates the viability of reuse at a small scale when it is generally only seen as viable at much larger scales.

Wastewater reuse represents a viable option to deal with wastewater problems in many small communities. The CCME have sponsored an entire workshop on reuse of wastewater and can be found at: *www.ccme.ca/sourcetotap/workshops*

greater than 10,000 m^3/day[1]. This legislation could create jurisdictional conflicts between the provincial and federal governments, as the provinces are currently responsible for the regulation of wastewater treatment plants.

The implementation of sustainable wastewater systems in small communities faces many barriers when it comes to regulatory issues, including lack of capacity and/or expertise to meet standards as well as lack of oversight and acceptance of new innovative technologies by regulatory bodies with limited performance data.

To accommodate the unique issues and needs faced by small communities, the following actions could be taken on the regulatory side:

- regulatory authorities give a higher priority to the needs of small communities, recognizing that they have fewer resources and less financial support,
- regulatory authorities consider giving small communities some flexibility in the application of regulations and standards, recognizing the site-specific risk factors to human health and environmental quality,
- more emphasis be placed on performance requirements rather than prescriptive design/codes (though this will generally require additional resources on the part of the regulator to administer),
- regulatory authorities recognize decentralized systems and be willing to further explore and consider new technologies with limited performance data,
- consider implementation of effective enforcement of existing rules that seek compliance, not penalties, and
- regulatory authorities be given more authority to oversee system maintenance to ensure continued operation and maintenance of decentralized systems.

Financing

Residents in small communities typically have much lower annual household incomes than urban dwellers and often cannot afford the annual user fees to repay loans and the upkeep of a conventional wastewater collection and treatment facility. This dearth of financing capacity usually results in an inadequately funded facility falling into disrepair. As a result, when upgrades are necessary, local funds are not available and grant and loan programs must then be relied upon, reducing the benefit that public financing programs can have on improving sanitation in small communities.

Decentralized treatment systems can reduce capital costs of a public facility and reduce operating and environmental costs. Unfortunately, intensive use of decentralized systems often triggers central wastewater facility planning, and they are seldom evaluated as a permanent solution. This is because on-site systems have not been managed to meet water quality goals over reasonable system lives. These systems need to become widely accepted and considered a viable option for small communities.

The cost of collection systems/sewers is often very high for small communities who have limited capacity to generate sufficient revenues; user fees and full cost pricing, which are important for sustainability. The

1. This has recently been changed to 5,000 m^3/day

CASE STUDY - Peat systems

Innovative systems take on many forms. Peat is an increasingly commonly used medium for a type of trickling filter. These peat filters are used in both small individual home systems (e.g. the Premier Tech Ecoflo system) and for larger facilities and communal systems (e.g., PeatLand Systems). In peat systems, effluent from the septic tank is discharged evenly over an engineered peat bed. The peat filter provides an aerobic environment for bacteria and the structure of the peat holds effluent in capillary pores, permitting good wastewater retention in the filter. The acid nature of peat provides a level of disinfection. The effluent from the peat filter is collected and discharged into a conventional leaching bed system, allowed to infiltrate into the ground under the peat, or sent through a small subsurface wetland.

standards set by new legislation (e.g., Nova Scotia - Sewage Management Strategy, Ontario-Sustainable Water and Sewage Systems Act, 2002) will likely lead to higher financing requirements which may be beyond the ability of small communities to manage.

Provincial regulations are increasingly requiring municipalities to implement full-cost accounting of municipal services, including wastewater treatment. In the past, systems have been operated partially out of property taxes, and capital expenditures have to a large extent been covered by grants from senior levels of government. In many municipalities sewer use fees are not sufficient to cover facilities operation and maintenance, and reserve funds for system replacement. Most households in Ontario pay between 1-3% of household income for sewer services, while up to 5% is considered a reasonable amount. Typically, to attain the appropriate level of financing: sewer use fees will have to increase to cover the shortfall; innovative public-private arrangements will need to be pursued; or senior levels of government will have to transfer income tax dollars to municipalities.

Small communities face many barriers when it comes to financing small systems including low household incomes, downloading of services from the provincial to municipal level, high costs of collection and waste management systems, lack of financing to meet the high standards being set, and lack of acceptance of new, low-cost technologies.

Some delegates advocated the need to adapt infrastructure funding programs for small communities to make funding available for operation, maintenance and training. To finance small systems, options identified included:

- financial planning based on political, financial and social objectives,
- grants from senior levels of government,
- revolving funds,
- amalgamation of operations under regional operating authorities,
- contracting out of capital and/or operating activities to third parties (e.g. wastewater utilities), and
- development of public-private partnerships.

Research Needs

A great deal of expertise in wastewater treatment systems is available in Canada and internationally. This expertise is in academic settings as well as engineering design offices and companies selling and developing new technologies.

New regulations can have the impact of creating the need for additional research. For example, new limits on the application of biosolids and septage to agricultural lands are forcing communities to develop plans for their treatment. Existing approaches often do not meet the economic and geographic requirements of communities and new methods of treating these components of any wastewater stream are needed.

More research and pilot studies need to be conducted to evaluate wastewater alternatives for small communities: for example in areas such as

- bio-solids management (including septage),
- pathogen removal from small and communal systems,
- economical and reliable methods for nutrient reductions in discharges to the environment,
- the fate of pharmaceuticals and endocrine disruptors
- viable grey water and black water systems,
- waterless technologies,
- risks and causes of failure of traditional and advanced decentralized wastewater systems, and
- development and application of risk based performance codes.

Training and Education

Small communities generally lack the expertise and resources to operate and maintain complex wastewater treatment systems once they are put in place. Workshops speakers indicated that there are many new, low cost technologies and potentially more effective treatment options available to small communities. Unfortunately, most people are unaware of these alternatives. This lack of awareness causes a barrier resulting in public perception that decentralized technologies fail to treat wastewater adequately to protect public health and in regulatory bodies unwillingness to accept new and unproven technologies.

The main barrier to provision of adequate training programs for small communities is inadequate financing for education programs that would help to increase awareness, foster acceptance of new technologies, and increase the number of qualified people who will be able to operate and maintain the systems.

For acceptance of new technologies and long term sustainability of decentralized systems to occur, performance data along with education and training in all sectors of the decentralized industry including public, regulators, designers, consultants, operators and managers are necessary.

Specific education and training needs are defined as:

- consultants need to be trained to design low technology systems for small communities,
- the public and regulators must be educated on the effectiveness of the various new technologies,
- local operators have to be educated and trained on how to operate and maintain systems so they will not fall into disrepair once the consultants are gone, and
- funding is needed to finance education programs.

Coordination and Sustaining Dialogue

A lack of coordination exists in areas such as research, alternative selection, evaluation, design, operation, maintenance and regulation of wastewater systems for small communities. In Canada, this is partly due to the fact that there is no central organization responsible for the coordination of small systems. This poses a barrier to the success of systems in small communities. In the U.S., the Environmental Protection Agency acts as the central coordinator for small-scale systems by providing management, guidelines and sponsorship of organizations such as the National Small Flows Clearing House (see Information Sources Text Box for this and other URLs for information) and the National Environmental Training Center for Small Communities.

The major barrier to coordination within the industry is the lack of a central organization responsible for small community wastewater systems. There is a similar lack of coordination at the provincial level, with responsibility for decentralized systems divided between two or more ministries at the provincial level (i.e. between the Ministries of Municipal Affairs and Housing and Environment in Ontario), with shared responsibility with local governments to approve and in many cases operate communal systems.

Maintaining the dialogue between scientists and policy/program managers in the small community wastewater industry is vital. Bringing the most current scientific knowledge to decision-makers is critical for development and implementation of sustainable wastewater technologies for small communities.

The previously mentioned examples of coordinating information in the U.S. (National Small Flows Clearinghouse and National Environmental Training Centers for Small Communities) are but two examples of models by which the dialogue can be maintained. Periodic national conferences are another example that can be drawn from the U.S. The annual conference sponsored by National Onsite Wastewater Recycling Association and the conference held every 3 years by the American Society of Agricultural Engineers for Small Community Systems are two further examples that draw all the interested personnel together to keep a sustained dialogue going.

Beyond these organizations, which are frequently aimed at soil treatment or soil disposal within individual systems, there is a need to bring together civil engineers, plumbers' associations and municipalities, to design small collection systems, disinfection systems, and plumbing and irrigation systems.

It is also important for dialogue between communities and regulatory authorities to be sustained. For this to happen, residents in small communities must become active participants in the planning of wastewater infrastructure by articulating their vision of what they want their community to be and what the priority of improved wastewater treatment is to be.

Better coordination and sustained dialogue could result in initiatives that would prove to be highly beneficial to the industry including:

- an ongoing national forum to identify research needs and problems,

- a standard national protocol for the evaluation and acceptance of new technology,
- better linkages between provincial legislation and standards,
- a national infrastructure guide for best management practices, and
- a Canadian organization such as the Water and Environment Association of Ontario, Canadian Water Resources Association, Canadian Society of Civil Engineers, or Environment Canada could take the lead in the coordination effort,
- stronger representation/involvement from building and plumbing inspectors, civil engineers and municipalities,
- follow up workshops and sessions at conferences for these groups
- use of electronic networking to sustain dialogue

Canadian Initiatives

Two Canadian initiatives discussed at the CCME workshop were the Centre for Water Resource Studies (CWRS) and the Ontario Rural Wastewater Centre (ORWC). Both of these centres are involved with on-site wastewater activities including research, education and training. Results from research conducted by the CWRS and ORWC have been presented in courses, conferences, reports and papers. Limited funding is available for the development of these types of Centres.

These Centres have established leadership positions in their respective regions. However, since they both operate on a cost-recovery basis their ability to provide long-term leadership on a larger scope is limited.

Centre for Water Resource Studies

The CWRS was established at the Technical University of Nova Scotia (now the Faculty of Engineering, Dalhousie University) in 1981. Its mandate is to undertake applied research and technology transfer that address water related problems of particular concern to Nova Scotia and Atlantic Canada.

This organization is supported by provincial and federal agencies including NSERC and Central Mortgage and Housing Corporation.

Some of their technology transfer activities include offering various on-site courses in the Maritimes and workshops for local and national audiences including professional engineers, planners, designers and regulators.

The CWRS is currently developing a field research, demonstration and testing site. Research conducted at the testing site will initially focus on the performance of sloping sand filter systems that are the basis for new and remedial systems specified in the Nova Scotia Guidelines.

Ontario Rural Wastewater Centre

The Ontario Rural Wastewater Centre was created in 1999 by the University of Guelph (Collège d'Alfred and the School of Engineering) in partnership with the Rideau Valley Conservation Authority and many industry and government stakeholders. The mission of the ORWC is to promote environmentally sustainable development of rural and unsewered areas through the effective use of wastewater treatment technologies.

Information Sources

Canadian Water Resources Association
www.cwra.org

Canadian Society of Civil Engineers
www.csce.ca

Ontario Rural Wastewater Centre
www.orwc.uoguelph.ca

Centre For Water Resource Studies
www.dal.ca/~cwrs/index.html

National Onsite Wastewater Recycling Association
www.nowra.org

National Small Flows Clearinghouse
www.nesc.wvu.edu/nsfc/

National Environmental Training Center for Small Communities *www.nesc.wvu.edu/netcsc*

American Society of Agricultural Engineers
www.asae.org

US Environmental Protection Agency
www.epa.gov/owm/onsite

Electronic Journal of Cold Region Technology
www.members.shaw.ca/cryofront/cryofront.htm

The ORWC provides training, demonstration and applied research in the areas of residential on-site, communal and agri-food wastewater management. In the past 4 years, the ORWC has presented over 50 workshops and short courses to over 1500 participants.

The Centre has demonstration sites in central and eastern Ontario. The sites offer a wide variety of

wastewater courses utilising demonstration technologies to provide a true hands-on learning experience.

The ORWC is currently conducting research involving natural systems, septic systems, nutrient removal, membrane technologies and biosolids application. Like the CWRS, they are also in the process of developing a full-scale field research and testing facility.

Experiences Elsewhere

The U.S. has a long history of wrestling with wastewater treatment options for small communities. As noted by one speaker, the common sequence for a small, rural community is to begin development with individual on-site systems. With time the systems begin to fail and concern rises about public health. Sewers are installed leading to a central wastewater treatment plant. The cost of the installation is generally highly subsidised by upper levels of government. Operation and maintenance are left to the community, which struggles with the high costs that are generally not covered by upper levels of government.

Europe is a very diverse region of different states, cultures and economies resulting in different social and environmental concepts from country to country. This results in every country having its own effluent standards, which in turn leads to different technological solutions from place to place. The European Union does not address wastewater treatment in communities with less than 2000 inhabitants; in many countries legislation requires only solids and carbon removal.

Simple, yet reliable designs are of great importance for small plants. During the planning phase, the need for high quality operation and maintenance is often overlooked - the quality of effluent will be only as good as that of the operation. With respect to cost, reliability and sustainability experience in Austria shows that sequencing batch reactors are the best option for small sites.

Additional costs to be considered in the United States and Europe are sludge treatment and disposal or reuse. If sludge reuse in agriculture is not possible in a given region, centralized wastewater solutions may be cheaper for small communities.

Summary

The treatment of wastewater and management of the facilities are major concerns for small communities throughout Canada. What was clear from the workshop was that while many communities are facing similar problems, there is a considerable improvement needed in the way communities deal with these problems. Problems include a lack of financial resources, poor information on available technologies, and a need for proper coordination among the various groups such as provincial and territorial governments, professional groups such as engineers and other designers, and municipal governments.

A clear message from workshop participants was that the public needs to be involved in any solution for wastewater treatment in small communities. This begins with an improvement in public awareness that poorly treated wastewater poses a real threat to local environmental quality and public health, and results from poorly operated systems and over- taxed old systems, as well as occurring in areas where no treatment exists. Public health can also be threatened by poorly maintained systems, even those designed with the latest technological advances.

Finances are a key constraint for most small communities. Financial incentives, whether by provincial or

CASE STUDY - Wastewater Treatment in the Canadian North

An example of the challenges faced by northern communities is the lagoon system in Grise Fiord, Nunavut.

Grise Fiord, Nunavut is an Inuit community of approximately 140 people with an economy based on hunting, trapping and artwork. It is one of 26 isolated communities in Nunavut with an average population of 1200. Many unique factors had to be considered when evaluating options for a small wastewater system including limited construction area, limited construction materials, high construction costs, extreme climatic conditions including permafrost, limited construction window (2-3 months) and the desire to use local construction resources. An additional hurdle in the far north are designers' lack of experience with cold climate systems and the difficulty to meet discharge regulations.

A long-term detention pond with seasonal discharge was selected as the most appropriate, cost effective solution. In 1997, an earthen type lagoon was completed in Grise Fiord, Nunavut. The system design was based on trucked sewage discharge into the lagoon, a permafrost freezeback into the berm and a seasonal pumped discharge over the berm structure.

federal governments, are needed to promote upgrades to existing systems or develop new ones where none exists. In addition, the public needs to be made aware of the cost of providing wastewater services and be prepared to pay their share. Along these same lines, there is a need for regulatory authorities to create a framework that promotes compliance with discharge and operating permits in coordination with enforcement action for polluters.

Small communities have limited resources, not only financial but also in terms of labour, technical expertise, and operational capabilities. Regulatory authorities need to recognize these limitations and need to provide assistance by shaping the regulatory framework to accommodate the needs of small communities. Municipalities and other government bodies need to ensure that management and technical resources are available locally.

With the expansion of technological options available to small communities for wastewater treatment, help is needed for all those involved to educate them on the options available. This could include a program of national testing and certification of technologies (e.g. for decentralized systems). In addition it could include the coordination of standards and regulations across the country. Most importantly, it needs to include a coordinated dialog among the various groups - the public, small community managers, engineers, regulators, technology manufacturers, researchers, and provincial and federal ministries.

The importance of appropriate management of small community systems was identified as perhaps the greatest need. A key observation from this workshop was that if appropriate management systems are in place, in many instances traditional passive and low maintenance technologies will provide cost- and environmentally-effective service. However, without effective management, both simple and complex technologies will usually lead to more failures and higher remedial costs.

Selection of Supporting References

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APPENDIX 1 – WORKSHOP AGENDA

Linking Water Science to Policy: Wastewater Treatment for Small Communities. A CCME Sponsored Workshop Canada Centre for Inland Waters, Burlington, Ontario - February 11-12, 2003

AGENDA

Tuesday February 11 - afternoon

1:00-1:30 Welcome from the National Water Research Institute
Alex Bielak Director, Science Liaison Branch, NWRI
Opening comments from CCME-WCC Co-chair
Ken Dominie ADM, Dept of Environment, Newfoundland & Labrador
Opening comments from Workshop Co-chairs
Peter Seto, Mano Manoharan, Sandra Kok

1:30-2:00 Small Wastewater Systems in Canada: Issues and Concerns
Ken Dominie

2:00-2:20 Break

2:20-3:20 Technology Options and Management Issues
Integrating conventional sewerage and onsite treatment: a new paradigm for serving rural communities
Dick Otis, Ayres & Associates, Madison, Wisconsin

3:20-3:50 Case Study #1 - The Experience with Lagoons
Dan Smith, University of Alberta, Edmonton, Alberta

3:50-4:20 Case Study #2 - Sewage Treatment with Emphasis on Re-Use in Western Canada
Craig Jowett, Waterloo Biofilter, Waterloo, Ontario

4:20-4:50 Case Study #3 - Colchester County: Moving Towards a Cleaner Future
Susheel Arora, Colchester County, Nova Scotia

Wednesday February 12 - morning

9:00-9:30 Financing Wastewater Operations in Small Municipalities
Mike Fortin/Mike Loudan, Consulting Economists, Guelph, Ontario

9:30-10:30 Panel - Regulatory Issues
Brief presentations and discussion on the regulatory & approvals process, enabling legislation, enforcement issues, etc. in various agencies.

- Ontario - Janusz Budziakowski, MOE
- Quebec - Michel Morissette, MENV
- Nova Scotia - Robert Anderson, DEL
- Nunavut/N.W.T - Kriss Sarson, GN/Siva Sutendra, GNWT
- Alberta - Bijan Aidun, AE
- B.C. - Jack Bryden, WLAP
- Environment Canada - Update on the proposed risk management strategy addressing ammonia, inorganic \chloramines and chlorinated wastewater effluents - Claude Fortin, Municipal Wastewater Effluent Division, ETAD

10:30-10:50 Break

10:50-11:20 Case Study #4 - Performance of Recirculating Sand Filters in Wisconsin
Jim Owen, MSA Professional Services, Baraboo, Wisconsin

11:20-11:50 Case Study #5 - Natural Systems in Six Nations, Ontario and Forteau, Labrador
Kathleen Blanchard, Intervale Conservation and Heritage Associates, St. Anthony, NF, and Dennis Martin, Peat Land Treatment Systems Inc, Nepean, Ontario.

11:50-12:20 Case Study #6 - Sewage Treatment Systems in the Canadian North: Technologies and Case Studies
Ken Johnson, EBA Engineering Consultants Ltd., Edmonton, Alberta

12:20- 1:30 Lunch

Wednesday February 12 - afternoon

1:30-2:00 U.S. Initiatives on Small Wastewater Systems
Bob Bastian, Office of Wastewater Management, EPA, Washington

2:00-2:30 European Experiences with Small Wastewater Systems
Otto Nowak, Vienna University of Technology, Vienna

2:30-3:30 Canadian Initiatives

- Short presentations on various industry/agency initiatives or networks related to small wastewater systems in Canada.
- Ontario Rural Wastewater Centre - Doug Joy, University of Guelph
- On-site, Nova Scotia, and CWRS - Don Waller, Dalhousie University
- Water Quality in First Nations Communities: Situation Assessment - Ian Corbin, Indian and Northern Affairs Canada
- Assessment of Appropriate Technologies for Wastewater Treatment and Disposal for Rural Communities in Newfoundland and Labrador - Haseen Khan, Newfoundland and Labrador Department of Environment

3:30-4:00 Wrap Up & Next Steps - Workshop Co-chairs
Develop key observations and messages back to CCME

APPENDIX 2 – LIST OF WORKSHOP PARTICIPANTS

** indicates speakers*

British Columbia Ministry of Water, Land & Air Protection
Jack Bryden *

Alberta Environment
Bijan Aidun *

Ontario Ministry of the Environment
Mano Manoharan
Vincent Pileggi
Janusz Budziakowski
Henry Jun

Ontario Ministry of Municipal Affairs and Housing
Norma Forrest

Québec Ministère de l'Environnement
Michel Morissette *

New Brunswick Environment & Local Government
André Chenard

Nova Scotia Environment & Labour
Alan Benninger
Robert Anderson *

Service Nova Scotia and Municipal Relations
Aileen Waller-Hebb

Newfoundland & Labrador Environment
Ken Dominie *
Haseen Khan *

Government of Nunavut
Kriss Sarson *

Government of the Northwest Territories
Siva Sutendra *
Paul Guy

Indian and Northern Affairs Canada
Ian Corbin *
Kristina Taracha

Public Works and Government Services Canada
Robert Thomson
Jim Callan

Environment Canada
Peter Seto
Alex Bielak
Karl Schaefer
Liz Lefrançois
John Temple
Danielle Rodrigue
Pierre-Yves Caux
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