Technical Information Document

COMMUNITY SOLID WASTE

RPS for INAC
TID-MS-03
July 2002

Table of Contents

PART 3: HAULING WASTE OFF-RESERVE TO A NEARBY

PART 4: TRANSFER STATIONS

PART 5: COMMUNITY SOLID WASTE LANDFILL SITE

Foreword

This document is a general awareness type publication. It is intended to provide an overview and general appreciation of solid waste management options available to most First Nation communities. By reading through the document and exploring the various solid waste management options, First Nation communities will be able to decide which method of managing solid waste is best suited to their community.

Policy and Standards

Policy and standards related to community solid waste systems in First Nation communities are addressed in the DIAND Corporate Manuals System (CMS) policy document "Capital Facilities and Maintenance - Community Solid Waste Systems". Directives related to the permitting of solid waste systems in First Nation communities are addressed in the DIAND, Lands and Environment Branch "Manual for Permitting of Solid Waste".

Scope

The document begins by providing an overview of community solid waste before detailing solid waste management options available to most First Nations communities. The primary objective of this document is to provide basic information to Band Managers and decision makers in evaluating the economic feasibility of various alternatives of solid waste managements.

Responsibilities

A community solid waste facility must be designed by a qualified and experienced professional engineer. Drawings and reports should bear the stamp or seal of the licensed professional engineer who is responsible for the design. The engineer should be registered in the province or territory where the project is located.

Part 1: Community Solid Waste

1.1 What is Community Solid Waste?

Community solid waste is not garbage! Garbage can refer to just about anything that is no longer useful or wanted and for which disposal is sought. Community solid waste (also called municipal solid waste or domestic solid waste) has a far more specific meaning; it refers to the types of 'garbage' that can be accepted for disposal in a community or regional landfill or incinerator. Community solid waste includes typical household waste such as food waste, packing materials, cardboard, yard waste, metals, plastics, and other items. Bulky goods such as old stoves, old refrigerators, empty oil drums, miscellaneous equipment, vehicles and small quantities of sewage sludge from septic tanks or wastewater treatment plants, are also considered domestic waste. These wastes are often managed in separate and specially designated areas. Perhaps a better way of defining community solid waste is to state what elements are excluded. Hence, solid waste does not include industrial waste, medical waste, contaminated soil, or hazardous waste such as batteries, solvents, used motor oil, paints, etc. For these types of wastes, a special disposal method is required.

1.2 What is Wrong with a Garbage Dump?

The garbage dump is a site designated for a community's waste disposal. At the dump, all kinds of garbage – including hazardous waste – is piled up and left uncovered to degrade. As rain and snow fall on the garbage dump, water seeps down through the garbage and picks up contaminants. This contaminated water is termed 'leachate'. Leachate is a potential environmental and health hazard if not contained or collected and treated. The leachate can flow toward surface water, such as nearby lakes and rivers, or even seep down further into the groundwater below the garbage dump. Contamination of water sources is an environmental hazard that threatens wildlife and marine life and can even be detrimental to the community drinking water supply.

The uncovered waste at garbage dumps attracts insects, rodents, birds, and other scavenging animals. These animals, aside from being exposed to contaminants, can become carriers of disease to the community. Garbage dumps can also effect the quality of life in a community. They often produce a strong, unpleasant odour and are an eyesore in the community. Litter is often blown from the dump and carried by wind onto streets and into yards.

Garbage dumps where the waste is burned, commonly known as burning pits, can also be troublesome. In addition to the problems shared with garbage dumps (leachate, scavengers, unsightly odours and appearance), burning pits create significant and harmful air pollution. Since garbage dumps and burning pits are usually unfenced and uncontrolled, they can be subject to exploitation by off-reserve individuals and companies. These unauthorized dumpers often dispose of their hazardous waste and other garbage at the First Nations community dump, to avoid paying costs associated with safe and legal disposal elsewhere.

The environmentally-friendly and sanitary alternatives to garbage dumps and burning pits are solid waste management facilities known as: landfill sites, transfer stations and air pollution controlled incinerators. These options are defined and explored later in this document.

1.3 Planning Considerations for Waste Disposal Options

The community population, characteristics of the solid waste, solid waste volume and solid waste collection all play a role in determining the best method and equipment for community waste management.

1.3.1 Community Population

Current and future demands for waste disposal services and the economics of alternative methods of providing services depend mostly on the size of the population to be served, now and in the future. Therefore, it is important to collect the most recent and accurate population data available.

1.3.2 Composition of Solid Waste

Solid waste in most small communities is primarily domestic in character. Besides domestic waste there are also industrial and commercial waste, which may be generated in small quantities. It is important to note that hazardous commercial and industrial waste should be disposed separately from domestic waste.

There are some ‘bulk’ wastes which can be of a domestic, industrial or commercial origin. Large metal items including discarded vehicles, snowmobiles, appliances, oil drums, machinery, and holding tanks should be hauled to a ‘bulk’ waste disposal area.

1.3.3 Solid Waste Volume

Knowledge of the waste generation rates and quantities are necessary to determine the required capacity of a solid waste disposal option. Ideally, such parameters should be based on historical data of solid waste generation for a community to develop the best option. If such information is unavailable, waste volumes can be estimated assuming an average rate of daily waste generation. It is generally assumed that an average Canadian produces approximately 1.5 kg of waste per day, with the average First Nations community member

producing slightly less. The daily and annual waste generation can be easily estimated if there is an assumption of waste generation, per person, per day.
For example, a community with 200 residents where each resident produces 1.5 kg of solid waste per day, will accumulate 300 kg (200 x 1.5 kg) of waste in 1 day. The community will generate 109,500 kg of waste per year (300 x 365 days).

Table 1 shows examples of estimates.

Table 1 Estimates of Waste Production

Population	Waste Generations	
	waste per day (kg)	waste per year (kg)
200	300	109,500
500	750	273,750
1,000	1,500	547,500
1,500	2,250	821,250

The volume of solid waste depends on waste generation (production) and on the compaction rate. Usually, solid waste in small communities is insufficiently compacted and the soil cover is placed on a quarterly or semiannual basis. Solid waste densities (or the specific weights) vary greatly and depend on compaction rates and type of waste collected. The density of waste without any compaction could range from 50 to 150 kg/m^3. The following example illustrates how waste volume requirements can be calculated with an assumed density of waste of 150 kg /m^3 and annual waste generation per person of 550 kg.

$$550 / 150 = 3.7 \text{ m}^3 \text{ /person/year}$$

The annual volume of solid waste would allow an estimate to be made for the capacity of a future waste disposal option.

1.3.4 Solid Waste Collection

Most people do not like the idea of carrying their household solid waste directly to a disposal site. If there is no community waste collection, some First Nations residents may dispose of their waste by burning it in an empty oil drum on their property. This is an environmentally hazardous practice because air pollution is released as plastics and other items burn.

Regular and frequent solid waste collection allows for a cleaner community without requiring a large effort from residents. A minimum level of service of weekly collection is generally sufficient to maintain acceptable sanitary and aesthetic conditions within a community. In some communities, collection may occur twice per week or once every other week. The type of collection vehicle depends on the size of the community, types of road and their level of maintenance. The collection vehicles may range from an open cart pulled by an all terrain vehicle (ATV), to a full sized packer truck for larger communities. Pickup trucks are commonly used to collect solid wastes in smaller communities.

Obviously, solid waste collection itself must be done in an environmentally friendly manner. Garbage collection dates should be consistent and well known throughout the community. Wherever possible, garbage should be put out for collection in lidded garbage cans or garbage bags which have been tied closed. Also, garbage which is awaiting collection should not be easily accessible to scavenging animals. This is particularly important when garbage bags are used as they can easily be torn open by scavenging animals. To prevent scavenging, garbage awaiting collection can be protected by placing it in a closed container.

Once a year, following snow melts, each community should organize a spring cleanup to collect and dispose of loose refuse accumulated during the winter months. It is also good practice that during this same period, metal wastes and bulky items such as old appliances or discarded snowmobiles be disposed of by collection crews.

1.3.5. Siting Principles

Initially a site should be developed with a capacity to accommodate a minimum of approximately 5 years of community solid waste. However, it is considered good practice if the selected site has the flexibility for further expansion with a capability of waste disposal for up to 20 years.

To summarize, the following factors should be considered in evaluating potential sites for the long-term disposal of solid waste:

- haul distance (i.e., short distances will minimize operating costs)
- soil conditions (i.e., geologic, hydrogeologic, availability of cover material and topographic)
- location restrictions (i.e., including a buffer zone, keeping a minimum distance from: airport, houses and buildings, water sources, local wildlife environment, public roads)
- available land area (i.e., 5 years for an immediate disposal and 20 years for future expansion)
- site access (site location must be accessible to vehicular traffic year round)

- climate (i.e. predominant wind directions, wind speed and local temperatures)
- direction of surface water flow

1.4 What Community Solid Waste Disposal Options are Available?

There are various solid waste disposal options that can be used by communities. Among others, the following solid waste disposal alternatives are available to First Nation communities.

- Hauling Solid Waste Off-Reserve
- Transfer Station
- Sanitary Landfill Site
- Community Incinerator

Since the choice of a suitable method is a site specific task, when planning a solid waste disposal option, analysis of each option will be beneficial. Sometimes combination of two of the above options could to be advantageous for the community (i.e., landfill and incineration).

1.4.1 Hauling Solid Waste Off-Reserve (Direct Hauling)

Community solid waste is transported directly to a nearby existing municipal/regional landfill site after each collection day. In small communities, the collection of waste once or twice a week is suggested.

1.4.2 Transfer Station (Indirect Hauling)

After collection, the community solid waste is temporarily stored in a transfer station. Later, at a scheduled time the solid waste is transported to a nearby existing municipal/regional landfill site.

1.4.3 Sanitary Landfill Site

This option creates a provision for First Nation communities to construct and operate their own sanitary landfill facility.

1.4.4 Community Incinerator

A community incinerator provides an option where some solid waste can be burned in a designed and controlled manner. However, because not all waste material is combustible, provisions have to be made for disposal of non-combustible solid wastes (e.g. white metals, appliances, etc.).

Since each First Nation community is unique, there is no one method best suited for management of community solid waste. Rather, each First Nation community should consider an option that will be able to address their solid waste management requirements.

1.5 Cost Elements of Each Option

There are a great variation of factors such as a community size, type of system, geographical location, available financial and human resources, that directly influence the cost estimates of alternatives making it impossible to provide cost examples. However, cost elements associated with each option can be easily defined and they are summarized in the following table.

Table 2. Typical Cost Components of Each Option

Option	Capital Cost Components	Operation & Maintenance Cost Components
Hauling Solid Waste Off-Reserve	Conventional garbage truck and packer (waste collection)	operators' salary maintenance of transfer trucks tipping fees for the final disposal fuel
Transfer Station	Conventional garbage truck and packer (waste collection) <u>Transfer Station Construction:</u> -site grading, clearing, fencing -building and/or roll-off containers -equipment (i.e., a compactor, hopper) -engineering fees	operators' salary maintenance of transfer trucks, trailers and equipment tipping fees for the final disposal fuel
Sanitary Landfill Site	Conventional garbage truck and packer (waste collection) <u>Landfill Site Construction:</u> -site grading, clearing and fencing -building and equipment -an equipment shed -engineering fees Environmental monitoring (i.e., waste segregation, leachate monitoring)	operators' salary maintenance of the landfill and equipment maintenance of garbage collection truck fuel
Community Incinerator	Conventional garbage truck and packer (waste collection) <u>Incinerator Construction:</u> -site grading, clearing and fencing -a shed with equipment -engineering fees Environmental monitoring	operators' salary maintenance of the incinerator and equipment fuel storage and transport of non-combustible materials

1.6 Waste Diversion Techniques

Finding alternative solutions to land filling for dealing with wastes that have been produced, is known as waste diversion. Regardless which community solid waste disposal option is chosen by a First Nation community, the environmental and economic costs of waste disposal can be significantly reduced by applying the "3 R's" system – Reduce, Re-use, Recycle. Although many First Nation communities are too small to make a large-scale recycling viable, the first two R's – Reduce and Re-use – and/or composting of food waste, are immediately available to all communities.

Re-use, recycling and recovery are the chief means of accomplishing this. The term "re-use" means to use the discarded material again in more or less the same form as the original product. An example is the re-use of wood palettes. "Recycling" occurs when the process results in a change to the waste material, and its form may be different to the original product. An example is the recycling of plastic bottles to produce plastic lumber products.

Community members can help reduce the total volume of waste their community produces by purchasing products which feature minimal packaging and not buying unnecessarily large quantities of products that will only go to waste. When less waste is generated in the first place, there will be fewer issues of environmental damage, pollution and disturbances simply because the demand for additional disposal sites and landfill capacity will be less.

1.7 Developing a Waste Diversion Plan

Developing a plan to minimize the amount of solid waste generated at the source, is an important part of any waste management plan for a community.

The components that can be built into a waste diversion plan include:

- reduce the waste generated by using different practices;
- re-use the waste in its present form (e.g., wood palettes);
- recycle the waste (e.g., scrap metal); and
- recover useful materials from the waste.

A waste diversion plan for a community must be carefully planned, in order to ensure that it is consistent with the waste stream generated, the capabilities of local contractors, and the interest of the public participating in the program. The steps that should be taken in developing a waste diversion plan include:

- assessing the types of waste generated;
- estimating the quantities of each type of waste;
- identifying sources of recycling or re-use;

- determining the feasibility of recycling, re-use;
- implementing programs that are feasible;
- enacting by-laws if necessary to stimulate participation;
- informing users of the program (signs, advertisements); and
- monitoring and evaluating the results of the program, and making re-adjustments where necessary.

In determining the feasibility of recycling or re-using a particular waste stream, the following factors may be considered:

- availability of a facility or contractor to accept the wastes;
- ease of separation from other wastes (at source, transfer station, etc.);
- scale of the program (does the waste volume justify efforts to recycle);
- transportation costs;
- storage requirements and costs;
- environmental and human safety risks of processing the wastes; and
- overall balance of risks, costs and revenues for recycling or re-using the waste.

1.8 Implementing a Waste Diversion Plan

Many small communities in Canada have implemented various waste diversion programs, contributing to an overall waste minimization effort. As a result, the demand for landfill sites has been reduced substantially. Furthermore, the operational life of existing landfills has in many cases been extended. This means not only a reduction in the environmental and socio-economic impacts that can stem from disposal operations, but often a source of revenue from recycled materials which offsets operating costs.

Some communities have established a system of "drop-off recycling facilities". In a drop-off program, residents of a community deliver their recyclable materials to a central location or depot, often at a landfill or waste transfer facility, but it could also be at another accessible point in the community. In well designed drop-off programs, the quantity of materials collected may be close to that of curbside programs and the cost per tonne of material will usually be lower. Drop-off systems are excellent for rural areas where long distances between houses make curbside systems too costly. Most brokers will pick-up recyclables from the drop-off site.

A typical drop-off recycling facility at a waste transfer station could comprise a row of recycling bins placed along a circular driveway, separate from waste area. Clear signage is placed at the entrance and around the driveway, indicating where the goods are supposed to be deposited. Large bins are used for paper, cardboard, plastic, etc., while smaller bins for glass, metal, etc. Appliances, metals, wire, and other common recyclable wastes are deposited in separate piles, with clear signage indicating what is supposed to go there and what is not. A used oil tank, with a removable cap and a disposal funnel, is used to store used automobile oil from the public. Agricultural, horticultural, and yard and garden wastes are deposited in compost piles. Wood is deposited in two piles, with alternate burning operations. Special storage containers are set up for holding old automobile batteries, aerosol tins, etc. The entire facility is surrounded by a fence.

Part 2: Roles and Responsibilities

For effective and coordinated waste management by First Nations communities, it is important to understand the roles and responsibilities of all players.

2.1 First Nations Responsibilities

For any waste management operations occurring on a Reserve, the Chief and Council are responsible for the following actions:

- as a proponent, undertake an environmental assessment (EA) for the proposed waste management site;
- obtaining a Permit from DIAND;
- constructing, operating and monitoring waste management sites in accordance with agreed to codes and regulations;
- assisting in the conducting of inspections and audits;
- cleaning up and closing existing sites;
- providing training and communications; and
- developing and implementing waste minimization and recycling programs.

2.2 Indian and Northern Affairs Canada Responsibilities

The role of DIAND is centered around the authority of the Minister of DIAND to issue a permit for proposed waste disposal, burning or storage operations on Reserves. Also, DIAND through it's Capital Management program provides funding towards the design, construction and operation of community waste management sites on reserves. Under this authority, the Minister:

- is responsible for ensuring that the requirements of the Indian Reserve Waste Disposal Regulations are enforced;
- approves applications for Permits issued by the Minister;
- allocates funding for design, construction and operation;
- provides technical advice and assistance in the design, construction, operation and permit application process;
- if issuing a Permit, as Responsible Authority (RA) under CEAA, must render a s.20 determination prior to the approval of the Permit; and
- if funding a waste management site, must render a EA screening decision in accordance with DIAND's Directive DD.5.2 Transfer Payments-Environmental Assessment Process before the release of funding.

2.3 Regulations and Codes

Regulations and codes for waste management on Reserves exist at both the federal level, and in most provinces, at the provincial level as well.

One of the important differences between a regulation and a code is that a regulation falls under an act of law and its provisions can be enforced by the responsible government agency. A code ("code of practice" or "guideline") is a set of instructions that serves as a standard for operators to meet. Thus, it serves as a recommended level of performance which defines the "best management practices" for a particular type of operation. Sometimes, however, a code can be referenced by an act or regulation, in which case it becomes enforceable. Usually, a code of practice is more technically detailed and prescriptive than a regulation.

2.4 Environmental Assessment Requirements

Before construction of a solid waste disposal facility, a project should include an initial environmental screening according to the requirements set out in the Canadian Environmental Assessment Act (CEAA). Environmental assessment is a process which enables review of the environmental implications of a project proposal early in the planning stages. The CEAA and four key regulations (law list, a comprehensive study list, exclusion list, inclusion list) set out the responsibilities and procedures for the environmental assessment of federal projects. There are four types of environmental assessments: screenings (including class screenings), comprehensive studies, mediation and panel review.

No one should operate a solid waste disposal facility, destroy, dump or burn waste on reserve land without a permit as prescribed by the Indian Reserve Waste Disposal Regulations. Sometimes First Nation disposal sites are planned on nearby provincial crown lands and in these situations provincial permitting and requirements should apply.

2.5 Draft Model Class Screening Report

The Canadian Environmental Assessment Act encourages the use of a Class Screening process for conducting Environmental Assessments of routine or repetitive projects such as developing a small-scale solid waste management facility. Accordingly, a Draft Model Class Assessment process is being developed by DIAND for the assessment of waste disposal or waste transfer facilities on Indian Reserves. The central document for this process is a Draft Model Class Screening Report (MCSR). The MCSR provides an inventory of information on potential environmental impacts, siting and design, operational, monitoring and other measures for reducing or avoiding adverse impacts, and the means of determining whether impacts are likely to be significant. The use of the MCSR is intended to streamline the EA process and enhance consistency of approach.

The mitigative measures that are prescribed in the MCSR's for Landfills and Waste Transfer facilities are similar to those listed under the draft DIAND Code of Practice.

2.6 Indian Reserve Waste Disposal Regulations

The Indian Reserve Waste Disposal Regulations, which come under the Indian Act, generally set the rules for the planning, development, implementation and permitting of waste disposal on Reserves across Canada. The Regulations prohibit the disposal, storage or burning of wastes on an Indian Reserve without a permit from the DIAND Minister. Under the Regulations, a permit from the Minister is required to:

- operate a garbage dump on Reserve;
- use any land on a Reserve for disposal or storage of waste; and
- burn waste on a Reserve.

The Regulations prescribe penalties for operating without a permit from the Minister. The permit must be renewed annually if the operation is ongoing.

2.7 Obtaining a Permit for Waste Management Facilities

For obtaining a Permit for the construction, lateral expansion or operation of a waste disposal facility, the following is required:

- general information;
- site investigation report;
- operations plan;
- closure and reclamation plan;
- Environmental Assessment under CEAA; and
- waste management plan for Reserve.

The site investigation report is a site-specific study aimed at determining whether there are any existing or potential environmental problems or constraints at the proposed site for the operation, and what special mitigative measures might be required to accommodate site factors.

It is important to note that the issuing of a Permit from the Minister triggers the need for an Environmental Assessment (EA) under the Canadian Environmental Assessment Act (CEAA) where the department is the Responsible Authority (RA) to make a s.20 determination under the Act. The EA is required to identify and evaluate the potential environmental effects of the proposed operations and provide the environmental protection (mitigative) measures that will be required to prevent environmental damage. If it is believed that adverse and significant effects will remain even when mitigative measures are applied, the Permit is not approved by the Minister.

The waste management plan should include: estimates of how much waste is generated, and the types of waste; plans for collection and transportation of the wastes; plans for disposal, treatment and storage of wastes; and plans for the minimization of wastes, including recycling and re-use of materials.

For an existing waste disposal site, the above information is required. In addition, however, an assessment of the level of compliance of the operation with relevant regulations, codes and guidelines is required, as well as a plan for bringing the operation into compliance if necessary.

For the renewal of a Permit, the following is required:

- general information;
- site annual report (compliance);
- update of design, monitoring programs;
- update of operations plan; and
- update of closure and reclamation plan.

Specific permit conditions are required for landfills accepting >10,000 tonnes of waste per year, for landfills accepting hazardous wastes, or for landfills located in a ravine, gully, buried valley or other environmentally sensitive areas.

2.8 Draft DIAND Code of Practice

A draft DIAND Code of Practice has been developed for Waste Management Facilities (Environmental Services, Public Works and Government Services Canada). This code prescribes technical standards (best practices) for landfill facilities on Reserves. The code applies to landfills that accept 10,000 tonnes of waste per year or less, and that do not accept hazardous waste and are not located in a sensitive area such as a wetlands, gully, ravine or buried valley. The latter case requires specific permit conditions.

The draft DIAND Code provides guidance on the siting and design, operating parameters, monitoring, corrective action, reclamation, closure and post-closure care, record-keeping and reporting requirements for landfills.

2.9 Other Federal Government Departments

Health Canada also has a key role to play, which it implements through the First Nation and Inuit Health Services Branch (FNIHSB). This role consists of the following activities:

- conducting inspections of waste management sites;
- ensuring compliance with approved standards;

- monitoring water and wells for ground water contamination; and
- making recommendations to Chief and Council for corrective action.

Environment Canada acts through the Enforcement Division of its Environmental Protection Branch, to enforce the provisions of CEPA (pollution prevention) and the Fisheries Act (protection of fish habitat). In addition to enforcing these acts, Environment Canada's role is to provide technical advice to DIAND or First Nations on mitigation measures and pollution prevention. Environment Canada may be consulted before the Minister issues a Permit for a proposed waste management facility.

The Department of Fisheries and Oceans (DFO) is responsible for the protection of fish habitat in Canada. Fish habitat may be put at risk by poor siting, design or operation of a waste management facility, through seepage of contaminants, poor erosion control measure and so forth. If fish habitat is potentially affected, the Minister of DIAND may consult with DFO and receive its concurrence before a Permit is issued for a proposed waste management facility.

2.10 Provincial Governments

As a best practice, DIAND takes the position that projects or activities on federally administered lands should meet or exceed the standards of the surrounding provincial/territorial jurisdiction, to the extent possible. The role of the provincial government in respect to operations on Indian Reserves is to address any off-site impacts, and work through federal departments such as DIAND or directly with the First Nation to correct any problem situations.

Part 3: Hauling Waste Off-Reserve to a Nearby Landfill

3.1 Overview

When a local landfill closes or has not yet been developed, community leaders are faced with two options. They can directly haul their solid waste to a regional landfill or they can construct a transfer station. The option with direct hauling of wastes to a nearby landfill involves negotiating an agreement between the First Nation community and a nearby municipal or regional authority to dispose of solid waste. Financial payment is made to the municipality or region operating the landfill. Normally, a tipping fee is charged, based on the weight of community solid waste being brought to the landfill for disposal. The First Nation community is responsible for its own garbage collection, and waste collected is then transported off-reserve to the municipal/regional landfill. Hazardous waste and special wastes, such as white metals, will need to be deposited separately at the landfill. Different tipping fees may be applied to these wastes. When the truck carrying the First Nation community's solid waste arrives at the landfill, typically the truck is driven onto a weigh scale to determine the weight of the solid waste, so that the appropriate tipping fee can be assessed.

Depending on the proximity of a municipal/regional landfill to the First Nation community and the tipping fee, transporting the community's waste off-reserve may prove to be an economically viable and environmentally responsible waste management option.

3.2 Advantages and Disadvantages of Hauling Off-Reserve

Advantages

The advantages to this waste management option, include:

- community solid waste will ultimately be disposed of in a safe and environmentally responsible manner. Regional/municipal landfills are built and operated according to strict provincial regulations.
- it frees the First Nation community of the responsibility and cost of building and operating a landfill.
- it avoids using First Nation community land for waste disposal, leaving it available for other uses.
- tipping fees may encourage waste reduction and re-use in the community, increasing environmental awareness at the community level.

Disadvantages

The disadvantages to this waste management option, include:

- municipal and regional landfills may increase tipping fees over time, increasing the First Nation community's waste disposal costs.
- some remote First Nation communities may be located a long way from a municipal or regional landfill willing to accept their waste. As a result, the costs of transporting the waste to the distant landfill may be high, making hauls of the community's waste off-reserve economically unattractive.
- the First Nation community's environmental awareness for waste disposal may not be increased, since the waste is hauled off-reserve and 'out of sight, out of mind'.

3.3 Conclusions

Where economically feasible and attractive, hauling community solid waste off-reserve to a nearby municipal/regional landfill is a good option for many First Nation communities. Essentially, this option ensures that the waste will be disposed of in a safe and environmentally responsible manner, while leaving community land available for other uses.

Part 4: Transfer Stations

When a direct haul distance to nearby municipal landfill is not economically feasible, a transfer station can be utilized. A transfer station is a location where solid waste that has been picked up by collection trucks is unloaded into larger transfer vehicles or containers. The solid waste is stored in the station until a delivery truck will transport it to a final disposal site (i.e., a nearby municipal landfill). Essentially, a transfer station is the indirect hauling of waste off-reserve.

In considering the use of solid waste transfer stations, the primary factor is the distance to the final disposal site. Overall, a transfer station offers potential savings in manpower and collection equipment requirements. However, the system may require higher capital and operation costs than the landfill system.

Transfer stations have the capacity to hold a number of loads of solid waste from collection vehicles. The capital cost of a transfer station includes the construction and operating equipment costs. Operation and maintenance costs are the costs that incurred continuously to operate the facility (labour, fuel, etc.).

4.1 Design Considerations

In the design and layout of a transfer station, the key consideration should be simplicity. Complex mechanical systems are not suitable for small communities. The number of containers required will depend on the size of the area served and the collection frequency. To facilitate unloading, the top of the containers may be set about 1.5 metres above the top of the unloading-area platform. Alternatively, the top of the containers may be set level with the unloading area, and the area behind the containers can be freed for easy manoeuvring of collection vehicles, when the contents of the containers are emptied. A building would be a great asset to the transfer station as it will permit to continue operation despite weather conditions and will provide a place for offices and vehicle storage.

4.2 Transfer Operations

In general, the transfer operations involve loading, unloading, storage and transport of solid wastes to a landfill site for ultimate disposal. The transfer facilities are also used for the recovery of recyclable materials.

4.3 Siting Recommendations

Whenever possible, transfer stations should be located:

- within an easy access of major highway routes;
- where there will be minimum public and environmental objections;
- where construction and operation will be most economical.

Under ideal conditions, the transfer stations should be located to minimize transportation costs.

4.4 Capital Costs

Many factors influence the capital cost of a transfer station including location, distance from the landfill, equipment used and the volume and type of material handled. The main components of the capital cost are the following: site preparation, building, ramp and retaining wall, fencing, crushed rock, transfer trailer, stationary compactor, roll off containers, hopper and chute, transfer truck.

4.5 Operating Costs

Operating costs include annual expenditures for items such as; fuel, labour, maintenance, and fringe benefits needed for the operation of the system.

Part 5: Community Solid Waste Landfill Site

Landfills are facilities that serve as long-term disposal sites for community solid wastes. They are designed and operated to protect both the community and the environment from contamination. When properly operated, landfill sites can ensure clean groundwater and clean air in the community and environment.

5.1 Considerations in Landfill Design

Proper landfill design will enhance the environmental protection provided by locating the landfill correctly. When selecting a landfill location it is preferable to have a site located in an environment that provides natural protection. Similarly, a site where landfill generated contaminants are naturally reduced to acceptable concentrations or are naturally contained is preferable. This is known as a site with abilities of natural self attenuation. Where self attenuation is not possible, it is necessary to construct a landfill facility in a designated area.

5.1.1 Siting Criteria

A landfill should be sited in a location where the risk of contaminating the local environment and community is minimized. Generally, a landfill should be built in an area of low permeability soil such as glacial till and silt. The siting criteria have been developed to ensure that selected landfill sites are located away from sensitive receptors and in areas that would not be adversely affected by their construction and operation. Requirements of minimum setback distances vary from province to province. Nevertheless, based on the federal guidelines, a selected landfill should be a minimum of:

- 300 m from a private house;
- 300 m from a non- residential, commercial and/or industrial building;
- 100 m from a highway;
- 300 m from a water supply;
- 100 m from surface water including lakes, ponds, streams, creeks, and brooks;
- 100 m from heritage and archeological resources;
- 8 km from an airport.

Setback distances may be increased or decreased with prior approval from the appropriate regulatory authorities, such as Transport Canada.

A landfill should also be located:

- 1.0 m above the seasonal high groundwater table;
- where cover material is readily available at or near the site to be developed;
- in an area with natural buffers;
- where surrounding topography is gently sloping and well drained;
- in fine grained (low permeability) soils such as clays, glacial tills, and silts.

A landfill site should not be located within:

- a designated water supply watershed;
- the 100-year flood plain;
- parks, and ecologically sensitive areas;
- areas of shallow or exposed bedrock;
- areas with steep slopes and potential for severe erosion.

5.1.2 Design Life

Although there are no firm rules, it is desirable to have an area, including an adequate buffer zone, sufficient to operate for at least 5 years. If the area is proven adequate for landfilling operations, it is preferable to ensure that the land be reserved for disposal of wastes for up to 20 years. This will allow the site to be expanded progressively to accommodate the needs of the community.

5.2 Landfill Operational Factors

It is good practice to develop a landfill operation plan that will include information on the following elements: operating schedules, filling plans for the placement of solid wastes, operating records, load inspection for hazardous wastes, and site safety and security. Other considerations in operating a landfill are signing the hours of operation and provision of fencing and locked gates.

5.2.1 Controlled Access

Operation of landfills should be permitted only to authorized persons. The site should be fenced and gated.

5.2.2 Cover of Waste

Dumped waste should be regularly covered with a layer of soil. Preferably solid waste should be covered immediately upon disposal. This minimizes odours, blowing litter, scavengers, and the risk of fire. The thickness of immediate soil cover ranges from 0.15 m to 0.3 metres in depth.

The depth of final cover should be between 0.6 and 1.0 metres. In northern communities an adequate cover material is often not readily available. In these circumstances, coverage is maintained infrequently, only when cover material can be hauled from surrounding areas.

5.2.3 Winter Operation

Drifting snow and frozen ground can interfere with the operation of a landfill site. The following suggestions are helpful:

- portable snow fencing can be used in addition to the regular fencing to prevent drifting snow from interference with the operations;
- trenches should be dug during the summer months;
- cover material should be stock piled for winter use;
- if cover material is frozen or unavailable, snow can be used as a temporary cover material.

5.2.4 Groundwater Protection

The bottom of the landfill is lined with an impermeable material to prevent leachate from seeping down to the groundwater and contaminating it. Often, this liner is made of compacted clay. The clay liner is sometimes replaced with a synthetic liner -- essentially a plastic sheet which prevents water from passing through it. Details on landfill leachates are covered in Section 5.4.

5.2.5 Compaction of Waste

Dumped waste is regularly compacted to minimize its volume and maximize the landfill capacity. In small communities, a front-end wheel or crawler (track) loaders are commonly used.

5.2.6 Hazardous and Bulky Waste

Only community solid waste is accepted at the landfill site.

Hazardous wastes, medical wastes, etc. must only be disposed of at a collection facility authorized to manage hazardous waste.

Preventing hazardous waste from being disposed in the landfill is a key operational consideration. This will be best done by limiting access to the site by physical barriers. Hazardous waste from federal facilities (including reserve land) should be disposed in approved hazardous waste disposal facilities which follow the Canadian Council of Ministers of the Environment (CCME) Guidelines. An exception to that disposal method is friable asbestos containing products.

Asbestos may be deposited at solid waste landfills provided certain operational procedures are followed. Specifically:

- asbestos waste producers must obtain permission from the owner of the landfill site in advance;
- the operator must be notified about when the asbestos will arrive to prepare a work crew to handle the waste. Provincial occupational health and safety requirements for handling asbestos must be followed; and
- the incoming asbestos must be in barrels or double bagged and the waste must be disposed of in a cell dedicated specifically for disposal of this waste and covered with 0.6 metres of soil immediately after its placement.

Materials such as “white metals” (old refrigerators, stoves, freezers, etc.) and old automobiles are stored in a separate and designated area of the landfill site. This allows recycling of scrap metal and permits more efficient use of the landfill. “Dry waste,” such as construction debris, is often disposed of in a separate and designated area of the waste site. Sometimes, a separate drying bed for sewage sludge is also used.

5.2.7 Decommissioning

When a landfill is full, it is covered with a compacted clay cap to minimize water seeping into it and creating more leachate. A layer of fertile soil is placed over the entire landfill site and the area is often seeded or sodded to create an aesthetically pleasing landscape. Many landfill sites have been converted to parks, tobogganing hills, golf courses, and other useful functions. Consideration should be given to possible settlements of the closed landfill ground. Decomposition of waste materials will continue for decades following site closure which can cause wide cracks in the final cover material. Decommissioning and end uses (parks, golf courses, etc.) should be based on local land use by-laws and following provincial regulations. Some provincial regulations require lengthy monitoring procedures after closure of old landfills.

5.2.8 Safety

Both operators and supervisors of landfill facilities are responsible for all aspects of solid waste disposal. The following are some suggestions for safe operating procedures:

- public access to the landfill site should be allowed only during operational hours;
- always wear water and puncture proof gloves and safety boots;
- hands should always be washed thoroughly after work;
- stand clear of burning wastes since toxic fumes, smoke and exploding aerosol cans can be harmful;
- never leave burning waste unsupervised;
- check your doctor to ensure appropriate vaccinations have been received;

- do not handle hazardous wastes if you are not properly trained to do so;
- take all precautions when operating machinery.

5.3 Methods of Landfilling

There are three main techniques when operating landfill sites: trench, area and slope/ramp. The sections below outline the characteristics of each method.

5.3.1 Trench Landfill Method

The trench landfill method is the most commonly used landfill design. It should be used in areas of relatively impermeable soils where the water table is well below the ground surface. Essentially, the method involves excavating a trench and depositing waste directly into the trench. Deposited waste is compacted to ensure efficient use of the trench volume. Waste can be compacted in horizontal layers, but sloping layers that form a ramp at one end of the trench can also be used. Periodically, the waste is covered with a thin layer of soil. Soil cover should be placed on the waste at least once a week, and for many communities, daily cover is recommended. Ultimately, the frequency of soil cover needed for a particular community's landfill, will depend on the volume of waste being deposited in the landfill. Typical soil cover thickness is a minimum of 150 mm. When the trench is filled, it is covered with a layer of soil and sealed with a layer of low permeability clay. This is to prevent water from seeping into the closed trench and producing more leachate.

Basic criteria for trench landfill design and operation include:

- Topsoil is stripped and stockpiled in a separate area so that it may be used as final covering and landscaping at the site.
- The bottom of the trench must be a minimum distance above the seasonal high groundwater table. The bottom of the trench should be gently sloping and wastes should be sequentially disposed of from the high end to the low end of the trench.
- The trench is excavated as narrow as possible while allowing enough room for equipment to work when compacting and covering the waste. The trench is excavated large and long enough to contain the waste generated by the community during a year. Trench walls should be as close to vertical as possible.
- The trench should be excavated with its length running perpendicular to the direction of the prevailing wind to minimize blowing litter.
- The area where vehicles back up for dumping should be sloping away from the trench to prevent water runoff from getting into the trench.

5.3.2 Area Landfill Method

The area landfill method should be used where soils are unsuitable for excavation or where a high groundwater table exists. It is recommended for soil and site conditions that do not allow use of the trench landfill method. Essentially, the method involves placing waste directly on the ground surface within a confined area and regularly compacting it. As the waste deposited increases, a mound will form. Periodically, the mound is covered with a thin layer of soil. Typical soil cover thickness is a minimum of 150 mm. When the mound has reached a certain size and height, it is covered with a layer of soil and sealed with a layer of low permeability clay. This is to prevent water from seeping into the closed landfill and producing more leachate.

Basic criteria for area landfill design and operation include:

- Topsoil is stripped and stockpiled in a separate area so that it may be used as final covering and landscaping at the site.
- A berm is constructed to provide some control over the size of the mound by allowing waste to be pushed up against it.
- A stockpile of cover soil is imported if necessary.
- Temporary fencing is erected around the dumping area of the mound to help minimize the dumping area and control waste boundaries.
- If a natural hillside exists above the area where waste is to be dumped, a trench is excavated in the hillside to keep surface water from flowing down into the landfill.
- The area where vehicles back up for dumping should be sloping away from the mound for good drainage.

Since this type of landfilling requires more soil for cover and the construction of berms, it is typically more expensive than the trench landfill method.

5.3.3 Slope/Ramp Landfill Method

The slope/ramp method is a combination of the trench landfill method and the area landfill method. It should be used where soils are unsuitable for excavation or where a high groundwater table exists. It is recommended for soil and site conditions that do not allow use of the trench landfill method. Essentially, the method involves dumping the garbage against a natural hillside or slope and regularly compacting it. Periodically, the garbage is covered with a thin layer of soil. Cover soil is obtained by excavating or scraping directly in front of the landfill's active dumping area, or 'working face'. To minimize surface water flowing down the natural hillside into the waste, a trench should be excavated in the hillside above the landfill area.

5.4 Buffer Area and Dealing with Leachate

5.4.1 Buffer Area

A buffer area may be defined as a land strip around a landfill site contained within the landfill site boundary. Depending on local regulations and adjacent land uses, the required width of the buffer area may range from 30 m. to 50 m. but should not be less than 15 m. The buffer area can be used for the following purposes: operation and maintenance of the site, material storage, construction of administration and maintenance buildings, or simply as physical separation from adjacent land (i.e. for fire prevention).

5.4.2 Leachate

Leachate is a toxic liquid that forms when water seeps down through the waste in a landfill and picks up contaminants. If the leachate is allowed to seep into the soil surrounding the landfill, contamination of the environment will occur. The danger of leachate entering either groundwater or surface water is particularly serious. If this occurs, the contaminated water will pose a health threat to animal and plant life which relies on the water supply. Ultimately, the community water supply may also be contaminated.

5.4.3 Minimizing Risks of Leachate Contamination

The first step in minimizing the environmental and health risks is to minimize leachate produced. Since leachate is formed when water comes into contact with the waste in a landfill, it is important to limit water entering the landfill waste. Inevitably, some water will enter the site as it falls on the landfill area as rain or snow, however, surface water flow can be kept out by providing good drainage away from the landfill. Groundwater flow should also be kept away from the landfill by ensuring that the base of the waste lies well above the seasonally high groundwater table.

The direction of groundwater flow should also be considered when selecting a landfill site. Ideally, groundwater flow should be away from the community or nearby water sources. This way, if leachate were to seep into the groundwater beneath a landfill, it would drain away from the community and water sources, minimizing the effects of groundwater contamination.

Leachate that forms within the landfill should also be contained and prevented from leaving the waste area. This is done by employing a low permeability clay layer under the landfill. Where necessary, the clay layer can be replaced by a synthetic membrane. The low permeability of the liner system prohibits leachate movement out of the landfill and into surrounding soil and groundwater. In some larger landfills, leachate is produced in sufficient quantities to warrant a leachate collection system. This is a series of pipes installed between the landfill waste and the liner system which collect the leachate as it is formed. The collected leachate is then treated to remove its contaminants before it is returned to the environment. Most First Nations communities, due to their small size, will not require leachate collection and treatment.

Even in a well designed landfill, there is always the chance that some leachate escapes into the surrounding soil and groundwater. Consequently, monitoring wells need to be installed at various strategic locations around the landfill. Groundwater samples from these monitoring wells are taken frequently and regularly and tested for leachate contamination. This ensures that any contamination is promptly noted and that appropriate remedial action can be implemented quickly and effectively. If leachate is found to be migrating off-site, the installation of perimeter barrier walls, a collection system, purge wells or other corrective measures may be required.

When a landfill is filled and retired, further measures against leachate production need to be taken. The landfill is capped and sealed with a layer of low permeability clay or a synthetic membrane. This keeps rainfall and snowfall from entering the landfilled waste and generating more leachate. Groundwater monitoring should be continued for many years after a landfill is decommissioned from use.

5.5 Good Housekeeping Practices

Responsible management of a community solid waste landfill includes careful application of several “good housekeeping” practices. Good housekeeping practices are simple, common sense measures which are taken to minimize the potential problems and nuisances of a landfill.

For example, the appearance of the landfill is rendered more attractive to neighbouring communities when the active portion of the landfill is hidden from view of passers by. This can be done by using portable screens or soil berms. The waste site’s operating hours should also be limited to reasonable working day hours to minimize disturbance of the neighbouring community.

Stray litter can be particularly troubling if it is allowed to blow beyond the boundaries of the waste site and into the surrounding environment or nearby community. Blowing litter can be minimized by careful dumping of the waste, followed by prompt compaction and soil cover. Portable fencing or soil berms placed around the active portion of the landfill serve as a further check on blowing litter. Any stray litter that manages to blow outside the waste site must be retrieved immediately. Prompt compaction and covering of waste will also help control problems with scavenging birds and vermin. If a problem with vermin does develop, an extermination program should be conducted.

These good housekeeping practices will contribute to a safer and more aesthetically pleasing landfill site which benefits on-site workers and the surrounding community and environment.

5.6 Decommissioning and End Uses

Responsible landfill management includes the decommissioning of a landfill site and extends to decades of post-closure monitoring. When a landfill has attained its full capacity, a final cover of low permeability clay is applied to minimize water from rainfall and snowfall seeping into the covered waste and generating large quantities of leachate. A layer of fertile soil is placed over the entire landfill site, allowing the area to be revegetated. To encourage surface water runoff, the landfill site is gently graded.

Since leachate could still escape the site, even after its closure, continued monitoring of groundwater quality around the landfill is essential. The monitoring wells around the retired landfill site are regularly sampled for many years following the site's decommissioning.

Complete records of the landfill must be kept to protect future generations who may consider redevelopment of the land surrounding the waste site. Records should precisely indicate the size of the landfill, the type of waste disposed, dates of operation, locations of monitoring wells, and any other of the landfill's design characteristics.

The decommissioned landfill site can also be converted to a productive and visually pleasing end use. Examples of successful end uses include converting the landfill area to a recreational park, open field, conservation area, golf course, or parking lot. However, due to the possibility of uneven settlement of the decommissioned landfill area, buildings or structures with in-ground foundations should not be built on the site.

5.7 Advantages and Disadvantages of Landfills

Advantages

A properly sited and engineered landfill offers much better control of the environmental and health hazards associated with waste disposal than a garbage dump or burning pit. After a landfill has been closed, the site is landscaped and can be converted into a park, tobogganing hills, golf courses, etc. A new landfill can also serve as an incentive for increased environmental awareness in the community. In communities currently using a garbage dump or burning pit, the regular collection of community solid waste and its disposal in a landfill encourages the separation and safe disposal of hazardous waste and can even serve as a starting point for a recycling program. A well-run landfill can become a source of pride to a First Nations community, allowing the community to serve as a model of environmentally responsible community solid waste management.

Disadvantages

A key disadvantage of the community solid waste landfill relates more to public perception than with a flaw in the solid waste management method itself. Many people, usually confusing the landfill with the uncontrolled garbage dump, react negatively and strongly to the idea of building a new community solid waste landfill in their community. This syndrome is common enough to have earned its own acronym – NIMBY ("Not In My BackYard")!

One operational disadvantage is the difficulty in applying cover materials in winter months. To ensure the coverage of wastes in winter conditions, heavy equipment may be needed which may not be available in small communities.

Despite its significant improvements over a garbage dump or burning pit, a community solid waste landfill does possess some drawbacks. Firstly, although a landfill produces significantly less leachate than a dump, the leachate produced must still be contained to prevent it from contaminating the surrounding environment. Secondly, a landfill also produces what is commonly termed "landfill gas." This gas, which consists primarily of methane, forms because of the decomposition of organic wastes in the landfill. If allowed to accumulate in a confined space, landfill gas can pose a danger as an explosive. Because of the small scale of a typical First Nations community landfill, the low level of landfill gas produced, does not usually pose serious hazards to the community and to the environment.

Also, depending on community size, landfills require a large land base to meet the community's current and future needs. Hauling waste off-reserve to a nearby municipal or regional landfill would better preserve a community's land base. Finally, constructing and operating a community solid waste landfill may require more financial resources than hauling waste off-reserve.

5.8 Conclusions

Where economically feasible, the use of an on-reserve community solid waste landfill is a good option for many First Nation communities. A vast improvement over a garbage dump, the community solid waste landfill protects both the community and the environment, making it a responsible choice. Landfill design must be a "cradle to grave" approach, with correct decommissioning and end use of the landfill being given as much thought as initial siting and operation. When this approach is followed, the landfill can become a source of pride to a First Nation community, allowing the community to serve as a model of environmentally responsible community solid waste management.

Part 6: Community Solid Waste Incineration

6.1 What is community solid waste incineration?

Community solid waste incineration involves burning waste at high temperature inside a specially engineered and purpose-built incinerator. By incinerating the community solid waste, its weight and volume is greatly reduced, often by as much as 85% to 95%. The ash that remains will thus take up much less space in the landfill where it is sent for ultimate disposal.

It is important to note that community solid waste incineration is very different from simply burning waste in an oil drum or burning pit, a practice that leads to significant and harmful air pollution. An incinerator is designed to burn waste at a much higher temperature than a simple burning pit could achieve (typically more than 1000 EC). Also, an incinerator is designed and operated to achieve carefully controlled burning; with the temperature kept constant, air flow to the furnace regulated, and waste fed to the incinerator in a steady manner.

As an incinerator burns community solid waste, it produces ash and hot combustion gases. The ash may contain contaminants, and so must be treated before being brought to a properly equipped landfill for environmentally-responsible disposal. Similarly, the hot combustion gases produced can cause air pollution if allowed to escape to the atmosphere untreated. Therefore, air pollution control equipment is incorporated into an incinerator facility. This equipment removes harmful contaminants from the exhaust gases and filters out particulate matter or 'soot' before allowing them to vent up the facility's stack to the atmosphere. Finally, water is used in an incinerator to cool the ash, as well as in some air pollution control systems. This water becomes contaminated as it comes into contact with the ash and combustion gas and must be treated before it can be discharged to the environment.

In some incinerator applications, there is a potential for recovering some energy from the process of burning waste. Heat produced by the incinerator may be used to heat the facility or even to generate electricity for running the plant's electrical systems. Occasionally, electricity generated from incinerator facilities can be supplied to houses or buildings in the nearby community.

Before an incinerator can be constructed, environmental assessments of the proposed site and of the incinerator design must be done to ensure that the incinerator will not harm the health of the community or its environment. Typically, a buffer zone is needed to separate the incineration facility from any nearby residents or sensitive ecological areas. Generally, incinerators are best suited for use by larger communities or cities where a steady supply of waste can be assured and where a reasonable economy of scale can be achieved.

6.2 Advantages and Disadvantages of Incineration

Advantages

There are several advantages to this waste management option, including:

- volume and weight of community solid waste needing landfilling are greatly reduced.
- the First Nation community's environmental awareness may be increased.
- possible energy recovery.

Disadvantages

There are several disadvantages to this solid waste management option, including:

- the air pollution controls required in incinerators are complex and expensive. Often, up to half the capital cost of an incinerator facility is due to the air pollution controls! As environmental regulations become more strict, air pollution controls on an incinerator may need updating, leading to even greater costs in the future.
- energy recovery from the incinerator as heat or electricity is not likely to be practical for a small community.
- despite air pollution controls, the community may have air emission concerns and selecting a site for an incinerator may prove difficult.
- the ash resulting from incineration of community solid waste must be disposed of in a landfill, incurring transportation fees to bring the ash to the landfill and tipping fees to dispose of it there.
- an adequate buffer zone is needed around the incineration facility, using up First Nation community land which could be put to better use.

6.3 Conclusions

Due to the inherent cost and complexity of siting, building, and operating a community solid waste incinerator, a relatively large community is needed to yield the appropriate economy of scale. In addition to cost issues, a small community cannot supply the steady flow of community solid waste needed for efficient operation of an incinerator. Communities using incineration must still dispose of incinerator ash in a municipal/regional landfill. For these reasons, a community solid waste incinerator is not recommended as a viable waste management option for most First Nation communities.

7.0 Selecting the 'Best' Waste Management Option

There is no single 'best' method of community solid waste management. There are many factors governing the selection process. The most appropriate option for solid waste disposal will be dictated by factors such as: community needs, financial resources, and the most cost-effective implementation process. If a generalization can be made, it is that most First Nation communities do not have the population size needed to provide a reasonable economy of scale for building and operating an on-reserve incinerator.

In selecting a solid waste management option, Band Managers and DIAND Funding Services Officers should carefully review the environmental and economic advantages and disadvantages of both hauling waste off-reserve and building and operating a new on-reserve landfill site. Long-term thinking is also essential to good community solid waste management. With this in mind, decision makers should consider the community's future waste needs as well as its current needs. First Nation communities will always benefit by applying the "3 R's," particularly waste reduction and re-use.

Where such an informed decision is made, the solid waste management system employed by a First Nation community will allow it to serve as a model of environmentally responsible waste management and environmental stewardship.

Glossary

Attenuation	the reduction of contaminant concentrations to safe levels in landfill-generated leachate.
Burning pit	the burning of waste is done in a pit or an oil drum. It creates significant air pollution and can also present a fire hazard.
Community solid waste	waste that can be accepted for disposal in a landfill or incinerator. Includes food waste, paper and cardboard, yard waste, metals, plastic, etc.
Cover material	a material, typically a sandy soil, placed regularly on waste deposited in a landfill to minimize odour, blowing litter, scavengers, and fire risk.
Environmental stewardship	the philosophy and accompanying actions of valuing and protecting the environment as something held in trust for future generations.
Erosion	the wearing away of rock or soil by wind, water, or glacial action.
Final cover	the layer of clay, synthetic liner, and soil placed over a filled landfill to seal it and minimize water seeping into the waste and generating large quantities of leachate.
Garbage dump	any waste disposal site that does not meet the standards of a community solid waste landfill.
Hazardous waste	waste materials that may pose a threat to human health or to the environment if not properly disposed of.
Household hazardous waste	waste generated by households that may pose a threat to human health or the environment if not properly disposed of.
Impermeable material	a material that prevents water from flowing through it.
Industrial waste	waste resulting from industrial operations or manufacturing processes.
Landfill gas	gas, composed primarily of methane, formed in a landfill as a result of the decomposition of organic waste.

Landfill	a disposal site for community solid waste sited, designed, and operated to protect the health and safety of humans, to maintain clean groundwater and clean air in the environment, to protect wildlife and marine life, and to meet aesthetic standards.
Leachate	a toxic liquid that forms as water seeps down through the waste in a landfill and picks up contaminants from the waste.
Leachate collection and treatment system	series of pipes underlaying the waste in a large landfill designed to collect leachate for treatment at an on-site or remote treatment facility.
Medical waste	biological waste originating from hospitals and nursing stations.
Methane	an odourless, colourless, combustible gas that is lighter than air and is the primary component of landfill gas.
Monitoring well	a water well used to monitor groundwater conditions near a landfill and ensure that leachate has not escaped the landfill liner and contaminated the groundwater.
Organic waste	waste containing animal and plant products, such as food waste and yard waste, which decomposes in a landfill.
Permeability	a measure of how easily water can flow through a substance.
Runoff	precipitation (rainwater, snow melt) that flows overland and does not infiltrate the ground surface.
Sewage sludge	sewage material collected in septic tanks and also generated from water and wastewater treatment plants.
Synthetic membrane	highly impermeable man-made plastic or rubber-based sheet used in a landfill liner to prevent leachate and landfill gas from escaping to surrounding soil and groundwater.
Waste transfer station	a facility where community solid waste is brought by smaller collection vehicles and consolidated into larger vehicles for transport to large regional landfills, recycling facilities, or processing facilities.
White metals	discarded household appliances and other large enamelled appliances such as old refrigerators, stoves, freezers, washing machines, etc. Also known as “white goods.”