ALBERTA TRANSFER STATION TECHNICAL GUIDANCE MANUAL

Alberta Environment

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Solid Waste Association North America

Northern Lights Chapter

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PREFACE

This Technical Guidance Manual was prepared for Alberta Environment by SWANA – Northern Lights Chapter in association with JL Technical Services. An advisory committee consisting of municipal representatives volunteered their time to provide their opinions on the manual content and to critique the document. These individuals include:

- Donna Chaw, Alberta Environment
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- Jim Lapp, Solid Waste Association of North America – Northern Lights Chapter
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- Rob Smith, Athabasca Regional Waste Management Services Commission
- Jim Schubert, City of Edmonton, Waste Management Branch
- Joanne Walroth, County of Rockyview

Manual Objectives

The intent of the manual is to promote best practices in the design and operation of municipal waste transfer stations in Alberta and provide guidance for environmental protection and work place safety. With an increasing emphasis on diverting resources away from landfill disposal, the Manual addresses the integration of materials recovery for recycling and the safe management of household hazardous waste.

The manual will assist the reader to understand the steps involved in planning, design and operation of transfer stations. It will also provide the reader with alternative transfer station system designs and their application within rural and urban waste management systems, and within regional waste management systems.

Who Should Use The Manual?

The manual can be used by individuals who are involved in either the establishment or operation of transfer stations, and may include:

- Municipal administration staff
- Engineers and planners
- Operators of transfer systems
- Contractors and equipment suppliers
- Alberta government funding and regulatory personnel

General Content of the Manual

The manual includes:

- A review of regulatory requirements that apply to transfer stations in Alberta
- Recommendations for siting of transfer station facilities and design of transfer stations
- Suggestions for planning and financing transfer station systems
- A description of municipal solid waste storage and collections systems
- An overview of typical waste collection and transfer vehicles
- A catalogue of municipal solid waste transfer systems, including public convenience drop-off facilities
- Recommendations for preparing operating plans for transfer stations including safety and emergency response plans
- Recommendations for keeping and maintaining operating records
- Recommendations for decommissioning of a transfer station should it no longer be viable

How to Use the Manual

The manual is prepared in Chapters that cover specific topics in a step-by-step approach. Each chapter is presented so that the user can easily read the entire manual or only those chapters of specific interest

Additional useful information is provided in Appendices documents such as typical site plans, design checklist, outline for an operations manual, a waste handling guide, and a form for Notification to Alberta Environment.

1 OVERVIEW OF WASTE MANAGEMENT SYSTEMS

1. Integrated Waste Management Systems

Integrated solid waste management systems (ISWM) refers to a comprehensive system of waste storage, collection and transportation, processing, and disposal in a manner that protects the environment and that is economically viable. The most desirable and logical approach to ISWM systems would typically include:

- Reduction of the amount of waste generated,
- Promotion of re-use and repair vs. throw-a-way and replace,
- Provision of convenient short-term storage, collection and transfer that maximizes diversion and efficiency,
- Recovery of organic materials for beneficial use,
- Recovery of recyclable materials to produce new products,
- Segregate hazardous materials from solid waste,
- Utilize when practical the remaining waste for energy recovery, and
- Disposal in properly designed and operated landfills those materials which cannot be economically removed from the waste stream.

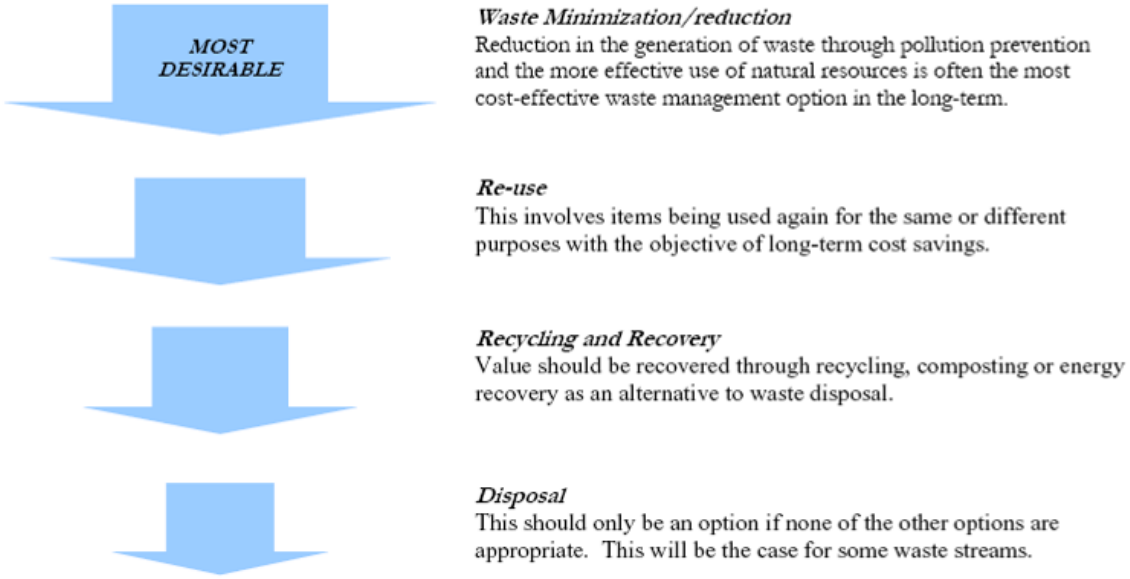


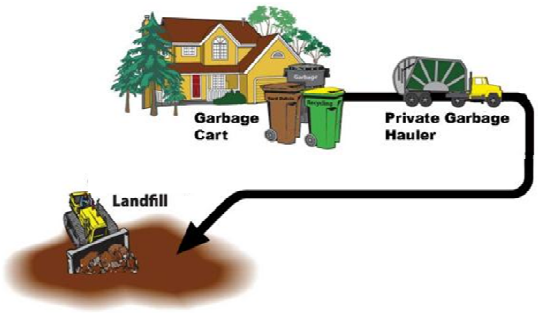
Figure 1-1
Alberta Waste Management Hierarchy

The efficiency of each individual component in a solid waste management system can be directly affected by any or all other components of the system. In a properly planned ISWM system, all components of the overall waste management program are designed to be compatible.

An integrated waste management system often includes a waste transfer station that can provide a variety of services for solid waste storage, processing and recovery.

2. Direct Haul Collection Systems

Direct haul with collection vehicles is used where processing or disposal sites are within close proximity to the point of waste generation. Generally, this occurs when hauling distance are less than 15 km, although some collection vehicles provide economical hauling for distances up to 40 km.



Direct Haul Collection System

3. Role of Transfer Stations in Municipal Waste Management

A solid waste transfer station is simply a facility that receives waste materials from a community where it is consolidated by transferring it to a larger vehicle for more efficient and economical transport to a distant waste disposal facility.

A transfer stations in Alberta are typically used to

1. Economically transport waste to a distant landfill,
2. Increase municipal collection efficiency,
3. Provide convenient drop-off locations for residents
4. Reduce traffic volume at a landfill.

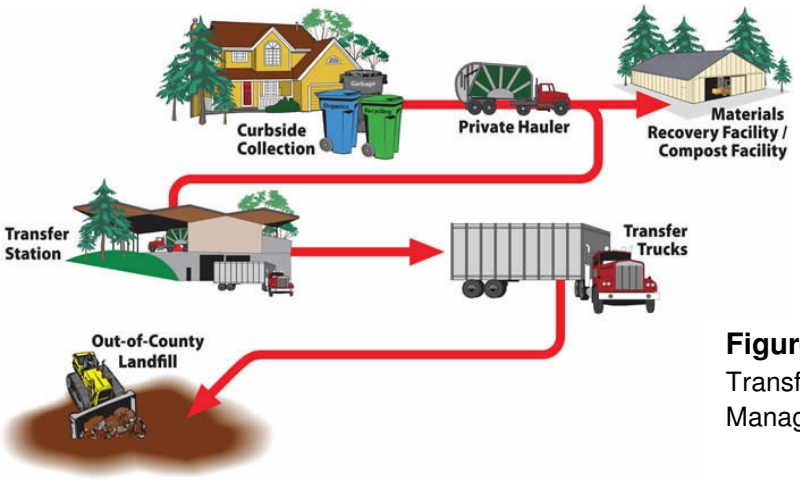


Figure 1-3
Transfer Station in a Waste Management System

Transfer stations are more commonly used as multi-purpose facilities that include storage of recyclable materials, household hazardous waste collection depots, and in some cases collection points for organic materials destined for composting sites. Figure 1-4 shows a generic site plan for transfer station that incorporates recycling, grass and leaf drop-off for composting, a waste exchange, appliance drop-off, and roll off containers for solid waste transfer.

Generally, there is no long-term storage of solid waste at a transfer station. The speed at which these materials are consolidated and loaded for transport will largely depend on the size of facility and whether it is rural or urban. Sparsely populated areas may not generate enough waste to warrant daily removal, but typically, the waste is transferred weekly to minimize health nuisances. In an urban setting, the volume of waste generated will typically warrant more frequent removal of waste, and may require daily or continuous removal to minimize health nuisances.

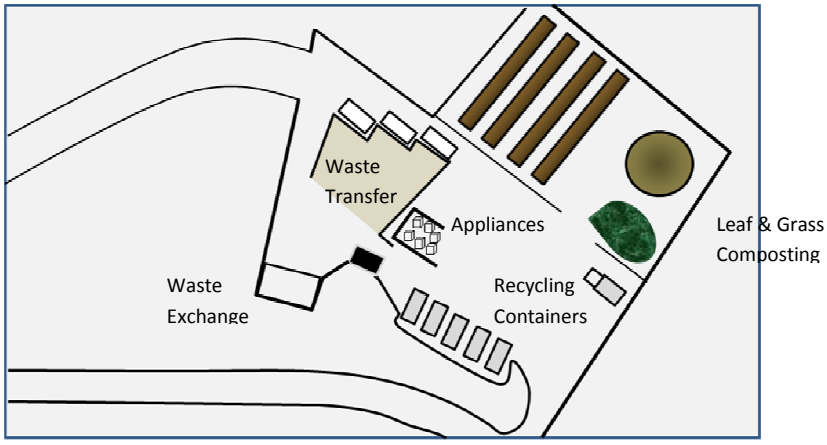


Figure 1-4
Transfer Station with Recycling and Composting

2 *REGULATIONS AFFECTING TRANSFER STATIONS*

1. Municipal Government Act

The Municipal Government Act (MGA) enables municipalities to "*provide services, facilities or other things that, in the opinion of council, are necessary or desirable for all or a part of the municipality".* This in essence applies to waste management services provided by the municipality either directly or indirectly through contracted services.

i. Subdivision and Development Regulation

Section 13 of the Subdivision and Development Regulation (AR 43/2002) specifies setback distances for waste disposal facilities from school, hospital, food establishment or residence.

The setback for a waste storage facility is 300 metres.

The regulation includes a reciprocal clause that prohibits a subdivision authority to issue a permit for development of a school, hospital, food establishment or residence within 300 metres of a waste storage facility. A variance of the 300 metre setback may be obtained by the subdivision authority or development authority if it obtains the written consent of the Deputy Minister of Environment.

2. Environmental Protection and Enhancement Act (EPEA)

The purpose of EPEA is to support and promote the protection, enhancement and wise use of the environment. Regulations under this Act cover a wide range of activities including waste management. The regulations under EPEA that are relative to municipal solid waste transfer stations are summarized below. Transfer station planners, owners, and operators should refer to the regulations for specific requirements and amendments to those regulations.

Section 176 of EPEA requires that waste must be disposed at a waste management facility or in a container that will be taken to a waste management facility.

The following sections of EPEA are relevant to transfer station facilities in the event of a substance release, such as a chemical spill or fire with smoke emission.

- Section 109: prohibits release of a substance to the environment where no approval or registration has been issued,
- Section 110: requires the person responsible to report the release of a substance to the Director as soon the person knows or aught to know of the release,
- Section 111: specified the manner in which a release is to be reported, and
- Section 112: specifies a duty of the person responsible to take remedial action.

i. Waste Control Regulation

The Waste Control Regulation (AR 192/96) defines hazardous waste and regulates the management of hazardous and non-hazardous wastes. The regulation provides a definition for a 'storage site' which is defined as a 'waste management facility, where waste, other than hazardous waste is:

(1) Stored
(2) Sorted, compacted, shredded, ground or processed, or
(3) Collected and held for removal to another waste management facility

The regulation does not include any provisions specific to the development and operation of transfer stations. It does include clauses that may apply to facilities or operations that are included as part of a transfer station facility such as storage and handling of hazardous wastes (Section 12).

ii. Activities Designation Regulation

The Activities Designation Regulation (AR 276/2003) specifies activities that require approvals, registrations and notifications. Transfer stations fall under the definition for waste storage facilities in Section 4 (Definitions – notice activities). Under Schedule 3, the owner must submit a notification for the construction, operation and reclamation of a waste storage site. The content of the notification is specified in Section 7 and must include the following information as a minimum:

- Name and address of the person responsible,
- Location and description of the facility,
- Proposed dates for commencement of construction, completion of construction, and commencement of operations,
- Any other information requested by the Director.

The form of notification is provided in Appendix A

3. Public Health Act (PHA)

The purpose of the Public Health Act is to protect public health. Regulatory responsibilities are delegated to Regional Health Authorities. Section 75 of the PHA gives it paramountcy over all other acts and regulations with the exception of the Bill of Rights.

i. Nuisance and Sanitation Regulation

For transfer station owners and operators, because the Nuisance and Sanitation Regulation (AR 243/2003) prohibits any person from creating, committing or maintaining a nuisance. This means that an executive officer of a Regional Health Authority could take appropriate action should it be determined that the transfer station is a 'nuisance'.

Specific sections in this regulation that apply to waste collection or transfer stations include the following:

- Section 4: "Disposal of things" gives the executive officer the powers to dispose of or order the disposal of a thing that is or may likely become a nuisance,
- Section 8: Storage of garbage and refuse in containers until it is collected for final disposal

4. Occupational Health and Safety Act

The Occupational Health and Safety Act sets standards to protect and promote the health and safety of workers in Alberta. It defines the rights and obligations of employers and workers and establishes the authority and powers of Occupational Health and Safety Officers. It also establishes rules of procedure in the case of a workplace incident.

i. Occupational Health and Safety Regulation

The Occupational Health and Safety Regulations establishes broad rules that apply to Alberta workplaces. These provisions reflect government policies and are the minimum requirements to ensure the protection of workers.

ii. Occupational Health and Safety Code

The Code contains detailed technical requirements for creating safe and healthy work places. In some cases, the Code specifies an objective requirement which allows for creative options, and in other cases it specifies precise requirements.

5. Public Highway Development Act

i. Highways Development Control Regulation

This regulation establishes limits on development within a controlled highway and specifies appropriate directional signage. In Alberta, the following minimum development set backs are as follows:

- 300 metres off a controlled highway, and
- 800 metres off the centre point of an intersection of a controlled highway and another highway or other public roadway.

6. Traffic Safety Act

i. Commercial Vehicle Dimension and Weight Regulation

This regulation specifies the maximum dimensions and weights for commercial vehicles on Alberta Highways. The regulation allows for exceptions if permits are issued. Specific information on dimensions and weight limits can be viewed at the following web page.

http://www.trans.gov.ab.ca:81/docType281/production/teg012.htm

7. Codes

Codes that will have an influence on how a transfer station is constructed or operated may also include:

- Alberta Building Code
- Alberta Fire Code

3 *SITE SELECTION*

1. Community Consultation

It is often difficult to site waste management facilities that satisfy technical and economic issues, and that have community acceptance. Involving the community at an early stage of the siting process can help to define a suitable level of service and to address specific concerns in the planning and design of the facility. It is often more effective to address these issues prior to confirming a specific site and preparing a detailed design. If community issues are not addressed early, it could result in delays or development permits could be denied, or additional conditions added to the development permit that increase costs.

Concerns often raised by the community include:

- Safety and health impacts
- Traffic volume and noise
- Litter
- Odour and dust
- Insects, birds, and other scavenging animals
- Operating hours
- Level of service (convenience, access)
- Visibility and aesthetics
- Siting and planning process
- Costs to taxpayer
- Zoning
- Property values

In general, the community should be regularly informed throughout the transfer station planning and development process. An appropriate level of consultation should be considered for each facility and situation. This may depend on factors such as:

- Population density,
- Size of the facility,
- If site is an upgrade to an existing site (e.g. old landfill)
- Existing opposition or support for the transfer station

Typical methods for disseminating information and involving the community include:

- Mail out of newsletters, feedback forms, brochures
- Information packages to residents surrounding proposed sites
- Press releases and advertisements in local newspapers
- Establish call-in phone lines or “hot lines”
- Community open houses or workshops
- Engage community service groups

- Communicate with municipal councils and administrations

The community consultation process should not focus on just providing information, but should focus on public views and concerns. This can help to identify the community's:

- Concerns about the facilities impacts
- Desired level of service
- Advice on resource recovery
- Feedback on development and operation performance
- Opinions on environmental, social and financial issues.

2. Siting Criteria

a. Regulatory

Regulatory siting criteria for development of a transfer station fall under the following:

- Municipal zoning bylaws
- Subdivision and Development Regulation
- Highways Safety Act Setbacks
- Setback from municipal roads and streets (local bylaws)

The facility planner should refer to these specific regulatory documents and consult with municipal and government agency officials so that all set backs or other constraints are fully understood.

b. Technical

The technical criteria may vary with the specific facility, but generally will include:

- Centrality of the location to the waste source and collection routes
- Access to major transportation routes and road suitability to load size along planned transfer haul routes
- Consideration of safe entrances or exits onto public roads
- Site size requirements including space for the transfer buildings, recycling facilities, composting or other planned activities
- Sufficient space for on-site roads to allow for efficient vehicle routing, queuing of collection vehicles, and parking for trailers & site staff
- Access to existing utilities such as 2 or 3-phase power, natural gas services, and water and sewer utilities where such utilities are necessary for operation of the transfer station

- Ability to expand the facility in the future either because of population and waste volume growth or because of an expanded service area
- Gently sloping topography that is compatible for building necessary ramps
- Consideration of on-site and off-site drainage controls and surface water management
- Geotechnical considerations for supporting building and retaining wall structures, and may include geotechnical investigations to confirm
- Allowance for site buffers and landscaping including fencing, berms, open spaces, and trees.

c. Sensitive Environmental Areas

Selection of site should be done in consideration of impacts on sensitive environmental areas such as:

- Wetlands and floodplains
- Habitats of endangered and protected flora and fauna
- Areas of historical, archeological, and cultural significance
- National, Provincial, and Public parks

This does not preclude siting facilities in such areas; however specific design criteria may be necessary to mitigate potential effects, which may influence the overall cost of construction and operation of the transfer station.

d. Community-Specific

Community-specific criteria are normally established through community consultation. This may be defined through community workshops to establish acceptable community-specific criteria. Such criteria could include such issues as:

- Avoidance of clustering and cumulative social or environmental impacts
- Proximity limits to schools, churches, recreation areas, residences, or businesses
- Collection vehicle and transfer haul vehicle routing
- Upgrading of utilities and roads
- Design and operation planning for mitigation of nuisances including litter, noise, dust and odours
- Siting and design buffers and setbacks
- Hours and days of operation, either for providing an acceptable level of service, or to mitigate concerns of noise and traffic

e. General Selection Criteria for a Transfer Station Site

The general selection criteria for a transfer station site that should be considered is summarized in Table 3-1

TABLE 3-1 GENERAL SITE SELECTION CRITERIA

Consideration	Criteria	
Land Use	Appropriate development areas may include industrial areas and rural areas with consideration to the Sub-division Development Regulation and local municipal development and zoning bylaws.	
Access Roads	Access to a transfer station site should consider the requirements set out in the Highways Development Control Regulation (AR242/90) and local bylaws. Vehicle types, sizes, and weights should be considered in locating a transfer station along public roads	
		Separation Distances
Airports	Transport Canada Land-use Guidelines, or Airport Zoning Regulations	Generally 8 km from an airport used by commercial aircraft
Residence, Hospital, food establishment, school	Sub-Division Development Regulation (AR212/95	300 metres
Flood plain	No regulatory reference	Not within 1:100 year floodplain
Property Line	No regulatory reference	Active areas (e.g. tip area, storage compounds) not within 5 metres of the site property line

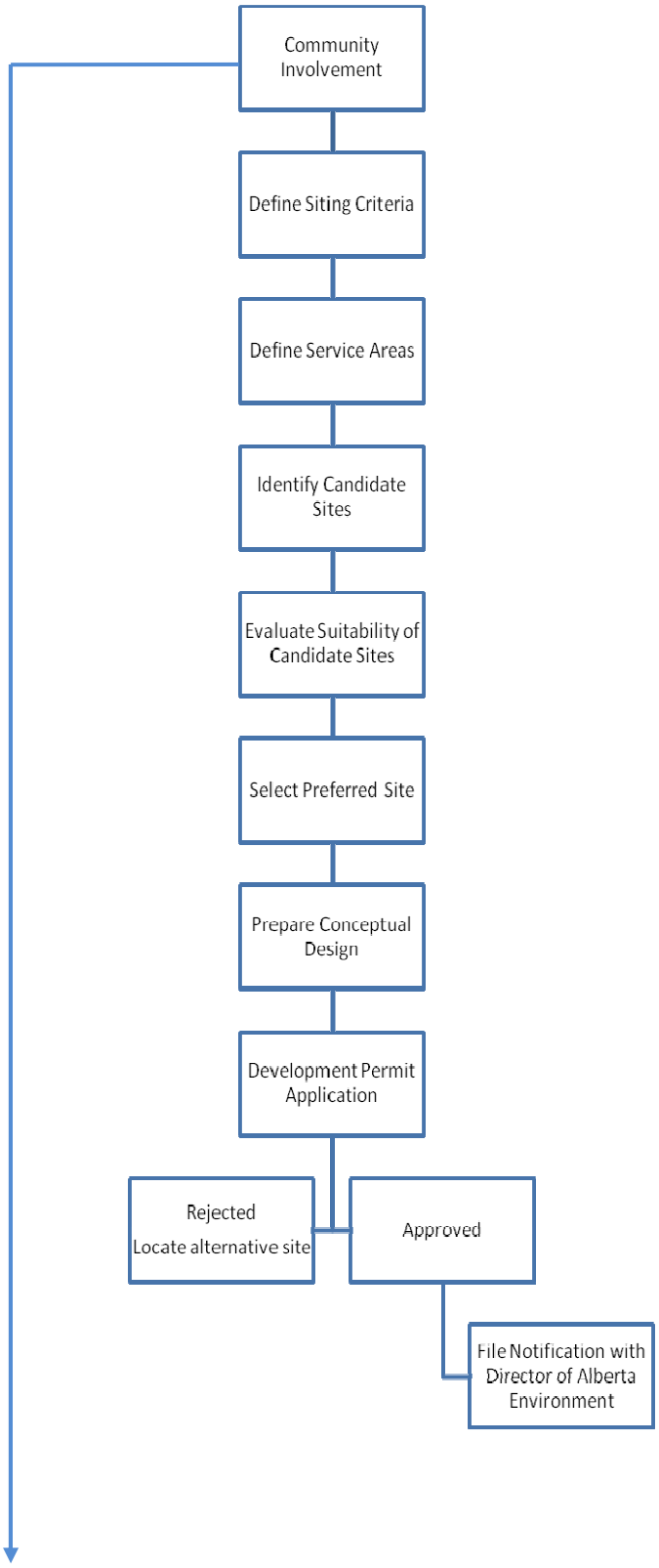
3. Siting Process

The siting process should follow a logical sequence to achieve the desired outcome. This is illustrated in Figure 9-1 at the end of this chapter. In cases where it is appropriate, the community involvement process should begin at the outset and may continue throughout the siting process. This will largely be determined by public response to the project.

By applying the principles described in Chapter 7 and above, the planner should determine service areas to establish appropriate locations where a transfer station is required. A number of potential candidate sites may be identified and evaluated. In some cases, this process may be simplified. For example, where it is planned to close an existing landfill and construction the transfer station at that site, it may not be necessary to follow all of the steps shown in Figure 9-1. The planner should still complete a site evaluation to determine if the site is suitable for a transfer station development. In that case, the designer may need to consider risks, such as foundation support and landfill gas, that may be associated with constructing on or around a waste fill.

Once a preferred site is selected, a conceptual plan should be prepared along with a description of the facility and operating plans for submission of an application for a municipal development permit. Upon issuance of a development permit, opponents have the right to appeal the decision. If upheld, and the permit stands, the planner may then submit a Notification on the project to the Director at Alberta Environment.

Figure 3-1
Transfer Station Siting Process



4 PLANNING A TRANSFER STATION SYSTEM

1. System Planning

Planning of either a single transfer station or a network of transfer stations in a regional system, should be done in a systematic way to achieve a desired result. Typical factors in the planning of transfer station include the following:

- Environmental,
- Social,
- Economics, and
- Potential for regional cooperation.

Planning for a transfer station or regional system should be done by an experienced waste management professional.

2. Planning Horizon

To set out the basis for planning of a transfer station, a planning horizon should first be agreed upon. A typical planning horizon will be 20 or 30 years into the future, although shorter or longer periods may be considered in some circumstances. Establishing a planning horizon assists the planner to:

- Evaluate future needs based on projected waste volumes,
- Determine design criteria for longevity of the facility and it's components,
- Allow for planned expansion, and
- Establish appropriate zoning set backs for potential future development on adjacent property

3. Service Requirements

i. Type of Service

The type of service should be clearly defined. This may include the following options:

- Service to only organized collection vehicles
- Service for residents use only
- Service to residents and organized collection vehicles.

Furthermore, it may be decided that commercial collection vehicles will also use the facility, or they may be required to find their own alternatives. This decision may be based on a variety of factors including economics and the need to provide the service.

ii. Recycling and Other On-site Facilities

Facility development criteria will be affected by desired ancillary facilities such as:

- Recycling activities such as drop-off facilities or processing facilities,
- Storage compounds metals, tires and pesticide containers,
- Household hazardous waste storage, or
- Disposal or recycling of construction and demolition materials.

The need for these facilities may vary from location to location and may be determined based on other facilities and services in the area. For example, where recycling facilities exist locally, inclusion of recycling activities may not be necessary.

iii. Level of Service

Establishing the desired level of service for public use may affect the facility design and operating criteria, and may also influence the number of transfer stations in a regional system. Level of service considerations include:

- Hours of operation
- Days of operation
- Longest acceptable travel distance for residents

The hours and days of operation may impact economics; however, limiting the hours may reduce the desired level of service to residents.

Acceptable travel distances may vary from one area to another. This may be simply be determined by considering travel patterns to existing waste management facilities, or it may be determined based on affordability of building numerous transfer stations.

iv. Define Service Areas

The service area and level of service are closely linked. To define the service area for transfer stations, the transfer station planner will need to consider the longest acceptable travel distance for residents. The simplest approach is to map the service area by drawing a radius of this distance around the transfer station location.

This approach can be used to assist in determining logical areas for siting transfer stations and the appropriate number of facilities within a regional system. This is illustrated in the following figures.

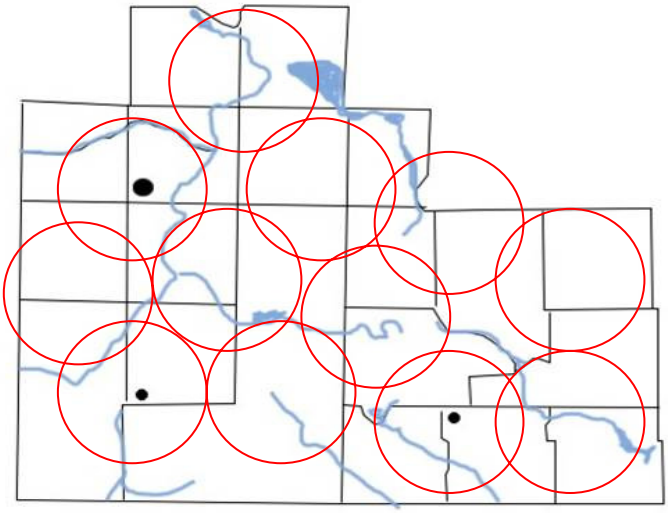


Figure 4-1
Small Radius Service Areas

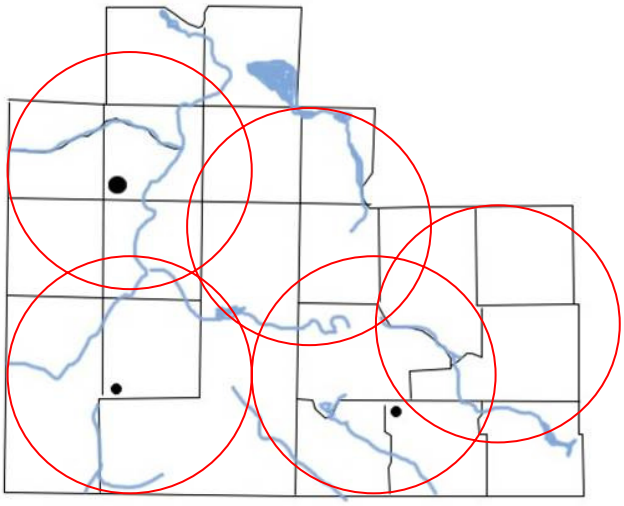


Figure 4-2
Large Radius Service Areas

A comparison of using a small radius or a large radius for determining service areas is explained in Table 4-1 below.

Table 4-1: Comparison of Service Area Design Radii

Small radius	Large radius
• More facilities	• Fewer facilities
• Higher level of service	• Lower level of service
• Higher capital and operating costs	• Lower capital and operating costs
• Lower potential for illegal dumping	• Higher potential for illegal dumping

Service areas in Alberta are commonly established using a minimum design radius of 15 km radius It may also be appropriate to use a longer design radius in some regions, and in some cases variety of design radii may be desired.

4. Waste Assessment

To design a transfer station and determine ancillary facilities, it is necessary to determine the amount and types of wastes, bulky materials, and recyclable materials that can be expected.

Waste volumes can be determined by existing records if they are available, or by referring to records in similar communities in other jurisdictions. To apply this data to each transfer station facility, populations within each service area can be determined and a per-capita rate from other data sources used to calculate expected volumes.

To determine material types, a waste analysis could be conducted. This could involve a detailed sampling and sorting program, however these types of analysis can be costly to achieve reliable results. Alternatively, waste analysis data from other jurisdictions may be applied to provide a reasonable estimate. In addition, observations at existing disposal operations will provide good first hand information for potential problem materials.

5. Traffic Evaluation

i. Vehicle Types

A transfer station must be compatible to handing existing collection vehicles. The types of collection vehicles used in a community will affect design capacity, building design, and site layout. A transfer station planner should take an inventory of existing collection vehicles and make experienced observations of public vehicles that will likely use the transfer station. Important considerations include:

- Truck body capacity

- Dump height
- Vehicle length and turning radius
- Method of dumping (e.g. dump, push-out)

ii. Traffic volume and patterns

Traffic patterns and volumes for organized collection systems can be determined by interviewing the managers of those systems. Basic information of value includes:

- Collection days
- Number of loads hauled per day
- Typical time per load

This information will give an indication of peak days and times for waste delivery by collection vehicles so that the transfer station designer can address queuing requirements and for scheduling of transfer vehicles to coincide with these peaks.

Determining traffic volumes and patterns by public self-haulers is much more difficult, however typical patterns can be assumed. Generally, the public may use a transfer station facility on week-ends more than week-days, and may use the facility in early evenings more than mid-day. Such assumptions should not be relied on entirely, since the public could arrive at any time during any day.

6. Waste Disposal and Recycling Markets

In planning the transfer station system, it will be necessary to have a clear understanding of where the materials gathered at the facility will be transferred to. This may include the following materials:

- Solid waste for disposal at a landfill,
- Bulky materials (e.g. metals, pesticide containers, tires),
- Household recyclables (e.g. paper, cardboard, tins, etc.),
- Organics for composting, or
- Household hazardous wastes brokers.

Useful information generally includes:

- Location of disposal facility or material broker,
- Distance of haul,
- Method of transport,
- Who transports,
- Requirement for preparing materials for hauling, and
- Haul routes

7. System Selection

The first question to ask when planning a transfer station is:

"Is a transfer station really necessary?"

This decision should be based on the desired level of service and economical factors. If the intent is to construct a local facility that is convenient for residents to drop-off wastes and recyclable materials, the governing factor is level of service. If the intent is to provide economical hauling for waste collection services, then economics should govern this decision, and should be based on a comparison of hauling costs (see following section on financial planning).

When it is decided to build a transfer station, the following questions may influence the decision on the type of facility or facilities that are potentially suitable.

"*How much segregation of waste will be done?"*

Regardless of the type of transfer station used, not all waste can be easily transferred. As much as 1/3 of the waste stream may include bulky materials such as appliances, mattresses, furniture, equipment and automotive parts, trees and shrubs, fencing materials, and construction and demolition materials. Most of these bulky materials are difficult to handle, while others, such as concrete and rubble, are not appropriate to handle through a municipal solid waste transfer station.

Should minimal separation be desired, the equipment and containers used must be sized accordingly and be robust enough to minimize potential damages. With aggressive separation for re-use or recycling, a greater variety of transfer station systems may be applicable.

"Will the transfer station be used only as a public drop-off facility?"

If the transfer station is to be used only as a public drop-off facility, any design type may be used, however the capital and operating costs must be carefully considered with more complex facilities. In most cases, simple container systems may be appropriate, however where long distances are involved, TRANSTOR's, rural push-pit, or compaction facilities may be favoured because of more economical hauling.

"Will the transfer station be used by collection vehicles?"

Different types of transfer stations have different capabilities of receiving a variety of collection vehicles. Facilities that use front-end loader containers, for example, are not suited to receiving waste from collection vehicles. Simply put, a 12 cubic yard load from a collection truck will not fit into an 8 cubic yard box. Roll-off containers have been used

where small collection trucks are used, however they do not normally provide any economic value over direct haul. TRANSTOR's, compactor systems, and push-pit systems are capable of accepting a variety of collection vehicles; however specific designs must consider the types and nature of collection vehicles to be received.

The following table may provide guidance to selection of appropriate transfer station systems.

Table 4-2: Selection of Transfer Station Systems

OPERATION	SUITABLE TYPE OF FACILITIES
Low amount of waste segregation	Roll-off containers Push-pit Stations
High amount of waste segregation	All types
Public drop-off with short haul distances	Roll-off containers Front-end containers
Public drop off with long haul distances	TRANSTOR Rural push-pit Stationary compactors
Transfer from residential collection vehicles	TRANSTOR Push-pits stations Compaction systems
Transfer from residential and commercial collection vehicles	TRANSTOR (with limitations) Push pit stations Compactor systems

8. Financial Planning

Economics should be considered in designing a transfer station or a regional transfer system.

i. Compare Direct Haul and Transfer

Before designing a transfer station, a waste planner should determine if it makes economic sense to transfer waste from community collection vehicles. This holds true for planning of a single facility or a regional network of transfer stations. It may in fact be less costly to direct haul rather than transfer. A general rule of thumb is that transfer station may be more economical where haul distances are greater than 25 or 35 km. As transportation costs increase and labour cost for collection staff increase, this could change. A more reasonable approach to comparing these costs is to determine a 'break even' point. This is the point at which it is more economical to transfer than direct haul and is calculated by determining the following values:

- Transfer station cost to build, own, and operate in $/tonne
- Direct haul payload in tones
- Transfer haul payload in tones
- Trucking cost for direct haul or transfer haul in $/Km
- Distance of haul (2 way distance) km

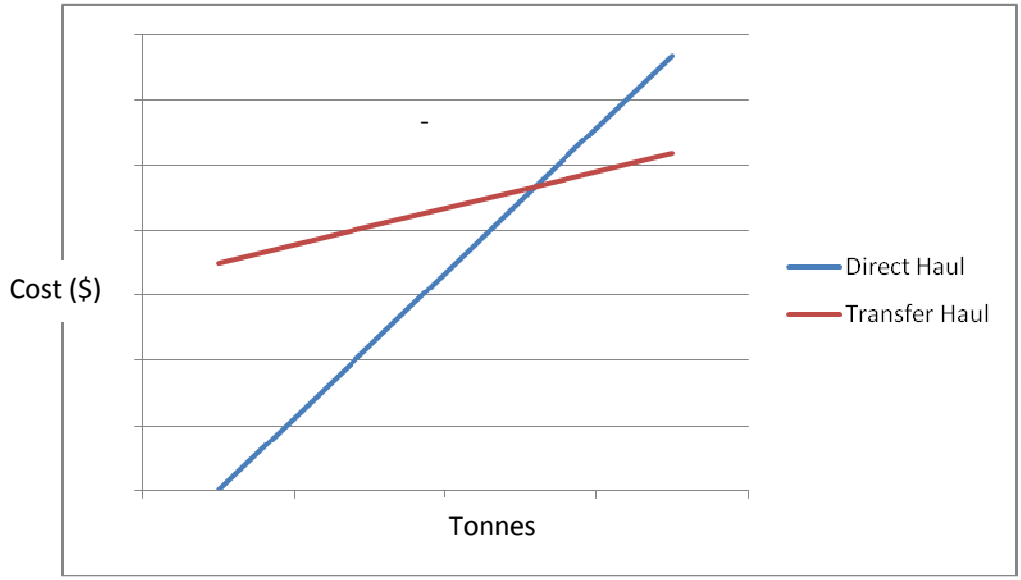
With these values known, the following formulas are used to calculate the different costs

$$\text{Cost of Direct Haul} = \frac{\text{distance (km) x trucking cost (\$/km)}}{\text{direct haul payload ((tonnes)}}$$

$$\text{Cost of Transfer} = \frac{\text{TS cost (\$/tone) + distance (km) x trucking cost (km)}}{\text{transfer haul payload (tonnes)}}$$

Using these calculations for various distances, the break even point can be determined by plotting these values on a graph as illustrated in Figure 4-3.

Figure 4-3
Direct Haul vs. Transfer Haul Break-even Point



i. Estimating Capital Cost

Estimating capital cost is useful to determine the following:

- Feasibility of a project
- Budget planning for a project
- Construction budget

Estimating capital costs will require some level of understanding of the types of transfer station or system that is planned. The accuracy of cost estimates should increase as the level of detail increases in the planning and design stages of the project.

Table 4-3: Comparison of Capital Cost Estimates

Level	Purpose	Plan or Design Detail
1st Order	Feasibility Study	• Conceptual plan • Cost based on other similar projects • 60% to 75% accuracy
2nd Order	Budget Planning	• Preliminary Design • Cost based on other similar projects and/or quantity estimates • 75% to 90% accuracy
3rd Order	Construction	• Detailed Design • Cost based on quantity take-offs and unit costs • ≥ 90% accuracy

A sample capital cost estimation worksheet is provided in Appendix B

ii. Operating Cost

Estimating labour and operating costs for a transfer station is useful to determine:

- Feasibility of a project, and
- Detailed budget planning

Similarly to capital cost estimates, the level of accuracy may depend on the stage of planning or design. At the feasibility stage, costs may be based on known cost of operation of other facilities or systems. Detailed budget planning should be done when a higher level of design detail is known and specific operating requirements are know. Costs estimates at this stage may also use known costs at other operations, but should also be based on locally known costs for labour and transportation

A sample operating cost estimate is provided in Appendix B

iii. Estimate Haul Costs

To estimate hauling, or transfer, costs, the planner should first determine the number of loads that may be hauled over a given period of time.

$$\text{Number of trips} = \frac{\text{waste volume to transfer}}{\text{Truck or container volume}}$$

Estimating hauling, or transfer costs, should be based on local knowledge of trucking costs. Various cost estimation approaches are compared in Table 4-4 below.

Table 4-4 Cost Estimation Approaches

Method	Approach	Attributes
Cost per hour	Estimate operating time based on loading, travel, and unloading times	• Least common • Simple
Cost per kilometer	Estimate based on haul distance	• Most common • Simple
Cost per tone/kilometer	Estimate based on haul distance and average vehicle payload	• Most complex • Specific to type of transfer vehicle used

5 TYPICAL MUNICIPAL SOLID WASTE COLLECTION SYSTEMS

1. Storage

The starting point in a municipal solid waste management collection system is storage of the waste at the point of generation. The waste generator is normally responsible for the waste they produce prior to collection, but once it is set out for collection, the responsibility transfers to the municipality. The container systems used by the waste generator can either aid or hinder the collection activity depending on its ease of handling and compatibility to the collection vehicles used.

Municipalities often establish bylaws for waste containers set out by households and businesses. Bylaws will typically specify the type and size of container that is allowed so that lifting of the container is safe for the collector, or the bylaws may require specific container types to ensure compatibility to the type of collection vehicles used. Specific clauses can also be included that set limits on the size or type of waste that will be collected. Generally, this would not provide for pick up of large bulky materials such as furniture and appliances.

To allow for efficient collection, bylaws may also include clauses that specify where the waste is to be set out (curb or lane) and may specify the days on which it is to be set out.

In Table 5-1 below an overview of common waste storage containers is provided.

TABLE 5-1: Common Waste Storage Containers

Type	Typical Applications	Attributes
Bags 	Hand collection of waste	• Low weight & ease of handling • Low weight • Reduces litter, however bags tear easily Prevent fly entrance or emergence • No return trip to curb saves collection time • Residents pay for the bags • Susceptible to animals

Type	Typical Applications	Attributes
Blue Bag 	Hand Collection of recyclables	• Ease of handling • Recyclable contents unaffected by rain • Bags may tear and are not suitable to hold sharp objects • No return trip to curb • Convenient to resident • Contents can be identified by collector • Resident pays for bags • Requires debagging and more intensive sorting after collection
Clear Bag 	Hand Collection of organics	• Ease of handling unless bag is filled with heavy wet organic materials • Convenient to use by homeowner • Non-degradable bags require debagging at compost facility • Biodegradable bags may be added into compost facility • No return trip to curb • Contents can be identified by collector
Blue Box 	Hand Collection of Recyclables	• Allows for curb side sorting • No debagging required at MRF • Less intensive sorting after collection • No cost to resident • Quality may affected by rain • May not be large enough for all users • Return trip to curb adds to collection time
Metal or Plastic Cans 	Hand collection	• Can be easily lifted if under 100 L size and less than 20 Kg • Equipped with lids • If overloaded can be difficult to lift • Homeowner provides container • Can accommodate bags • Odours may develop if not cleaned regularly • Requires return trip to curb

Type	Typical Applications	Attributes
Roll-out carts 	Semi-automated collection of waste Automated collection of waste	• Typical sizes 130 L to 360 L • Ease of use – rolled by resident to set out point • Too large for hand collection • Safe and efficient when used with automated collection • Can be used for waste, recycling, or organics collection • Must be compatible to the type of collection vehicle lift systems used
Front-end loader bins 	Multi-family collection ICI (industrial, commercial, institutional) collection	• More efficient than hand collection of ICI waste stream • Can accept larger objects • Robust • Can be adopted for rural containerized collection • Suitable for homeowner convenience drop off facilities • Lifted only with compatible front-end compactor vehicles • Can be difficult to place in crowded lanes • Can be designed for homeowner drop-off recycling depots
Side Loader Bins 	Multi-family Automated residential collection in lanes – typically 1 bin per 2 residences ICI collection	• Versatile applications • Efficient collection and can reduce collection costs • Can be used in rural collections systems • Improves lane aesthetics over can or bag systems • May be used for recycling depots and homeowner drop-off facilities • Residents may oppose placement of bins in residential areas • Must be compatible to type of side-loader lifting system • May be high cost to implement in a municipality

Type	Typical Applications	Attributes
Hyd-a-Way Containers 	Residential Multi-family Parks Commercial	• Animal proof • Waste is fully contained • Can be adopted for recycling depots • Generally limited to bagged garbage • Compatible to Haullall Collection vehicles
Litter Receptacles (various) 	Streets Public parks Special events	• Convenient litter receptacles • Reduces public littering • Numerous variations • Some systems can be used for collection of beverage containers • Must be collected frequently to avoid overfilling and nuisances
Roll-off Bins 	Construction and demolition Industrial	• Can accept large objects and large volumes • Can be used for rural homeowner drop-off facilities • Can be designed for use in recycling depots • Bin designs must be compatible to specific lifting equipment and truck rails
Lugger Containers 	Industrial uses Scrap metal Sludge handling	• Can receive large objects • Can be used for home owner drop-off facilities • Can be designed for use in recycling depots • Can be used for sludge handling • Must be compatible to lugger truck lifting devices
Self-Contained Compaction Containers 	Grocery and retails stores Shopping malls	• Self contained • Compaction reduces storage requirement • Compactor is hauled with the container • Suited to high volume generators • Not well suited to handle

Type	Typical Applications	Attributes
		construction debris and like materials • Can be used for compaction and storage of cardboard at recycling depots • Compatible power systems required to operate compactor • Must be compatible with design of tilt frame truck used

Municipalities commonly set out bylaws that specify the type of container allowed in the community. Bylaws may allow for a variety of containers, but may set size limits where hand collection systems are used. Where a specific container system is required, such as with semi-automated or automated collection, the bylaw may specify the type and size of container allowed. In many cases, the municipality will supply the initial container when semi-automated or automated systems are introduced.

Collection container selection may be based on the following factors:

- Level of service desired in a community
- Community standards
- Type of collection system in use or desired
- Convenience to the waste generator
- Waste types and volumes generated
- Length of required storage time (time between collection days)
- Available commercial services in a community
- Economics
- Community diversion goals

6 *COMMON COMPACTION EQUIPMENT*

Compaction equipment is commonly used in the solid waste industry to consolidate materials for more efficient storage and transportation. Compactor systems typically consist of a feed hopper and a push plate operated by a hydraulic ram. The waste is compressed into the receiving container or trailer. Compaction occurs inside the trailer or container.

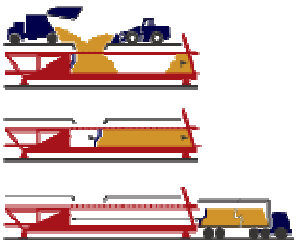
A variation to standard compactor systems is a “pre-crush” compactor where the waste is compacted in a chamber attached to the compactor. Waste is compacted inside the compaction chamber and then the compacted slug is pushed into the receiving trailer. Because compaction occurs outside the trailer, the trailer can be lighter than with other compactor systems.

Baling systems compact the waste and use a tie system or wrap system to hold the bales together. Bale systems are common in recycling programs to consolidate the material for more economical transport. Bale systems are also used with waste destined for landfills. In landfill applications the baled material can provide higher densities than typical landfill compaction methods, and it can be used to reduce wind-blown litter.

In either case, these types of compaction systems are used in waste transfer stations throughout North America. Stationary compactors are more common at Alberta Transfer Stations. These systems are described in Table 6-1 below.

Table 6-1 Common Types of Compaction Equipment

Type	Typical Applications	Attributes
Stationary Compactor 	High volume generators Transfer stations	• Waste is loaded into a hopper and compacted into closed top containers or trailers using a hydraulic ram and push plate • Requires compatible power source for compaction equipment • Some systems are not well suited to handle construction debris and like materials • Trailer or container must be connected while operating compactor

Type	Typical Applications	Attributes
Pre-crush Compactors 	Transfer stations	• Pre-crushes and charges into an enclosed chamber outside the trailer or container • Pre-crushed “slug” is pushed into trailers • Compactor may continue to be operated while trailer or container is being switched • Because compaction occurs outside the trailer, less wear and tear on the trailer occurs than with other systems.
Horizontal Bailers 	Recycling facilities Landfill balefills	• High volume baling of recyclable materials for efficient transport to market • High density bales of solid waste for landfill applications (balefills)
Vertical Bailer 	Recycling Facilities	• Generally applicable to small recycling facilities • Lower density of bales than with horizontal bailers

When selecting of compacting systems, the following factors should be considered:

- volume of waste to be handled
- size and type of receiving vehicle or container
- characteristics of the waste (moisture content, size)

- location of the compactor (room, placement, access)
- method of hopper feed (direct dump, pit system, feed conveyor, hand loaded)
- electrical system (single or 3 phase, voltage)
- features (security, safety, cycle time)
- foundation requirements for installation

It is important that buyer of compaction systems works closely with the equipment supplier so that the proper machine is selected based on the specific application, and so that the site design and preparation matches the suppliers equipment. Equipment suppliers will normally provide engineering details for foundation requirements, power requirements and installation for their equipment.

7 *COMMON COLLECTION AND TRANSFER VEHICLES*

The selection of a collection vehicle in current times requires the buyer to consider operator comfort and ergonomics, safety, fuel consumption, collection efficiency, and cost. The number and type of collection vehicles in organized collection systems in large urban communities can be quite varied depending on their specific purpose. In smaller communities, economics may dictate that only one or two vehicle types are used.

The size and type of vehicles used are normally determined by the level of service desired, the amount of waste generated, and the type of waste being collected. If a collection vehicle is being selected on the basis of collecting waste from existing storage containers, choices may be somewhat limited, whereas, if the municipality is looking to change to a more efficient collection system, the type of storage containers used may need to be changed to match the vehicle selections. This is particularly true where a municipality converts to automated collection from manual collection systems.

When planning a transfer station, it is essential that the designer has a complete understanding of the types of vehicles used for waste collection in a community. The transfer station must not only be able to handle the volume of waste that will arrive, but it must be able to safely handle the number and type of collection vehicles that it will serve. The solid waste systems planner should also consider the capability of existing equipment to haul directly to a landfill and the economics of that haul before deciding on the type of transfer station required, or even if a transfer station is required.

Common collection vehicles are shown in Table 7-1. This is not intended to be an exhaustive list of all makes and models, but is intended to provide a general overview of the types of vehicles available.

TABLE 7-1: Common Waste Collection Vehicles

Type	Typical Application	Attributes
Rear Loader Compactor 	Urban residential Rural mail box collection	• Hand load bags or cans into rear hopper • Compaction blade packs from hopper into truck body • Low lift height • 16 to 25 cu.yd. capacity • 2 or 3 man crew • Economic hauling up to 40 km depending on size.

Type	Typical Application	Attributes
Semi- automated Rear Loader 	Urban residential Rural mail box ICI	• Fitted with hydraulic lifts to raise and dump roll-out carts • Reduces collector injuries • Can accommodate larger containers than with hand collection • 16 to 25 cu.yd. capacity • 2 or 3 person crew • Economic hauling up to 40 km depending on size.
Haul All 	Small communities as multi-purpose collection Residential collection	• Can operate on streets and lanes where large trucks cannot operate efficiently • Low gross weight advantage where acceptable axel weights are low • Economical haul distance up to 10 km • Low lift height for collectors • Low compaction • 12 to 15 yd capacity • 1 person crew • Compatible with Hyd-a-way container systems • Can be operated with right hand drive or dual steering
Side Loader Compactor 	Urban residential Rural mail box	• Side loading hopper • Lift height for collector varies with design • Compaction into truck with blade or rams • Economical haul up to 40 km depending on body size and compaction • 1 person crew • Can be operated with right hand drive or dual steering

Type	Typical Application	Attributes
Automated Side Loader 	Urban Residential Collection Rural mail-box Small volume ICI	• Mechanized lifting arm to raise and empty containers into a hopper • Compaction into truck body with ram or blade • 1 person crew – no out of cab handling of containers • Lifting mechanism must be compatible with containers used • Economical haul distance depends on body size
Dual Compartment Rear Loader 	Multi-material collection	• Two compartments for two stream collection system • Compartments are different sizes to reflect material volume differences • Once one compartment is full, truck must make trip to tip areas • Efficient when both materials can be unloaded at same location
Dual Compartment Side Loader 	Multi-material collection	• Two compartments for two stream collection system • Compartments are different sizes to reflect material volume differences • Once one compartment is full, truck must make trip to tip areas • Efficient when both materials can be unloaded at same location

Type	Typical Application	Attributes
Front-end Compactor 	ICI collection Multi-family	• Uses front arm and forks to lift containers • Unloaded into opening in top of truck body • High compaction with hydraulic rams • 30 to 36 cu. yd. body size • Economical haul up to 40 km • Can be used for residential collection with low-height bin • High gross weight may restrict use in residential streets
Tilt Frame – Cable Hook 	Services roll-off bins	• Tilt frame with guide rails hoists to load and empty roll-off containers • Uses hook carriage system or cable system to pull bins onto tilt frame • Can accommodate bins sizes from 20 to 50 cu. yds depending on truck capacity • Can be used for other equipment such as water tanks
Hook Hoist 	Services Hook Lift bins	• Hook system pulls bins onto truck frame and lifts bins to empty • Similar attributes to Tilt-frames

Type	Typical Application	Attributes
Lugger Trucks 	Lifts lugger bins	• Uses a frame that lowers to the bin and lift and swings it onto the truck bed
Open-top Self-unloading Trailers 	Top loading transfer stations Compost hauling Wood chip hauling	• No compaction • Legal loads can be achieved with large trailer box and tamping of loads with backhoe or grapple systems • Unloading floors include walking floors, chain conveyors, and rubber conveyor floors
Compaction Trailers 	Compactor transfer stations	• Closed top • High strength side walls to absorb compactor pressures • Typically smaller box size than open top trailers to avoid exceeding legal road limits • Trailers used with pre-pack compactors may have lighter side walls • Unload with push-out rams or walking floors
Self- Compaction Trailers 	Top loading transfer stations Internal push ram compacts load	• Compatible with push-pit transfer stations and TRANSTOR stations • Can achieve higher payloads than open top trailers in some circumstances • Push-out unloading

The factors that should be considered in selecting collection vehicles typically includes:

- Intention of the collection system
- Type of storage containers used
- Loading location (curbside or lanes)
- Truck body or container capacity
- Minimum crew size
- Lift height
- Safety and operator comfort
- Required turning radius to access streets and lanes
- Loading and unloading mechanisms
- Legal load limits
- Hauling distance from collection route to tip location
- Economics

8 *MUNICIPAL WASTE COLLECTION SYSTEMS*

1. Self Haul Systems

In self-haul systems the waste generator delivers their own waste to a processing or disposal facility. In such cases, there is no organized collection or transfer system.

Even with organized collection systems, there remains a certain portion of solid waste that is still self-hauled. Typically this portion of the waste stream includes materials, such as bulky objects that are not picked up by existing collection services. Self-haul collection is illustrated in Table 8-1.

Table 8-1: Self Haul Systems

System	Typical Application	Attributes
Self-haul Collection 	Small communities Rural areas	• Used where no organized collection service is provided • No direct cost to municipality • Generators may still self-haul for materials not collected by organized collection service • Potential for litter along roadways leading to disposal sites • Potential for illegal dumping • Potential for unsightly and

System	Typical Application	Attributes
		unsanitary storage of waste on generator's property • Not all residents have the ability to haul their own waste • Can result in high traffic volumes at disposal facilities

2. Rural collection systems

i. Mail box

'Mail box' collection provides house-to-house collection services in rural areas. The basis of this collection system is the assumption that:

- If a mail truck can travel a given route, a waste collection vehicle can travel the same route
- Collection points are located at the same location as postal mail boxes, usually at the road side near the entrance to the homeowner's property.

Where postal mail boxes are not used, the resident must have an agreement with the collection agency on a mutually acceptable pick-up location.

Vehicles used for mail box systems may include rear loader or side loader compaction vehicles. Front-end loader compaction vehicles may be used in some cases where the containers are modified for manual collection. Other suitable vehicles include automated side loader compaction vehicles. Travel distances in mail box systems may make the use of non-compaction vehicles uneconomical.

Table 8-2 illustrates a rural mail-box collection system

Table 8-2: Rural Mail-box Collection

System	Typical Application	Attributes
Mail-box Collection 	High density rural residential areas	• Highest level of scheduled collection in rural areas • Collects highest percentage of household waste generated • Can accommodate collection of source separated materials for recycling • Labour and equipment intensive • Highest cost for rural collection services • Participation is critical to economics of the system • Limited to household waste

Mail box collection systems in Alberta are typically used in high density areas surrounding larger urban centres. Service is often provided as a subscription service with a private hauler or may be provided through municipal services and paid for through user fees.

ii. Rural Container Systems ("Green Box" Systems)

Rural container collection systems typically use 4 yd or 8 yd front-end loader containers that are set out in strategic locations. These containers have been known as "green box" collection so named after early 'green boxes' were set out in a rural Montana system. Green box service may be provided to individual farms or groups of farms depending on the level of service desired. There are a few systems in Alberta where containers are provided through a subscription service (County of Wainwright, County of Flagstaff, MD of Provost). This type of service has also been used in small villages and hamlets in Saskatchewan. In those cases a single container serves up to four dwellings or an individual business.

An alternate rural container collection service involves setting out containers at road-side locations where residents deliver their waste. These systems are typically located in sparsely populated areas and are unsupervised. With this type of service, recycling containers may also be provided.

Front end loaders are most common for rural container collection systems because of their large capacity bodies and their ability to lift larger volume containers (up to 8 yd) than other collection vehicles. Side loaders can provide a similar service, however they

are generally less efficient because of smaller bodies and limitations of container size (typically 4 yd or less). A rural container system is illustrated in Table 7-3.

Table 8-3: Rural Container Collection

System	Typical Application	Attributes
Rural Container System 	Rural Residents Rural businesses Small communities	• Lower cost than mail-box systems • Can be used in small communities as low cost collection service • Same vehicle can serve convenience drop off facilities • Not limited to household wastes • Can offer individual or group service in rural areas • Prone to being overfilled • Cannot handle farm waste such as fence posts with wire, demolition materials, or equipment parts

3. Urban collection systems

Organized residential collection may occur either at the front street (curb-side) or back lane. With curb-side collection, waste is set out by the resident on collection day, while with lane collection, waste may be stored between collection days. The choice of lane or curb-side collection may be based on:

- Existence of lanes
- Ease of access by collection vehicles
- Truck load limits in lanes or streets
- Community objectives

In either case, collection systems may include hand collection, semi-automated collection, or automated collection. In hand collection systems, containers used by residents generally include bags or cans that are less than 100 L in size. Larger

containers are difficult to manage by collection crews and can result in injuries to collectors.

With semi-automated and automated systems, containers can be larger because they are lifted with mechanical devices. Residents may use roll-out carts in both curb-side and lane collection systems, whereas, side loading dumpster type containers may also be used in automated lane collection systems. With bin systems, each bin may serve up to 4 residents and therefore reduce the number of stops by the collection vehicle. In some cases, municipalities have used roll-out carts for curb-side collection and bins for lane collection.

Collection for the ICI sector or multi-family locations is done mostly in lanes. With well organized collection system, lane storage is typically in dumpster bins that may be either front loading or side loading. In smaller urban communities, commercial collection is commonly done with hand collection. Businesses served with hand collection often are required to haul larger materials on their own to the disposal location. Containerized commercial collection is normally more efficient and provides more contained storage than hand collection systems.

Commercial collection may be provide through the municipality, but in many cases, this service is provided through private waste companies who enter into service contracts with the business. Municipalities may enact bylaws that specify waste storage in the ICI sector.

Urban collection systems are illustrated in Table 7-4

Table 7-4: Urban Collection Systems

System	Typical Application	Attributes
Lane Hand Collection 	Urban residential	• Residents provide containers • Side loading or rear loaders • Waste stored at lane between collection days • Storage can result in unsightly lanes • 1 to 3 person crews • Can collect from both side of the lane & reduce return travel

System	Typical Application	Attributes
Curb-side Hand Collection 	Residential	• Residents provide containers • Side loading or rear loaders • Storage on resident's property between collection days • Residents must follow set out schedules • 1 to 3 person crews • Normally collection is from one side of the street requiring return trips
Semi-automated with Roll-out Carts 	Residential Commercial	• Municipality normally provides roll-out carts to residents • Residents roll carts out to the curb or lane • Collectors roll to truck to empty with lifting devices on the truck • 1 to 3 person crew • Can collect from both sides of lanes and streets
Automated Collection with Roll-out Carts 	Residential	• Containers may be provided either by municipality or residents • Can be used in either lane or curb-side programs • Collects only from one-side, therefore return trips are required • Carts must be set in specific location by residents to be picked up • Carts may be blocked by vehicles • Can be difficult to pick up carts in winter if snow piles are not cleared

System	Typical Application	Attributes
Automated Collection with Bins 	Urban residential collection Commercial collection	• Containers provided by the municipality • Only used in lane collection • Dumpster containers may serve up to 4 residences • Waste stored in bins between collection days • Lanes tend to be cleaner than with hand collection storage containers • 1 person crew • Collection truck only picks up vehicles on one side – return trips may be required to collect on both sides of the lane • Containers may be overloaded • Difficult to attribute waste to individual households
ICI Hand Collection 	Small community commercial collection	• Generally used where commercial collection services are not available • Often combined with residential collection service • Storage container size is limited to ability of collection crew to handle • Storage can be unsanitary • Long stop times for collection crew, slows collection • Generators may be required to self-haul large objects to disposal facilities
Commercial Dumpsters 	Large urban municipalities commercial collection Regional commercial collection systems	• Serves ICI generators • Containers may be sized to individual business requirements • Containers typically rented to the business or included in service fee charges • Can be collected on a pre-defined schedule and frequency • More sanitary storage than small container storage

4. Regional Collection Systems

In Alberta there are numerous urban and rural municipalities that have developed regional landfills and a network of waste transfer stations. Many have incorporated recycling systems into these regional facilities. A few have implemented regional waste collection systems (e.g. Flagstaff Regional Waste Management Association, Beaver Regional Waste Services Commission, and County of Vulcan).

The major benefit of having a regional waste collection service is economics. Where a regional waste system includes several small communities, the regional system can provide more economical collection because the numerous collection vehicles owned by each municipality can be replaced by one or two vehicles. The number of collectors can also be reduced, although it may not necessarily reduce public works employees since collection may be carried out in many small communities by public works staff who also perform other duties. Furthermore, if larger collection vehicles are used that can haul larger loads over longer distances, the need for transfer stations to receive waste from small local collection vehicles can be avoided, and the capital and operating cost of a transfer station system could be lessened.

Additionally, commercial collection services can be provided to businesses in the region using commercial container systems. Depending on the systems used, these can be linked to public drop off transfer station facilities. In some cases, rural containerized collection has been provided with trucks used for commercial and transfer station container collections (e.g. Provost Regional Waste Management Authority, Flagstaff Regional Waste Management Association).

Table 8-5 illustrates typical regional collection systems in Alberta

Table 8-5: Regional Collection Systems

System	Typical Application	Attributes
Satellite Collection 	Urban residential	• Collection vehicle stays on collection route rather than hauling to the disposal site • Satellite vehicle fills container and drops at local transfer station • “mother truck” (Front-end compactor) picks up the container on normal route for transfer bins and commercial service

System	Typical Application	Attributes
		• Light weight vehicle • Single truck can service several small communities • Reduces transfer station infrastructure requirement
Direct Haul Collection 	Urban residential ICI collection	• Large compaction vehicle allows for longer economical hauling distances • Waste is hauled direct from collection route to disposal facility • Can serve both residential or commercial generators • Possible to reduce infrastructure requirement for a transfer station • Where long distances are involved, collection efficiency can be reduced.

5. Collection of Recyclables

Collecting recyclable materials normally adds another collection activity into a waste management system. In planning a collection system for collection of recyclables, the following factors should be considered:

- Level of service desired in a community
- Intended recovery and landfill avoidance objectives
- Cost of the collection system
- Type and variety of materials to be collected
- Hauling distances to materials recovery facilities (MRF) or brokers
- Quality of material desired by MRF or broker

A waste manager will often be challenged to achieve maximum recovery while minimizing expenses for implementing and operating the collection system. Revenues gained from sale of collected materials should also be taken into consideration.

Table 8-6 illustrates various collection systems for recyclable materials.

Table 8-5: Collection of Recyclable Materials

Multi-Material Collection 	Urban residential	• 2 or 3 stream collection system • May be collected in multi-compartment trucks or separate vehicles • Uses roll-out carts, blue box containers, or coloured bag containers • Suitable to dry recyclables, source separated organics, and wastes • Can result in significantly higher collection costs unless carefully planned • Highest level of service and usually highest recovery rate
Drop-off Depots 	Small municipalities Rural systems	• Variety of container systems may be used (e.g. front-end bins, roll-off bins) • Relies on cooperation of residents • Compatible with waste collection systems • Can be incorporated into transfer stations and landfill development • Separation into several bins may require additional trips by collection vehicle to keep materials separated • Multi-compartment may minimize trips by the collection vehicle • Level of service depends on number of locations used

Mobile Units 	Urban and rural locations	• Mobile systems can be scheduled for specific days at various locations • Low cost system • Multi-material collection in single unit
Stationary Depot 	Urban and rural locations	• Containers transfer to collection vehicle • Collection vehicle can be designed with multi-compartments to reduce return trips • Used for collection of a variety of materials
Regional System 	Regional systems	• All collection systems can be applied in regional systems • Large geographic collection areas may require unique solutions to minimize collection costs
 **Multi-purpose Facilities**	Urban municipalities	• Public drop-off for solid wastes, electronics, recyclable materials, and household hazardous wastes • Can be incorporated into transfer station facilities

9 *MUNICIPAL SOLID WASTE TRANSFER SYSTEMS*

1. Public Drop-off Facilities

Public drop-off facilities may be generally describes as sites that are located in a convenient location where residents can drop off their solid waste or recyclable materials. These sites typically have minimal development. At typical public drop-off facilities, the containers are simply set out on a flat grade. Residents unload waste into the bins by hand. They may include fenced compounds around the containers to limit vehicle access to discourage drop-off of large volumes and large objects. If a waste generator has a large amount of waste to dispose of, they may be directed to haul those materials to a landfill or an appropriately sized transfer station.

In Alberta, these types of facilities are used in sparsely populated areas where waste volumes are small and a fully developed municipal waste transfer station is not warranted.

i. Front end container sites
ii. Roll-off container sites
iii. Mobile sites

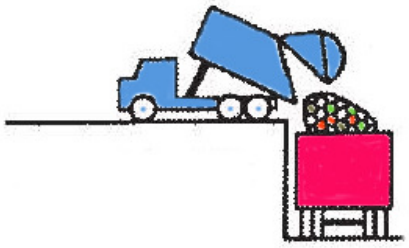
2. Municipal Waste Transfer Stations

A transfer station is developed so that waste can be unloaded from the vehicle in which the waste is hauled. The scope of the site development and type of transfer station applied is largely influenced by the volume of waste that will be received and the types of vehicles that will use the facility. Commonly in Alberta, transfer stations are used as both public-drop off sites and for transfer from municipal solid waste collection vehicles.

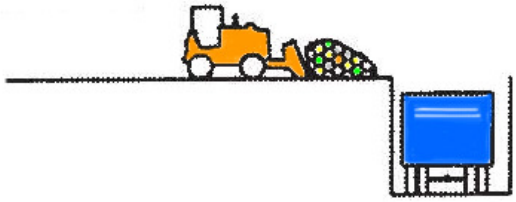
There are four basic types of transfer stations that are common around the world. These include:

- Direct dump transfer stations, where waste is unloaded directly into the transfer vehicle or container from the collection truck
- Inverting bin system (TRANSTOR), where waste is unloaded into a bin that in turn empties into the transfer vehicle
- Push-pit transfer station where waste is unloaded from collection vehicles onto a concrete floor (tip floor) then pushed into the transfer vehicle,
- Compactor transfer station where waste either unloaded directly into compactor feed hopper or onto a tip floor and pushed into the feed hopper; compactor loads into the transfer vehicle

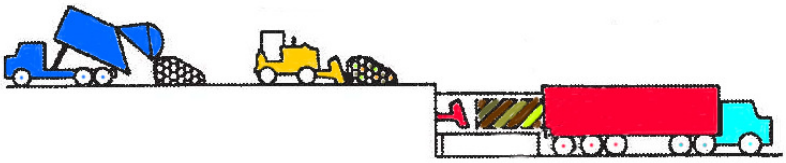
Direct Dump Transfer



Push-Pit Transfer



Compactor Transfer Station



Inverting Bin Transfer

Figure 9-1 Basic Variations of Transfer Station Systems

Variations of these four systems have been developed, however these four types are the most common types used in Alberta. Table 9-1 provides descriptions of the common types of transfer stations.

Table 9-1: Common Transfer Stations

<table>
<tr><td colspan="3">Front-end Container Systems
   </td></tr>
<tr><td>Application

Public drop off sites</td><td>Design Features

• Up to 2 M. elevated ramp with retaining wall
• Retaining walls constructed with wood timbers, poured in place concrete, concrete lock-block or steel bin-wall
• Typical container size is 6 or 8 cu. yd.
• Containers picked up by Front-end loader compaction truck</td><td>Attributes

• Household waste, yard waste, and debris that can fit into the container
• Compatible only with “Burro” collection vehicle
• Site storage capacity depends on number of containers provided
• Transfer capacity 6 to 8 tonnes per trip
• Typically, lifts 4 to 6 full containers per load
• Transfer vehicle can service more than one transfer station in a single route</td></tr>
</table>

Roll-off Box

Applications	Design Features	Attributes
Public drop-off sites	• Up to 2.4 M. elevated ramp with retaining wall • Retaining walls constructed with wood timbers, poured in place concrete, concrete lock-block or steel bin-wall • Typical 'saw tooth' retaining wall design allow for access to multiple containers • Typical container size is 40 cu. yd. • Containers picked up by tilt-frame roll-off or hook-lift truck	• Household waste, yard waste, and debris that can fit into the container • Can accommodate small amounts of demolition debris • Not usually used for transfer from collection vehicles • Site storage capacity depends on number of containers provided • Transfer capacity averages between 3 & 5 tonnes per trip • If hauled in tandem, transfer capacity is between 6 & 10 tonnes per trip • Transfer vehicle services only one station per trip • Inefficient if containers are not full when hauled • Can store recyclable materials

TRANSTOR

Applications	Design Features	Attributes
Public Drop-off facilities Transfer from residential collection vehicles Can transfer from commercial collection depending on collection vehicle capacities	• 3.35 M. elevated ramp with retaining wall • Retaining walls include poured in place concrete, concrete lock-block or steel bin-wall • TRANSTOR set on structural foundation • Container size is 40 or 50 cu. yd. • Containers hydraulically lifted to empty into open top trailer or self-compacting trailers	• Household waste, yard waste, and debris that can fit into the container • Not suitable for demolition debris • Site storage capacity depends on number of containers provided • Transfer capacity averages between 11 to 15 tonnes per trip with open top trailers, or up to 20 with self-compaction trailers • Typically empties 3 to 5 containers per trailer load • Transfer vehicle can service more than one station in a route • Can be used for storage and transfer of recyclable materials

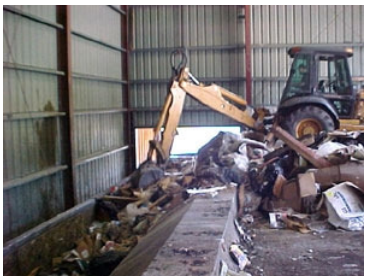
Rural Push-pit Transfer Stations

Applications	Design Features	Attributes
Public Drop-off Transfer from residential collection vehicles Can transfer from commercial collection depending on transfer station design and vehicle sizes	• 4.3 to 4.5 M. elevated ramp with retaining wall • Retaining walls typically constructed poured in place concrete, although steel bin-wall may be used • Building must be set on structural foundation • Tip floor may be either structural slab or slab on grade design • Waste unloaded onto 'tip floor', and then pushed into open top trailers. • Skid Steer loader can be carried with transfer trailer • Trailers can be loaded in 20 minutes	• Household waste, yard waste, and debris that can fit into the container • Can accommodate some demolition debris with limitations • Site storage capacity determined by design and operation practices • Transfer capacity averages between 11 to 15 tonnes per trip with open top trailers, or up to 20 with self-compaction trailers • Transfer vehicle can service more than one station in a route

Urban Push-pit Stations

Applications	Design Features	Attributes
Transfer from residential and ICI collection vehicles Public drop-off	• Drive through tunnel with 4.3 to 4.5 M. grade separation below tip floor • Concrete foundations and sub-structure • Typical design with pre-engineered steel building • Waste unloaded onto 'tip floor', then pushed and tamped into open top trailers or trailers are loaded with grapples • Backhoe or grapple tamping equipment • Can load up to 80 tonnes/hour with single trailer bay	• Household and ICI waste, yard waste, and debris that can fit into the container • Can accommodate some demolition debris with limitations • Site storage capacity determined by design and operation practices • Typical transfer capacity averages between 20 to 24 tonnes per trip

Direct Dump Transfer Station



Applications	Design Features	Attributes
Transfer from residential and ICI collection vehicles Public drop-off	• 4.3 to 4.5 M. elevated ramp with retaining wall • Retaining walls and structural constructed poured in place concrete, • Building must be set on structural foundation • Tip floor may be either structural slab or slab on grade design • Waste unloaded directly into open top trailers • Loading time depends on traffic flow	• Household and ICI waste, • Can accommodate some demolition debris with limitations • Site storage capacity determined by trailer size (typically 110 cu.yd) and number of trailer bays. • Transfer capacity with no tamping equipment between 11 and 15 tonnes • Transfer capacity with tamping equipment between 18 to 22 tonnes

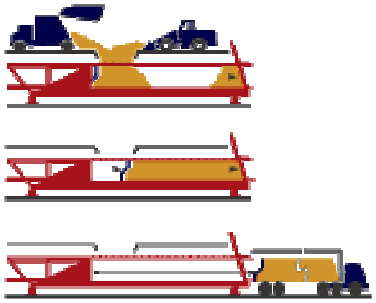
Rural Stationary Compactor System

Applications	Design Features	Attributes
Transfer from residential and ICI collection vehicles Public drop-off	• Elevated ramp with retaining wall – height depends on hopper design • Retaining walls and structural constructed poured in place concrete, • Compactor and containers should be placed on a pad with structural support to carry the weight • Hopper typically 20 cu. yd or greater • Waste unloaded from collection vehicles into hopper • Containers are transported on roll-off trucks • Rollers allow change-out of containers without truck on site	• Household and ICI waste, • Not compatible with demolition wastes • Site storage capacity determined by number of compaction containers and compaction units. • Transfer capacity approximately 10 tonnes with single container • Transfer capacity approximately 20 tonnes with tandem haul

Urban Compactor Stations

Applications	Design Features	Attributes
Transfer from residential and ICI collection vehicles	• Within building structure designed with back-in tunnel below tip-floor • Concrete foundation and substructure • Typical pre-engineered steel building, • Collection vehicles unload onto tip floor • Compactor hoppers fed with loaders (similar to push-pit) • Load up to 80 tonnes/hour	• Household and ICI waste, • Not compatible with demolition wastes • Site storage capacity determined by tip-floor design • Transfer capacity limited to 20 to 24 tonnes with 45 foot compaction trailer

Pre-pack Compactor Stations



Applications	Design Features	Attributes
Transfer from residential and ICI collection vehicles	• Within building structure designed with back-in tunnel below tip-floor • Concrete foundation and substructure • Typical pre-engineered steel building, • Collection vehicles unload onto tip floor • Compactor hoppers fed with loaders (similar to push-pit) • Load up to 125 tonnes/hour	• Household and ICI waste, • Not compatible with demolition wastes • Allows compaction process to continue while trailers being changed out • Site storage capacity determined by tip-floor design • Transfer capacity limited to 20 to 24 tonnes with 45 foot compaction trailer

Baling Systems

Applications	Design Features	Attributes
Transfer from residential and ICI collection vehicles	• Typical baler system designed with conveyor feed from tip floor • Concrete foundation and substructure • Typical pre-engineered steel building, • Collection vehicles unload onto tip floor • Loader feeds waste to conveyor • Bales can be transported on flat-deck trucks as long as they are covered.	• Household and ICI waste, • Not compatible with demolition wastes • Site storage capacity determined by tip-floor design • Transfer capacity limited to 20 to 24 tonnes per trip • Bales offer advantages at landfills with litter control and higher compaction densities

10 TRANSER STATION DESIGN AND CONSTRUCTION

1. Engineering and Consulting Services

i. Selection of Engineering Consultants

In most cases, an engineering consultant should be hired to assist with system planning, prepare engineering designs, and oversee construction of the transfer station. The required involvement of an engineering consultant will depend on the nature and complexity of the transfer station facility being developed. In cases where the facility only consists of containers without structural walls or earthen ramps, and engineering consultant may not be necessary.

In selecting a consultant, the developer may select an experienced consultant who is known and trusted. Where the developer is seeking out an experienced consultant, the following process may be followed:

- Prepare a terms of reference for the project that outlines the required services and contractual terms
- Establish a selection criteria based on qualifications, experience, methodology, and cost
- Issue a call for proposals, or alternatively invite consulting firms to submit proposals, based on the terms of reference
- Review proposals and rate them according to the selection criteria
- If a clear decisions can be made then award, however, if there is not a clear choice, the developer may short-list and conduct interview the top prospects before making a final decision
- Upon award, complete contract documents.

ii. System Planning

The engineering consultant may be used to assist during the system planning stage. This may include evaluating alternatives, preparing cost estimates, and determining the feasibility of a transfer station facility or regional transfer system.

iii. Facility Design

Design of a transfer station facility may include the following steps:

- Preparation of a conceptual design
- Preparing a preliminary design, and
- Completing the detailed design and specifications

A conceptual design may be useful to provide initial cost estimates and for submitting applications for development permits. The detail provided on a conceptual plan may be determined by the information required by the municipal development officer. Conceptual designs typically include the following:

- Site location plan showing surrounding land use, roads, and utilities
- A site layout showing site access, roads, fences, and location of various components
- Where applicable, the plan will show a building footprint
- 1st order cost estimate

A preliminary design provides a higher level of detail and provides documentation on engineering criteria for preparing the detailed design. The preliminary design typically includes:

- Site elevations and grades
- Drawings of retaining walls and structures
- Layout of site facilities and buildings showing elevations and dimensions
- Drainage systems
- Fencing and gates
- Signage
- Locations of utilities and services
- Site access tie in to public roads
- A design-basis report defining specific criteria for structural loading, building design, utility requirements, lighting, and other components
- 2nd order cost estimate

The detailed design and specifications provide the necessary information to construct the transfer station. The detailed design and specifications are based on the preliminary design drawings and design basis report. It will provide details and specifications on all components of the facility such as roads, building foundations and structures, utilities and equipment. A 3rd order cost estimate may be developed based on unit costs to construct the facility.

The developer may choose to forgo the conceptual design or preliminary design stage in cases where:

- There is a clear definition of the facility requirements
- The facility is small and the detailed design is minimal
- Detailed information is required for a municipal development permit application

2. Transfer Station Sizing

A transfer station should be designed with a large enough capacity to handle the expected amount of waste throughout its operating life. This may require the transfer station to be designed with excess capacity or with the ability for expansion to accommodate future growth. Factors to consider in sizing of a transfer station include:

- Size and capacity of collection vehicles using the facility
- Desired number of days for storing waste
- Unloading time for collection vehicles
- Number of vehicles expected including peak times
- Transfer vehicle capacity and loading capacity
- Number of transfer vehicles available
- Days or hours of operation
- Available vehicle queuing space
- Waste sorting or processing that will take place

3. Design Capacity

There are several capacity values that should be considered in the design of a transfer station. These are described below.

Storage capacity is the amount of waste that can be stored in the transfer station (m^3 or tonnes). Storage capacity is generally limited by the size of the facility or the size and number of receiving containers. For small rural facilities, the required storage capacity may be calculated by simple volume-density calculations, while complex calculations may be required for large urban facilities.

Transfer vehicle capacity is the amount of waste that the transfer vehicle can legally hold (m^3 or tonnes). This is an important factor in determining loading capacity and transfer capacity. Typical vehicle capacities are included in Chapter 4 – Waste Collection and Transfer Vehicles.

Maximum loading capacity is the amount of waste that can potentially be loaded into transfer vehicles within a given period of time, usually measured as tonnes per hour. Loading capacity will vary with the type of transfer station and capability of equipment being used. Loading capacity should not be confused with transfer capacity.

Transfer capacity is the amount of waste that can be hauled within in a given period of time, usually calculated as tonnes per day. It is determined by the number of transfer vehicles in service and the number of trips each can make in a single day.

Design calculations for determining transfer capacity is included in Appendix D

4. Site Design

i. Roads

Roads should be designed with:

- All weather road surfaces
- Widths that are designed to accommodate intended vehicle traffic
- Minimum 6% uphill grade for loaded vehicles
- Minimum 8% uphill grade for empty vehicles
- Turning radii designed for largest vehicles
- Ditches incorporated into overall site drainage systems

ii. Traffic Patterns and Circulation

The site should be designed so that traffic is:

- Routed one way through the site
- Drive through for transfer trucks where possible
- Provide space for backing of transfer vehicles when necessary
- Queued on-site and not backed onto public roads
- Self-haul vehicles and collection vehicles are kept separate at busy sites

iii. Site Lighting

Site lighting should be designed to provide

- site safety and security
- mandatory lighting in work areas if site is operated after dark

The number of lights will depend on the size of the site and traffic patterns. Small rural sites may only require a single yard light, while large urban facilities may require an extensive lighting network.

iv. Parking

Parking areas should be provided for:

- site employees and visitors
- untarping and tarping areas for customer vehicles and transfer vehicles

- parking transfer trailers
- lay down areas for roll-off containers

v. Landscaping

Landscaping can improve a transfer station image and raise employee and customer attitudes. Landscaping plans should consider:

- Surrounding landscapes and land uses
- Visual screening of operating areas
- Provide wind shelter
- Low maintenance landscaping where appropriate
- Provide easy access to maintenance equipment (e.g. lawnmowers)

vi. Utilities

Utility requirements will depend on the size and type of transfer station, and the hours the facility will operate. Small rural facilities may require only basic utilities such as:

- Portable washroom facilities
- Propane heating of attendant's shelter
- electricity for lighting and basic conveniences

Large urban facilities may require:

- water and sewer services
- natural gas heating
- 3-phase power for operating equipment, such as stationary compactors

vii. Fences and gates

Fences and gates are necessary to provide site security and litter control. Fence and gate designs should include:

- 6 or 8 foot perimeter fence using chain link or other secure fence materials
- Wide double swing gates that extend beyond the road surface
- Interior litter control fencing around storage compounds, open waste containers, and vehicle loading areas.

viii. Signs

Signs are useful to provide customers with directions on site rules and procedures, and to direct traffic through the site. Typical signs include:

- An entrance sign with site name, and emergency contact numbers
- A sign listing prohibited wastes
- A sign that shows tipping fees, when applicable
- Signs that direct traffic through the site
- Signs posting site rules and procedures

ix. Gate House

An attendant's shelter may be all that is required at small rural stations. The shelter should provide:

- Heating during cold weather,
- Lighting and electrical outlets for basic conveniences

At large facilities staff facilities may be necessary. Often these facilities can be incorporated into a site office or scale house, or they may be stand-alone facilities. The design of staff facilities should consider the following:

- Provision of a lunchroom with basic conveniences
- Lockers, washroom and shower facilities

A gate or scale house should be designed to:

- Allow for clear vision of inbound and outbound vehicles and site operations if appropriate
- Provide ability of attendant to communicate with inbound customers to determine waste type and to provide directions to the customer
- Include traffic control devices for inbound and outbound traffic
- Include a safe for security of cash

x. Scales and scale equipment

Weigh scale may only be applicable at larger transfer station facilities where traffic volumes warrant them. Scales are useful to provide data for managing the site operations and to provide a means of charging customers by weight of waste deposited. A single scale platform may be appropriate for most sites where traffic volumes will not result in traffic delays when entering or exiting the scale platform. Where high traffic volumes are encountered, a double scale system may be required to safely manage inbound and outbound traffic.

A scale design should include:

- A raised platform, designed to allow drainage from under the scale
- Piles and foundation designed to support the scale over its intended lifetime
- A 45 to 60 foot scale platform for inbound collection vehicles
- An 80 foot scale platform if outbound trailer units are weighed
- An eleven foot wide platform
- Certification by Canada Weights and Measures for legal tender
- Electronic weighing system with appropriate computer software

Weighing systems for transfer vehicle may be installed so that they are filled to maximum legal payload to achieve transportation efficiencies. Weighing systems for transfer vehicles may include:

- Platform scales
- Axel scales
- On-board scales

Only platform scale may be certified for legal tender.

xi. Ramps and Retaining Walls

Ramps are required for most transfer station types. Poorly designed retaining walls can fail and cause operational and safety concerns. The height of the ramp will depend on the height of containers, loading hoppers, or tip floors. Sites with natural slopes may provide advantage to minimize embankment costs for ramp construction. Ramps should be designed and constructed to support the weight of loaded vehicles without rutting or settlement. Compaction densities should be a minimum of 98% Standard Proctor.

Retaining walls are used as an end wall to ramps where containers or loading hoppers are placed. Retaining walls may be constructed with the following or other appropriate materials:

- poured in place concrete
- ‘lock-block’ wall
- galvanized steel bin wall
- wood timbers

The importance of an engineering design for retaining walls cannot be overstated. Retaining walls must be designed with suitable foundation structures, reinforcement, and tie-backs that will support the earthen ramp.

xii. Transfer Buildings

Enclosed transfer station buildings must be designed be a professional engineer. Building designs will typically include:

- A geotechnical investigation with recommendations for foundation structures
- Concrete foundations and substructures designed to support the load of the building, loaded collection vehicles as moving loads, and the weight of solids waste at or above design capacity
- Abrasion resistant concrete tip floor
- Pre-engineered steel structures with consideration of durability, fire resistivity, reparability, wind and snow loading, and aesthetics
- Building designed to meet building, fire, electrical and plumbing codes
- Skylights and/or translucent wall panels to provide natural lighting of the interior
- Roof line with at least 30 foot clearance (including lights, utility piping, and sprinkler systems) to allow for raised bodies on collection vehicles
- Minimum 16 foot wide x 24 foot tall overhead doors for collection vehicle access
- Doors should be electrically operated
- Personnel doors should be included at suitable locations to comply with building and fire codes
- 12 foot high push and stacking walls that are substantially designed to prevent damage to the building structure and with suitable enclosures at the top of the push wall to building wall to prevent waste from falling in between
- Concrete bollards at entrance doors
- Use roof and through-wall exhaust fans where vehicle and equipment exhaust will accumulate, and consider wall louvers to increase circulation of outside air
- Tip floor designed to drain to load out bays with capture in truck bays
- Over-height vehicle warning devices to protect door openings

xiii. Integrated Facilities

Ancillary facilities should be integrated into the transfer station site as appropriately determined in the planning stage. These facilities may be included to handle materials

that are problematic to transfer operations, or included for recovery or processing of useful materials.

1. Bulky Material Storage

Outdoor compounds may include areas for:

- Tires storage
- Metal storage
- Pesticide containers

The location and design of storage compounds should consider site traffic flow and should provide adequate space for loading of stored materials onto transport trucks. All storage compounds should be designed with:

- Clearly defined areas
- Containment berms, fences, or walls
- Well drained all weather surfaces

Tire storage area may be developed as intermediate collection sites from which the tires are then hauled to designated tire marshalling yards. Marshalling yards are typically constructed with three compounds for storing passenger tires, truck tires, and off road tires separately. Compound walls are commonly constructed with concrete lock-block. To set up a tire marshalling yard, the Alberta Recycling Management Association (ARMA) should be contacted.

Metal storage compounds may include separate areas for:

- Cast iron
- Pared metals (steel plate)
- Tin
- Aluminum
- White goods (appliances)

Each compound area may be separated by using soil berms or lock-block walls. Fence materials are not recommended as they are commonly damaged by stored materials. Fences are more effective if they are placed outside earth berms.

Pesticide container sites may be designed as uncovered or covered facilities. Typical uncovered facilities are constructed with a clay lined base as a minimum, and may be designed to include a synthetic membrane liner. Pesticide container storage sites should be designed to drain to a liquid holding basin to avoid contamination surrounding surface water systems. Fences should be designed to prevent blowing of the stored containers during windy conditions

Covered pesticide container storage compounds may include pole roof structures or roofed cattle shelter structures. These structures should be constructed inside clay perimeter berms with a lined base. Fencing should be erected as needed to prevent blowing of the stored containers.

2. Drop-off Recycling Facilities

Recycling facilities may include:

- Public drop-off containers
- Tip floor recovery
- Processing equipment

Where public drop-off containers are used, they should:

- Be located such that traffic circulation is not interrupted
- designed to avoid cross-traffic between containers when possible
- placed on solid ground with an all weather driving surface,
- include fall protection if elevated walkways are used to access containers,
- clearly marked with material types for each container

3. Tip Floor Recovery

Where a community collects recyclable materials separately, it may be delivered to an independent materials recovery facility (MRF). This may be located either on the transfer station site, or at a different location. In some cases, recovery of recycling materials is included in the transfer station facility. The design of the transfer station in these cases should provide a separate tip area for unloading recycling collection vehicles. The design should avoid cross traffic in the transfer station and the potential for mixing labourers and equipment working in the same areas

4. Processing Equipment

Processing equipment at small facilities may consist of a baler to consolidate cardboard and other products for economical shipping to markets. Balers may be small hand loaded vertical bailers where volumes are low, or they may be larger horizontal or vertical balers that are loaded by conveyor system where volumes are large enough.

More complex sorting and processing equipment may be used at very large facilities.

In both cases, the processing equipment should be kept in a separate area away from tipping floors and collection vehicles.

5. Household Hazardous Waste

Household hazardous waste drop-off facilities may be included at a transfer station site. They should be designed in accordance with the requirements set out in section 11 of the Waste Control Regulation. In general, a HHW storage site should include:

- An impermeable base
- Secondary containment
- Security to prevent unauthorized entry
- Prominently identified as a hazardous waste storage facility
- Emergency response equipment (e.g. spill response kits)
- Surface water controls to prevent entry of surface water

Should the HHW facility store waste for a continuous period of more than 365 days, or if HHW is stored more than 10 tonnes at any time, an Approval for the facility will be required.

Options for HHW storage facilities include:

- Covered structure with impermeable base
- Portable containment structures with built in secondary containment
- Drive through buildings
- Drop-off trays for site customers

The Alberta Recycling Management Association (ARMA) should be contacted to coordinate HHW collection and recycling and disposal operations. ARMA should also be contacted if the owner wishes to register as a paint recycling collection site.

6. Electronics Recycling

Electronic recycling facilities should be developed in conjunction with ARMA. Electronic storage areas should be designed to include:

- A secure fenced compound
- An all weather surface
- Signs that mark designated storage for various electronic components
- Pallets for storage and shrink-wrapping of electronic equipment

7. Composting Operations

Where a yard waste composting operation is integrated into the transfer station site, the composting facility should be designed in accordance with the Code of Practice for

Composting Facilities. The designer should reference the Draft Alberta Standards for Compost Facilities for design details.

8. Safety Features

The design of a transfer station should consider features to protect the health and safety of customers and site employees. Safety features should include consideration for the following:

- Fall protection along retaining walls, open containers, and loading hoppers
- Traffic controls (e.g. one way routing, speed controls, signs)
- Ventilation for equipment exhaust in enclosed buildings
- Fire prevention equipment (fire extinguishers at small sites, hydrants at large urban sites)
- Spill response equipment
- Adequate site and building lighting
- Security fencing to prevent access to unsafe areas
- Separation of pedestrian footpaths and equipment and vehicle routes

5. Construction

i. Construction

The construction of a transfer station should be completed in accordance with the design and specifications as prepared by a professional engineer. Construction activities should be supervised based on specific design requirements and at critical stages of the construction. A quality control and quality assurance plan should be defined prepared prior to the start of construction.

Upon completion of the construction, a construction report should be prepared and filed by the owner. The construction report should include:

- Quality control and quality assurance records
- As-built records

11 *OPERATION AND SITE MANAGEMENT*

1. Operations Plan

The primary objectives for operating a transfer station should be to protect public health and safety and the surrounding environment while remaining economically viable. The owner of the transfer station should prepare an Operating Plan that should include:

- An operating schedule that specifies days of the week and hours on each day the site is open
- Staffing plans including duties and responsibilities and staff training
- Site security
- Waste acceptance and screening policies and procedures that describe acceptable and prohibited waste
- Procedures for diverting and reporting of prohibited wastes
- Operating procedures for:
    - Waste storage and transfer operations
    - Bulky materials storage and handling
    - Recycling operations
    - Household hazardous waste storage and handling, and
    - Other site operations that may be included as part of the facility
- Nuisance Management Protocols
    - Litter
    - Dust
    - Odour
    - Noise
    - Insect, animal and birds
- A safety plan for employees and customers
- An emergency response plan

2. Operating Schedule

Operating schedules may vary with the size and type of facility. To manage operating costs, the days and hours of operation at small rural facilities used as public convenience sites may be limited (e.g. 1 or 2 days per week). Larger urban facilities may remain open longer hours over 6 or 7 days of the week.

For transfer stations that serve both the public and waste collection services, consideration should be given to scheduling public access on days or during hours when collection vehicles are not delivering to the site. This can avoid issues of mixing collection vehicles and the public. It can also aid in scheduling transfer vehicles around waste collection schedules and public hours.

3. Supervision and Operating Staff

All transfer stations should be supervised when it is open to public access. Supervision of a transfer station is valuable in maintaining control of the types of waste received and the placement of different materials in their appropriate locations. Small rural sites may

only require an attendant. Larger facilities may require more than one employee and may include a site manager, gate attendant, and equipment operators. At sites with high traffic volumes, particularly during public use, spotters may be necessary to manage the traffic flow.

Site supervisors should be provided with appropriate training for their specific duties and responsibilities. Voluntary certification offered by Alberta Environment is recommended for those persons who have supervisory control over a transfer station. Training for transfer station operations may be obtained through waste industry associations or trained in-house personnel.

In cases where only one employee is at the site, the employer and the employee should be aware of work alone legislation and refer to the following guide:

- *"Working Alone Safely – A Guide for Employers and Employees" (Alberta Human Resources and Employment, Sept. 2000)*

4. Site Security

Security should be maintained at transfer stations to prevent:

- Unauthorized use
- Depositing of prohibited waste
- Vandalism and abuse

Security measures generally include maintaining perimeter fences and locking of access gates when the site is not open to the public. During operating hours, security is maintained with site supervision. A well lit site may also discourage site abuses during darkness.

5. Waste Acceptance and Screening

A description of acceptable waste should be documented and posted on signs at the site. Prohibited materials should also be documented and posted. The acceptable wastes should be specific to the site design and facilities provided. Transfer station owners may prohibit materials that are oversized for transfer containers and transfer vehicles, may cause damage to transfer equipment, or that are difficult to handle through the transfer station (e.g. construction and demolition debris).

Waste that should be prohibited at all municipal waste transfer station sites include:

- Bulk liquid waste
- Hazardous wastes from non-household sources
- Waste from medical and veterinarian clinics
- Animal carcasses
- Explosives
- Radioactive materials

Methods that may be employed for screening of waste loads include:

- Local knowledge of waste haulers
- Customer information on vehicle loads
- Vehicle observations and inspections
- Observation of vehicles unloading

In the event that a prohibited waste arrives at a transfer station, customers should not be allowed to unload the waste, and they should be referred to an appropriate facility. If the waste has been unloaded, procedures should be established to safely remove the material and deliver it to an appropriate facility. The owner of the transfer station may require the customer to remove the waste, or if the customer cannot be identified, the transfer station owner may be responsible to remove the waste. If the waste is a hazardous waste, it should be reported to the Director at Alberta Environment.

6. Material Storage and Handling

The methods for storage and handling of waste will be dependant on the design of the transfer station. For sites using containers, waste should be stored only in the containers provided for that purpose. When practical, containers should be covered with tarpaulins or covers to minimize litter. For transfer stations with enclosed buildings and tip floors, waste should only be stored inside the building. If equipment is available at the site, waste should be pushed into stockpiles to conserve floor space.

Putrescible waste should be transferred within a reasonable time frame to minimize odours and the harbouring of insects and rodents. At small facilities, storage should not be greater than 1 week. At large facilities, putrescible waste should be removed daily with a maximum storage time of 96 hours allowed to accommodate peaks and transfer interruptions. Where a transfer station is located in close proximity to residents, the objective may be to remove all stored waste by the end of the day.

Bulky materials should be stored in organized piles within the storage areas provided. Scheduled removal of these materials should be arranged with reliable brokers, scrap dealers, or end users. Storage should be done in accordance with appropriate sections of the Fire Code.

Recyclable household materials should be stored in enclosed containers or in buildings. Materials that are baled may be stored outdoors while waiting for shipment to markets.

A table describing various methods of storing bulky materials and recyclable materials is provided in Appendix E.

7. HHW Storage and Handling

If a transfer station is designed for receiving and storing household hazardous waste (HHW), site operators should be trained so they are able to:

- Identify the various types of hazardous materials
- Safely handle the materials
- Wear appropriate PPE
- Respond appropriately to spills or releases

Household hazardous waste should only be received and stored in the facility provided for that purpose. Containers should be appropriately labeled for the type of material stored with secondary containment. Collection and shipment of the HHW should be scheduled with a licensed transporter to an approved broker or disposal facility. The owner of the transfer station that ships a hazardous waste for treatment or disposal should register at a hazardous waste generator with Alberta and complete hazardous waste manifest forms as required under the Waste Control Regulation.

8. Nuisance Management

i. Litter

Litter management should include:

- Covering of inbound and outbound loads with tarps or other covers
- Storage of waste and recyclable materials in containers and/or buildings as intended in the design
- Use of fences in appropriate locations to contain wind-blown litter from escaping the site
- Retrieval of litter on the site, surrounding properties, and along roads leading to the site

ii. Dust

Management of dust may include:

- Use of paved roads
- Reduce speed limits on unpaved roads
- Prohibit powdery or granular materials that are prone to creating dust problems
- Use “misters” in enclosed buildings to knock down dust particles

iii. Odours

Odour management may include:

- Use of vegetation buffers around the site
- Timely removal of stored waste
- Clean or wash containers and tipping floors
- Use building ventilation
- Maintain adequate setbacks from neighbouring development (siting & design)

iv. Noise

Mitigation of noise may include:

- Use of noise barriers such as trees or fences
- Used paved road surfaces and maintain roads to lessen traffic noise

- Maintain adequate setback from neighbouring development (siting & design)
- Schedule operating hours to avoid early morning or evenings
- Maintain equipment to operate within noise limits set by the manufacturer

v. Insects, animals, and birds

The control of 'vectors' such as insects, animals and birds should include:

- Timely removal of stored waste
- Elimination of areas where water collects on site
- Use electric fences if bears are a problem
- Hire exterminators in cases where insect or rodent infestations occur
- Use electric fences if bears are a problem
- Hire exterminators in cases where insect or rodent infestations occur

10. Safety and Emergency Preparedness and Response

i. Safety Plan

A documented safety plan should be prepared and implemented in accordance with the Occupation Health and Safety Act. The plan should address hazard assessments and mitigation of safety hazards through engineered, administrative, and/or personal protective equipment. All site staff should be adequately trained for the duties they perform and be competent to operate equipment they are assigned. The safety program should include mechanisms for ongoing communication of safety requirements and issues, and should include reporting and investigations of near misses and safety incidents.

The safety plan should establish rules for site customers to follow to keep them safe. Measures should be designed into the facility to prevent customers from slips, falls, or other injuries. When possible, public customers should be kept out of high commercial traffic areas where they are less familiar with the potential hazards.

ii. Emergency Preparedness and Response Plan

The emergency preparedness and response plan should be prepared with consultation of local emergency services. The plan should document response plans for the following:

- Emergency evacuation
- Fires
- Spills and environmental releases
- Medical emergencies
- Police emergencies
- Injury and Non-injury vehicle accidents
- Discovery of hazardous materials
- Power failures
- Interruption of transfer vehicles

- Severe weather

The emergency response plan should identify:

- First aid, spill response, and other such training
- Declaration of an emergency
- Who takes charge at the scene of the incident
- Coordination with emergency services
- Reporting to appropriate government agencies
- On-site emergency response equipment inventory and location

All site operating staff should be trained to respond appropriately to any emergency.

12 *RECORDS AND REPORTING*

1. Administrative Reporting

Maintaining records on the operation of a transfer station can be useful for budget and operation planning.

In planning new facilities, have local data is valuable for the system planner to establish reasonable hours based on actual traffic flow patterns and volumes and types of wastes received. This can be done by observing and recording this information at existing waste disposal sites.

For existing transfer stations, this same type of information can be useful to review and plan:

- Days and hours of operation based on peak traffic periods
- Storage or container requirements based on amount of waste received
- Scheduling of transfer vehicles based on volume and peak traffic periods
- Annual budgets based on known quantities.

At small facilities vehicle records can be documented and waste volumes estimated either by vehicle size or volume stored in containers or on tip floors. At larger facilities, traffic and waste volumes may warrant installation of weigh scales. In either case, the waste that is transferred is likely to be weighed upon delivery to a landfill. Similar approaches can be used for recording bulky materials and household recyclable materials.

Useful data may include:

- Arrival and departure times for customer vehicles
- Vehicle ID (license plate, owner)
- Estimated load volume or weight if scaled
- Origin of the waste (e.g. town resident, commercial, farm)
- Type of waste
- Fees, if charged

Plotting data can be useful to visually display traffic and volume patterns through a typical day, week, or month.

Figure 12-1
Example of Daily Traffic and Volume

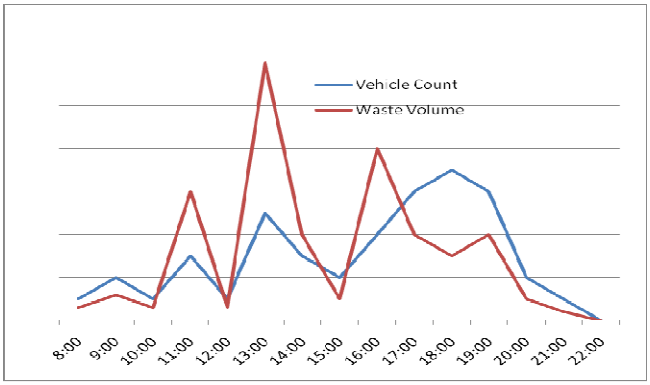
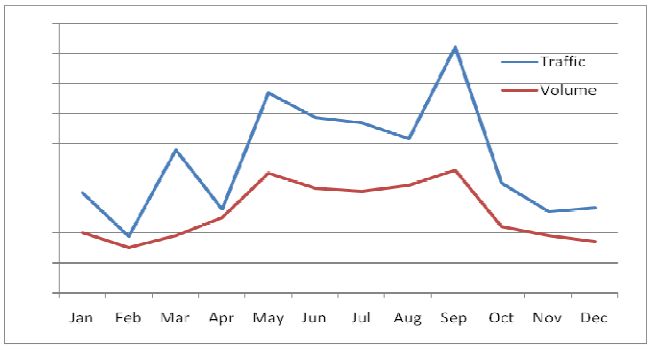


Figure 12-2
Example of Seasonal Traffic and Volume



2. Daily and Monthly Operating Record

A daily and monthly operating records would be useful to the site operators and administrators to demonstrate due diligence in operating practices and for preparing administrative reports.

Daily reports may include:

- Hours site is open
- Weather conditions
- Number & type of vehicles using the site
- Weight data (where scales are used)
- Loads transferred out (including recycling materials)

Monthly reports may include a summary of the daily information and identify the amount of materials stored in recycling compounds.

3. Regulatory Reporting

i. Release reporting

Any contravention of EPEA or regulations under the Act should be immediately reported to the Director of Alberta Environment. At transfer stations this may include such incidents as:

- Spills that result in an off-site release
- Drainage of a contaminant to a water course
- Accidental fires
- Other incidents that result in a release of a substance.

The owner of the transfer station should contact the Director by telephone at (780) 422-4505. A written report is then required to be submitted to the Director within 7-days that provides:

- A description of the contravention
- Date of the contravention
- Explanation on why the contravention occurred
- Name of the owner of the property where the contravention occurred
- Preventative actions that were taken prior to the contravention
- Summary of actions taken to mitigate the contravention
- Summary of measures that will be taken to address any remaining effects of the contravention
- Any other information requested by the Director

13 DECOMMISIONING AND RESTORATION OF CLOSED FACILITIES

1. Notification of Site Closure

Should a transfer station be closed, the owner should provide notice to the Director at Alberta Environment of the effective date when the transfer station is closed.

Prior to closure, the owner should issue a public notice of the intent to close the transfer station and provide information on alternative facilities that are available.

2. Removal of Stored Materials

Upon closure of the transfer station all stored waste, bulky, recyclable and other materials should be collected and removed from the site and take either to material brokers, end users, or to an approved waste management facility.

3. Soil and Groundwater Remediation

Where stored materials, such as pesticide containers, have resulted in a contaminant impacting soils or groundwater beneath the site, the soils should be removed or remediated to achieve the objectives set out in the Alberta Soil and Groundwater Remediation Guidelines.

4. Structures and equipment removal

Structures and equipment should be dismantled and removed from the site, unless the structures are intended to be used for another purpose.

In the case of a small rural site that is constructed with a ramp and retaining wall, the retaining walls should be dismantled and removed.

In the case of a building structure, if the building may be used for another purpose, it should be cleaned of any remaining debris and washed down prior being used. If the building is not to be used for another purpose, it should be deconstructed and removed from the site.

5. Site Restoration

Unless the site is to be used for another purpose, the site should be restored to near original grades with natural drainage systems maintained. The site should be reclaimed by replacing sub-soil and topsoil in accordance with the Conservations and Reclamation Regulation (AR 160/2005)

APPENDICES

APPENDIX A

NOTIFICATION OF A WASTE MANAGEMENT STORAGE FACILITY

Appendix A: Notification of a Waste Management Storage Facility (Alberta Environment)

Alberta
ENVIRONMENT

NOTIFICATION OF A WASTE MANAGEMENT STORAGE SITE

PERSUANT TO SECTION 89 OF THE ENVIRONMENTAL PROTECTION AND ENHANCEMENT ACT (Revised Statutes of Alberta 2000 Chapter E-12)

NAME OF OPERATION	
OWNER OF FACILITY:	
ADDRESSOF OWNER:	
TELEPHONE # OF OWNER:	
FAX # OF OWNER:	
OPERATOR OF FACILITY:	
ADDRESSOF OPERATOR:	
TELE # OF OPERATOR:	
FAX # OF OPERATOR:	
LEGAL LOCATION OF FACILITY/ ACTIVITY:	

FACILITY/ACTIVITY:		
Description:		
Construction:	Commencement:	
	Completion:	
Operation:	Commencement:	
Operations Plan:		
Waste Destination (Landfill Site)		
Attachments: Y/N (If Yes, provide list)		

PLEASE PROVIDE SKETCH OF FACILITY/ACTIVITY LAYOUT ON SEPARATE SHEET (Scale: at least 1:500)

IF YOU BURN SOLID WASTE AT YOUR FACILITY BURNING SHALL OCCUR ACCORDING TO THE ALBERTA WASTE CONTROL REGULATION AND SUBSTANCE RELEASE REGULATION

OWNER'S NAME/TITLE (Print):	
OWNER'S SIGNATURE:	DATE:

FOR OFFICE USE ONLY:

DATE RECEIVED: _____

NOTIFICATION ENTERED BY: _____

_____ _____ _____

SIGNATURE: REGIONAL ENGINEER DATE

NOTIFICATION NUMBER: _____

NB: Contact AENV regional office to obtain a copy of this form.

APPENDIX B

SAMPLE COST ESTIMATION TABLES

SAMPLE CAPITAL COST ESTIMATING WORKSHEET

1. Land

_____ hectares x _____ $/hectare = $ _____

2. Site Preparation

Site preparation (earthmoving)	$ _____ -
Ramps and Retaining walls	$ _____ -
Roads and parking areas	$ _____ -
Fill materials	$ _____ -
Storage compounds	$ _____ -
Utilities	$ _____ -
Drainage systems	$ _____ -
Fencing and gates	$ _____ -
Landscaping	$ _____ -
Signs	$ _____ -

Sub-Total $ _____

3. Building and equipment

Foundations	$ _____ -
Building	$ _____ -
Staff facilities	$ _____ -
Scale	$ _____ -

Containers	$ _____ -	
Hoppers and chutes	$ _____ -	
Transfer vehicles	$ _____ -	
Operating equipment (e.g. wheel loader)	$ _____ -	
Compaction equipment	$ _____ -	
Recycling Equipment/containers	$ _____ -	
Sub-total -		$ _____

4. - **Engineering & Construction Management**

_____% of Capital -	$ _____

5. - **Permitting & Legal Costs**

Municipal Development Permit	$ _____	
Notification	$ _____	
Sub-total -		$ _____

TOTAL CAPITAL COSTS - **$ _____**

SAMPLE ANNUAL OPERATING COST ESTIMATES

Annual Expenses

1.	**Labour**			
	Operator	hours/yr x hourly rate	$ _____ -	
	Labourer	hours/yr x hourly rate	$_____ -	
	Scale attendant	hours/yr x hourly rate	$ _____ -	
	Fringe Benefits	Total labour cost x ____%	$ _____ -	
	Sub-total			$ _____ -
2.	**Utilities**			
	Electricity		$ _____ -	
	Gas		$ _____ -	
	Heating		$ _____ -	
	Water		$ _____ -	
	Septic Services		$ _____ -	
	Sub-total			$ _____ -
3.	**Disposal fees**			
	Landfill tip fee ($/tone) x Tonnes/year			$ _____
4.	**Hauling costs**			
	Km/yr x $/km		$ _____	
	or			
	Tones/yr x $/tone/km		$ _____ -	
	Sub-total			$ _____ -

5. - Maintenance

Site maintenance	$ _____ -	
Equipment maintenance	$ _____ -	
Building maintenance	$ _____ -	
Road maintenance	$ _____ -	
Litter control	$ _____ -	
Sub-total		$ _____ -

6. - Equipment operation

Hours/year x $/hour	$ _____

7. - Insurance $ _____

8. - Administration

Total Operating Cost x _____ % -	$ _____

TOTAL OPERATING EXPENSES - **$ _____**

Annual Revenues

1. - Tip fees

Tonne/yr x $/tonne	$ _____

2. - Recycling revenues

Kg/yr x $/kg	$ _____

TOTAL OPERATING REVENUE **$ _____**

Municipal Requisition

Total Operating Expense – Total Revenues -	$ _____

APPENDIX C

CHECKLISTS

(Site Selection, Design, and Operations)

Site Selection Checklist -

Key Criteria	Yes	No
Community Involvement Process		
Regulatory Requirements known		
Service area(s) defined		
Siting criteria documented		
Size of required site determined		
Appropriate zoning		
Meets municipal development set backs		
Meets set backs from highways and intersections		
Meets setback from municipal roads and streets		
Land ownership secured		
Appropriate buffers and setbacks		
Avoidance or mitigation for environmental, heritage, or cultural sites		
Integration with existing and future waste management systems		
Centrally located		
Accessibility		
Existing Services		
Geotechnical conditions suitable		
Topography suitable		
Drainage patterns		
Acceptable haul routes		
Safe access to public roads		
Municipal Development Permit		
Notification of Director (Alberta Environment)		

Design Checklist -

Key Criteria	Yes	No
If located on a former landfills site, has the design considered potential impacts of landfill gas and site stability?		
Has a geotechnical investigation for design of foundations and structures been completed?		
Is the site topography used to best advantage?		
Safe and efficient traffic routing – one way traffic		
Unloading areas provided with sufficient space for vehicles		
Parking area for staff, equipment, and transfer vehicles		
Turning radii designed for largest vehicles		
Sufficient room for transfer vehicles to maneuver		
Are approaches to scale, loading bays sufficient length?		
Gate or scale house, or attendant's shelter		
Adequate utilities to suit the facilities needs		
Road grades designed appropriately for loaded and empty vehicles		
Security fencing and gates		
Landscaping and site aesthetics considered		
Litter controls		
Measures to mitigate control odours and dust		
Signs		
Engineered retaining walls		
Road and ramps designed to support loaded vehicles		
Are safety features incorporated into the design?		
Buildings designed according to appropriate Codes		
Building foundations designed to support expected loads		
Has adequate ventilation been provided for enclosed buildings		
Has equipment installations and foundations been designed to manufactures specifications?		
Storage compounds designed for anticipated volume of materials		
Recycling containers located with customer safety in mind		
Recycling operations separated from transfer tip floor operations		
Do recycling and storage compound conform to Regulations, Codes and guidelines?		
Adequate lighting provided for safe operation during darkness		
Is fire protection included in the design?		

Operations Checklist -

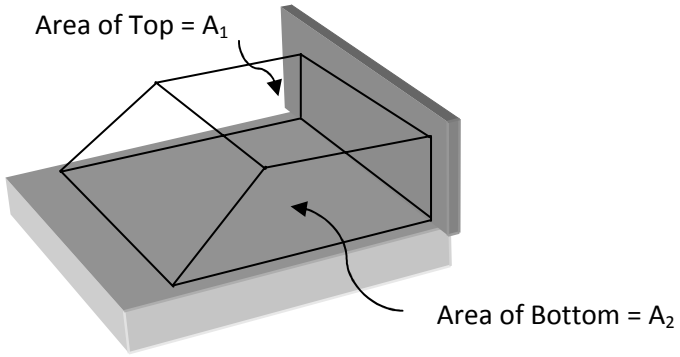
Key Criteria	Yes	No
Operating Schedule		
Staffing Plan		
Staff Training		
Site security		
Waste acceptance and screening procedures		
Procedures for Reporting Prohibited Waste		
Waste Storage and Handling Procedures		
Bulky Materials Storage and Handling Procedures		
Recyclable Materials Storage and Handling Procedures		
Household Hazardous Waste Storage and Handling Procedures		
Litter Management Protocols		
Dust Management Protocols		
Odour Management Protocols		
Noise Management Protocols		
Vector Management Protocols		
Site Safety Plan		
Emergency Evacuation Plan		
Fire response plan		
Spill and environmental release response plan		
Response plan for medical and police emergencies		
Response plan for discovery of a hazardous waste		
Severe weather response plan		
Plan for interruption of transfer vehicles		
Plan for power failures		

APPENDIX D

DESIGN CALCULATIONS

AND DESIGN DATA

METHOD 1: Simple Storage Volume Calculation for Tip Floor Storage *(From SWANA)*



$$V = h \left(\frac{A_1 + A_2}{2} \right)$$

Density may be assumed as 240 kg/m^3

METHOD 2: Simple Method to Calculate Size of Large Urban Transfer Station Tip Floor

(From: US EPA, Waste Transfer Stations: A Manual for Decision-Making)

Start with 400 M^2 as default floor area

Add 1.8 M^2 for each tonne of waste received per day

400 M^2 + (_____ t/day x 1.8 M^2) = _____ M^2

METHOD 3: Complex Formulae for Determining Transfer Station Capacity

(From: US EPA, Decision-Makers Guide to Solid Waste Management, Second Edition)

Stations with Surge Pits

Based on rate at which wastes can be unloaded from collection vehicles:

$C = P_C \times (L / W) \times (60 \times H_W / T_C) \times F$

Based on rate at which transfer trailers are loaded:

$C = (P_t \times N \times 60 \times H_t) / (T_t + B)$

Direct Dump Stations

$C = N_n \times P_t \times F \times 60 \times H_W / [(P_t/P_c) \times (W/L_n) \times T_c] + B$

Hopper Compaction Stations

$C = (N_n \times P_t \times F \times 60 \times H_W) / (P_t/P_c \times T_c) + B$

Push Pit Compaction Stations

$C = (N_p \times P_t \times F \times 60 \times H_W) / [(P_t/P_c) \times (W/L_p) \times T_c] + B_c + B$

Where:

C = Station capacity (tons/day)
P_C = Collection vehicle payloads (tons)
L = Total length of dumping space (feet)
W = Width of each dumping space (feet)
H_W = Hours per day that waste is delivered
T_C = Time to unload each collection vehicle (minutes)
F = Peaking factor (ratio of number of collection vehicles received during an average 30-minute period to the number received during a peak 30-minute period)
P_t = Transfer trailer payload (tons)
N = Number of transfer trailers loading simultaneously
H_t = Hours per day used to load trailers (empty trailers must be available)
B = Time to remove and replace each loaded trailer (minutes)
T_t = Time to load each transfer trailer (minutes)
N_n = Number of hoppers
L_n = Length of each hopper
L_p = Length of each push pit (feet)
N_p = Number of push pits
B_c = Total cycle time for clearing each push pit and compacting waste into trailer

Conversion Data for Waste Volume

Standard household garbage can 11 cans	2.5 ft.^{3} 1.0 ft ^{3}	0.07 M^3 0.8 M^3
Plastic household garbage bag 10 bags	2.8 ft3 1 yd^3	0.08 M^3 0.8 M^3
Standard Front-end Containers	2.0 yd^3 3.0 yd^3 4.0 yd^3 6.0 yd^3 8.0 yd^3	1.5 M^3 2.3 M^3 3.0 M^3 4.6 M^3 6.0 M^3
Standard Roll-off Containers	20 yd^3 30 yd^3 40 yd^3 50 yd^3	15 M^3 28 M^3 31 M^3 38 M^3
1 cubic meter of: Loose dry household waste Loose wet household waste Compacted dry refuse Compacted wet refuse Baled refuse Shredded refuse	75 to 103 kg 199 to 296 kg 340 to 483 kg 454 to 624 kg 1191 kg 238 kg	

APPENDIX E

STORAGE OPTIONS FOR RECYCLABLE MATERIALS

STORAGE OPTIONS FOR RECYCLABLE MATERIALS -

Type of Storage	Methods	Suitable Materials	Attributes
In Building	Gaylords, bunkers, containers, pallets	All except bulky materials	• Secure • Close to processing equipment • Convenient for operators • Most expensive • May be inflexible
Trailers	Storage of post processing materials (e.g. Baled, gaylords, pallets)	All except bulky materials	• Relatively inexpensive • Secure • Materials moved directly to market • If backed to loading dock, reduced handling • Handling materials in a confined space • Requires fork lift or skid steer loader to load trailer
Covered Roll-off Container	Loose	Any except bulky materials	• Secure • Can be designated for specific materials • Can be hauled directly to market • Least material handling • Loose materials may be lightweight and result in inefficient hauling
Open Roll-off Containers	Loose	Scrap metal, appliances, electronics, tires, wood waste, yard waste	• Exposed to weather • May not be secure • Can haul direct to market • Potential for inefficient hauling
Pole-barn	Stacked	Pesticide containers, electronics, scrap metal, appliances	• Secure • Require lined base and perimeter berms for pesticide containers • Fencing to contain materials • Easy access for delivery and loading • Relatively inexpensive
Outdoor bunkers	Stacked or loose	Glass, scrap metal, appliances, tires, electronics, yard waste	• Easy access for delivery and loading • Inexpensive • Not secure • Requires extra handling to load

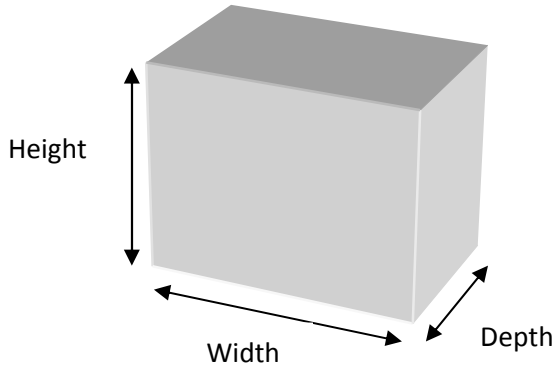
Type of Storage	Methods	Suitable Materials	Attributes
			• Not appropriate for materials that need to be protected from weather
Outdoor ground storage	Loose or stacked	Tires, Scrap metal, appliances, concrete, asphalt, wood and brush, yard waste	• Easy access or deliver and unloading • Least expensive • Suited to bulky materials • Not secure • May become unsightly and unconfined

APPENDIX F

CONTAINER DIMENSIONS

FRONT-END CONTAINER DIMENSIONS

NOTE: Container dimensions should be confirmed with specific bin manufacturer



Imperial Measurements

(Approximate outside dimensions)

Volume (Cubic Yards)	Width (inches)	Depth (inches)	Height (inches)
2	71	36	36
3	71	42	48
4	71	54	48
6	71	66	58
8	71	66	61

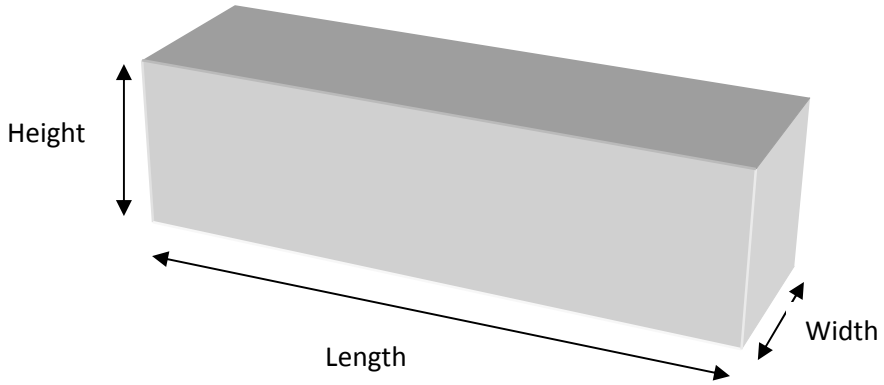
Metric Measurements

(Approximate outside dimensions)

Volume (Cubic M)	Width (cm)	Depth (cm)	Height (cm)
1.5	180	95	95
2.3	180	107	122
3	180	137	122
4.6	180	168	147
6	180	168	155

ROLL-OFF CONTAINER DIMENSIONS

NOTE: Container dimensions should be confirmed with specific manufacturer



Imperial Measurements

(Approximate outside dimensions)

Volume (Cubic Yards)	Length(inches)	Width (inches)	Height (inches)
20	246	84	48
30	246	84	70 ¾
40	246	84	93

Metric Measurements

(Approximate outside dimensions)

Volume (Cubic M)	Width (cm)	Depth (cm)	Height (cm)
15	625	213	122
23	625	213	180
30	625	213	236

APPENDIX G

EXAMPLE TRANSFER STATION OPERATING PROCEDURES PLAN OUTLINE

EXAMPLE TRANSFER STATION OPERATING PROCEDURES PLAN OUTLINE

NOTE: *Level and detail of operating procedures should be appropriate to size and complexity of the facility. Small and simple facilities may only require a basic plan and procedures, while large and complex facilities may require greater detail that is specific to the types of equipment and facilities that are used.*

1. Introduction
    a. Facility location
    b. Facility site plan
    c. Purpose of the transfer station
2. Administrative Procedures
    a. Organization chart
    b. Operator duties (as appropriate to facility size)
        i. supervisor
        ii. Attendant(s)
        iii. Equipment operator(s)
        iv. Labourer(s)
    c. Administrative records
    d. Hours of Operation
    e. Fees
3. Waste Acceptance Procedures
    a. Acceptable waste
    b. Prohibited waste
    c. Waste screening
4. Scale or Gatehouse Operations
5. Transfer operations
    a. Waste storage and handling
    b. Equipment operation & maintenance
    c. Loading of transfer vehicles (bins, trailers etc.)
    d. Transfer schedule
    e. Facility maintenance
6. Procedures for Recycling Compounds and Storage Facilities (as applicable)
    a. Bulky Metals Storage & Recycling
        i. White goods
            1. CFC recovery
    b. Tire storage
    c. Used Oil Storage
    d. Household Recyclables
        i. Cardboard
        ii. Household metals

iii. Plastics
iv. Others

e. Household Hazardous Waste (HHW) Storage and Handling
i. Storage and Handling
ii. Transport of HHW

7. Composting Facilities (where applicable)
a. (refer to Standard for Compost Facilities in Alberta)
a. (use separate operating policy and procedures if appropriate)
8. Nuisance Management Procedures
a. Odours
b. Litter
c. Insect, birds, animals
d. Noise
e. Dust
9. Emergency Response Procedures
a. Fire prevention and response
b. Severe weather response
c. Spill prevention and response
d. Hazardous waste detection and response
10. Safety Procedures (refer to existing safety manuals when appropriate)
i. Facility hazard assessments
ii. Site safety procedures
1. Staff
2. customers
iii. Safe equipment operation procedures
11. Reporting Procedures
a. Administrative Reporting
b. Environmental reporting
c. Safety reporting

APPENDIX H

TYPICAL RECORD SHEET

EXAMPLE DAILY CUSTOMER VEHICLE RECORD (for facilities with no weigh scales)

Date: _____/_____/_____

Arrival time	Departure time	Vehicle ID	Estimated Load M^3	Type of Waste	Applicable Fee

Supervisor _____ -

EXAMPLE DAILY/MONTHLY SUMMARY RECORD

Date: _____/_____/_____

Weather Conditions		
Hours of Operation	Open: ____:_____	Closed: _____:_____
Summary Scale Data*	Inbound Loads Outbound Loads - Transfer - Recycled (List material type)	Total Weight or Number of Loads
	Material Types - MSW - Appliances - Mixed Metal - Pest. Containers - Wood wastes - Tires	Estimated Totals
Site Maintenance	Activity (e.g. litter retrieval, road grading, clean container)	
End of Day Check	Buildings Secure Equipment Secure Storage areas Waste storage Gates Closed/Locked	Yes _____ No _____ Yes _____ No _____ Yes _____ No _____ Yes _____ No _____ Yes _____ No _____
Incidents and Reporting	OHS Incidents (falls, injuries, vehicle accidents, near misses) Environmental (e.g. spills, surface water releases, litter, nuisances)	

Supervisor _____

APPENDIX I

WASTE TYPES AND HANDLING

WASTE TYPES AND HANDLING -

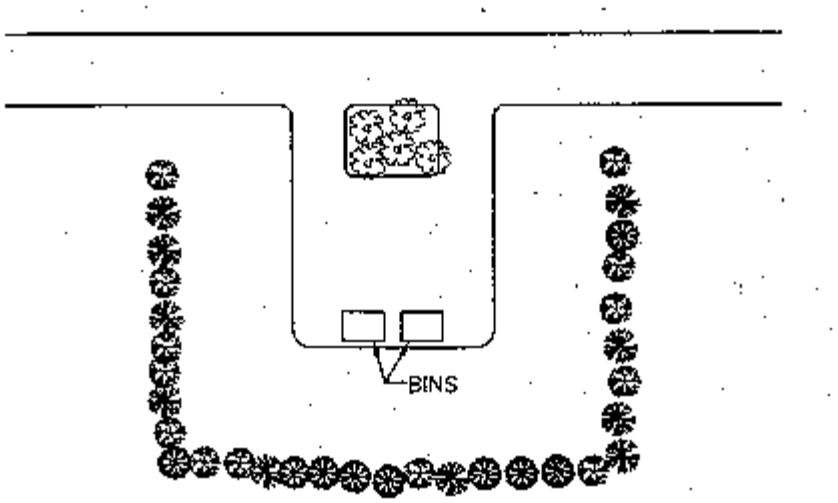
Types	Sources	Description/Issues	Materials Handling at Transfer Station
Putrescible	Residential, commercial, and institutional	- Waste from preparation and handling of food - Odours, attraction of insects, animals, birds	- Store in transfer containers/buildings - Minimize storage time - Frequent scheduling of transfer vehicles
Rubbish	Residential, Commercial, Institutional, Industrial	- Paper, cardboard, cartons, wood, plastics, rags and cloths, leather, rubber, bricks, ceramics, glass, metals, soil and rocks - Litter, some materials may bridge in containers	- Store in transfer containers/buildings - Where applicable, divert specific materials to recycling
Yard Waste	Residential, Commercial, Institutional, Industrial	- Grass, leaves, garden residuals, shrubs - Can become odourous, brush can consume space in containers	- Store in transfer containers/buildings - Frequent scheduling of transfer vehicles - Encourage home composting or diver to compost facilities
Ashes	Fire places, burning barrels, wood or coal burning furnaces, industrial processes	- Residential, industrial - Dust nuisance (OH&S, fire hazard, industrial sources may contain hazardous constituents	- Do not accept in transfer facilities - Divert to landfill -
Bulky Waste	Automobile parts, tires, white goods, bulky metals, furniture, crates, trees and stumps	- All sources - Difficult to handle at transfer stations - Can consume excessive space in transfer containers and vehicles	- Divert to appropriate storage facilities for bulky materials - Divert to landfill - Store in separate roll-off containers for recycling or transfer to disposal
Street Refuse	Street sweepings, leaves, catch basin dirt, contents of litter receptacles	- Urban public works departments	- Store in transfer containers/buildings -
Dead Animals & animal parts	Small animals, farm animals, road kill	- Farms, abattoirs, veterinary clinics - Odours, attraction of insects, birds, animals	- Do not accept and transfer stations - Divert to landfill for disposal - Rendering facilities

		- Potential for BSC restricted materials -	
Abandoned Vehicles	Automobiles, trucks, equipment	- Large bulky materials - Difficult to handle at transfer stations	- Divert to appropriate storage facilities for recycling
Construction & Demolition Waste	Lumber, roofing materials, plastic sheeting, rubble, concrete, plaster, drywall, conduit, pipes, wire, insulation, asphalt, etc.	- Build construction, renovation, or demolition - Street construction and repair - Too heavy for most transfer systems - Difficult to handle and can damage transfer equipment	- Divert to appropriate storage areas for recycling - Collect small volume (e.g. residential) in roll-off containers for transfer
Industrial Refuse	Food processing wastes, boiler cinders, wood, plastic, metal scraps, dust and shavings, process sludges	- Manufacturing facilities, gas and oil related industries - Generally large volumes, can be problematic to handle - Some industrial waste may have hazardous properties	- Do not accept at transfer station unless small in volume and the waste does not create health and safety issues and is not classified as a hazardous waste
Special Waste	Biomedical wastes, oil field wastes, radioactive materials, hazardous wastes	- Industries, hospitals, clinics, veterinarian clinics, institutions	- Do not accept at transfer stations
Agricultural Waste	Bedding materials, manures, crop residues, treated seen	- Can be large volumes - Oil field waste restrictions - Farms, feed lots	- Do not accept at municipal waste transfer stations
Liquids and Sludges	Bulk liquids, industrial and municipal sludges, paints and solvents, etc.	- Industrial or municipality operations, car wash and industrial sumps, repair shops (used oil) - Potential for spills and surface water contamination - Some liquids or sludges may be classified as a hazardous waste	- Do not accept in transfer facilities - Divert to appropriate liquid waste facilities for disposal or treatment - Used oil may be stored in containers for recycling

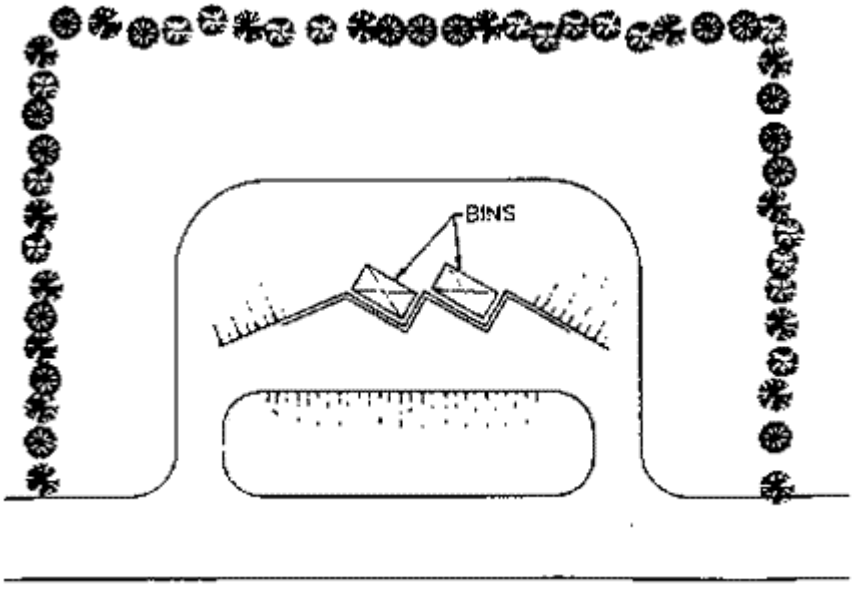
APPENDIX J

TYPICAL SITE LAYOUTS

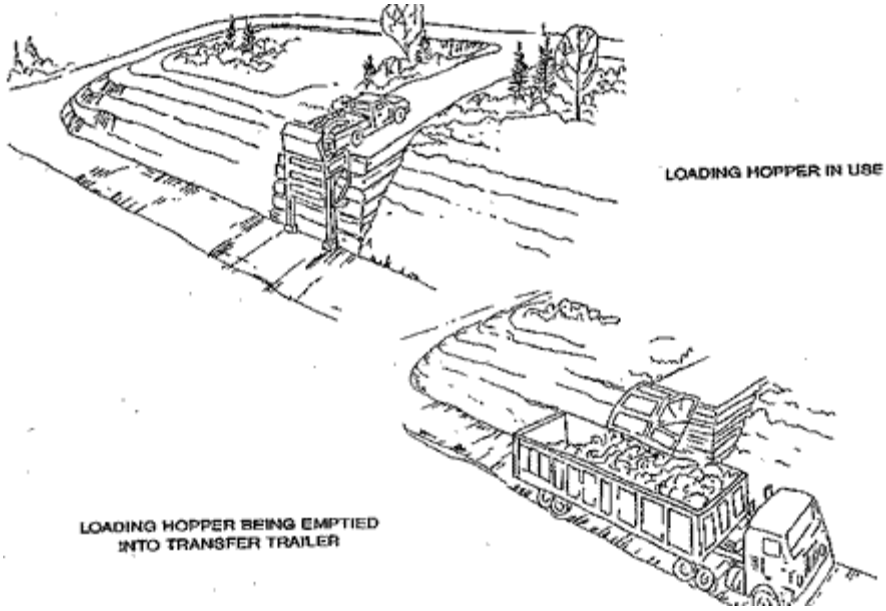
Walk-Up Bin System -



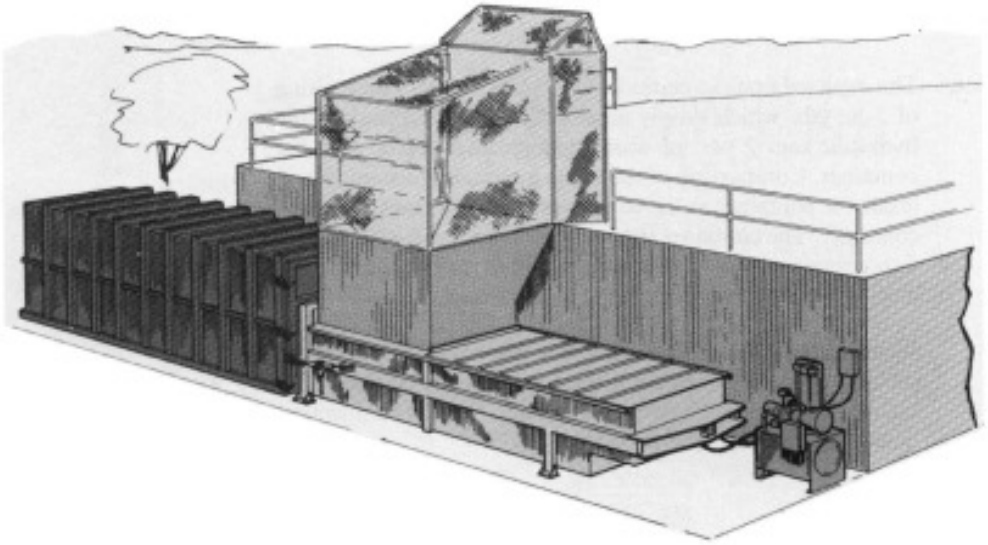
Typical Roll-off Container Transfer Station -



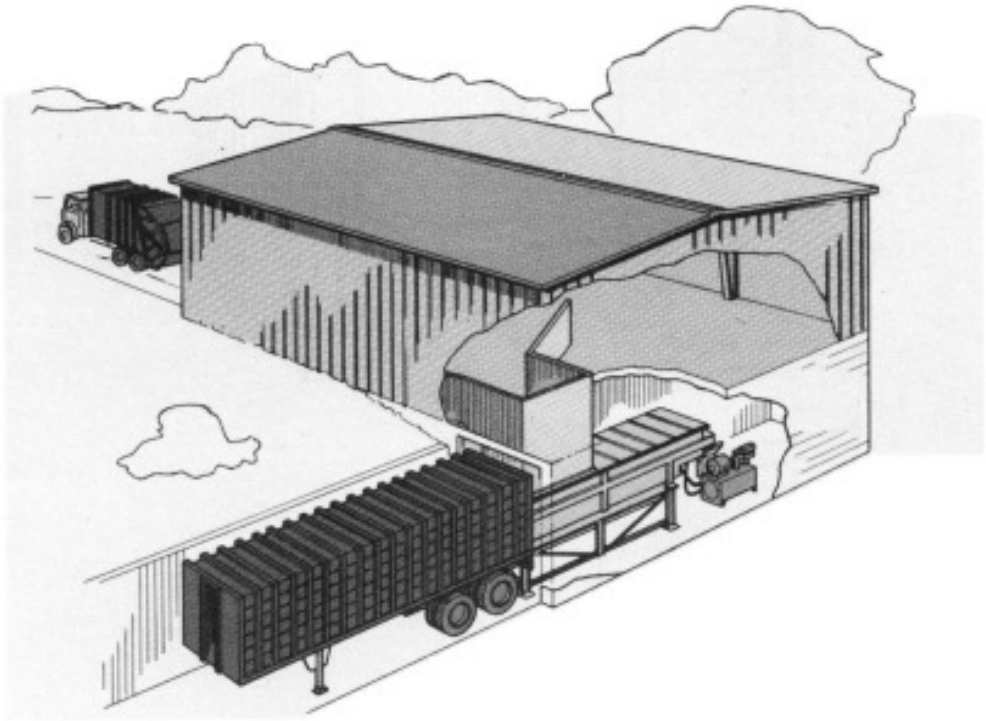
TRANSTOR Transfer System -



Typical Compactor Transfer Stations -

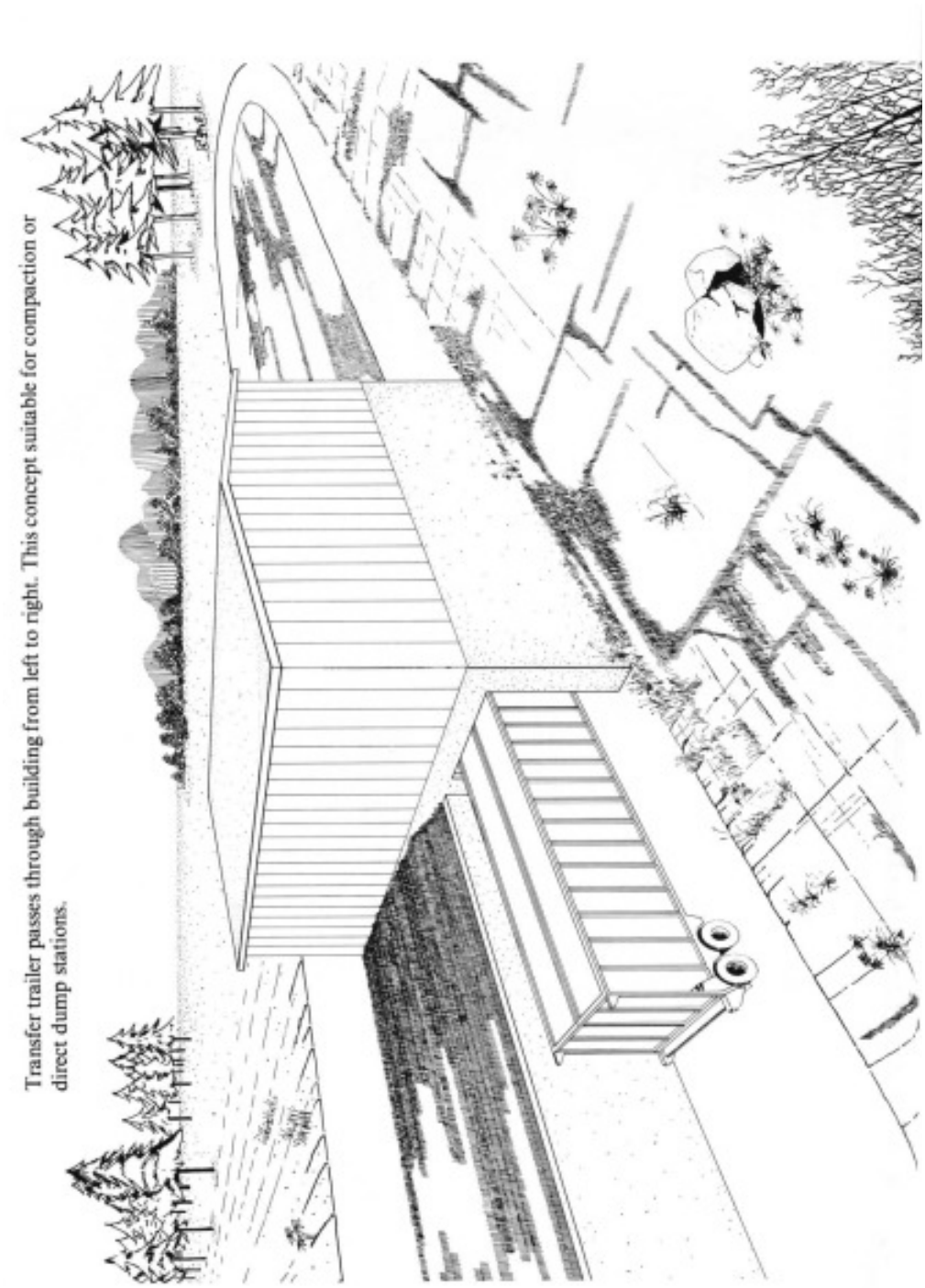


Typical Outdoor-Type Mini-Transfer Installation



Typical Mini-Transfer Installation in Building

Push-pit Transfer Station -



Vermilion

Push-pit Transfer Station

Strathmore

(Drumheller & District Regional Waste Association)

TRANSTOR Facility

Innisfail

Compactor Transfer Station

References for Figures

Chapter 1

Figure 1-1	Alberta Waste Hierarchy	Alberta Environment
Figure 1-2:	Direct Haul Collection System	City of Beaverton, Oregon
Figure 1-3:	Transfer in a Waste Mgt. System	City of Beaverton, Oregon
Figure 1-4:	Transfer Station with Recycling	JL Technical Services

Chapter 2

No figures

Chapter 3

Figure 3.1:	Transfer Station Siting Process	JL Technical Services

Chapter 4

Figure 4-1:	Small Radius Service Area	JL Technical Services
Figure 4-2	Large Radius Service Area	JL Technical Services
Figure 4-2	Direct Haul vs. Transfer Haul	JL Technical Services

Chapter 5

	Garbage bag	City of Denver, Co.
	Blue Bag	RD of Kootenay Boundary
	Clear Bag	Compobag
	Blue Box	City of Penticton
	Metal or Plastic Cans	Co. Marion, US
	55 Gal. Drum	Dept. Ecology, WA,
	Roll out carts	Roto Industries Inc.
	Front-end Bin	WM, Orange County
	Hyd-a-Way Containers	Haul All Equipment

Litter Receptacles	Haul All Equipment
Side Loader Bins	City of Denver, Co.
Roll-off Bins	Universal Handling Equipment
Lugger Container	Universal Handling Equipment
Self-Contained Compactor Container	Galbreath Inc.

Chapter 6

Stationary Compactors	Marathon Equipment
Pre-Crush Compactor	Harris Waste Mgt. Group
Horizontal Bailers	Phoenix Compactors
Vertical Bailers	The Alliance Group

Chapter 7

Rear Loader Compactor	Heil Environmental
Semi-automated Rear Loader	Anon
Haul All Side Loader	Haul All
Side Loader Compactor	City of Camrose
Automated Side Loader	Heil
Dual Compartment Rear Loader	Heil Environmental
Dual Compartment Side Loader	Haul All
Front-end Compactor	Wittke Waste Equipment
Tilt-Frame (Cable Hook)	JL Technical Services
Hook Hoist	BC Truckbody
Lugger Trucks	Clean Harbours

Open Top Self Unloading Trailer	American Carrier Equipment
Compaction Trailer	Universal Handling Equipment
Self-Compaction Trailer	Universal Handling Equipment

Chapter 8

Mail Box Collection	Anon
Rural Container System	JL Technical Services
Lane Hand Collection	City of Camrose
Curb side Hand Collection	London, Ontario
Semi-Automated	Anon
Automated with Roll-out Carts	Rapid Rail
Automated Collection with Bins	Regina, Sask.
ICI Hand Collection	Anon
Commercial Dumpsters	Lexington, Kty.
Satellite Collection	JL Technical Services
Direct Haul	Beaver Reg. Waste Services Commission
Multi-material Collection	Strathcona County
Drop-off Depots	Marsden, Sask.
Stationary Depots	City of Calgary
Regional Collection Systems	Northern Care (Alberta)
Multi-purpose Facilities	City of Edmonton – Eco Station
Mobile Recycling Trailer	Anon

Chapter 9

Figure 9-1: Variations of Transfer Stations	JL Technical (adopted from USEPA)
Front-end Loader Container	JL Technical Services
Roll-off Box Systems	JL Technical Services
TRANSTOR	JL Technical Services/Haul All Equip. Ltd.
Rural Push Pit Stations	JL Technical Services
Urban Push Pit Stations	JL Technical Services/Lancaster County
Direct Dump Transfer	JL Technical /Valley Solid Waste, NB
Rural Stationary Compactor	JL Technical Services
Urban Compactor (Photo)	JL Technical Services
Pre-pack Compactors	ANON
Bailing Systems	Prince Albert, Sask.