Alberta
ENVIRONMENT
Southern Region

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SOUTHERN ALBERTA INTEGRATED WASTE MANAGEMENT STUDY

FINAL REPORT

VOLUME 1 OF 2

March, 1994

Stanley

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March 15, 1994
File: 67-010-01-01

Mr. John Slupsky, P.Eng
Alberta Environmental Protection
Materiels Management Branch
5th Floor, Oxbridge Place
9820 - 106 Street
Edmonton, Alberta
T5K 2J6

Dear Mr. Slupsky:

Reference: Southern Alberta Integrated Waste Management Study Agreement #93-0179

We are pleased to present the final report for the above captioned project. Additional copies have been forwarded to the Committee members.

We believe the results and recommendations contained in this report provide the Committee with the information required to implement an integrated waste management system for the southern Alberta region. The work undertaken over the past year presents a number of integrated system options which could be readily implemented in the region. Implementation could be accomplished in a phased manner where, as a minimum, a complete regionalized landfill and transfer station infrastructure would provide the initial building blocks for a comprehensive integrated system incorporating all of the 4R's.

The report has been divided into two volumes; the main body of the study, and the appendices, which contain complementary and supplementary information. In addition to the two volume report, an Executive Summary has been prepared for the convenience of the Committee members, as well as for general distribution.

We enjoyed working with you and the members of the Project Steering Committee.

Sincerely,

STANLEY INDUSTRIAL CONSULTANTS LTD.

Kevin L. Metcalfe, B.Sc., P.Eng.
Waste Management Engineer

Jim Schubert, B.Sc., P.Eng.
Waste Management Engineer

Enclosure

cc: Committee Members

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ABBREVIATIONS

AEP	Alberta Environmental Protection
APC	Air Pollution Control
ASWMC	Alberta Special Waste Management Corporation
BACT	Best Available Control Technology
BTU	British Thermal Unit
°C	Degrees Celcius
C & D	Construction & Demolition
CCME	Canadian Council of Minister's of the Environment
CEM	Continuous Emission Monitor
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COR	Canadian Oil Reclamation
EFW	Energy from Waste
EPA	Environmental Protection Agency (US)
HCl	Hydrogen Chloride
HDPE	High Density Polyethylene
IC&I	Industrial, Commercial, Institutional
ID	Improvement District
kPa	Kilopascals
MD	Municipal District
mg/Rm^3	Milligrams Per Reference Cubic Metre
MRF	Materials Recovery Faciltiy
MSW	Municipal Solid Waste
NITEP	National Incinerator Testing and Evaluation Program
O_2	Oxygen
OCC	Old Corrugated Cardboard
ONP	Old Newspaper
PCB	Polychlorinated Biphenyls
PCDD	Polychlorinated Dibenzo-p-dioxin
PCDF	Polychlorinated Dibenzofuran
PET	Polyethylene Terephthalate
PPMDV	Parts Per Million Dry Volume
PVC	Polyvinylchloride
RDF	Refuse Derived Fuel
RMOC	Regional Municipality of Ottawa-Carleton
UFA	United Farmer's Association

GLOSSARY OF TERMS

Aeration: A process used in composting by which air is applied to compostables to biodegrade them.

Agricultural Chemical Containers: Containers as defined by the Agricultural Chemicals Act which require special disposal and are collected at permitted sites.

Aluminum: A silvery-white metallic element, the most abundant in the earth's crust.

Back End Separation System: A process for recovering resources from the organic portion of the waste stream. This automated system processes ash residue for removal of ferrous and non-ferrous metals.

Baler: A machine in which waste materials are compacted to reduce volume, usually into rectangular bundles.

Biomedical Wastes: Anatomical, infectious anatomical, and pharmaceutical wastes and sharps produced at health care facilities, including hospitals, dentists, medical clinics, laboratories, funeral homes, and veterinarians. These mdeical wastes can be infectious and/or hazardous and require proper handling and disposal.

Boxboard: Paper used in the manufacturing of cartons and rigid boxes.

Classification: The arrangement or sorting of waste materials into uniform categories or classes, usually by size, weight, color, organic/inorganic make-up, etc.

Collection: The act of picking up waste materials at homes, businesses or industrial sites, and hauling it to a facility for further processing, transfer to large vehicles or disposal. Various collection methods include single stream and multiple stream collection.

Combustibles: Burnable materials in the waste stream, such as paper, plastic, lawn clippings, leaves and other light, organic materials.

Commercial Waste: Waste material which originates in wholesale, retail or service establishments such as office buildings, stores, hotels, universities and warehouses.

Commingled Wastes: Wastes which are not sorted.

Compactor: Any power-driven mechanical equipment designed to compress and reduce the volume of waste materials.

Compactor Truck: A large truck with an enclosed body and a mechanism for loading and compacting waste materials.

Composting: A solid waste management technique which uses natural processes to convert most organic materials to humus by micro-organism activity. Composting is not effective on plastic and rubber.

line lime or limestone and soda ash. Crushed glass (cullet) has traditionally been added to make the mixture of raw materials more workable. Colored glass is usually obtained by adding small amounts of selected metals, salts or oxides such as iron salts or chromia.

Hazardous Waste: Waste material that may cause or significantly contribute to serious illness or death, or that poses a substantial threat to human health or the environment when improperly managed. These materials include old explosives, radioactive materials and some chemical and biological wastes, usually produced in industrial operations or in institutions. This term is not meant to imply that other wastes are non-hazardous. They require special handling and disposal as regulated in the Hazardous Chemicals Act.

High Density Polyethelene (HDPE): Classified as #2 plastics, includes milk jugs, trash bags, detergent bottles, bleach bottles, and aspirin bottles. Approximately 31% of plastic stream.

Incinerator: A plant designed to reduce waste volume by combustion. Incinerators consist of refuse handling and storage facilities, furnaces, subsidence chambers, residue handling and removal facilities, chimneys and other air pollution control equipment.

Industrial Waste: Those waste materials generally discarded from industrial operations or derived from manufacturing processes.

Inorganic Refuse: Waste material made from substances composed of matter other than plant, animal or certain chemical compounds of carbon.

Leachate: A liquid containing decomposed waste, bacteria and other noxious and potentially harmful materials which drains from landfills and must be collected and treated to prevent contamination of water supplies.

Litter: Man-made (or man-used) misplaced solid waste, discarded outside the established collection-disposal system. Properly containerized solid waste is often referred to as trash or garbage.

Magnetic Separator: Equipment, usually consisting of a belt, drum or pulley with a magnet, used to attract and remove magnetic materials from other materials.

Material Recovery Facility (MRF): A facility where recyclables are sorted. Can be low tech, i.e. depots, or high tech, i.e. a dedicated facility with mechanical and manual sorting.

Methane: An orderless, colorless, flammable gas which is formed by the anaerobic decomposition of organic waste matter or by chemical synthesis. It is the principal component of natural gas.

Mixed Office Paper: Mixed waste paper which is generated in the office and is of high recycling value. See High Grade Waste Paper.

Mixed Paper: Waste paper of various kinds and quality, usually collected from stores, offices and schools.

Modified Landfill: An open land site where waste materials are burned, left to decompose, rust or simply remain. These landfills create problems such as air and water pollution, unsanitary conditions and general unsightliness. Occational cover is required.

Reclamation: The restoration to usefulness or productivity of materials found in the waste stream. Reclaimed materials may be used for purposes different from their original use.

Recovery: One of the 4R's, involves reclaming usable products from the waste stream.

Recycling: A resource recovery method involving the collection and treatment of a waste product for use a raw material in the manufacture of the same or a similar product (e.g., ground glass used in the manufacture of new glass).

Reduction (Source Reduction): Act of reducing quantities of waste produced by selecting alternatives which produce waste, i.e. not buying over packaged products, etc.

Refuse: Anything thrown away or rejected as worthless or useless.

Refuse-Derived Fuel (RDF): A solid fuel obtained from municipal solid waste as a result of a mechanical process or sequence of operations which improves the physical, mechanical or combustion characteristics compared to the original unsegregated feed product or unprocessed solid waste.

Reprocessing: The treatment of used oils by minimum physical methods, such as settling, in preparation for use as fuel oil or fuel supplements.

Re-refining: The use of petroleum refining techniques on used oil to produce lube stocks that are substantially equivalent in quality to lube stocks produced from virgin crudes. Techniques may include a combination of distillation, acid, caustic, solvent, hydrogen treating and other physical or chemical treatments.

Residential Waste: Waste materials generated in homes and apartments. Residential waste includes paper, OCCs, beverage and food cans, plastics, food wastes, glass containers, clothes, garden wastes, DIY used motor oil, etc.

Residue: The materials remaining following completion of a chemical or physical process such as burning, evaporation, distillation or filtration.

Resource Recovery: A term describing the extraction and utilization of materials and values from the waste stream either as materials which can be used as raw materials in the manufacture of new products, or as values which can be converted into some form of fuel or energy source.

Reuse: The use of a waste material or product more than once.

Rubbish: A general term for solid waste that does not contain food waste.

Salvage: The extraction of materials from the waste stream for reuse.

Sanitary Landfill: A method of disposing of refuse on land without creating nuisances or hazards to public health or safety. Careful preparation of the fill area and control of water drainage are required to assure proper landfilling. To confine the refuse to the smallest practical area and reduce it to the smallest practical volume, heavy tractor-like equipment is used to spread, compact and usually cover the waste daily with at least six inches of compacted dirt. After the area has been completely filled and covered with a final two or three-foot layer of dirt, and has been allowed to settle for an appropriate period of time,

Used Oil: Any oil refined from crude petroleum oil or any rerefined oil which, through use of contamination, has become unsuitable for continued service in the applications for which is was originally intended. Specifically excluded from this definition are fuels, waxes, petrolatums, asphalts and other petroleum products which are not generally considered to be oils or originally intended for use as a lubricant.

Volume Reduction: The processing of waste materials so as to decrease the amount of space the materials occupy, usually by mechanical (crushing or shredding), thermal (incineration or pyrolysis) or biological (composting) means.

Waste Materials: A wide variety of solid materials, that may include liquids in containers, which are discarded or rejected as being spent, useless, worthless or in excess. Waste materials, in this sense, do not usually include waste solids found in sewage systems, water resources or those emitted from smokestacks.

Waste Minimization: Practices which reduce the quantity of waste that must be landfilled, e.g. recycling.

Waste Paper: Paper that has been discarded. This paper can be used again as a recyclable material if the grade of paper is acceptable and if the paper is separated before it enters the waste stream.

Waste Stream: A general term used to denote the waste material output of an area, location or facility.

Yard Waste: Grass clippings, pruning and other discarded material from yards and gardens.

Waste Audit: An inventory of wastes produced by various sectors including businesses, governments, institutions and even private residences. This information can then be used to develop strategies to reduce wastes and even costs.

Windrow: A composting technique where compostables are placed in long piles which are periodically turned with a loader or compost turner.

SECTION 1.0

INTRODUCTION

1.0 INTRODUCTION

1.1 BACKGROUND

Stanley Industrial Consultants Limited (SICL) was retained by the Waste Management Branch of Alberta Environmental Protection to conduct an integrated solid waste management study for southern Alberta. This study includes an analysis of existing systems within the Region and a feasibility study for the integration of solid waste management practices such as combustion, composting and materials recovery into an overall strategy that will optimize waste reduction.

1.2 STUDY AREA

The study area for this project includes the following municipalities, municipal districts, counties and cities:

- The City of Lethbridge;
- The County of Lethbridge (No. 26);
- The Municipal District of Pincher Creek (No. 9);
- The Municipal District of Cardston (No. 6);
- The County of Warner (No. 5);
- The Municipality of Crowsnest Pass;
- The County of Forty Mile (No. 8);
- The Municipal District of Taber (No. 14);
- The County of Vulcan (No. 2);
- The Municipal District of Willow Creek (No. 26);
- The Municipal District of Cypress (No. 1);
- The City of Medicine Hat;
- Canadian Forces Base (C.F.B.) Suffield; and
- Improvement District No. 4 (Waterton Lakes National Park).

The study area includes all cities, towns and villages within the above mentioned Municipal Districts (M.D.), Improvement Districts (I.D.) and Counties. The study area is illustrated in Figure 1.1. As noted on Figure 1.1, the Municipal District of Cypress, the Canadian Forces

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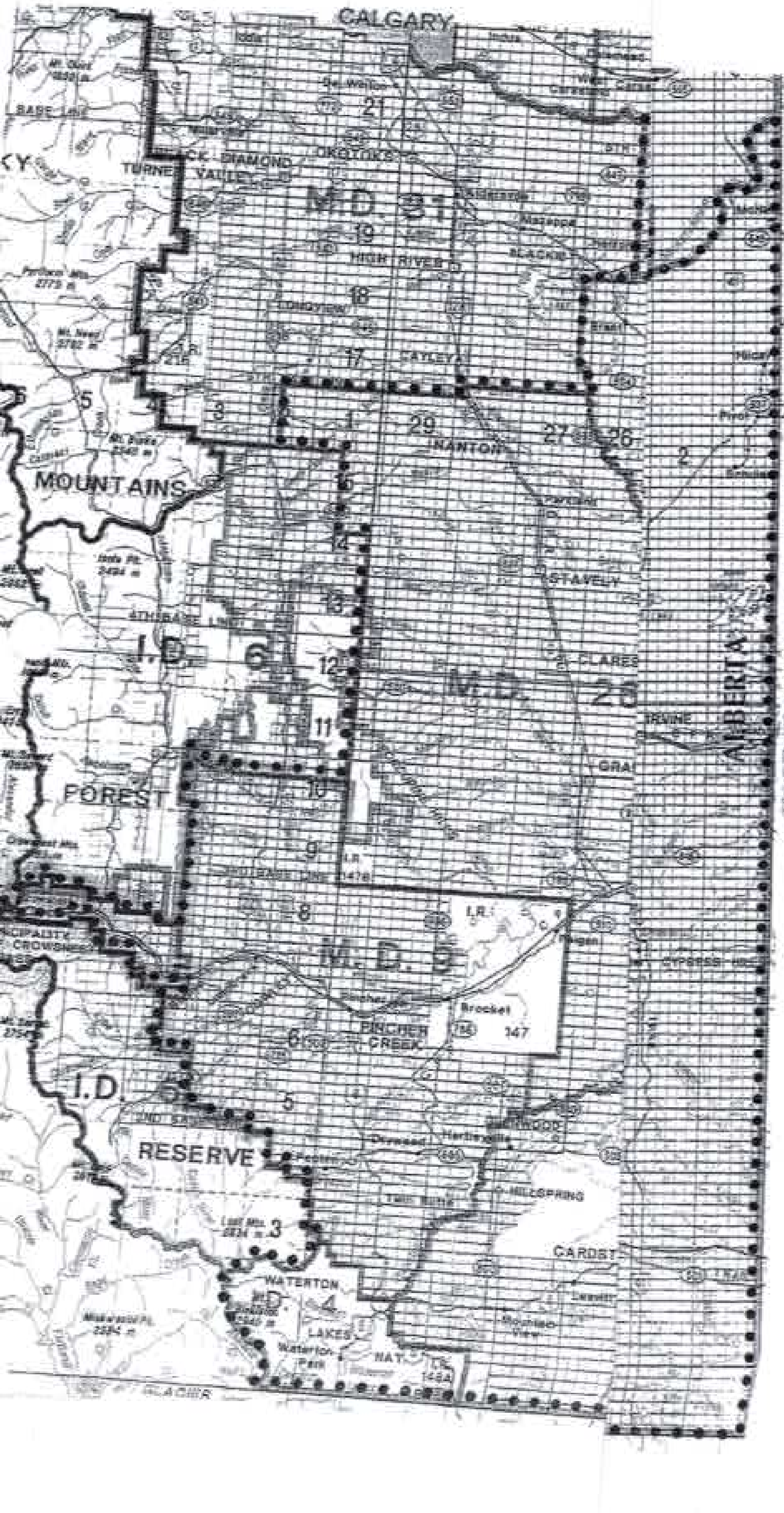

LEGEND :

• • • STUDY AREA BOUNDARY

Figure 1.1

SOUTHERN ALBERTA
STUDY REGION

6. To provide recommendations on the most appropriate integrated waste management system for the study area based on a process and/or methodology to determine public acceptability.

1.4 STUDY ORGANIZATION

A Steering Committee was formed to undertake the development of the Southern Alberta Integrated Solid Waste Management Strategy. It was composed of administrative and public representatives from the municipalities participating in the study. The Committee members included the following:

- John Zoeteman, M.D. of Willow Creek, Chairman;
- Debbie Gregorash, Coaldale Ecology Club;
- Walter Brodowski, City of Lethbridge;
- Brian Dalshaug, Baron-Eureka-Warner Health Unit;
- Dave Whitfield, Alberta Environmental Protection, Recycling Branch; and
- John Slupsky, Alberta Environmental Protection, Waste Assistance Branch.

1.5 PLANNING PROCESS

The Canadian Council of Ministers of the Environment (CCME, 1989) has recommended that Canadian municipalities reduce their solid waste generation by 50% by the year 2000. In order to meet this objective, creative waste minimization options are required both for urban and rural areas.

To meet the objectives of this study, an integrated, long term waste management strategy had to be developed incorporating a variety of waste minimization, handling and disposal approaches and treatment technologies. The final objective of this planning process was to develop a system which would reduce the amount of materials being landfilled, and provide technically feasible and compatible alternatives which are socially, economically and environmentally appropriate to the study area. The system also had to be acceptable within the provincial and federal legislative framework. An overview of the legislative framework is provided in Appendix B.

A literature search was conducted of local newspaper articles published in the last three years on the subject of solid waste, landfilling, recycling, composting, and incineration in the study area. A summary of the information obtained from this search is in Appendix E. This search provided background information on public opinion and was useful in determining what waste management alternatives were deemed appropriate by the public within the study area.

1.7 READER'S GUIDE

This report consists of nine sections. They are organized in the following way:

- Section 2 describes the study area in terms of existing waste generation rates, composition, and waste management systems. A data base is provided with references. The reader should refer to this section to obtain source information which forms the basis of options and alternatives presented in later sections of this report;

- Section 3 outlines proposed and planned waste management alternatives within the study area. This section will provide the reader with an understanding of the ongoing and planned initiatives with respect to solid waste management within the study area;

- Section 4 reviews and evaluates potential waste management systems and processes for the study area. This section will provide the reader with details of the most current waste management technologies available;

- Section 5 provides detailed costs for integrated solid waste management technologies appropriate for the study area. This section provides a basic understanding of costs associated with each technology evaluated;

- Section 6 provides the reader with four (4) integrated solid waste management scenarios appropriate to the study area. This section will provide the reader with costs for implementation of the different scenarios;

SECTION 2.0
DATA BASE

2.0 DATA BASE

2.1 INTRODUCTION

This section presents waste management data from southern Alberta. The purpose is to provide summaries and an overview of current and future (planned) solid waste management activities in the study area. This data will be used as a basis for the development of an integrated solid waste management strategy for southern Alberta.

Data were gathered through personal visits, telephone conversations and written communications with:

- representatives from the municipalities;
- Regional Authorities;
- Health Units;
- Planning Commissions;
- Provincial Agencies;
- Non-Government Organizations (Environmental Groups); and
- Industries.

Supplemental data were derived from site visits to most waste management facilities in the study region, published data, existing studies, in-house literature, and professional experience of the study team.

Most data are presented in graphs and/or in tabular form.

2.2 POPULATION AND DEMOGRAPHICS

Current population figures were available from the 1991 census and were provided by Alberta Municipal Affairs. Historical data, dating back to 1966 were obtained from reports prepared by the Southeast Alberta Regional Planning Commission and the Oldman River Regional Planning Commission in 1989 and 1987 respectively. Projected populations to the year 2011 in these studies were generated based on federal census information prior to

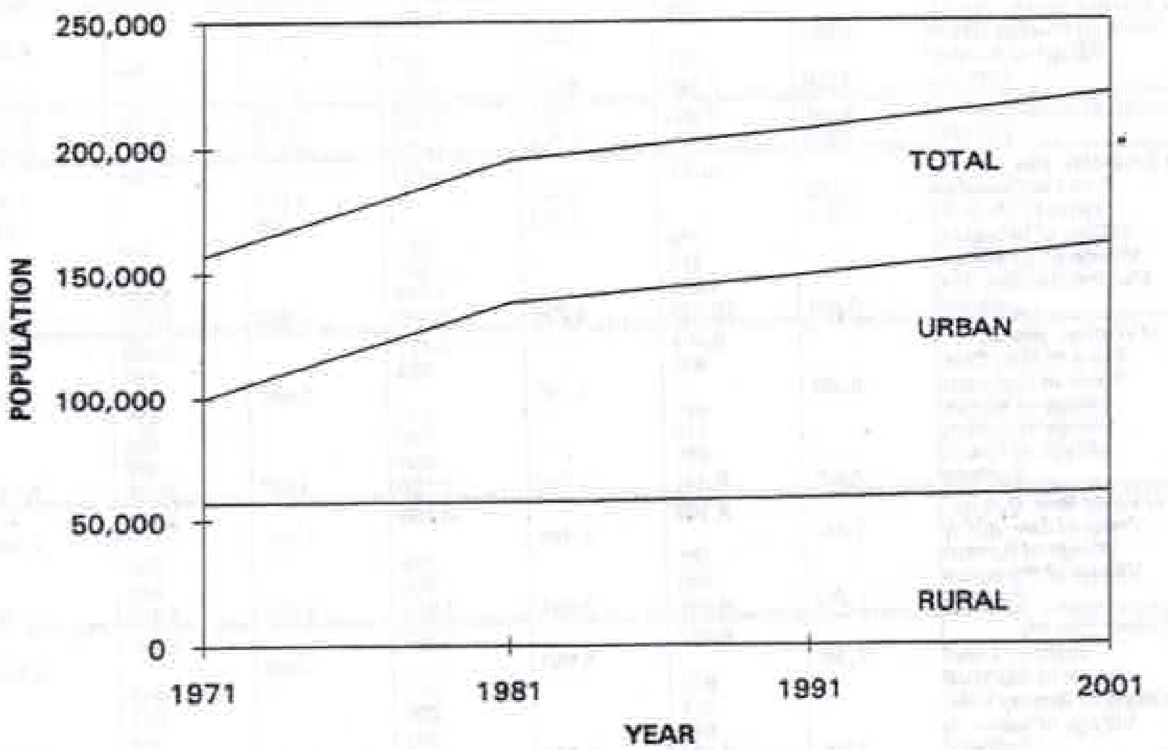

Figure 2.1

SOUTHERN ALBERTA POPULATION GROWTH

With increasing urban based populations, waste production is likely to grow as urban waste generation rates, such as the City of Lethbridge, are generally higher than rural rates. This growth can be counteracted by creative waste minimization practices. Therefore there is a need for an integrated waste management plan which will reduce the overall wastes generated.

2.3 SOLID WASTE SOURCES AND QUANTITIES

There are a total of five sanitary landfills in the study area. Of these, only the Bow Island location does not have a scale. Although the Lethbridge Regional Landfill (Kedon) has a scale, operators of the privately owned facility elected not to release any waste quantity information. Data was obtained from the City of Lethbridge for quantities hauled by the City to the Kedon site. The transfer systems operated by the Chief Mountain Regional Waste Authority and the Lethbridge Regional Waste Management Commission also provided totals of waste quantities that were brought to Kedon. Sources of information for waste quantities from the various jurisdictions are summarized in Table 2.2. Information from the survey of cities, towns and villages which is in Appendix D was also used.

2.3.1 Residential and IC&I Wastes

Waste generation by municipality is shown in Table 2.3. Population figures for 1991 were obtained from the census data and were the most recent statistics available. Waste quantity information was collected for 1992, if the information was available. In cases where actual tonnages were not available, total waste generation was calculated using the per capita rates found in previous studies. Per capita rates represent the average number of kilograms of solid waste generated by each individual per day. The proportion of waste generated between residential and industrial, commercial and institutional (IC&I), was either determined using given information or estimated by applying given residential/IC&I ratios to areas with similar characteristics.

TABLE 2.3: WASTE GENERATION RATES FOR THE STUDY REGION (1992)

Waste Generation Data	1991		Population	Residential	IC&I	Total	Rate
	Urban	Rural	1991	(tonnes/yr)	(tonnes/yr)	(tonnes/yr)	(kg/cap/day)
City of Lethbridge	60,974		60,974	19,700	43,100	62,800	2.82
County of Lethbridge (No. 26)		8,442	8,442	1,830		1,830	0.59
Town of Coaldale	5,310		5,310	1,950	960	2,910	1.50
Town of Picture Butte	1,559		1,559	570	280	850	1.50
Town of Barons		262	262	80	40	120	1.25
Town of Nobleford		517	517	350	40	390	2.07
Village of Coalhurst	1,322		1,322	480	240	720	1.50
Subtotal			17,412	5,260	1,560	6,820	1.07
M.D. of Pincher Creek (No. 9)		3,108	3,108	2,230		2,230	1.97
Town of Pincher Creek	3,660		3,660	1,690	1,130	2,820	2.11
Village of Cowley		277	277	120	120	240	2.29
Subtotal			7,045	4,040	1,250	5,290	2.05
Municipality of Crowsnest Pass	3,249	3,853	7,102	3,070	1,510	4,580	1.77
Subtotal			7,102	3,070	1,510	4,580	1.77
M.D. of Cardston (No. 6)		4,490	4,490	420		420	0.26
Town of Cardston	3,480		3,480	1,270	840	2,110	1.66
Town of Magrath	1,743		1,743	510	250	760	1.20
Village of Hillspring		238	238	160	20	180	2.06
Village of Glenwood		285	285	160	20	180	1.72
Standoff I.R. (No. 148)		4,013	4,013	360	240	600	0.41
Subtotal			14,249	2,880	1,370	4,250	0.82
County of Warner (No. 5)		3,677	3,677	2,200		2,200	1.64
Town of Milk River		926	926	570	140	710	2.12
Town of Raymond	3,130		3,130	850	560	1,410	1.23
Village of Warner		412	412	250	30	280	1.88
Village of Stirling		799	799	250	60	310	1.07
Village of Coutts		355	355	80	80	160	1.20
Subtotal			9,299	4,200	870	5,070	1.49
County of Forty Mile (No. 8)		3,193	3,193	1,840		1,840	1.58
Town of Bow Island	1,484		1,484	1,140	560	1,700	3.14
Village of Burdett		239	239	60	10	70	0.80
Village of Foremost		582	582	470	50	520	2.45
Subtotal			5,498	3,510	620	4,130	2.06
M.D. of Taber (No. 14)		5,317	5,317	1,640		1,640	0.85
Town of Taber	6,660		6,660	3,890	1,670	5,560	2.28
Town of Vauxhall		977	977	460	460	920	2.55
Village of Grassy Lake		206	206	160	20	180	2.39
Village of Barnwell		492	492	290		290	1.61
Subtotal			13,652	6,440	2,150	8,590	1.72
County of Vulcan (No. 2)		3,648	3,648	3,020		3,020	2.27
Town of Vulcan	1,466		1,466	810	400	1,210	2.26
Village of Champion		351	351	260	30	290	2.26
Village of Lomond		167	167	130	10	140	2.30
Village of Arrowwood		142	142	110	10	120	2.32
Village of Carmangay		251	251	190	20	210	2.29
Village of Milo		104	104	70	20	90	2.37
Subtotal			6,129	4,590	490	5,080	2.27
M.D. of Willow Creek (No. 26)		4,764	4,764	3,950		3,950	2.27
Town of Fort MacLeod	2,734	378	3,112	1,290	1,290	2,580	2.27
Town of Claresholm	3,297		3,297	1,370	1,370	2,740	2.27
Town of Nanton	1,589		1,589	880	440	1,320	2.28
Town of Stavely		478	478	320	80	400	2.29
Town of Granum		343	343	220	60	280	2.24
Subtotal			13,583	8,030	3,240	11,270	2.27
City of Medicine Hat	43,625		43,625	18,930	17,190	36,120	2.27
M.D. of Cypress (No. 1)		4,962	4,962	4170		4,170	2.30
Town of Redcliff	3,768		3,768	3,530	2,670	6,200	4.51
Town of Irvine		326	326	220	60	280	2.35
Subtotal			9,056	7,920	2,730	10,650	3.22
Total	149,050	58,574	207,624	88,570	76,080	164,650	2.17

- Population data is from Table 2-1, waste quantities are from sources listed in Table 2-2.

FILE: TAB2-3.WK3

IC&I wastes are defined as:

- Light Industrial: waste from light industries including crafts and other products manufactured on a small scale;

- Commercial: all solid wastes from offices and businesses;

- Institutional: all solid wastes from institutions such as schools, universities, restaurants, hospitals (excluding biomedical wastes), motels and hotels.

Residential wastes are those produced by households. It has been assumed that the IC&I component would be represented in the urban waste totals for the towns and cities, as opposed to the rural generators on acreages and farms.

Using the information given and estimated, waste quantities were calculated for urban and rural areas within each municipality. A total of 164,650 tonnes of solid waste were generated in the study area in 1992 by residential, light industrial, commercial, and institutional sources and the average per capita rate was 2.17 kg/capita/day. Of the total waste generated, 88,570 tonnes were residential solid waste and 76,080 tonnes were IC&I solid wastes.

The waste generation quantities shown in Table 2.3 are expressed as annual quantities. Seasonal variations are an important consideration in the design of waste management systems. In order to account for seasonal variations in waste production, peaking factors must be considered. A peaking factor is the ratio of the high (peak) or low generation rates to the average annual rate. Generally the high peak rate occurs during the summer and the low rate in the winter. A good example of peaking is illustrated using Waterton Lakes National Park data, where the July rate is 2.75 times higher than the annual average and the low rate in January is only one tenth (1/10) of the annual average. In addition to the high and low values, there may also be lesser peak in the spring and fall which correspond to spring and fall clean-ups. For the Town of Cardston, peaks occurred in May, July and October, with corresponding peaking factors of 1.2, 1.3 and 1.1 respectively.

TABLE 2.4: INDUSTRY WASTES IN THE SOUTHERN ALBERTA REGION

Industry	Location	Quantities (tonnes/yr)	Type of Waste	Disposal
Alberta Sugar Company	M.D. #14	1008.0	Paper, Cardboard & Pallets	Taber Land. & Paper Recycled
Alberta Dehydrating Company Ltd.	M.D. #14	12.0	Household, Paper & Cardboard	Vauxhall Landfill&Pap. Recycled
Diamond S Produce Ltd.	M.D. #14	2722.0	Carrots	50%Feedlot& 50%Taber Landfill
Diamond S Produce Ltd.	M.D. #14	3266.0	Potatoes	50%Feedlot& 50%Taber Landfill
Diamond S Produce Ltd.	M.D. #14	45.4	Turnips	Taber Landfill
Empress Foods Inc.	M.D. #14	500.0	Vegetables,Paper&Cardboard	Most to Feed Lot & Taber Landfill
Hostess Frito Lay Co.	M.D. #14	478.0	Vegetables	Feed Lot
Hostess Frito Lay Co.	M.D. #14	472.0	Cardboard & Paper	Recycled
Hostess Frito Lay Co.	M.D. #14	26.5	Household	Landfill
Pak Wel Produce Ltd.	M.D. #14	60.0	Household & Cardboard	Vauxhall Landfill
Vauxhall Foods Ltd.	M.D. #14	54.5	Dry Peels	Feed Lot
Vauxhall Foods Ltd.	M.D. #14	1200.0	Wet Peels & Potato Trim.	Feed Lot
Vauxhall Foods Ltd.	M.D. #14	6.0	Packaging / Paper	Vauxhall Landfill
Vauxhall Foods Ltd.	M.D. #14	100.0	Rocks (from potatoes)	Stored Onsite
Cowley Forest Products	M.D. #9	8300.0	Bark and Sawdust	Burned
Shell Canada Limited	M.D. #9	2500.0	Paper, Steel, Wood & Hazardous	Landfill, Recycle & Swan Hills
Tiger Brand Knitting Co. Ltd.	M.D. #9	5.0	Paper, Cardboard, Plastic & Cotton	Landfill
Atlas Lumber (Alberta) Ltd.	Crownest Pass*	unknown	Wood, Office&Household	Wood Incinerated&Hsld.Landfilled,Salvage
Mountain View Industries	Crownest Pass*	variable	Wood,Office,Sawdust,Paper	Reuse paper: firewood/sawdust landfilled
Rinke & Sons Lumber Ltd.	Crownest Pass*	5.0	Wood, Office&Household	Wood Chips for Bedding, Rest Landfilled
Saratoga Processing Company Ltd.	Crownest Pass*	35.4	Industrial & Household	Industrial to Class1&Household Land.
Summit Lime Works Ltd.	Crownest Pass*	5.0	Lime,Solvents,Office&Household	Lime&Solvents Onsite,Rest Landfilled
KC Doors	M.D. #26	52.0	Wood,Sawdust,Metal&House.	Sawdust for bedding,Wood Landfilled
Structural Truss System	M.D. #26	390.0	Wood,Metal&Office	Ft. MacLeod Landfill
Trus Joist (Western) Ltd.	M.D. #26	122.0	Wood,Sawdust,Office&Household	Landfill,Reuse of wood & feedlot
Glenwood Cheese Factory	M.D. #6	21.0	Paper & Cardboard	Transfer Station
Tanco Windows & Doors Inc.	M.D. #6	50.0	Wood,Sawdust& Aluminum	Transfer Station& Alum. Salvage Yard
Taurus Salt Company Ltd.	M.D. #6	2359.0	Paper,Office,Lunchroom	Town Landfill and some burning
Alpha Milk	County #26	365.0	Household,Cardboard,Plastic	Card.&Plas. Recycled, Rest Landfilled
Beatrice Foods	County #26	unknown	Mostly liquid,office paper,milk cartons	Landfill,Recycling,Water treatment
Berdick MFG. Lethbridge Ltd.	County #26	9.0	Household,Office,Metal,Wood	Landfilled
Braman Furniture Manufacturing	County #26	24.5	Wood,Sawdust,Foam&House.	Sawdust for Bedding,Rest Landfilled
lums Foods (1985) Ltd.	County #26	70.8	Paper,Cardboard,Wood,Plastic	Paper&Card. Recycled, Rest Landfilled
Canbra Foods Ltd.	County #26	547.0	Household,Office,Plastic,Card.	Off.,Card.,Plas. Recycled,House. land.
Catelli Limited	County #26	832.0	Household,Office,Cardboard	Feedlot, Rest Landfilled,Cardboard recycled
Charlton & Hill Limited	County #26	70.8	Steel,Cardboard,Wood	Cardboard Recycled, Rest Landfilled
City Packers Ltd.	County #26	35.0	Animal,Manure,Office	Rendering,Feedlot,Landfill
Coca Cola Bottling Ltd.	County #26	144.0	House.,Pap.,Glass,Plas.Wood	Pap.,Glass&Plas.90%Recy.,Rest Landfilled
Dresser-Rand Canada Inc.	County #26	35.4	Household,Office,Cardboard,Wood	Landfilled
Ellison Milling Company	County #26	106.2	Household,Office,Paper,Wood	Office Recycled, Rest Landfilled
Empress Foods Ltd.	County #26	70.8	House.,Paper,Card.,Plas.,Veg.	House. Land.,Veg. Feedlot, Rest Recy.
Graphcom Printers Ltd.	County #26	106.2	Household,Office,Card.,Wood	Landfilled
Haul-All Equipment Systems	County #26	20.4	Household,Office,Cardboard	Office&Card. Recycled, Rest Landfilled
Intercontinental Truck Body Ltd.	County #26	156.0	House.,Office,Card., Metal	Steel Recycled,Rest Landfilled
Kawneer Company Canada Limited	County #26	656.7	Office,Cardboard,Wood	Office&Card. Recycled, Rest Landfilled
Lethbridge Iron Works Company Ltd.	County #26	212.3	Office,Dust,Sand,Metal	Metal&Paper Recycled, Rest Landfill
Lilydale Co-operative Ltd.	County #26	177.0	Household,Office,Animal	Office Recy., Animal Rend.,Rest Landfilled
Mo-Tires Ltd.	County #26	8.2	Household,Office,Tires,Plastic	Tires Recycled, Rest landfilled
New Noble Service Limited	County #26	12.0	Household,Office,Steel	Paper&Steel Recycled,Rest Landfilled
Palliser Distillers Ltd.	County #26	11.0	Plastic,OCC,Wood,Glass,Filter pads Grain,Paper	60% recycling,Landfill 40%,some reuse
Regent Home Systems	County #26	4436.0	House.,Office,Wood,DryWall	Metal&Siding Recycled,Rest Landfilled
Robin's Southern Printing Ltd.	County #26	11.0	Paper,Metal Plates&Films	Recycling
The Door Store	County #26	66.0	Construction,Demolition,Sawdust,OCC	Landfill and Reuse
The Trans Canada Freezers	County #26	49.0	Household & Office	Paper Recycled, Household Landfilled
Timber Tech Truss Systems Ltd.	County #26	24.0	Lumber,Office,Sawdust	Landfill
Triple E Homes Ltd.	County #26	2050.0	Cardboard, Plastic&Wood	Landfilled
Wheatland Bins Ltd.	County #26	35.4	Pallets,Metal&Household	Metal Salvage,Pal. Recy.,House.Landfilled
Canadian Fertilizers Ltd.	M.D. #1	unknown	Household,Hazardous	Landfill,Swan Hills
Cancarb Limited	M.D. #1	180.0	Household,Rags,Filters,Metal,Paper,Oil,	Swan Halls,Landfill,Recycle
Clow Canada Division Canada Pipe	M.D. #1	unknown	Metal,Sand,Household,OCC,Pallets,Oildr	Reuse,Landfill,Recycle
Crain R L (Alberta) Inc.	M.D. #1	214.0	Paper,Household,wastewater	Recycle,Landfill,Water Treatment
Goodyear Canada Inc.	M.D. #1	158.0	Paper,Oil,Tires,PE,House.,Wood,Haz.	Swan Hills,Recycle,Landfill
NovaCor Chemicals	M.D. #1	500.0	Haz,C&D,OCC,Metal,Paper,Oil	Recycled,Landfilled,Deepwell
Ogilvie Mills Ltd.	M.D. #1	117.0	Flour&Grain Sweepings,OCC,Paper	Recycle, Landfill
Redi Enterprises	M.D. #1	unknown	Household items,OCC,Paper,Metal Beverage Containers,Glass,Plastic	Reuse/Recycle/Landfill
S F Scott Manufacturing Co. Ltd.	M.D. #1	unknown	Steel,Office,Household	Landfill,Steel Recycled
Wittkie Iron Works Company Ltd.	M.D. #1	7.0	Metal,OCC,Office,Hand Tissue	Salvage,Recycle Paper,Landfill
TOTAL:		35,312.5		

- Not in study area, however waste processed within area.

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reusing or recycling portions of their waste products. For example, wood chips are used for animal bedding or as an energy source.

As a result of the industrial base of the region, a significant portion of the wastes produced by industries are currently being diverted from landfills. It is estimated that 50% of wastes are currently diverted equalling 17,500 tonnes of waste and there is a potential for even more if more industries adopt waste minimization strategies.

There are several changes occurring in the industrial base of the region. Pratt & Whitney opened a facility in March, 1993 for the manufacture and testing of aircraft engines. It is currently in Phase I of its operation and employs 50 people. At full operation, it has the potential to employ 400 to 500 people. Dresser-Rand is likely to close down in January, 1994, eliminating 180 jobs. There is also an overall expansion in both the cattle and greenhouse industries. No major developments have occurred in the oil and gas industries.

2.3.3 Park Wastes

Waste generation for provincial parks and recreational areas is shown in Table 2.6. Provincial parks and recreational areas were contacted to determine actual quantities of waste produced. In general, waste generation information received was in the form of approximate volumes of waste collected. Due to difficulties in using this information, waste generation based on attendance figures was used to estimate total quantities of waste. Waste generation was based on a rate of 2 kg/person/day for campers and 1 kg/person/day for day users. These values were obtained from a study done by SENTAR Consultants Ltd. for Yoho National Park (1992). It is estimated that 926 tonnes of solid waste were collected in 1992 from provincial parks and recreational areas in the study area.

For wastes generated within Waterton Lakes National Park, actual waste quantities were obtained from the Chief Mountain Regional Solid Waste Authority. These values are shown in Table 2.7. In order to confirm the validity of the waste generation rate which was used for the provincial parks (2 kg/person/campground night), the same generation rate

TABLE 2.6: WASTE GENERATION FOR PROVINCIAL PARKS/ RECREATION AREAS SOUTHERN ALBERTA REGION (1992/93 FISCAL YEAR)

PARK/RECREATIONAL AREA NAME	ATTENDANCE			ANNUAL WASTE GENERATION (TONNES/YEAR) *
	DAY USE	CAMPING		
		GROUP	INDIVIDUAL	
WYNDHAM CARSELAND PARK	47,563	3,444	28,633	111.7
SUFFIELD REC. AREA	5,180			5.2
BEAUVAIS LAKE PARK	21,360	1,392	7,611	39.4
CHAIN LAKES PARK	11,135	2,664	5,005	26.5
LITTLE BOW PARK	25,790		21,268	68.3
PARK LAKE PARK	96,040	1,208	9,652	117.8
POLICE OUTPOST PARK	19,972		6,432	32.8
TABER PARK	38,290	1,210	7,011	54.7
WILLOW CREEK PARK	8,715		8,642	26.0
WOOLFORD PARK	1,355	293	342	2.6
CASTLE RIVER REC. AREA			591	1.2
CHIN COULEE REC. AREA			202	0.4
LUNDBRECK FALLS REC. AREA			9,787	19.6
SCANDIA REC. AREA			52	0.1
DEL BONITA REC. AREA			15	0.03
YARROW CREEK REC. AREA			301	0.6
ITTLE BOW RESERVOIR REC. AREA			336	0.7
OLD MAN RIVER REC. AREA			5,331	10.7
PAYNE REC. AREA	5,110		1,995	9.1
ST MARY'S REC. AREA			4,089	8.2
WATERTON REC. AREA			72	0.1
INDIAN GRAVES REC. AREA			2,018	4.0
JENSEN RESERVOIR REC. AREA			33	0.1
MAYCROFT REC. AREA			275	0.6
MCGREGOR RESERVOIR REC. AREA	4,620		1,075	6.8
OLD MAN RIVER DAM REC. AREA			2,119	4.2
CYPRESS HILLS PARK	154,327	5,697	71,665	309.1
WRITING-ON-STONE PARK	23,435	1,260	19,554	65.1
DUNMORE REC. AREA			381	0.8
TOTALS	462,892	17,168	214,487	926.2

* - Based on a generation rate of 2 kg/person/day for camping (Stanley, 1984) and 1 kg/person/day for day users (Sentar, 1992).

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TABLE 2.8 ANNUAL BIOMEDICAL WASTE QUANTITIES GENERATED

Location	Facility Name	Beds	Estimated Biomedical Waste Generated (tonnes/year)	Designated Regional Incinerators (Based on 1991 Alberta Health data)
Blairmore	Crowsnest Pass Health Care Centre	102	11.6	Lethbridge
Bow Island	Bow Island General and Auxiliary Hospital District #72 *	69	5.0	Medicine Hat
Cardston	Blood Indian Hospital	29	6.6	Lethbridge
	Cardston General and Auxiliary Hospital	93	9.9	Lethbridge
	Grandview Nursing Home **	40	1.9	Lethbridge
Carmangay	Little Bow Auxiliary Hospital *	20	1.5	Lethbridge
Claresholm	Claresholm General Hospital	40	6.6	Lethbridge
	Lander Treatment Centre **	48	2.3	Lethbridge
	Willow Creek Auxiliary Hospital and Nursing Home *	100	7.3	Lethbridge
Coaldale	Coaldale Health Care Centre **	25	1.2	Lethbridge
Fort MacLeod	Fort MacLeod Health Care Centre	70	8.3	Lethbridge
	Extendicare/Fort MacLeod **	50	2.4	Lethbridge
Lethbridge	Lethbridge Cancer Clinic ***	Outpatient	0.3	Lethbridge
	Lethbridge Regional Hospital	266	118.4	Lethbridge
	Lethbridge Hospital Auxiliary Wing	99		(Incl. in Leth. Reg. Hosp. Total)
	St Michael's Health Centre	107	37.3	Lethbridge
	Chinook Mall Group Home **	22	1.1	Lethbridge
	Edith Cavell Nursing Home **	100	4.8	Lethbridge
	Extendicare/Lethbridge **	120	5.8	Lethbridge
	Laura House **	6	0.3	Lethbridge
	Sifton Children's Centre	13	0.6	Lethbridge
	St Michael's Health Centre - Southland **	150	7.2	Lethbridge
	Westside Group	6	0.3	Lethbridge
Magrath	Magrath General Hospital	19	2.5	Lethbridge
Medicine Hat	Medicine Hat Cancer Clinic ***	Outpatient	0.3	Medicine Hat
	Medicine Hat Regional Hospital	426	77.0	Medicine Hat
	Central Park Lodge **	158	7.6	Medicine Hat
	Dr. Dan Mc Charles Extended Care Centre **	136	6.5	Medicine Hat
	Medicine Hat & District Association for the Mentally Retarded **	30	6.5	Medicine Hat
	Redi Group Home **	6	0.3	Medicine Hat
	Sunnyside Nursing Home **	100	4.8	Medicine Hat
Milk River	Border Counties General Hospital	27	3.0	Lethbridge
Picture Butte	Picture Butte Municipal Hospital	6	4.1	Lethbridge
Pincher Creek	Pincher Creek Municipal Hospital	64	5.0	Lethbridge
Raymond	Raymond General Hospital	48	2.6	Lethbridge
	Raymond Care Centre **	18	0.9	Lethbridge
Taber	Taber and District Health Care	112	7.5	Lethbridge
Vulcan	Vulcan General Hospital	27	4.1	Lethbridge
	Extendicare/Vulcan **	46	2.2	Lethbridge
Various	Veterinarians ***	100	232.0	Lethbridge/Medicine Hat
	Dentists ****	200	34.9	Lethbridge/Medicine Hat
	Doctors, Medi-clinics & Health Units*****	300	71.4	Lethbridge/Medicine Hat
TOTALS			**607.6**	

ber of Beds from Canadian Hospital Directory 1992-1993 and Directory of Long-Term Care Centres in Canada 1992-1993.
. quantities from Alberta Health (1991) except
estimated quantities * - hospital < 300 beds - 0.19 kg/day/bed
** - special care facility - 0.13 kg/day/bed
*** - veterinary - 9.3 kg/facility/day, 250 days/year
**** - dentists - 0.7 kg/facility/day, 250 days/year
***** - doctors, medi-clinic, health unit - 0.95 kg/facility/day, 250 days/year

Biomedical wastes including anatomical wastes and sharps requiring special handling and treatment
Source: Biomedical Waste Handling and Treatment Study (Saskatchewan), Stanley, 1991
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actual quantities, due to changes in waste segregation and handling practices since 1991. More recent data is not available, therefore these quantities have been used. Waste generation for the other health care facilities was calculated using generation rates from a report by Stanley (1991) for the Saskatchewan Property Management Corporation entitled "Biomedical Waste Handling and Treatment Study".

The quantities shown in Table 2.8 represent only the biomedical wastes which require treatment. Annually, a estimated total of 610 tonnes of biomedical waste are generated in southern Alberta.

Waste management systems for most types of biomedical waste consist of the following components:

- A universal containment system, including a thick plastic liner inside an outer cardboard shell. Storage and transportation of biomedical wastes should not take place at temperatures above 4°C. All containers must meet the standards of the Transportation of Dangerous Goods Regulations (TDGR) and must be transported according to TDGR.

- The use of an approved treatment and destruction technology. For most biomedical wastes, the recommended treatment is destruction using high temperature incineration with Best Available Control Technology (BACT) for control of process emissions.

- Final disposal of the residuals after treatment at an approved facility. Disposal usually occurs at a sanitary landfill, however testing must be conducted to confirm the suitability of the material for landfilling.

Currently there is only one biomedical waste incinerator in operation in the southern Alberta region. As Table 2.8 shows, in 1991 there were two regional incinerators in operation at the regional hospitals in Lethbridge and Medicine Hat. However, the incinerator at Medicine Hat is no longer licensed to treat biomedical wastes, however, the incinerator is still used to treat non-biomedical wastes. Some collection and storage of

Bay (51,313). The purpose of this study was to develop a method for determining residential composition and a per capita generation rate. In addition, a study was made of commercial generation rates in the Regional Municipality of Waterloo (population 342,030). Finally a user friendly manual was developed outlining procedures for conducting residential and commercial waste composition studies in municipalities in Ontario.

The data from the RMOC and Gore & Storrie studies is difficult to compare since Gore & Storrie broke wastes down into 15 categories and 53 subcategories while RMOC had 9 categories and 56 subcategories. The Gore & Storrie study excluded yard waste when working out composition data while RMOC did not. Therefore, extensive data manipulation would be required to make the results comparable.

Other existing information on generation and composition of solid waste is based on Canadian studies completed more than a decade ago, or on recent American studies. Other data available are less detailed and include reports from the Edmonton Clover Bar Landfill and an audit which was done for Jasper National Park and the Town of Jasper.

The most well known American study was conducted by the US EPA and is entitled "Characterization of Municipal Solid Waste in the United States". The latest version was updated in 1990. This study uses a materials flow methodology to produce waste characterization data for the entire country. This materials flow is based on production data (by weight) for materials and products in the waste stream. This produced information is specific to the U.S. and cannot be directly applied to solid wastes in Canada.

The RMOC study spanned a period of a year and a half and was completed in 1992. It involved a four season sampling program of residential and commercial wastes. The Ottawa-Carleton Region is comprised of five cities, one village and five rural municipalities with a total population of 670,000 people. Residential wastes were randomly selected from existing garbage collection routes which included all types of residential dwellings. Three sectors; rural residential, suburban residential, and high-rise buildings, were chosen for special analysis. The commercial waste stream was also sampled in a similar fashion. A sampling protocol was written to ensure consistency and accuracy. Wastes were sorted

TABLE 2.9
COMPOSITION OF RESIDENTIAL SOLID WASTE [1]
(% by Weight of Total Solid Waste Generated)

Type of Waste	RMOC Rural[2]		RMOC Urban[2]		Edmonton[3]
Paper	18.6%	(±2.5%)	15.4%	(±2.5%)	35.5%
Old Newsprint	5.7%	(±1.5%)	3.5%	(±0.8%)	(Included in Paper)
Old Corrugated Cardboard	5.2%	(±1.0%)	4.7%	(±0.8%)	4.0%
HDPE/PET[4]	0.7%	(±0.2%)	0.7%	(±0.1%)	(Included in Plastic)
Plastic	7.0%	(±1.0%)	6.7%	(±1.0%)	9.5%
Glass	4.3%	(±0.7%)	2.9%	(±0.7%)	1.7%
Ferrous Metal	7.8%	(±2.8%)	3.2%	(±0.7%)	4.0%
Non-Ferrous Metal	1.4%	(±-0.8%)	0.7%	(±0.2%)	(Included in Ferrous)
Yard Trimmings	10.6%	(±5.1%)	25.1%	(±7.3%)	(Included in Organics)
Food	12.1%	(±2.3%)	12.3%	(±2.3%)	(Included in Organics)
Organics[5]	18.2%	(±3.9%)	15.5%	(±4.6%)	40.4%
Hazardous	0.3%	(±0.2%)	0.1%	(±0.1%)	0.1%
Others	8.1%	(±2.2%)	9.6%	(±3.1%)	4.8%
Total	100%		100.4%		100%

1 Compositions exclude current recycling
2 90% confidence interval shown in brackets
3 City of Edmonton Clover Bar Landfill
4 HDPE - High Density Polyethylene
PET - Polyethylene Terephthalate
5 Wood, textiles, leather, etc.

2.4.2 IC&I Waste Composition

For the industrial, commercial and institutional waste (IC&I), information is available from the RMOC study done by Stanley in 1992, from the City of Edmonton Clover Bar Landfill in 1990, and from a waste audit done for the Town of Jasper in 1992. IC&I waste composition data from the various sources are compared in Table 2.10.

2.4.3 Waste Composition Data

Based on population data (Table 2.1), waste quantities (Table 2.3), and waste composition breakdowns (Tables 2.9 & 2.10), comprehensive tables were developed that provide a detailed breakdown of the waste stream by waste type, waste generator (residential or IC&I), generation rate, and waste origin (city, town, village, county or M.D.).

In order to accommodate the large amount of data, two tables were required. Table 2.11 provides information on wastes of residential origin and Table 2.12 reflects waste quantities originating in the IC&I sector.

The geographic location of major food processing plants, refineries and gas plants is presented in Figure 2.2. Solid waste from the upstream oil and gas industries are only an issue for this study insofar as their wastes are disposed of at municipal landfills.

2.4.4 Potential for Recycling

The potential for recycling of the wastes shown in Tables 2.11 and 2.12 will depend on many factors such as markets for recyclables, type of collection system and public education/participation. In the case of paper for example, Stanley's 1992 report entitled "Recycling Markets Study" found that 82% of all paper could be recycled and the remaining 18% could be composted. The amount of any material that is realistically recyclable will depend on the characteristics and setting of each specific community. The types of solid waste collection and their recycling potential is discussed in Sections 4.4 and 4.5.

2.5 GOVERNMENTAL RELATIONSHIPS

Within the study area there are governmental relationships formed between the governing waste management authorities, health units and regional planning areas. In Figures 2.3, 2.4 and 2.5, information is provided showing the jurisdictions of each of the respective waste management authorities (or commissions), health units and planning areas.

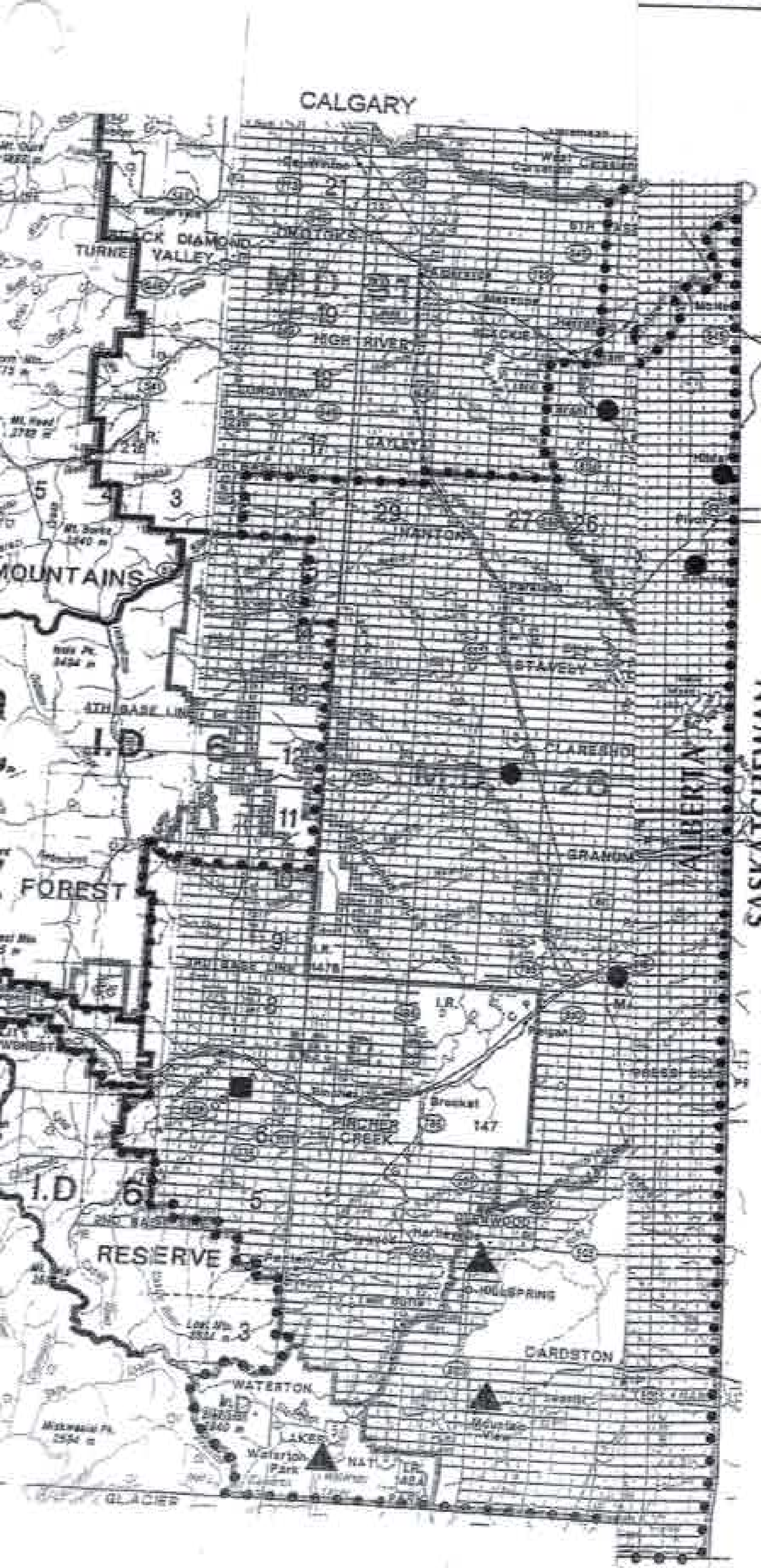
2.6 EXISTING WASTE MANAGEMENT SYSTEMS

The operating waste management systems in the study area include sanitary landfills, modified landfills, transfer stations and incineration systems. Figure 2.6 shows the approximate location of each landfill and transfer station in the study region. The operating incineration system in the region is located in Lethbridge and treats hospital waste only. The Medicine Hat Regional Hospital's incinerator is no longer licensed to treat biomedical wastes, but is permitted to treat non-biomedical wastes.

Table 2.13 summarizes the waste management facilities in the region according to the individual managing waste Authority, Commission, County, Municipal District, Improvement District or Indian Reserve. In total there are five (5) sanitary landfills, thirty-one (31) modified landfills, twenty-two (22) transfer stations (12 push-pit, 4 compaction, 6 drop-box), and one (1) hospital waste incineration system operating in the southern Alberta study area. The transfer stations in Waterton Lakes National Park and Blood Indian Reserve (No. 148) are not in the study area, but are included because the Chief Mountain Waste Authority handles their waste and transports it into the study region. Waterton Lakes National Park is serviced by the Chief Mountain Regional Authority on a contract basis and pays a fee based on the tonnages hauled. The Blood Indian Reserve is part of the Authority and pays on a per capita basis. Canadian Forces Base (CFB) Suffield is not in the study area because they fall under federal jurisdiction. Domestic wastes are disposed of at their on-site landfill. Scrap metal and hazardous wastes such as oil, oil filters, and batteries, are disposed of by contractors at various locations off base. Approximately 1500 people live on the base. For more details on each of the landfills and transfer stations, see Appendix G.

Government inter-relationships for each of the waste management facilities are summarized in Table 2.14. The table shows how jurisdictions of waste authorities (commissions), health units and planning commissions relate to each operating facility.

Stanley



LEGEND :

- • • • • • STUDY AREA BOUNDAR
- ▲ TRANSFER STATIONS
- ● MODIFIED LANDFILLS
- ■ SANITARY LANDFILLS
- ◈ DRY DISPOSAL SITES

SCALE : APPROX. 1 : 1,000,000

0 10km 40km

Figure 2.6

WASTE MANAGEMENT FACILITIES LOCATION PLAN

TABLE 2.13: SUMMARY OF WASTE MANAGEMENT FACILITIES IN THE SOUTHERN ALBERTA REGION

Waste Authority, Commission, County, M.D., I.D., or I.R.	Sanitary Landfills	Modified Landfills	Dry Disposal Sites	Transfer Stations	Incineration Systems	Type of System
Crowsnest - Pincher Creek Regional Waste Management Authority*	1					
Chief Mountain Regional Solid Waste Authority**			1	12		Push-pit
Lethbridge Regional Waste Management Commission				4		Compaction
North Forty Mile Regional Waste Commission	1					
Taber and District Regional Waste Authority		5				
Willow Creek Regional Solid Waste Authority		2				
County #2 (Vulcan) Regional Waste Authority		11		1		Drop-box
County of Forty Mile		5				
County of Warner		3		2		Drop-box
County of Lethbridge* (privately owned)	1	1	2			
City of Lethbridge					1	Incinerate Hospital Waste Only
Redcliff - Cypress Regional Waste Management Authority*	1			3		Drop-box
M.D. of Cypress***		4				
City of Medicine Hat*	1					
Totals:	5	31	3	22	1	

Sanitary Landfills With Onsite Weigh Scales.
* including Waterton Lakes National Park, Blood Indian Reserve, and the Town of Raymond and Village of Stirling in County 5.
*** includes C.F.B. Suffield

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TABLE 2.15: CURRENT WASTE MANAGEMENT PRACTISES

City/Town Village	Level of Service	Destination	Recycling Program	Collection Vehicle	Distance to Landfill (approx.)
Arrowwood	No collection. Village landfill open 7 hours per week.	Arrowwood Modified Landfill.	UFA outlet accepts used oil.	No collection	1.6 km (1 mile)
Barnwell	Decker Anderson collects from 30% of Barnwell residents for a fee. Most residents haul their own.	Taber Modified Landfill.	No local program Pays Taber $1000 per year for their program.	Decker Anderson collects waste with a 1/2 ton pick-up truck and a 16 foot trailer. He delivers one load per week.	8 km (5 miles)
Barons	Collection once per week by Contractor.	Although they are not part of the Lethbridge or Chief Mountain Waste Authorities, they haul their waste to Kedon Sanitary Landfill.	Multi material collection program under consideration	Collection is by LMN Disposals. They have a regular 2 ton truck that does not compact waste.	48 km (30 miles)
Brant	Landfill open 8 hours per week.	Brant Modified Landfill.			
Bow Island	Collection by Town once per week. The landfill is open 15 hours a week.	Taken to North 40 Mile Regional Sanitary Landfill.	The Lion's Club collects newsprint, cardboard, magazines and white, coloured mixed & computer paper UFA accepts used oil.	The Town's two ton compactor collection truck.	5 km (3 miles)
Burdett	Collection by Village once per week. A lot of waste is burned. The landfill is open 15 hours a week.	Taken to North 40 Mile Regional Sanitary Landfill.	The Bow Island Lion's Club collects news-print, cardboard, magazines and white coloured, mixed and computer paper.	The Village owns a one ton compactor truck.	16 km (10 miles)

TABLE 2.15: CURRENT WASTE MANAGEMENT PRACTISES (cont'd)

City/Town Village	Level of Service	Destination	Recycling Program	Collection Vehicle	Distance to Landfill (approx.)
Coaldale	Town collects once per week from residents & more often from some businesses. Burn barrels are used. Transfer station is open 20 hours a week. (1 km from town) The town collected 2200 tonnes in 1992.	Contractor takes waste from the Coaldale transfer station to Kedon. The transfer station is run by the Lethbridge Regional Waste Management Commission. Town of Coaldale hauls directly to Kedon Landfill.	Sunrise Bottle Depot accepts newsprint, town and transfer station have multi material collection trailers. generated in 1992.	One 21 cubic yard Clydesdale side loader and two rear loaders. All are compactors. 465,370 kg of waste was	26 km (16 miles)
Coalhurst	Contractor collects residential waste.	Kedon Landfill	Multi material collection trailer.		11.5 miles or 18.5 km to Kedon.
Coutts	Village collects from residents once per week. Landfill open 17 hours a week. 228 tonnes of waste were generated in 1992.	Coutts Modified Landfill.	Volunteer group operates small program. Multi material collection trailer.	One eight yard gravel truck hauls approximately loads a week to landfill. This truck is used for many town jobs, not just waste collection.	1.6 km (1 mile)
Cowley	The Village collects from residents and businesses once a week. The landfill is open 9:00 until 4:30 every day. 232 tones were landfilled in 1992.	Use Crowsnest Pass - Pincher Creek Regional Sanitary Landfill.	The Pincher Creek Elks collect from depots in Cowley. See Pincher Creek for more information.	One three ton compactor truck. Collects approximately three tons a week. The regional landfill received 232 tonnes in 1992.	5 km (3 miles)

TABLE 2.15: CURRENT WASTE MANAGEMENT PRACTISES (cont'd)

City/Town Village	Level of Service	Destination	Recycling Program	Collection Vehicle	Distance to Landfill (approx.)
Fort MacLeod	O'Sullivan Construction collects from residents and businesses once a week. Landfill is open 40 hours per week. 30,000 to 35,000 tonnes of waste are generated each week.	The Ft. MacLeod Modified Landfill is operated by O'Sullivan Construction.	The UFA Outlet accepts used oil. The Town's multi material collection program has a dedicated trailer which accepts plastics, cardboard, newsprint, mixed paper, glass, office paper and tin cans.	O'Sullivan Construction has one rear-load 20 cubic yard packer truck. Fort MacLeod generates approximately 30-35 tonnes per week.	4.8 km (3 miles)
Glenwood	No collection. Some people use burn barrels. Transfer Station is open 12 hours a week.	Residents take their wastes to the Glenwood/ Hillspring transfer station (11 km from town)and it then goes to Lethbridge Regional Sanitary Landfill (Kedon).	Volunteers occasionally take newsprint to Cardston for recycling.	The Village does not own collection equipment. 357,401 kg of waste was generated in 1992.	109 km (68 miles)
Granum	The Town collects waste once a week.	Claresholm Modified Landfill (until Willow Creek Regional Landfill is operational).	A backyard composting course is offered. UFA accepts used oil.	3 loads are hauled in one side load garbage truck.	19 km (12 miles)
Grassy Lake	No garbage collection. Landfill is open 18 hours per week.	Grassy Lake Modified Landfill.	No program is in place. Some people take items to Taber.	No collection equipment	8 km (5 miles)
Hays	Landfill is open 18 hours per week	Hays Modified Landfill			
Herronton	Landfill is open 18 hours per week	Herronton Modified Landfill			

TABLE 2.15: CURRENT WASTE MANAGEMENT PRACTISES (cont'd)

City/Town Village	Level of Service	Destination	Recycling Program	Collection Vehicle	Distance to Landfill (approx.)
Lethbridge	Residential waste is collected by the City once a week. Landfill is open 60 hours a week.	Lethbridge Regional Sanitary Landfill (Kedon).	Households in Lethbridge pay $2.50 per month (on utility bills) to fund drop-off recycling. 6 depots are in operation accepting newsprint, tin, clear glass, mixed paper, office paper, HDPE (#2) plastics, plastic film and cardboard. Backyard composting encouraged. UFA accepts used oil. GPS operates "Blue Box" and office collection programs for a fee. GPS accepts boxboard, aluminum cans, white and colored bond paper, computer paper, and magazines dropped off at the plant. G.P.S. is under contract to the City and the City manages the program.	The City has 12 collection vehicles which collected 24,951.61 tonnes of waste in 1992. These vehicles include: • six 21 cubic yard single axle side loaders; • three 12 yard one ton cabin chassis side loaders; • two 38 cubic yard front load over-head tandon trucks; • one 24 yard single axel automated pickup truck.	4 km (2.5 miles)
Lethbridge	Agric. Canada onsite disposal only - no outside wastes	Onsite Landfill at Animal Diseases Research Institute (ADRI).			
Little Bow	Park wastes only	Onsite Landfill			
Lomond	Waste is collected from residents and businesses twice a month. The landfill is not supervised and is open 24 hours.	Lomond Modified Landfill.	UFA Outlet accepts used oil. Some people take paper to Vulcan for recycling.	The Village has one non-compacting one ton truck which delivers two loads of waste to the landfill every two weeks.	0.8 km (1/2 mile)

TABLE 2.15: CURRENT WASTE MANAGEMENT PRACTISES (cont'd)

City/Town Village	Level of Service	Destination	Recycling Program	Collection Vehicle	Distance to Landfill (approx.)
Milo	A contractor collects from residents and businesses once a week. Burning barrels are not encouraged. The landfill is currently not supervised or locked but will be starting this spring 1993.	Milo Modified Landfill.	Milo School accepts newspaper, cardboard, tin cans, #2 plastic, mixed paper & glass. UFA accepts used oil.	A Ford one ton side load garbage truck hauls one load of waste each week.	1.6 km (1 mile)
Mountain View	Transfer station is open 6.5 hours per week	Lethbridge Regional Sanitary Landfill			79 km (49 miles)
Nanton	WASTECARE Inc. collects waste and hauls it to a landfill. The Town pays a flat fee per household or business for disposal. Waste is collected twice a week.	Foothills Regional Landfill (just outside of Okotoks). Run by Foothills Regional Commission	The Nanton Environmental Action Society operates quarterly recycling drives collecting office paper, newsprint, cardboard, tin cans, glass, and plastic. UFA accepts used oil. Multi material collection trailer.	WASTECARE Inc. has a Five ton front end loader. 20 tonnes are collected each week.	27 km (16 miles)
New Dayton	Transfer station is open 8 hours per week	Lethbridge Regional Sanitary Landfill			47 km (29 miles)
Nobleford	The Village collects waste from residents and businesses once a week. The transfer station is open 20 hours a week. 463 tonnes of compacted waste and 88 tonnes of rubble are generated each year.	They belong to Lethbridge Regional Waste Commission and have a transfer station (on outskirts of town). Waste is hauled to the Lethbridge Regional Sanitary Landfill (Kedon).	UFA accepts used oil. Multi material collection trailer operated by Lethbridge Regional Commission.	The Village has one 5 cubic meter compactor truck which takes 3 - 5 loads to the landfill each week.	47 km (29 miles)

TABLE 2.15: CURRENT WASTE MANAGEMENT PRACTISES (cont'd)

City/Town Village	Level of Service	Destination	Recycling Program	Collection Vehicle	Distance to Landfill (approx.)
Raymond	Mr. Rene Audenard collects waste from residents and businesses, and hauls it to the Raymond transfer station. The operation of the transfer station is also contracted out. It is open 21 hours per week (winter) and 27 hours per week (summer). Open burning and burn barrels are used by residents. 1,407 tonnes were generated in 1992.	They belong to Chief Mountain Waste Authority. Waste is hauled to the Raymond transfer station (1.6 km)and then taken to the Lethbridge Regional Sanitary Landfill (Kedon).	The Town is not involved in recycling. Ronna and Ryan Wright offer recyclable collection service for a fee. They collect plastic, newsprint, tin cans, mixed paper, cardboard and office paper.	Mr. Audenard has one 1 ton Haul-All truck that compacts waste slightly. 1,409,198 kg of waste was generated in 1992.	31 km (19 miles)
Redcliff	Weekly pick-up from 3 yard, 1 1/2 yard or 3/4 yard bins which are located on every block. In 1992, 1,429 tonnes were collected.	Redcliff-Cypress Regional Sanitary Landfill.	Used oil is accepted at landfill.	Town collects all residential and 2/3 of commercial waste. BFI also collects 1/3 of commercial waste. Town collects from bins with a side automated compactor truck that holds 17 yards. 1,429,442 kg of waste was collected in 1992.	5 km (3 miles)
Schuler	Landfill has 24 hours unsupervised access	Schuler Modified Landfill			

TABLE 2.15: CURRENT WASTE MANAGEMENT PRACTISES (cont'd)

City/Town Village	Level of Service	Destination	Recycling Program	Collection Vehicle	Distance to Landfill (approx.)
Taber	Waste is collected from residences once a week and businesses-as required. Landfill is open 50 hours a week. Taber residents and small businesses generate 9 tonnes per week.	Taber Modified Landfill.	The Taber Lion's Club operates a program which focuses on cardboard & paper. Landfill also acts as a clearing house for a variety of materials. UFA accepts used oil.	One 3 yard container truck and one 25 cubic yard truck collect 9000 kg each week from residents and local small businesses.	1.6 km (1 mile)
Vauxhall	The town collects from residents once a week and businesses twice a week. The landfill is open 19 hours a week.	Vauxhall Modified Landfill.	The Vauxhall United Church collects tin cans and the Vauxhall Advance Newspaper accepts newspapers. The Town composts grass clippings and encourages residents to drop off organics at public works yard.	The Town has one 12 yard truck with minimal compaction. It takes 50 loads each week to the landfill.	1.6 km (1 miles)
Vulcan	Laidlaw collects waste once a week from town residents. The waste is hauled to Calgary. The transfer station located on the outskirts of town & is used by rural residents. The county landfill is open nine hours a week and is used by town residents. 373 tonnes of residential waste was collected by Laidlaw last year.	Vulcan modified landfill. Waste is hauled by Laidlaw to BFI in Calgary	Vulcan Lion's Club accepts newsprint and cardboard. Recycled Rubber Products accepts tires. UFA accepts used oil.	Laidlaw uses a 29 yard compactor truck for residential collection and a 40 cubic yard compactor for commercial collection. Laidlaw makes 620 pick-ups a week	The BFI landfill is 62 miles or 100 km away. The dry waste site is on the outskirts of Town.

TABLE

Municipality/ Program Ope	TIC M	TIRES	Annual Recycled Quantities 1992 (TONNES/YEAR)	Annual Composting
City of Lethbr			847	279
County of Leth				
Coaldale				
M.D. of Pinche				
Town of Pinche			6	
			280	
Village of Cowie				
Town of Crowsn				
M.D. of Cardstor				
Town of Cardstor				
County of Warne			122	
Coutts				
Milk River				
Raymond				
Stirling*				
Warner			38	
County of 40 Mile				
Bow Isand				
Burdett				
M.D. of Taber			102	
Barnwell				
Grassy Lake				
Taber*				
Vauxhall				
			663	
County of Vulcan				
Champion				
Lomond				
Milo				
Town of Vulcan				
M.D. of Willow Creek		45		
Claresholm*			81	
Fort MacLeod*				
Nanton				
Granum			24	
			104	
City of Medicine Hat			34	
M.D. of Cypress				
Irvine			520	200
			384	
TOTALS		45	3,205	479

* Quantities estimated

Table 2.17: Hazardous Waste Management

City/Town/ Village/Hamlet	Collection Facility	Agricultural Chemical Container Collection Permit	Toxic Round-Up (1992)	Litres of Oil Collected from UFA Outlets March 1992-February 1993
Arrowwood		No	No	6,680 litres
Barnwell		No	No	No
Barons		No	No	No
Bow Island	North 40 Mile Regional Sanitary Landfill	Yes	22 barrels (approx 4510 litres)	2,465 litres
Brant		No	No	No
Burdett	North 40 Mile Regional Sanitary Landfill	Yes	(included in Bow Island totals)	No
Cardston		No	No	6,159 litres
Carmangay		No	No	No
Champion		No	No	No
Claresholm	Claresholm Landfill	Yes	150 litres	35,627 litres
Coaldale	Coaldale Transfer Station	Yes	1,808 litres	No
Coalhurst		No	No	No
Coutts		No	No	No
Craddock	Sunshine Seed Clearing Plant	Yes	No	No
Crowsnest Pass	Crownest Pass - Pincher Creek Regional Landfill	Yes	1799 litres	No
Del Bonita		No	No	No
Dunmore		No	No	No
Enchant	Enchant Landfill	Yes	No	No
Etzikom		No	No	No

Table 2.17: Hazardous Waste Management (cont'd)

City/Town/ Village/Hamlet	Collection Facility	Agricultural Chemical Container Collection Permit	Toxic Round-Up (1992)	Litres of Oil Collected from UFA Outlets March 1992-February 1993
Nanton		No	1003 litres	15,509 litres
New Dayton		No	No	No
Nobleford	Nobleford Transfer Station	Yes	361 litres	4,525 litres
Orion		No	No	No
Picture Butte	Picture Butte Transfer Station	Yes	827 litres	6,830 litres
Pincher Creek		No	1673 litres	No
Pincher Station	Mobile Facility	Yes	No	No
Queenstown		No	No	No
Raymond		No	No	No
Redcliff		No	No	No
Seven Persons		No	No	No
Schuler		No	No	No
Shouldice		No	No	No
Spring Coulee	Spring Coulee Transfer Station	Yes	No	No
Stavely		No	No	3,700 litres
Stirling		No	No	No
Suffield		No	No	No
Taber		No	8 barrels (approx 1640 litres)	18,480 litres
Vauxhall	Vauxhall Landfill	Yes	829 litres	No
Vulcan	Vulcan Landfill	Yes	No	11,430 litres
Warner		No	2665 litres	No
Welling		No	No	No
TOTAL			48,529	193,850

facility except those which are transported by DBS. Most of the hazardous wastes are disposed of at Swan Hills.

There are a total of 20 permitted agricultural chemical container collection sites in the region. There is regular collection of these containers from permitted sites. In addition, containers may be accepted at non-permitted locations. This service is offered for the convenience of local residents. The containers stored at non-permitted locations are then periodically transferred to the permitted facilities. Only those facilities holding actual permits are noted in Table 2.17.

At present there are three main recyclers of used oil in southern Alberta: Canadian Oil Reclamation (COR), Recycle West, and Hub Oil. Hub Oil currently receives all used oil collected by the United Farmers Association (UFA). From conversations with these companies, approximately 3.5 million litres of used oil are collected from the region. Due to their collection methods, exact figures for the area were not available. For this reason only UFA figures are shown on Tables 2.17. In 1992 UFA collected 193,850 litres of used oil.

2.8 ENVIRONMENTAL GROUP ACTIVITIES

As public opinion is very important to the success of any waste management project, five non-governmental environmental organizations, an Alberta Environmental Protection official and a recycler were provided with a brief description of the study and asked a series of six questions relating to waste management. The responses are provided in Appendix B.

While many of the recycling projects operating in southern Alberta are operated by service clubs (i.e. The Bow Island Lion's Club or the Pincher Creek Elks) or handicapped training projects (i.e. Cardston and District Association for the Handicapped and Stirling Handicapped Opportunities), there is a trend toward local governments taking a more active role in recycling. The environmental groups have responded by becoming more active in educating local government officials and the general public about environmental issues.

2.9 PLANNED CHANGES AND GROWTH

Several jurisdictions and Authorities in this study area have initiated activities of their own and are proceeding with their own waste management plans. The integration of these initiatives as well as costs of current and projected activities will play a major role in the development of a regional strategy. These proposed/planned waste management initiatives are discussed in Section 3.1.

2.10 SUMMARY

Study Area

The Southern Alberta Integrated Waste Management Study area includes five Municipal Districts (No.'s 1, 6, 9, 14, and 26), four Counties (No.'s 2, 5, 8, and 26), two Cities (Lethbridge and Medicine Hat), one Improvement District (No. 4), the Municipality of Crowsnest Pass (I.D. No. 6), Indian Reserve No. 148, and C.F.B. Suffield.

There are nine (9) waste management authorities or commissions in the study area. Only five (5) are operating as regional waste management systems, while the remaining four (4) are non-operative. The cities of Lethbridge and Medicine Hat do not belong to a commission or authority. There are four (4) Health Units, and two (2) Planning Commissions with jurisdictions in the study area.

Population

The population for the study area for 1991 was 207,624. Of this total, 149,050 or 71.8% lived in urban centres, while the remaining 58,574 or 28.2% lived in rural areas. The Cities of Lethbridge and Medicine Hat account for 50.4% (104,599) of the total population.

Waste Generation Quantities

It is estimated that a total of 88,570 tonnes of residential waste, 76,080 tonnes of industrial, commercial and institutional (IC&I) waste and 37,800 tonnes of heavy industrial wastes were generated in the study area in 1992. In total, 202,450 tonnes of waste were these costs may include collection, disposal, and transfer, as noted in the Table.) These per tonne figures translate to a per capita range of $4 to $40, with an average of $30 per capita. The differences in costs are mainly attributed to the level of service provided in each individual area. For instance many rural areas do not have any collection costs although they must pay disposal costs whereas other areas have collection, transfer and disposal related costs.

In addition to the existing waste management systems in place, regional landfill systems are being considered for the Willow Creek, County (Vulcan), and Taber and District regional waste authorities. This will be discussed in Section 4.0. It is expected that by the time the regional landfill systems become operational, most or all of the modified landfills will be closed.

Waste Minimization

The City of Lethbridge operates a drop-off depot recycling program which collects newsprint, corrugated cardboard, magazines, mixed paper, glass and yard waste. Other recycling initiatives are established in the following municipalities:

- City of Medicine Hat has a backyard compositing program and a drop-off depot that collects newsprint, magazines and books, as well BFI collects corrugated cardboard and office paper;
- Town of Bow Island has a permanent collection and sorting depot, with drop off boxes and collects corrugated cardboard, newsprint and mixed paper;
- Town of Cardston has a permanent collection and sorting depot, with bins located throughout the community and collects corrugated cardboard, newsprint and mixed paper;
- Town of Claresholm bottle depot collects #1 and #2 plastics, clear glass and tin cans;
- Town of Ft. MacLeod has a collection trailer and collects metal cans, glass, plastic, magazines, newsprint and corrugated cardboard;

SECTION 3.0

PROPOSED/PLANNED WASTE MANAGEMENT ONGOING INITIATIVES

3.0 PROPOSED/PLANNED WASTE MANAGEMENT ONGOING INITIATIVES

The following section provides an overview of the waste management initiatives proposed or under consideration for different regions in the study area. The information on these initiatives is based on feasibility reports written by consultants in the past, as well as initiatives that are presently being implemented.

The information that has been compiled in this section will be used in the later sections, where ongoing initiatives will be incorporated into the proposed waste management scenarios presented. This will try to minimize changes to any already ongoing waste management implementation plans by formed authorities.

3.1 COUNTY (VULCAN) REGIONAL WASTE AUTHORITY

Ongoing Initiatives

The County Regional Waste Authority has determined that a system of transfer stations throughout the County of Vulcan region, delivering the solid waste to a regional sanitary landfill is the preferred waste management option.

All existing modified landfills would be closed.

In May, 1993 the Authority retained Stanley to develop the landfill and transfer station components of the regional waste management system.

Preliminary design of four push-pit transfer stations which will be located at: Vulcan, between Champion and Carmangay, Milo, and Mossleigh, has been completed.

Preliminary investigation of the hydrogeology of the proposed landfill site near Lomond is currently underway. Results from this investigation should be available by the end of November, 1993.

3.2 RIDGE RIVER REGIONAL WASTE AUTHORITY

Initiative Based on the Recently Completed Feasibility Study

The Ridge River Regional Waste Authority was recently formed after a feasibility study was completed by UMA Engineering in October, 1992.

The solid waste management system proposed in the study is to consist of a regional sanitary landfill located central to the County of Warner study area, with three drop box transfer stations located near Masinisin, Milk River and New Dayton.

Modified landfills in New Dayton, Warner, Milk River and Coutts would be closed. The New Dayton landfill has already been closed and a drop box transfer station is in place at the old landfill site.

Residents of the Town of Raymond and the Village of Stirling presently deliver waste to existing push pit transfer stations in their respective communities. The waste is picked up under the jurisdiction of the Chief Mountain Regional Solid Waste Authority and delivered to the Kedon Landfill near Lethbridge.

The current push pit operations in Raymond and Stirling would remain part of the Chief Mountain system. It was recommended that the Chief Mountain Authority be contracted to dispose waste from Raymond and Stirling in the proposed regional sanitary landfill to reduce the annual per capita operating costs to the constituents of the proposed regional system.

If the regional sanitary landfill is sited in a central or northern location within the county, there may be an opportunity to develop a regional landfill in conjunction with the Chief Mountain and/or the Taber & District Waste Authorities.

3.3 TABER AND DISTRICT REGIONAL WASTE AUTHORITY

Initiative Based on the Completed Feasibility Study

The proposed waste management plan for the Taber and District Regional Waste Authority was based on the Associated Engineering feasibility study completed in April, 1986 and would consist of a network of push pit transfer stations delivering waste to a regional transfer station at Taber, with ultimate disposal at the Kedon Sanitary Landfill near Lethbridge.

All existing modified landfills in the M.D. of Taber would be closed.

The proposed system would be comprised of a series of rural push pit transfer stations in six M.D. of Taber sites and one larger regional transfer station in the Town of Taber.

Municipal wastes collected at the transfer stations would be hauled by a live bottom trailer (which is a tractor trailer for hauling loose waste complete with a chain drive to unload) to the Kedon landfill. Each transfer vehicle would carry a bobcat that would be used to load the waste into the trailer. No mobile equipment would be left at each site.

The proposed sizes of the transfer station facilities would be as follows:

• Taber	2500 sq. ft. (230 sq. m.)
• Vauxhall	1500 sq. ft. (140 sq. m.)
• All other locations	1000 sq. ft. (93 sq. m.)

Each facility would have a concrete tipping floor, retaining walls and a steel shell building. The sites would be fenced, graded and would have signs for traffic control.

Estimate Costs per capita: $17.46 (1986 dollars)
$24.57 (1993 dollars assuming a 5% increase per annum)

The proposed transfer stations in the study would be the push pit type enclosed in a steel building and located at:

- Nanton;
- Stavely;
- Granum;
- Fort MacLeod;
- Vulcan;
- Champion; and
- Carmangay.

Three variations to the overall study service areas were proposed:

Variation 1 includes M.D. of Willow Creek, plus the Towns of Nanton, Stavely, Claresholm, Granum and Fort MacLeod;

Variation 2 includes M.D. of Willow Creek, and the Towns within the M.D., plus the southwest portion of the County of Vulcan, Town of Vulcan and the Villages of Champion and Carmangay; and

Variation 3 includes M.D. of Willow Creek and the Towns within the M.D., plus the portion of the County of Vulcan west of the McGregor Lake reservoir and the Village of Milo.

3.5 THE KEDON LANDFILL

The Kedon Landfill near Lethbridge serves as the final disposal location for wastes from several of the regional authorities. Its continued existence and operation are items that are being relied upon for present and future waste management plans for a number of the authorities.

3.8 COUNTY OF NEWELL (No. 4)

Although not part of this study area, the County of Newell has put forth a Requests for Proposals from engineering firms to complete a siting study for a sanitary landfill. There is the possibility that if a landfill was sited close to the southern Alberta study area waste generators, it could potentially be used as a final disposal point for some of the wastes generated within the study. The future landfill in the County of Newell would have to have design a capacity to accommodate the extra study area wastes and this option should be looked at a later date when options for suitable landfill sites in the southern Alberta region have been exhausted.

SECTION 4.0

POTENTIAL SOLID WASTE MANAGEMENT SYSTEMS AND PROCESSES

4.0 POTENTIAL SOLID WASTE MANAGEMENT SYSTEMS AND PROCESSES

4.1 GENERAL

Currently, the majority of the waste generated in the Region is landfilled. Solid waste management is challenging communities and regions, not only in Southern Alberta, but throughout Alberta and North America. As old landfills sites are filled to capacity, new sites must be selected to replace them. In the past this has been an acceptable and effective waste management method; landfills met our needs, they were considered cost efficient, and simple to use and operate. At present, and probably for some time to come, a landfill is still required for some portion of the waste stream. However, with the increasing cost of landfilling, as well as the social issues associated with landfilling, there are opportunities for waste minimization options such as at source waste reduction, recycling, composting, combustion, etc. Carefully chosen waste minimization options can extend the life of the landfill and reduce the number of landfill sites needed. A good strategy can also reduce the amount of hazardous materials being landfilled.

It has been demonstrated that waste which is normally landfilled can be reduced between 5% and 25% through the application of waste minimization options. Typically, the adoption of a mix of options will provide an efficient system for any given generator area. In certain cases, however, one major piece of infrastructure (for example, an energy from waste facility) may provide a satisfactory level of service to the region. While the cost of some of these options can be extremely high, certain programs, or components, could be implemented that are economically viable at this time. Also, the availability of markets plays an important role in the feasibility of waste minimization programs which divert materials from the landfill. These options may become viable in the future and could then be implemented.

The major system elements available to the planning process for an integrated waste management system for Southern Alberta are described in the following sections. These elements will then be combined to form a number of potential plans which can be evaluated according to the needs and desires of the Region.

tipping fee will be levied to compensate for markets which are flat or nonexistent, or considerable financial resources must be expended to gain value from a certain material.

Issues that must be resolved before selecting a processing alternative are: quantity and quality of products (energy or materials), availability of markets, environmental impact of the process, potential for local economic development, public acceptance, and quality of working conditions within and near the facility.

The following sections examine these options in light of the waste management systems in place, and determine whether or not the option is viable for the area.

4.2 SOURCE REDUCTION

At the present time, there are five environmental groups in Southern Alberta. They are:

- Environmental Resource Centre;
- Burt Riggall Environmental Foundation;
- Coaldale Ecology Club;
- Going Green (Crowsnest Pass);
- Nanton Environmental Action Society; and,
- Southern Alberta Environmental Group.

An in-depth interview was held with each of these groups. A detailed description of their focus, and activities they are presently pursuing is given in Appendix C.

These groups are actively attempting to educate the public on current waste management issues such as reduction, re use, recycling, and composting. Pamphlets and informational brochures are available from the groups.

One of the most effective ways of minimizing waste is through source reduction. Source reduction means reducing waste where it is produced at households and places of work. Unlike other waste minimization options, which target a limited section of the waste community-wide effort that involves the contributions of several groups. A broadly-based effort, with participation from a range of community groups, provides a balanced, grass roots approach that has a better chance of gaining public acceptance.

Specific methods of education may include:

- distributing brochures and newsletters to promote source reduction;
- using advertising and public service announcements in local media;
- holding special events to promote waste reduction initiatives;
- Promoting backyard composting;
- setting waste reduction goals;
- establishing a committee, with representatives from a range of community groups, to manage day-to-day issues;
- holding public meetings to answer questions and develop initiatives that meet regional needs; and
- educating visitors to the region at campsites and hotels.

All of these suggestions can be incorporated into an effective education program to inform residents of ways to reduce waste at its source. Many of these ideas have already been initiated by several environmental groups in the study area.

Education of source reduction in the schools can be an excellent way to increase community participation in both the short and long term. Students often share ideas learned in school with their families, and the students themselves will develop a commitment to reducing waste that will continue into their adult lives. Information on reducing waste can be learned through hands-on projects, and may extend to competitions with other schools or institutions in the region. A regional waste reduction plan could be explained by an educator, who specializes in waste management, and who could visit all classrooms in the region.

landfilling. By including a capital recovery fund to account for the eventual closure, reclamation, and replacement costs for another regional landfill, the tipping fee would be much larger than the existing tipping fees found at area landfills.

4.2.3 Procurement Policy

An environmental buying policy can result in waste reduction by encouraging the purchase of goods and materials that create less waste, are made from recycled materials, and/or can be reused or recycled. Environmental procurement policies not only reduce waste, but also divert recyclables from the landfill and promote the development of markets for recycled products. Competitively priced goods of high quality include "green" cleaners, recycled paper, reusable batteries, re-refined motor oil, water-based paints, products from waste plastics, and others.

It would be a policy which would encourage governments, institutions and private businesses, and even homeowners to be more conscious when they buy. This would be accomplished by information sharing between groups such as chambers of commerce, tourism associations, health care boards, and others.

4.2.4 Waste Audits

Businesses, local government and institutions could be encouraged to identify ways of reducing waste through waste audits. Waste audits provide an mechanism to inventory current practices which assess the quantity and quality of the wastes generated, identify markets for recyclable materials and recycling brokers, waste reduction and recycling options specific to each business, and provide support and advise to the businesses. Often a side benefit is the identification of strategies that streamline operations and reduce costs. These audits can either be conducted by the business, government, or institution itself, or by a third party consultant. Several publications and manuals can help develop an effective audit, including "Profiting from Waste Reduction in Your Small Business"[1] and

(1) Profit from Pollution Prevention, Volume 1, A project of the Pollution Probe Foundation, A Guide to Waste Reduction and Recycling in Canada, Second Edition Revised, 1990.

4.3 RE-USE

'Re-use' is the repeated use of an item usually, but not always, for the same purpose. This second 'R', helps reduce waste generation, conserves raw materials (and thus energy), and usually results in less cost to the user.

Re-use can include:

- Re-using and refilling containers (eg. beverage containers);
- Repairing broken goods (eg. appliances, etc.);
- Second hand stores (Goodwill, Salvation Army Thrift Shops, Charities, etc.);
- Clearinghouses - establishments which collect used items for resale (eg. resale boutiques, thrift shops, Architectural Clearinghouse - Edmonton); and
- Waste Exchanges - a province-wide and country-wide program which links 'waste' generators with potential users of these 'wastes'.

The concept of re-use could be included in the educational program discussed in Section 4.2.1.

Depending on the participation rate and the effectiveness of a source reduction and re-use program, it is estimated that the cumulative waste diversion rates could reach 15%.

4.4 COLLECTION

4.4.1 Collection Alternatives

The most important aspects of a waste management system from a planning perspective, are generator participation, collection, processing, and residue management. Collection alternatives can be broken into two broad groupings: single stream collection, and multiple stream collection. Single stream collection refers to mixed waste collection (everything into one bin - typically hauled directly to disposal). Multiple stream collection systems represent attempts to segregate or group certain materials into streams that can be

All of the rural communities within the study area, with residential collection, are serviced by single stream collection. The Cities of Lethbridge and Medicine Hat are also serviced by single stream collection (with the exception of the 300 residents participating in the blue box collection program in Lethbridge).

4.4.3 Multiple Stream Collection

As stated previously, in those cases where collection services are designed to collect two or more distinct material categories, such systems will be termed multiple stream collection schemes. Such schemes can be applied at the curbside, loading dock, or depot levels. The number of categories into which garbage can be sorted is virtually limitless, although in practise it is usually restricted to only two or three.

Multiple stream collection schemes are typically designed in conjunction with downstream processing facilities, keeping the quality requirements in mind. For instance, two stream collection schemes usually define wet and dry categories. Under these schemes, all organic and other wet materials are placed in one category, while all other wastes are placed in the dry category. These systems enhance the quality and recoverability of various dry recyclables by reducing their contamination by wet materials. However, these systems do not necessarily provide the degree of protection necessary for the wet category to produce a suitable feedstock for composting, as there is no guarantee that the feedstock will be contaminant free.

Three stream systems (typically wet, dry and garbage) are sometimes employed to enhance the recyclability of both the dry and wet fractions of MSW. Under these schemes, specifications can be developed regarding the acceptable contents of wet and dry streams, with all other materials being considered garbage.

In certain situations, four streams or more may be appropriate. For instance, it may be prudent, given the location and infrastructure of a community, to consider separating the dry fraction into containers and paper products (or some other division), or the wet fraction into yard wastes and other organic materials. Of course, increasing the subdivision of

TABLE 4.1

COLLECTION SYSTEM COMPARISON

One Stream	Two Stream	Three Stream	Multi Stream
Description: Regular garbage collection with or without special bags for particular materials (co-collection). Mixed waste materials recovery facilities (or dirty MRF's) could manually and mechanically segregate materials for recycling and composting.	All dry materials are placed in one container and all wet materials are placed in the other. The materials recovery and and composting facilities are responsible for processing marketable recyclables and compostable organics.	Dry recyclable materials are placed in one bin, or bag acceptable compostables in a second and all non-acceptables (garbage) are placed into a third.	Increasing degree of separation of recyclable, and compostable, items. (Hazardous wastes could be a separate stream).
Advantages: - simple and familiar - may provide for significant recovery of recyclables with appropriate combination of mechanical/manual sorting techniques (better than multi-stream collection) since it provides access to all waste materials). Recovery of materials would supplement ongoing recycling initiatives.	- reduces contamination of recyclables by wet materials. - two distinct separation and collection systems. - maximum capture for recycling since it eliminates bleeding into the garbage system.	- well run system competes with two stream for maximum capture of materials for recycling. - provides very high quality of recyclables and compostables, as a result of better separation. - greater opportunity for reducing source contamination.	- greater opportunity for reducing source contamination

4.4.5 Two Stream Collection for Lethbridge and Medicine Hat

There is a large body of evidence (Guelph, Metro Toronto, Powell River, B.C.) which strongly indicates the importance of sourcing and collecting relatively uncontaminated organic materials. Materials with high concentrations of heavy metals or synthetic organics, for instance, will generate composts with even higher concentrations of these substances due to the volume and mass reductions inherent in composting processes. The implications of such an occurrence can range from limiting end use options for finished materials, to requiring the secure disposal of these materials in landfills. In addition, input materials with significant amounts of difficult to remove physical contaminants, such as plastic and glass, can severely damage the aesthetics, and hence utility, of finished products. Two stream collection has been favoured in areas where pilot programs have been operated, specifically Guelph, Ontario. Although three stream collection was preferred by residents for convenience and service, they were not willing to pay for it. It was also found that with the three stream collection scheme, there was one too many choices for the users. The 'garbage' option was often used, instead of the wet or the dry containers. It is, however, desirable to keep the household hazardous wastes out of both the wet fraction destined for a composting facility and the dry fraction destined for a materials recovery facility.

For these reasons, it is recommended that source segregation, and separate collection, of organics from municipal sources be implemented in the scenarios where 'high-tech' recycling and composting techniques are suggested to reduce the amount of waste landfilled by up to 50%. In these scenarios, a two stream collection scheme would be implemented in the urban centres of Lethbridge and Medicine Hat. Under the regional system, residents would be supplied with two large plastic collection containers to separate their household wastes into 'wet' and 'dry'. These containers could either be provided by the cities, subsidized by the cities, or purchased entirely by homeowners. It is suggested that 120 litre plastic wheeled carts be provided for the 'wet' stream and 240 litre plastic wheeled carts be provided for the 'dry' stream. If every single family residence receives two containers, over 57,000 carts would have to be purchased. The City of Guelph used plastic carts similar to these in a pilot program which began in 1987 and is soon entering the implementation phase. The City has budgeted over $2 million for collection vehicles and bins.

are especially sensitive to this cost trade-off due to their low annual volume of recyclable waste produced (relative to large cities with established recycling programs), their low population density, distance to recycling markets, and small tax base. These constraints preclude high-tech options such as curbside collection (source separated or co-mingled) of recyclables, and processes involving large sorting lines or mechanical separation which are suited to much larger waste streams than that found in these rural areas within the study area. Alternatively, very simple sorting procedures at a recyclables processing centre can be very cost effective.

4.5.2 Processing Alternatives: Material Recovery Facilities

The ability of a Material Recovery Facilities (MRF's) to capture recyclables from MSW is primarily a function of the collection system since, by definition, a MRF only receives recyclables which have been segregated from MSW (in a commingled or fine sorted manner). While MRF's may have significant variations in design, all provide a central station for separation of commingled or segregated recyclables. The materials are processed either manually or automatically, stored, and prepared for market. A MRF may be a simple transfer and storage station with minimal quality control, or a large plant that uses both mechanical and manual separation with packaging by a high production baler.

Facilities which remove recyclables from MSW, collected via single stream collection schemes, are considered to be a 'Dirty MRF', and are discussed in Section 4.5.3.

There are four basic functions performed by an MRF:

- separation of commingled waste streams;
- removal of contaminants from marketable commodities;
- packaging of marketable commodities; and
- consolidation/storage of marketable products for cost-effective delivery to markets.

While large MRFs provide economies of scale for large quantities of waste, MRFs for smaller waste volumes can also be feasible through good design and planning.

Contamination levels are typically low due to the division into multiple streams at the source (the home or the recycling depot). Typically, MRF vendors claim residues are less than 10% of collected materials.

Materials from the drop-off depots, if they are not supervised, may contain some degree of contamination. The City of Calgary found that the quality of materials collect in both schemes were acceptable to the processors, and that the level of contamination was easier to control in the curbside program, but they felt that public information and eduction could further reduce the contamination levels found in the depot program.

Expected Environmental Impacts

Environmental impacts associated with MRF facilities are similar to those for any light industrial development. Generally, only local site disturbances related to the erection of buildings, etc. are associated with the physical plant. Liquid effluents from MRF facilities are limited to sanitary (washrooms and clean-up facilities) and storm water flows (rainfall events) which are typical of similarly sized industrial operations. Air emissions are limited to those from facility heating plants.

Multiple stream collection programs may cause an increase in energy consumption due to additional pickups and/or increased collection time. These increases may be compensated, in whole or in part, by decreases in energy consumption depending on how far the vehicles have to travel, the location of the MRF, and the number of compartments in the collection vehicle.

Working Conditions

When proper consideration is given to employee health and safety in design and operation, MRF's generally provide a nonhazardous work place for employees. Some specific dangers and pro-active protective measures which can be employed include:

- exposure to broken glass and other sharp materials (wear protective gloves and clothing);
- dust and small fibres from baling and other operations (dust masks and/or dust collection equipment);

strict physical and chemical requirements which are imposed on finished materials and their usage. For instance, all mixed waste compost currently produced in the U.S., if produced in B.C., would be required to be landfilled under B.C.'s guidelines. Alberta draft guidelines are not yet finalized at the time of printing, however they are expected to be similar. For these reasons, 'dirty' MRF's will not be considered any further in this study.

4.5.4 Existing Recycling Programs

There were 19 recycling programs operating in 1992 in the study area. There were two programs which began in 1993, and an additional 3 programs which have received funding and are scheduled to begin start-up 1994. All of these programs are 'drop-off' in design, and there is a small blue box program operating in the City of Lethbridge (300 boxes). For a detailed listing of these programs, the type of program, those municipalities participating in the program, and which materials are collected, see Table 2.14 in Section 2.7. Table 4.2 summarizes the quantities collected for recycling in the study area.

TABLE 4.2
QUANTITY OF RECYCLABLES COLLECTED
(1992)

Material	Quantity (tonnes)
Old Newspaper	1,352
Old Corrugated Cardboard	1,296
Office and Mixed Paper	178
Old Magazines	95
Clear Glass	83
Metal Cans	12
#1 and #2 Plastics	40
Tires	45
Total	**3,101**

For the most part, the recyclables are marketed in Alberta. Table 4.3 catalogs the markets used for the materials collected in the study area.

4.5.5 Recycling Alternatives

Based on the preceding discussion of collection and material recovery schemes and existing waste minimization programs, this section of the report will outline the recycling alternatives considered for the study area. They are as follows.

Firstly, scenarios will be developed which will ensure that the majority of all recyclable materials for which feasible markets exist, local or distant, will be extracted out of the waste stream. This alternative will involve the following components:

- Two stream collection for residential waste streams (wet/dry) within the two large urban centres;
- Material Recovery Facilities located in the two larger urban centres to which all recyclables are delivered (including materials from the two stream collection scheme). Regional recycling programs would bring their recyclables into this facility. Recycling programs in rural towns and villages which are currently operating would continue to operate and could bring their recyclables into the larger cities and benefit from a joint marketing plan and materials sharing arrangement;
- A system of waste transfer stations strategically located in the rural areas of the Region at which recyclables could be collected (for example recycling trailers), and these recyclables would be brought to the MRF's for processing; and
- Regional landfills where rejects and contaminated materials would be disposed of.

Secondly, scenarios will be developed where recyclables will be captured on a drop-off basis. This alternative would involve the following components:

- Drop-off depots would be located in the larger urban centres for the collection of recyclables from residents, such as already existing in the City of Lethbridge. Recycling trailers would be placed at waste transfer stations strategically located in rural areas of the Region;
- Small Regional Processing Centres, such as G.P.S. Recycling in Lethbridge, located in the two larger urban centres, where recyclables from the drop-off depots would be processed, packaged, marketed, and where recyclables

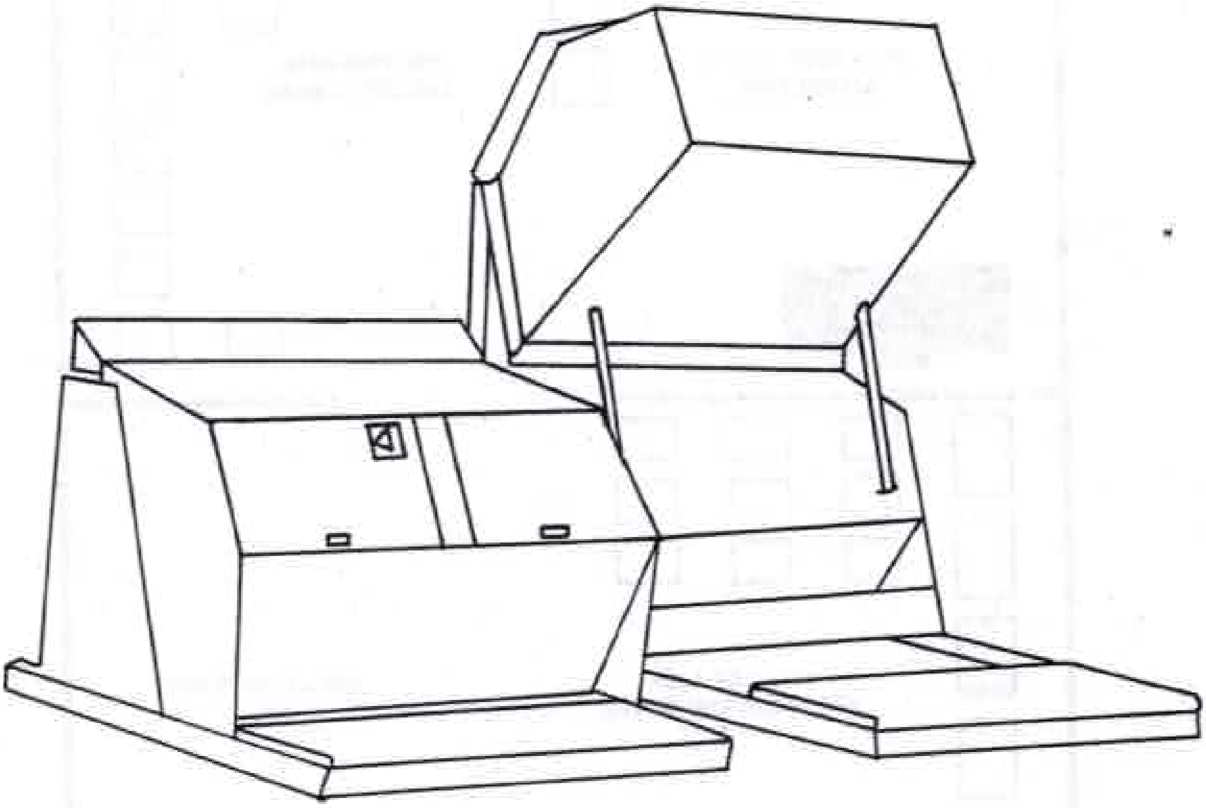


Figure 4.1

DEPOT CONTAINER

vehicles, compatible vehicles (such as the Haul-All Model #12 or #14) could be purchased to empty these containers and transport the recyclables to the sorting facility. Vehicles could be equipped with compaction capabilities to improve the economics of collection.

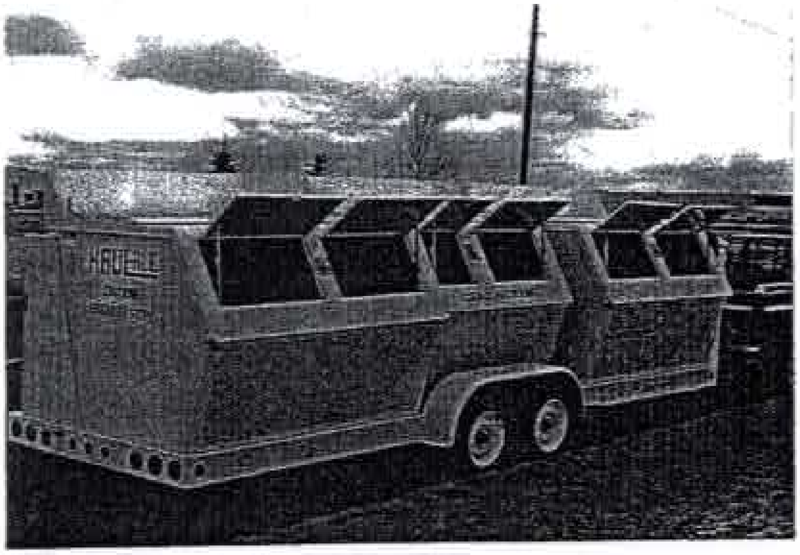
To begin with, the proposed program would include the same recyclables as the City of Lethbridge is presently collecting, processing and marketing, and with the aid of an educational program encouraging voluntary participation, approximately 10% of the residential waste stream could be collected. Although a higher capture rate may be attainable, a conservative 10% will be used.

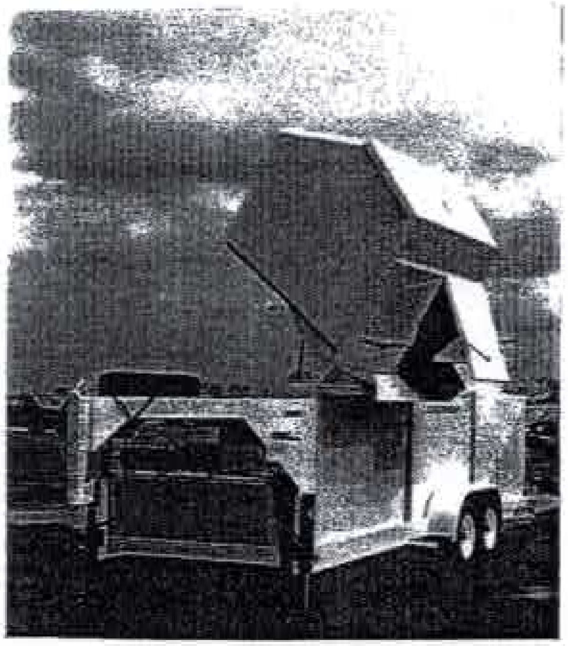
The small Recyclables Processing Centre would consist of a receiving/tipping area, sorting area, processing and baling area, storage area, and an administrative area. Equipment would consist of a manual sorting process, storage carts, a baler, a scale, a small loader, and ancillary equipment (See Figure 4.2)

As previously mentioned, the Centre would process the recyclables from the rural transfer stations, as well as from the Towns. The following is an outline of how the recyclables would 'flow' through the facility:

- Recyclables would arrive at the facility via the mobile recycling trailer from the rural transfer stations or via collection vehicles collecting from the drop-off depots in the Cities;
- The recyclables would then be sorted and processed, readying them for market (eg. baled or placed in carts); and
- Separated materials would be placed in sorting containers, or bins. These containers will be emptied on an as required basis and their contents transferred to the appropriate shipping container or baler as per the marketing requirements for each material.

As previously mentioned, a joint marketing scheme, or a materials sharing program, could be implemented.





Source : Haul - All Equipment Systems

Figure 4.3

MOBILE RURAL
RECYCLING TRAILER

lists the recyclers operating in the province. The Recycling Hot-line can also be called at 1-800-463-6326.

4.5.7 Material Recovery Facilities

For the scenarios recommending MRF's, the following is proposed.

City's of Lethbridge and Medicine Hat

For these scenarios, Material Recovery Facilities are suggested for the City's of Lethbridge and Medicine Hat. These MRF's would be supplied with the materials collected in a two stream collection scheme, as discussed in Section 4.4.

Dry goods at a MRF can either be processed or sorted manually or mechanically. Depending on the quantity of materials, or throughput, of the facility mechanical sorting may be too expensive. An example of a MRF which employs manual sorting is illustrated in Figure 4.4, while Figure 4.5 illustrates a MRF which employs both manual sorting and mechanical sorting. Larger bulky items (cardboard) are usually removed manually prior to the sorting process, followed by manual sorting (plastics, glass, paper, etc.) and mechanical sorting (metals, etc.).

It is estimated that approximately 12,500 tonnes per year (50 tonnes per day) will be processed by the MRF in Lethbridge and 6,000 tonnes per year (25 tonnes per day) by the MRF in Medicine Hat. (This includes the residential waste stream from both urban centres, as well as the recyclables brought to the MRF from the rural recycling depots. The existing depot system in Lethbridge would continue to operate and service those living in high-rise apartments and dwellings not serviced by the two stream collection scheme.) For the purposes of this study, the MRF's will be conceptually designed incorporating both manual and mechanical sorting.

The MRF's would consist of conveyors, sorting stations, bins, and magnetic separators. A baler, can flattener, and glass crusher would be utilized to prepare the recyclables for market. A loader and scale would also be required. The building which would house the process would be equipped with a dust collection system, noise suppression devices, odor lists the recyclers operating in the province. The Recycling Hot-line can also be called at 1-800-463-6326.

4.5.8 Industrial Wastes and Construction and Demolition Wastes

As a result of the industry survey in Section 2.3, Table 2.4, it was found that approximately 70% of the wastes generated could be categorized into three areas:

- Dry wastes (C&D wastes, wood, pallets, rocks, etc.);
- Compostables (vegetables and trimmings, sawdust, flour and grain sweepings, etc.); and
- Common household recyclables (paper and cardboard).

These wastes could be handled in a more appropriate and efficient manner. For example, vegetable peels could be composted as opposed to landfilling, or as animal feed, bark and sawdust could also be compost as opposed to being burned.

The survey concluded that all hazardous industrial wastes are being disposed of properly and appropriately (i.e. Swan Hills).

With this in mind, the following programs are suggested to be implemented.

Construction and Demolition Wastes (Dry Wastes)

The results of this study will recommend the closing of all modified landfills, thus it is suggested that in each County, Municipal District, or Improvement District, one of these landfills be converted to a dry disposal site. The modified landfill chosen to become a dry disposal site would have to meet the requirements outlined in the Waste Management Regulations under the Public Health Act. The following jurisdictions would host a dry disposal site:

- M.D. of Willow Creek;
- County of Lethbridge (existing - Boychuck's);
- County of Vulcan;

4.6 COMPOSTING

4.6.1 The Composting Process

There are many different definitions for composting, depending on the process and application. For this study, composting will be defined as the controlled, solid phase, aerobic biodegradation of organic materials. Thermophilic temperatures (greater than 55 degrees Celsius)[3] are specified to maximize the destruction of plant/human pathogens and weed seeds in finished composts. Composting processes are essentially complete within two weeks to six months, depending on the technique. It is not biologically possible to shorten this period, and therefore vendor claims to the contrary should be treated skeptically.

Figure 4.7 illustrates a typical compost facility flowchart.

This technology is increasingly being relied on in North America to manage a wide variety of organic wastes. Literally thousands of yard waste facilities, and hundreds of sewage sludge composting operations are currently operating. Other streams which are commonly composted include food wastes, agricultural residues, seafood processing residuals, and mixed MSW (although not in Canada).

Current and emerging regulations and guidelines in Canada preclude the production of usable composts from mixed MSW. This is due primarily to the strict physical and chemical requirements which are imposed on finished materials and their usage. For instance, due to contaminated materials, all mixed waste compost currently produced in the U.S. would be required to be landfilled in B.C under existing B.C. guidelines. Alberta draft guidelines will not be finalized until the summer of 1993, or later, however they are expected to be similar. Therefore, as previously mentioned in Section 4.4, for larger scale, high-tech recycling and composting alternatives, two stream collection (wet/dry) would be recommended.

(3) The Biocycle Guide to Yard Waste Composting, p109

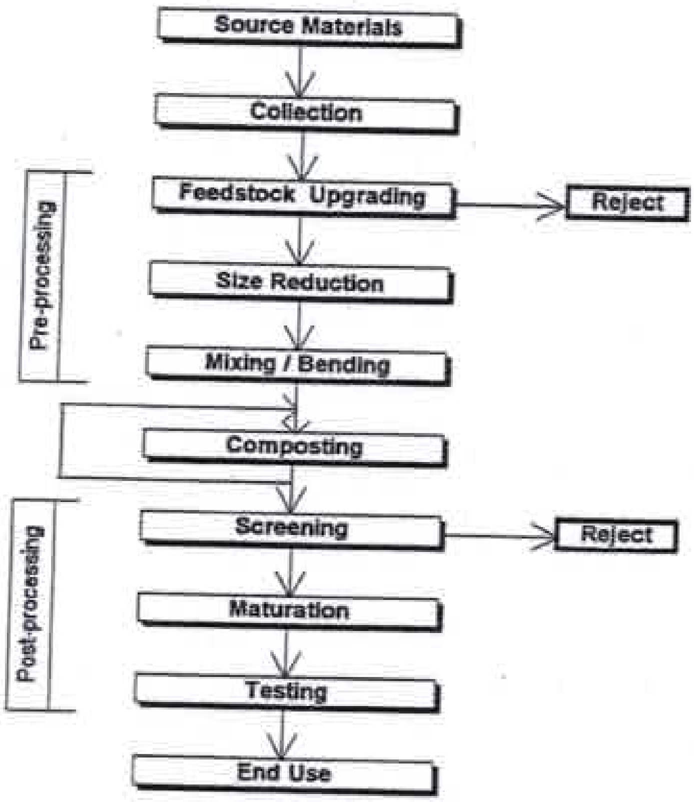


FIGURE 4.7
TYPICAL COMPOST FACILITY
FLOWCHART

Expected Environmental Impacts

The main issues impacting the development of composting facilities, from an environmental impact point of view, are:

- raw material;
- odours;
- dust;
- vectors (insects, birds, rodents, etc.);
- surface and groundwater contamination;
- physical disturbance of the site for construction/operation; and
- finished product usage concerns.

These issues can be satisfactorily addressed through good design, prudent operation, selecting suitable sites, and controlling facility feedstocks.

Multiple stream collection programs associated with composting facilities may also result in increased energy consumption due to additional pick-ups and/or collection time. This may be compensated wholly or partly by decreases in energy usage in the long haul trucking of wastes, depending of course on the location(s) of the facility(ies). Sanitation concerns with the collection network, particularly the methods of storing organics at source, also need to be carefully considered in program development.

Working Conditions

Occupational hazards facing compost plant workers include working proximity to mobile and stationary equipment, and exposure to dust, odour, endotoxins (noxious substances produced by bacteria), pathogens, and air borne fungi (specifically aspergillus fumigates). All of these hazards can be minimized or eliminated through good design and operations. As evidenced by the myriad of existing facilities in North America, composting operations can provide healthy, satisfying employment for their workers.

Hybrid systems employ both mechanical agitation and forced aeration. These techniques include aerated windrows (hybrid aerated static pile and turned windrow), channel systems (long concrete troughs which are mechanically mixed by a turner mounted on rails on the trough sides, and incorporating forced aeration for better process control), and a variety of other techniques. Most commercially available composting processes can be classified as hybrid systems.

The choice of the composting technique which is appropriate for a given situation is primarily a function of compostable materials, siting constraints, and economics. For instance, yard wastes can, generally, be satisfactorily managed in simple windrows. However, other organics such as food wastes would likely require more intensive management in the study area to avoid animal conflicts, minimize odour generating potential, speed decomposition, and in general, reduce the possible impacts of a composting facility into the local environment. Of course, increased process control, and additional facilities directly, increase the costs of ownership and operation.

A detailed description of composting technologies has been included in Appendix I.

4.6.4 Existing Composting Programs

The existing composting program operating in the City of Lethbridge captured 297 tonnes of yard waste in 1992. The materials included in the program include wastes from only the City's Parks Department. This includes all green matter, vegetation, and small chipped branches. The composting operation takes place in undeveloped park space in the river valley (Peenaquim Park). The compost piles are monitored for moisture content and temperature. This is the third year the program has been in operation. The compost has been tested for heavy metals and the results show that the compost is of good quality. The Department plans to further shred the compost in preparation for use.

The City, in association with the South Country Community Association, will begin the operation of a home composting demonstration site at the "Grow It Community Gardens" in the Spring of 1994. It will showcase various types of home composting bins, and provide helpful information to City residents.

voluntarily placed at the curb, collected, transported to the composting facility and processed;

- Centralized windrow composting facilities would be located in each of the urban centres. At these centres, compostables would be separated (minimal), processed, and if possible, packaged and marketed; and
- Regional landfills where rejects and contaminated materials from the composting programs would be disposed of.

The components of these alternatives will be discussed in the following sections.

4.6.6 Proposed Centralized Windrow Composting Program

For the scenarios recommending centralized windrow composting alternatives, the following is proposed.

Materials

While other wastes, such as vegetable scraps, paper, fruit scraps, straw, manure, sawdust, etc., can be composted, the present composting programs only include grass clippings, dried leaves, brush and small tree prunings. This program would continue to be operated, and expanded to include yard waste from the residential waste stream. Again, as with the present recycling program, higher volumes could be realized with additional public education programs to increase participation. It may be necessary to add straw, manure, or sawdust periodically to regulate the Carbon to Nitrogen (C:N) ratio during the 'feedstock upgrading' stage (Figure 4.7). A chemically balanced fertilizer, containing phosphorous (P), nitrogen (N), or potassium (K) may be added to enrich the final compost. Calculations show a 4:1 ratio of grass to leaves results in a carbon to nitrogen ratio of 30:1 (based on a C:N ratio of 19:1 for grass and 60:1 for leaves).

According to Table 2.11 in Section 2.4, approximately 4,900 tonnes of yard wastes are generated in the City of Lethbridge and 4,700 tonnes are generated in the City of Medicine Hat. Encouraging participation in this composting program will help eliminate yard wastes from entering the waste stream. Should it become necessary, by-laws could be passed to ban all yard wastes from the landfill. Fines could be issued to those failing to comply with

Composting Centre

When siting a composting facility, the following must be taken into consideration:

- Proximity to the landfill for disposal of residues;
- Proximity to generators to reduce haul costs;
- Local zoning and health ordinances;
- Adequate notification of the public;
- Surface and groundwater characteristics; and
- Volume of yard waste to be collected.

According to the Draft Guidelines for Compost Facilities prepared by Alberta Environmental Protection, Alberta Agriculture, Alberta Health, and Action on Waste, all compost facilities will require an Approval to Develop and a Permit to Operate under the Waste Management Regulations. The Board of Health currently requires all composting programs to obtain development and operating permits.

With respect to siting requirements, the Guidelines list five factors and criteria which should be considered when locating a Facility. Design practices and operating practices are also outlined. Funds have been allocated under 'Capital Costs' (see Section 5.5) for additional site work to be completed at the existing composting site. This additional work would ensure the site meets the following guidelines:

- Slope (1 to 2% to avoid ponding);
- Spacing between windrows (3 metres);
- Base (sufficient compaction to avoid rutting);
- Water (availability to moisten compost pile); and
- Storage area (curing pad - 15% of area required).

Operation of the Composting Centre

In Lethbridge, a fairly comprehensive monitoring program has been undertaken, with moisture content and temperature monitored, and a turning schedule implemented. This composting process is indeed complete. Curing allows the compost to reach a biologically stable condition, where microbial activity continues, but at a much slower rate, i.e. oxygen consumption, heat generation, and moisture evaporation are much less than during the composting process, and problematic odours are not usually a concern. The curing process starts once the windrow no longer reheats after it has been turned, and ends when the pile returns to ambient temperatures. It is usually recommended that the pile be allowed to 'cure' for at least a month.

By monitoring the 'ingredients' of the compost pile, as well as the temperature and moisture, the decomposition process should result in a quality compost.

Once all of the yard waste has decomposed, the result is a dark, humus type material, which indicates that the process is complete or stable. The length of time to complete the process depends on the composition of the organics entering the process, weather conditions, etc. Using the windrow method, it would take between 2 and 6 months to produce a useable end product.

The composting season would be limited to the late spring, summer, and early fall months, due to the colder climate of the area. The compost pile would more than likely remain dormant during the winter months, but could be reactivated the following spring.

Testing, Recording, and Reporting

According to the Draft Guidelines for Compost Facilities prepared by Alberta Environmental Protection, Alberta Agriculture, Alberta Health, and Action on Waste, all operators of compost facilities should submit annual written reports to the local Board of Health. These reports should contain the following information[7]:

- source and type of material composted;
- volume of material received and processed;
- period during which composting occurred;

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(7) Draft Guidelines for Compost Facilities, Alberta Environmental Protection, Alberta Agriculture, Alberta Health, and Action on Waste, July 1993, p10

The compost can be used for landscaping projects in the City. The City of Medicine Hat currently uses the compost in their flower beds. Additional uses could include:

- Home gardens, flower beds, top soil amendment, etc.;
- Garden centres, greenhouses, nurseries, landscapers;
- Golf courses (top dressing for turf, soil amendment for greens and tee construction, landscaping); and
- Land reclamation projects.

4.6.7 Proposed In-vessel Composting Program

City's of Lethbridge and Medicine Hat

For these scenarios, a containerized composting program is proposed for the two cities. These facilities would be supplied with materials from the two stream collection scheme outlined in Section 4.4.

As previously discussed in Section 4.6, the choice of the composting technique is a function of the type of material, siting constraints, and economics. For these scenarios, the materials would be essentially the same, consisting of household organics, non-recyclable paper (tissues), and yard wastes. There are numerous techniques which would be able to convert these wastes into useable compost (i.e. channel, in-vessel, container, etc.). In the course of obtaining information on various larger scale composting facilities for this study, several vendors stated that they would be willing to design, build, and operate a facility, if a guaranteed tonnage of organics could be supplied. Ultimately the decision lies with the Committee as to which vendor/technique they would choose, after the tendering process. As an alternative, the committee could choose to have a vendor design, build and operate the facility with the municipality paying a tipping fee to the owner.

In-vessel Composting Systems (Containerized Systems)

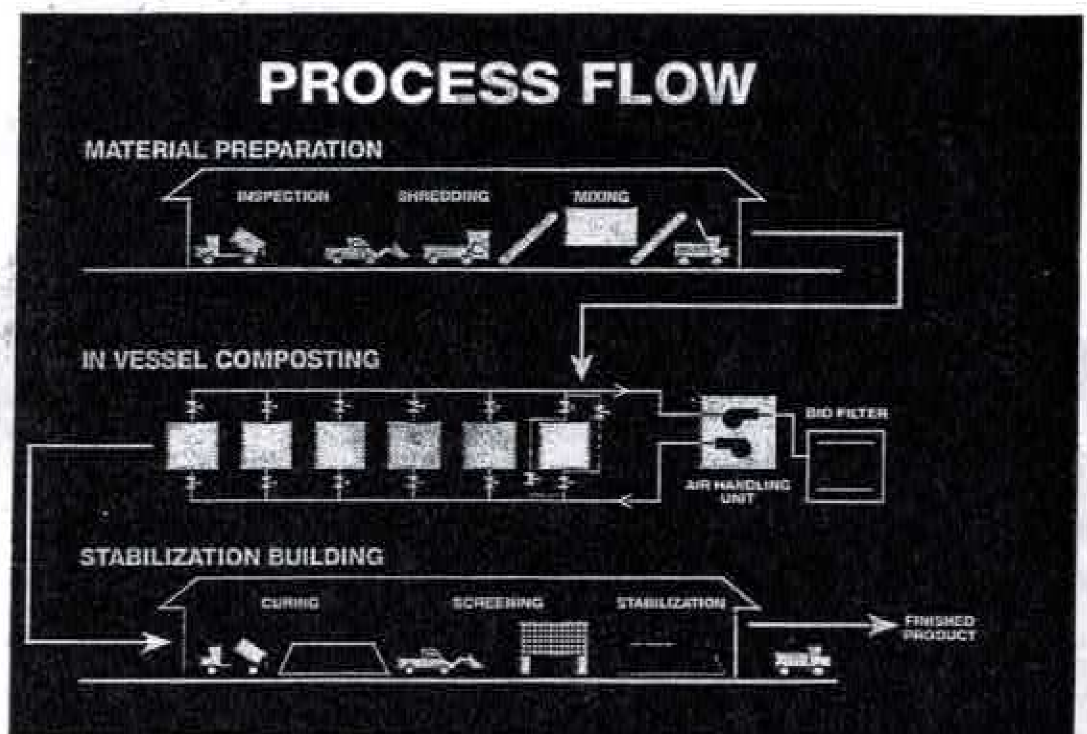
Three recent Canadian municipalities have piloted multiple stream collection and in-vessel composting programs: Guelph, Metro Toronto, and Powell River. In Powell River, a composting program was piloted in 1990 involving an enclosed, continuous flow reactor.

4. Energy - requires minimal mechanical energy expenditure for both operational simplicity and energy conservation;
5. Appearance - aesthetically pleasing in appearance (relative); and
6. Solving problems: particle size reduction, air channeling, mixing, and cold weather composting (due to insulated containers).

Figure 4.8 illustrates the process flow of an in-vessel composting system, and Figure 4.9 illustrates a schematic of a composting facility, designed by Stanley, for a municipality in B.C. which utilized the containerized composting system. Figure 4.10 illustrates a large scale, modular, containerized system.

Two stream collection may not yield feedstocks capable of producing very high quality end products. This is due to the lack of an option to otherwise dispose of problematic, from a composting point of view, materials such as leaking batteries, solvent soaked rags, food coated plastic wraps, and other materials by generators. These types of materials could result in heavy metal or physical contaminant levels which are unacceptable in finished products. Two stream collection, however, should yield higher quality feedstocks than mixed waste collection. The City of Guelph considered this issue prior to deciding to implement a two stream collection program. The pilot program found that the majority of problematic materials (hazardous or toxic) were found in the 'dry' stream. An effective public education program emphasizing the importance of proper source separation could help alleviate some of these problems.

Prior to composting, received organics would undergo some pre-processing to improve their compostability. These materials (non-recyclable paper, household organics, leaves and grass clippings) would be size reduced, blended with complimentary materials (such as manure, wood chips, etc.), and thoroughly mixed. A suitable pre-processing sequence would include a slow speed shear shredder and open top auger based mixer (such as a modified fertilizer mixer or rotating concrete mixer). Preprocessed organics would be discharged and placed into containers (specially designed containers or retrofitted containers). Air is blown into these containers and exhaust air collected and processed through a biofilter. Compost remains in these containers for a total of 21 days, composting at thermophillic temperatures (typically about 55 degrees Celsius). As the composting process is monitored (temperature, moisture, volume, air flow, etc.), material is



SOURCE :

STINNES ENERCO INC. Oakville, ONTARIO.

Figure 4.8

PROCESS FLOW OF AN INVESSEL COMPOSTING

facility could be operated at the feed lots where the vegetable wastes could be combined with manure.

The technique and operation of this facility would be similar to the centralized windrow composting program suggested in Section 4.6.6. Vegetable wastes would be brought to the facility by the producers and placed in windrows. Due to the inconsistent nature of the compostables, it may become necessary to include an additive, such as manure, to balance the C:N ratio. The program would include program whereby the temperature and moisture of the compost pile are monitored, and a 'turning' schedule implemented.

4.7 OTHER WASTE MINIMIZATION OPTIONS

4.7.1 Minimization Options for Hazardous and Special Waste

All successful integrated waste management systems must contain a hazardous and special waste program. Hazardous and special wastes include antifreeze (glycol), solvents, used motor oil, garden products (fertilizers, etc.), pest control products, cleaning products, paints, batteries, and all other commercial and special hazardous products. While these materials amount to less than one percent of the total waste stream (depending on the classification of a household hazardous waste), they can result in great risks to ground and surface water, air, and soil. An effective hazardous and special waste program can reduce these risks to the Region and its residents.

The handling of hazardous and special wastes at the source is of particular concern, since many households and businesses dispose of them incorrectly by pouring them down the drain, including them in garbage, dumping them in a roadside or back alley, or leaving them in storage.

In Alberta, the Alberta Special Waste Management Corporation (ASWMC) has put in place the Alberta Special Waste Management System, which provides communities with programs that deal with hazardous and special waste. The Region can either participate in the programs offered by ASWMC, or can set up similar programs at its own cost. Programs which ASWMC offers to communities are described in the following sections.

depot. Recycling storage units for these wastes range from $1500 to $31,000 depending on their volume.

Batteries

Household batteries can be disposed of at household hazardous waste roundups, since there is no recycling program for this material in Alberta. Used lead-acid (vehicle) batteries can be taken to a broker for rebuilding (if in good condition) or recycling. Alternatively, lead-acid batteries could be collected at transfer stations and stored on pallets covered by tarpaulin and resting on a limestone base to neutralize acid which may leak from the batteries. Leaking batteries not stored properly could cause problems, such as contaminated soil or groundwater.

Tires

Negotiations are underway between the Alberta Tire Recycling Management Board and two cement manufacturers, Inland Cement in Edmonton and LaFarge in Exshaw, to use tires as a supplemental fuel. The burning of tires could replace 10 to 15 percent of the natural gas used to heat the cement kilns. In addition to recycling tires as a fuel, there are other options that may become available. The infrastructure for tire recycling (collection and hauling) is still under discussion by the Board and will soon be announced. In the interim, used tires should be stored at transfer stations and regional landfills in clearly marked areas. Storage should be in the form of neat small piles allowing for fire lane space to prevent the spreading of fire, should it occur.

Agricultural Chemical Container Program

The Alberta government developed a program requiring agricultural chemical container storage sites to be built and operated according to strict guidelines. The guidelines of the Agricultural Chemical Container Collection Program promote the safe handling, collection and disposal of pesticide containers, primarily among farmers. The agency responsible for managing the program is the Alberta Special Waste Management Corporation (ASWMC). The ASWMC hires contractors to clean and recycle or dispose of the containers, and funds the program through a $1.00 fee for the purchase of pesticides. Containers are stored at twenty locations throughout the study area (see Table 2.15).

Anaerobic systems gained widespread use for the stabilization of sewage sludges during the early twentieth century. Today, there are hundreds of successfully operating anaerobic digestion systems operating at sewage treatment plants in North America. These systems typically operate at solids contents (5 to 10%) which are much lower than are found in MSW derived organics (40% to 60%).

Recent advances in 'solid state' anaerobic digestion (up to about 40% solids) have brought this technology to the point of potentially managing food and other MSW derived organics. Numerous companies have commercialized anaerobic processes designed to capture significant quantities of energy (methane) and produce usable end products from waste organics.

Anaerobic digestion could handle the same range of materials as aerobic composting.

Vermicomposting

The use of various worm species to convert organic waste materials into usable end products is well established. This technology is generally referred to as vermicomposting.

Vermicomposting systems are not yet commonly employed in the management of MSW derived organics, at a commercial scale, in North America. This is due primarily to the relative newness of the technology. Steady improvements and attempts at commercialization over the past two decades, however, have yielded systems that can be readily employed.

While many agricultural wastes (manures with bedding, etc.), sewage sludges, and certain other materials are readily handleable by vermicomposting systems, typically food wastes and other MSW derived organics need to be pre-composted to yield inputs suitable for these systems. Pre-composting is needed to destroy pathogens (sewage sludges also benefit from this) and create a more suitable substrate for worm metabolism. This requirement increases the costs associated with the development of vermicomposting facilities.

grinding units and delivered to sewage treatment facilities along with other sanitary wastewaters. Municipalities have very little control over this practice, except to set limits on solids discharge (or BOD - Biological Oxygen Demand) to public sewers in local sewage bylaws. Surcharges can be levied for exceeders, but this is rarely done except for very large generators, even in large cities with sophisticated compliance monitoring systems.

Comminution typically appears to be a very low cost, and convenient, organics disposal option for many small generators. Only the cost of the grinding unit, infrequent servicing, and electricity costs are incurred by the user. The resulting increased sewage treatment costs and other environmental impacts such as odours, increased residue in the water, etc. are merely transferred. It can be argued whether or not comminution should be termed a waste minimization technology because it appears to only transfer waste from one facility to another.

c) **Flexibility of Materials** - While the waste entering an urban transfer station may vary, the composition of waste delivered to a rural transfer station could range from bagged household refuse to white goods, vehicle components, and grain and straw. The system must handle these wastes without major upsets or mechanical failures. Also, these large, bulky or undesirable wastes could be redirected to the regional landfill, which would be designed to accommodate these wastes. **Supervision of the transfer stations greatly reduces this problem.**

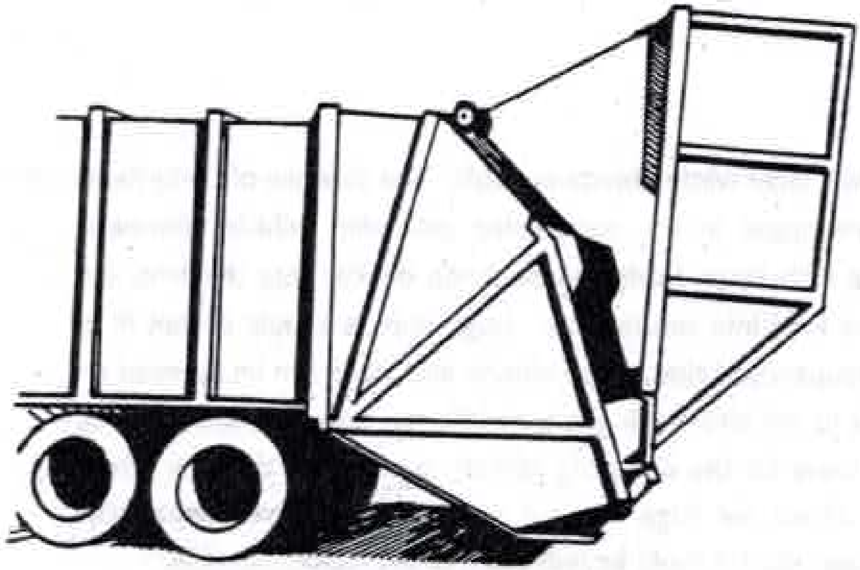
d) **Durability and Dependability** - The system components must withstand rough handling, severe exposure conditions, and be vandal-resistant. There must be adequate capacity and flexibility in the system and its transfer components to provide dependable service. A well engineered transfer station, suitable to the study area, would be durable and dependable. **Supervision of the transfer stations greatly reduces this problem.**

e) **Cost Effective** - Provincial capital grants currently available are limited. Operating costs, including maintenance and equipment replacement, are borne entirely by the users of the system. **Capital recovery funds <u>must be</u> included in the per capita fee for the replacement of equipment.**

There exist several different systems available for implementation as solid waste transfer stations. A brief description of each system follows, as well as advantages and disadvantages of each system.

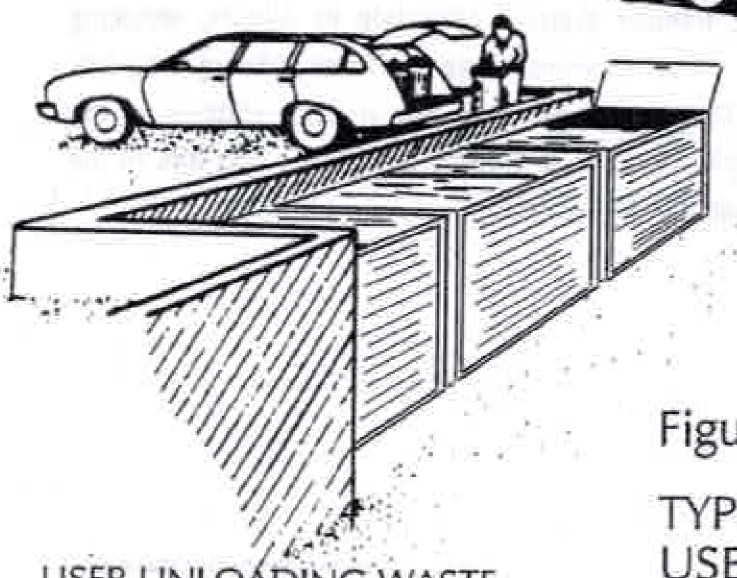
4.8.2 The Green Box System

The green box transfer station consists of a series of metal containers, usually from 6 to 8 cubic yards in volume, placed in an enclosed area with sufficient space for private vehicles and collection vehicles to maneuver.



REAR CONTAINER LOADING

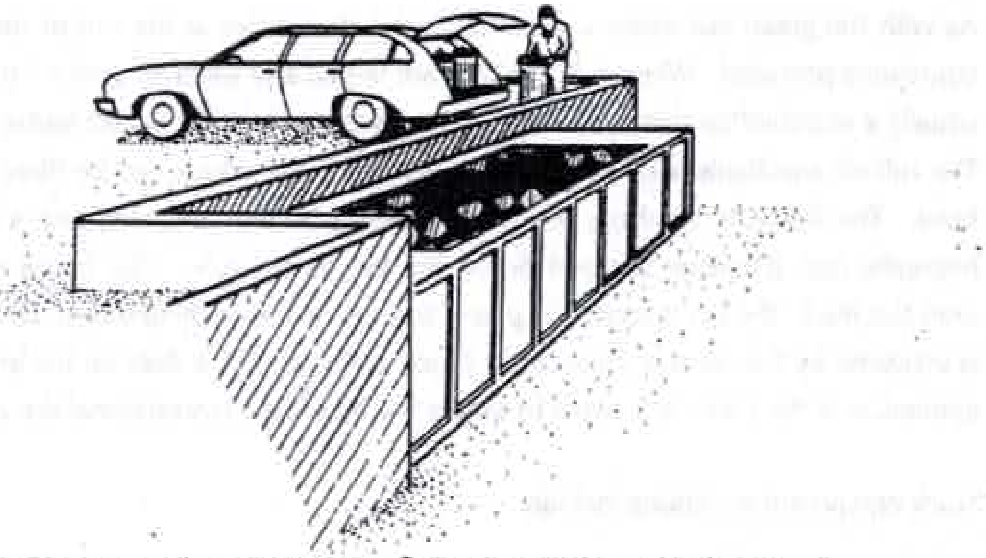
FRONT CONTAINER LOADING



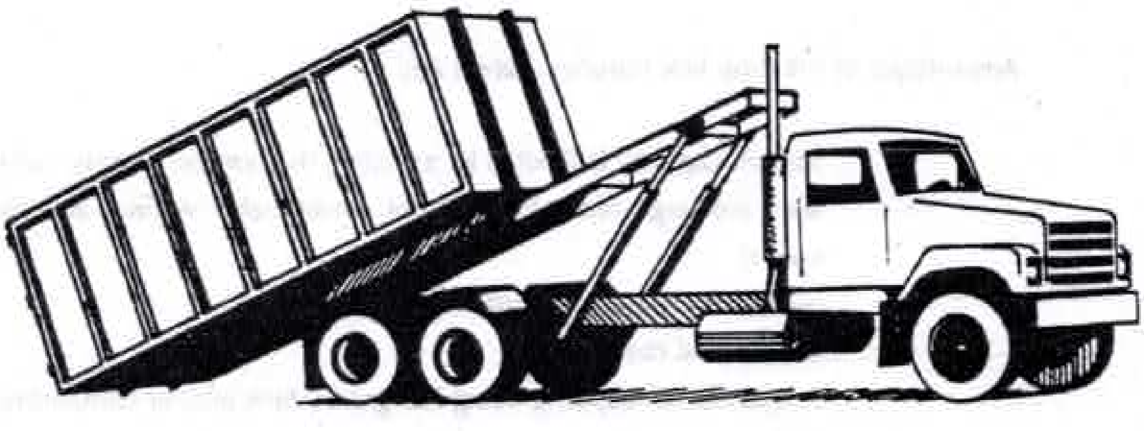
USER UNLOADING WASTE
INTO TYPICAL BIN

Figure 4.11

TYPICAL BINS AND VEHICLES
USED WITH GREEN BOX
TRANSFER SYSTEM



USER UNLOADING INTO ROLL OFF CONTAINER



LOADING ROLL OFF CONTAINER

Figure 4.12

DROP BOX TRANSFER SYSTEM

- Waste quantity and size is limited by size and number of bins;
- Load may need to be leveled prior to tarping;
- Municipal collection vehicles, as well as users with large loads, have difficulty direct-dumping into bins without spillage;
- Specialized truck is required;
- Larger collection vehicles can easily fill one container with one load; and
- Waste is uncompacted during the haul to the landfill.

Summary

As mentioned there are three existing drop box transfer systems operating in the study area. These systems are operating well, and will be incorporated into the recommended integrated waste management system.

4.8.4 The Push Pit System

There are six push pit transfer systems presently operating in the province. A typical push pit station, similar to the implemented system in the Chief Mountain Regional Waste Authority, is shown in Figure 4.13. This type of transfer station employs a building enclosure as opposed to a wire enclosure similar to that which has been employed by the Lac Ste. Anne Regional Authority (see Figure 4.14). The Chief Mountain Regional Waste Management Authority is presently operating twelve push pit transfer stations.

The storage area for a push pit is an enclosed area (a concrete pad within either a wire enclosure or a steel clad building) where wastes are simply dumped. When wastes are to be collected for transfer, the transfer vehicle pulls beneath the storage floor and a loader is used to push the wastes through an opening in the floor into the trailer below. The transfer vehicle consists of a large trailer pulled by a highway tractor. The pushing equipment, a small Bobcat, is can be hauled from site to site on a special platform on the transfer trailer.

Depending upon the design (ceiling clearance and door opening), this type of transfer station can accommodate municipal collection vehicles.

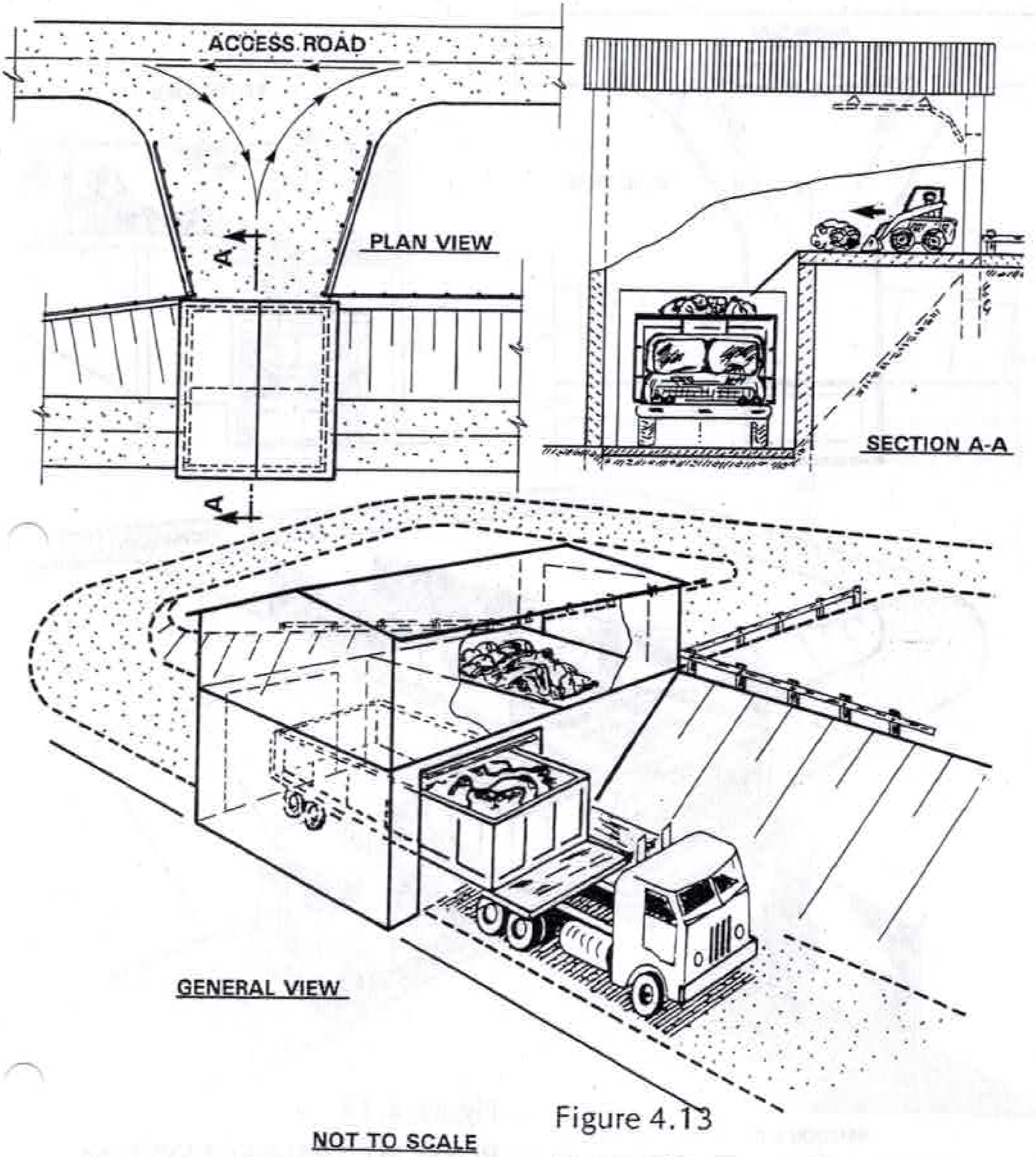


Figure 4.13

PUSH PIT TRANSFER SYSTEM
(BUILDING ENCLOSURE)

Summary

The push pit transfer stations are operating very effectively for the Chief Mountain Regional Solid Waste Authority. This type of system is also currently planned for the County of Vulcan. This type of transfer station will be considered a viable, and appropriate, option for other municipalities within the study area which do not have transfer stations.

4.8.5 The Transtor System

The Transtor is a patented mechanized bin as shown in Figure 4.15. The bin is mounted at the end of a ramp such that users can back up and dump wastes directly into it. Typical capacities of the units range up to 32 cubic meters. Multiple units can be installed to increase capacity.

When the transfer vehicle (similar to that used in the push pit system) arrives, it uses the truck hydraulics to activate the transtor mechanisms which tips the bin and empties its contents into the trailer.

The Drumheller and District Solid Waste Management Association uses 32 cubic meter Transtor units. The Association reported early problems with fires, mechanical damage, and overloading the units. **These problems were largely due to the lack of supervision, and the lack of a maintenance program.**

Transtors have been installed at transfer stations in Lake Louise, Banff, and Kananaskis Country, where the main purpose was to reduce bear problems.

Advantages of the transtor system are:

- Low operating costs;
- No need for pushing equipment;
- Lower capital costs than the push pit system;

- Relatively easy to expand capacity by adding units;
- Transfer vehicle can service more than one site per trip; and
- Transtor stations can accept wastes from municipal collection vehicles.

Disadvantages are:

- Susceptible to vandalism and fire damage if not supervised;
- Susceptible to damage from direct dumping of heavy loads (a site supervisor could redirect these loads to the regional landfill);
- Maintenance costs can be high if not supervised; and
- Load and material size is limited by bin size and capacity.

Summary

The Transtor system, while quite dependable provides no real advantages over a drop box or push pit system.

4.8.6 Compactor Systems

Typical stationary compactor systems consist of a compaction unit placed such that trucks can dump directly into the hopper as shown in Figure 4.16. Wastes fall into a ram chamber and are hydraulically compacted into closed roll-off bins of 24 to 32 cubic meter capacity. The compactors require a power supply in the form of either a 3-phase electrical service or self enclosed diesel drive units.

Depending on the composition, wastes can be compacted to typical densities of up to 450 kilograms per cubic meter (1295 lbs/yd^3) in the compactor bins. The practical weight limit for wastes in the bins is usually governed by the legal weight the transfer vehicle is capable of carrying.

When full, the bins are loaded onto a roll-off truck, such as that which was described for the drop box system, and hauled to the disposal site.

One or more open top roll-off bins can be provided for collecting large items, such as rubble or white goods, which cannot be put through the compactor, and separated materials such as household recyclables.

There are four compaction transfer station systems presently operating in Alberta. Compaction units service populations as small as 5,000 and as much as 22,500. Compaction transfer stations have been employed by the Lethbridge Regional Solid Waste Authority which operates four supervised compactor transfer stations. The Lacombe Regional Solid Waste Authority operates six supervised compactor transfer stations. Both systems have been operating satisfactorily to date. Some problems have occurred with waste freezing in the containers.

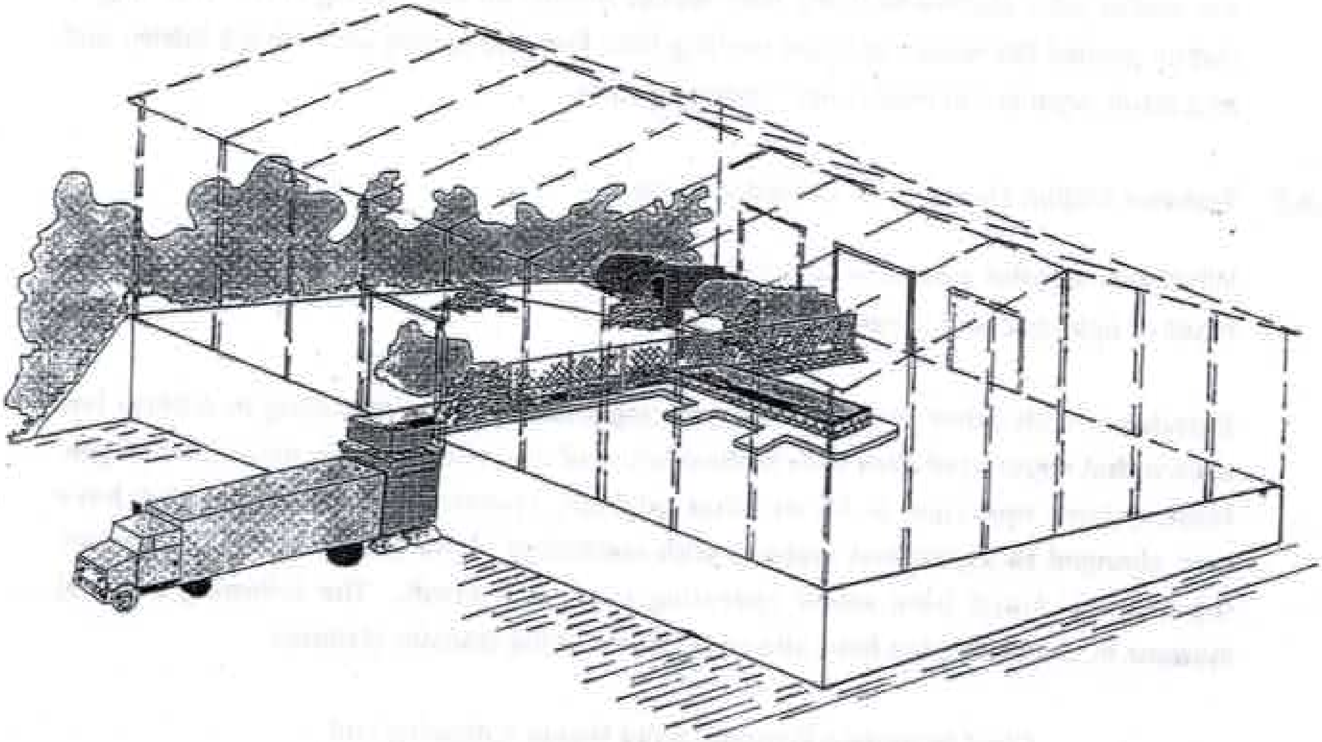
The transfer station located in Lacombe, municipal collection vehicles can dump directly into the compaction units. Road ban load limits restrict the amount of weight which the containers can hold. Load cells can assist the transfer station attendant in determining the maximum amount of waste a container can take.

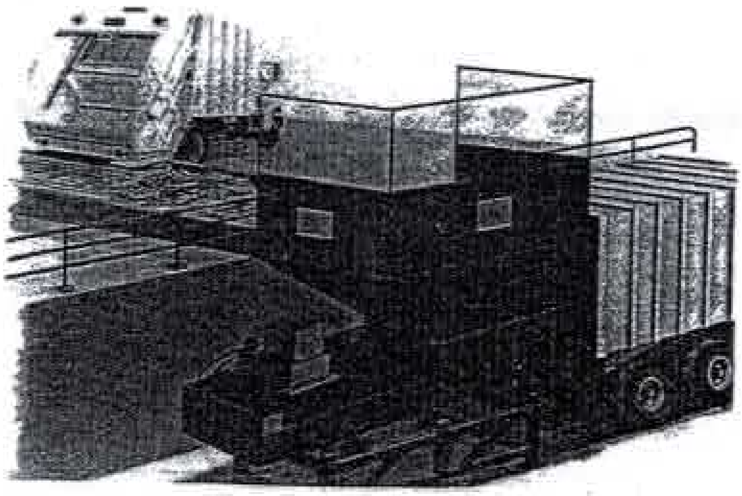
Advantages of the compactor system are:

- System is very attractive for its aesthetic and health benefits;
- Efficient use can be made of the bins and of the transfer truck;
- Site storage capacity is maximized;
- Use of a roll-off truck provides ability to utilize supplementary open top bins making the site conducive to the separation of recyclables and large objects; and
- Wastes are always in an enclosed container.

Disadvantages are:

- High capital costs, operating costs and maintenance costs;
- Dependence on mechanical equipment;
- Specialized truck is required;





VEHICLES UNLOAD ONTO TIPPING FLOOR,
LOADER PUSHES WASTES ONTO
"WALKING FLOOR" CONVEYING SYSTEM,
WHICH THEN FEEDS A COMPACTOR.
THE COMPACTOR THEN FEEDS
A COMPATIBLE
"WALKING FLOOR" EQUIPPED
TRANSFER TRAILER.

SOURCE :

KEITH MANUFACTURING Co.

Figure 4.17

LARGE WALKING FLOOR COMPACTION TRANSFER STATION

Unsupervised sites should not be considered. However, any savings in labor costs will be offset with the expense of:

- cleaning up messy and littered sites;
- abuse of types of wastes left at stations and the associated disposal costs; and
- repairing containers due to vandalism.

4.9 RESIDUE DISPOSAL/LANDFILL

4.9.1 Landfilling Operations

With the advent of recycling, composting and recovery programs, the amount of waste going to landfills will decrease. But there will always be a residue of any system that must be sent to a landfill site.

The design and operation of landfills for the disposal of solid waste has become more and more complex as the understanding of the short-term and long-term environmental implications of landfilling increases. Where once it was thought that the organics in landfills would biodegrade over time, it has now been found that the process is more complicated and not necessarily the most desirable environmental alterative for all wastes. As the composition of solid waste going to the landfill changes, through reduction, reuse and recycling, the process dynamics will also change.

The following is a review of the constraints to landfilling and some new technologies being applied or considered to deal with the design and operation of landfills in light of new regulations, public concerns and changes in waste composition.

4.9.2 Landfill Siting

The siting of landfills in Canada and Alberta has received much attention in recent years as the public awareness of health and aesthetic aspects of landfill waste disposal has increased.

Sites with high permeability soils (i.e.: sand), are not considered to be naturally suitable under these requirements. Protection of the local environment around such sites is highly dependent on the performance of the engineered systems which will control potential pollutants. The long-term performance of many of the engineered systems (for example, lining and leachate collection systems), is not known with certainty; naturally suitable sites offer additional long term environmental protection over engineered systems. For example, the rate of decomposition of wastes in southern Alberta is very slow due to the dry and cold climate. An engineered system must maintain its integrity against the escape of leachate over time.

4.9.3 Landfill Liners

The landfill liner is a low permeability layer constructed at the base and sides of the landfill site. The purpose of a landfill liner is to:

- contain leachate within the landfill, (to protect groundwater quality); and
- exclude groundwater from the landfill, (to minimize the volume of leachate produced).

The requirement for a liner for a landfill is site dependant and can be made a condition by the regulators. Alberta Environmental Protection, in its capacity as a referral agency to the local health unit, assesses sites for landfills. Recent conversations with Alberta Environmental Protection have indicated that where a potential site does not meet all of the guidelines, engineering of the site is recommended. One of these engineering steps is the construction of a liner.

The most common lining systems are:

- natural (or 'clay') liners;
- geomembrane (or flexible membrane) liners; and
- composite liners (a natural liner with a geomembrane liner).

The main characteristics of these liners are discussed briefly in the following sections.

The main advantages and disadvantages of natural liners are:

Advantages

Thickness: natural liners are relatively thick.

Durability: a protective layer is not required over a clay liner to prevent damage from the waste material being landfilled.

Conductivity: natural liners have very low conductivities to prevent the passage of liquids.

Flow Control: a clay liner will control the rate at which liquids pass into the soils below the site.

Adsorption of Chemicals: clay particles can adsorb and bind chemicals from the leachate.

Cost Effectiveness: where clay sources area available, they can be the most cost effective form of lining.

Disadvantages

Volume: natural liners involve the placement of a relatively large volume of soil. This can be expensive, especially if soil must be hauled a long distance to the site.

Desiccation: natural liners will shrink and crack if allowed to dry out before waste is placed in the landfill.

Variability: reliable sources of clayey soil suitable for use in the liner are not always available.

Leachate flow: natural liners are not impermeable; leachate will flow through them at a rate governed by the permeability of the liner and the head of leachate above it. Leachate flow can be expected over the entire area of the liner since all of the upper surface of the liner will receive leachate from the landfilled waste.

A typical cross-section of a clay liner is shown in Figure 4.18.

Geomembrane Liners

Geomembrane liners are constructed of impermeable plastic sheeting which is delivered to the site in rolls or panels and welded on site to form a continuous liner. These synthetic liners are available in a range of materials including High Density Polyethylene (HDPE), Polyvinyl Chloride (PVC), butyl rubber, plus a wide range of plastic alloys which have been developed over the years for a variety of applications. In Europe and North America HDPE has become the material of choice for landfill lining due to its high resistance to the chemical compounds commonly found in landfill leachate.

Geomembrane liners are typically 1mm to 2.5mm thick and are supplied in rolled sheets up to 10 metres wide. The sheets are unrolled at the site and cut into a series of panels. The panels are arranged on a carefully prepared subgrade free from sharp objects and softened zones which could pierce or stress the geomembrane. The overlap between adjoining panels is welded using either fusion welding (in which a hot wedge produces a melt zone within the overlap) or extrusion welding (in which a bead of melted polyethylene is run along the upper edge of the overlap).

Experience has shown that the welded overlap between the panels is likely to be the weakest part of the geomembrane liner. Moisture and dirt in the overlap, the temperature and speed of welding, and the technique of the welding technician can all affect the quality of the weld and result in all or part of the weld not meeting the weld specification. Welds which are incomplete or are too weak can lead to rapid loss of leachate through the geomembrane liner. Defects caused by physical damage to the geomembrane can produce similar results.

An intensive program of checks is required during construction of the liner to monitor the subgrade, geomembrane material, weld integrity and strength, and any repairs to defects identified during the construction. Both on-site and laboratory tests of the materials and workmanship are required. These checks have been formalized into 'Construction Quality Assurance' programs which are now common place in Europe and North America.

The integrity of geomembrane liners is based upon the following parameters:

- Geomembrane liners are not eternally resistant to UV light;
- Geomembrane liners have good chemical stability against MSW; and
- Mechanical stability of joints are as good as the quality control at the time of installation.

Composite Liner

A composite liner consists of a natural liner immediately overlain by a geomembrane liner. The composite liner combines the advantages of the natural and geomembrane liners and if constructed properly can have an effective permeability several orders of magnitude lower than either of the other liners if used individually.

The key to the performance of the composite liner is that the geomembrane is held tightly onto the clay liner by the downward force of the waste which lies above it. Where the geomembrane is in good condition, it is virtually impermeable and there will be no leachate flow through it. Where there are slight defects in the liner, in the welds or in the material itself, the flow of leachate will be restricted to a very small area. In this way, the surface area of the clay liner which is exposed to leachate is very small, and the leakage of leachate is very low.

The main advantages and disadvantages of the composite liner are:

Advantages	Disadvantages
Performance: the composite liner has an effective permeability several orders of magnitude lower than either a natural liner or a geomembrane liner if used individually. Thickness: the composite liner is relatively thick due to the natural liner component. Desiccation: the geomembrane liner component helps to prevent desiccation of the clay liner component if the liner system has to remain exposed to dry conditions before any waste is placed.	Cost: the composite liner is more expensive than a simple geomembrane liner since a natural liner component is also required. If the thickness of the natural component is reduced because of the presence of the geomembrane, the composite liner may be cheaper than a simple natural liner in applications where suitable natural soils are very costly. Protection: the synthetic portion of the liner must be protected against puncture from operating equipment or waste material.

Figure 4.19 shows a typical cross-section of a composite liner.

Liner Construction Quality Assurance

The performance of the lining systems reviewed above is highly dependent on the care with which the liner is constructed. As mentioned in previous sections, quality assurance programs are frequently used to monitor liner construction, and identify defects which can be repaired before they are buried beneath further layers of liner, or beneath the waste itself.

Construction quality assurance programs involve four main stages:

1. **Preparation of a specification** which defines the requirement of materials and workmanship on the project;
2. **Preparation of a quality assurance plan** which defines the requirement and activities of a construction monitoring team operating independently from the construction contractor. The objective of the monitoring activities is to record the compliance or non-compliance of specified quality-related construction activities with the specification;
3. **Monitoring of the construction** by the monitoring team: identifying deficiencies, overseeing repairs, documenting repairs; and
4. **Preparation of a quality assurance report** which describes the activities of the monitoring team, presents the monitoring records and identifies any remaining areas of non-compliance with the specification. As-built records of the constructed liner should also be presented.

In addition to providing a means of identifying and correcting defects in the construction, the quality assurance monitoring represents a technique by which a landfill owner can measure the performance of the specialist contractor(s) employed to construct the liner. The detailed records maintained as an integral part of the quality assurance program can assist with contract administration and lead to savings in costs during and after the liner construction.

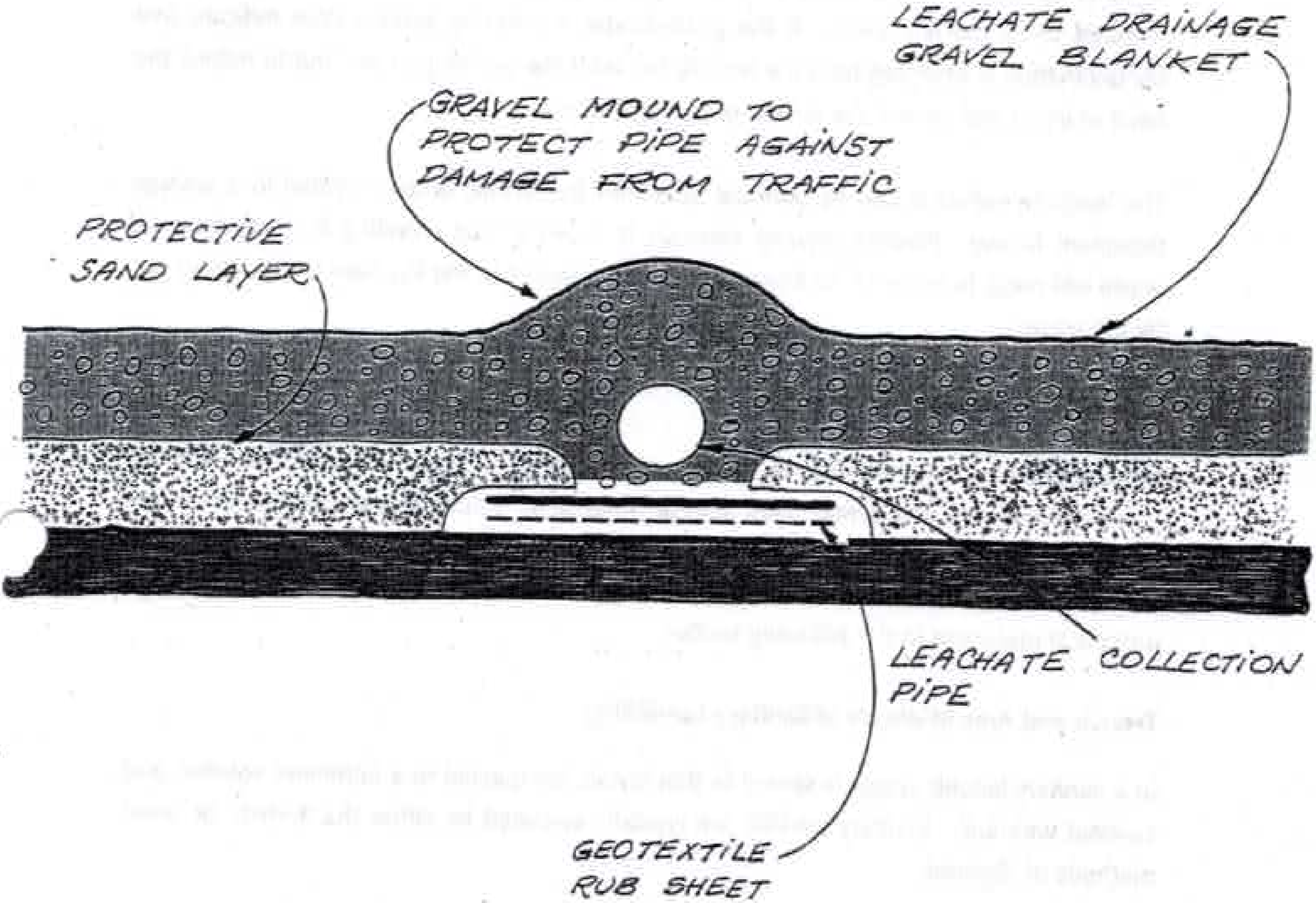


Figure 4. 20

TYPICAL CROSS - SECTION OF A LEACHATE COLLECTION SYSTEM

Cohesive soil such as clay is desirable for this method of landfilling since the walls between successive trenches can be thin and near vertical. The naturally occurring soils should also be resistant to leakage of leachate since this method of landfilling is not conducive to the installation of liners.

The most common form of large scale sanitary landfilling is the area method. This involves placing the waste on the ground, spreading it in layers and compacting it with compaction equipment. Daily soil cover is applied to minimize the blowing of paper and control odours, birds and vermin. Successive layers (or 'lifts') are built up until a final depth of approximately 3 metres is achieved. Intermediate cover material is recommended on the top and exposed surfaces of the compacted waste at the end of a working shift. Cells are created in this method by building earthen berms and filling the area between the berms with waste. A series of completed cells of the same height make up a layer. These layers will rise vertically until a total depth ranging from 15 to 30 metres is achieved depending upon the surrounding topography. A final cap of approximately one metre of low permeability soil is usually installed over the last layer of waste to promote run off of surface water away from the landfill, thus preventing infiltration into the landfill. Synthetic materials can be used for capping but are generally more expensive than clay.

An illustration of how a typical regional sanitary landfill is designed is provided in Figure 4.21. The illustration shows the overall design of landfill cells, as well as roadways, buildings and recycling areas at a landfill.

In order to achieve the maximum life for a landfill of a given capacity, it is important that the waste is compacted as much as possible within the site. The equipment best suited for compaction of waste are compactors that run on cleated steel wheels. The cleats will break down the waste and lead to optimum compaction. Uniformly high compaction is difficult to achieve due to the variability of the waste and the need for the owner/operator of a site to maintain a strict operation program. Although the cleated wheeled roller is the optimum for compaction, dozers are commonly used in locations that cannot justify the purchase of specialized equipment. A schematic of a typical sanitary landfill operation is shown in Figure 4.22.

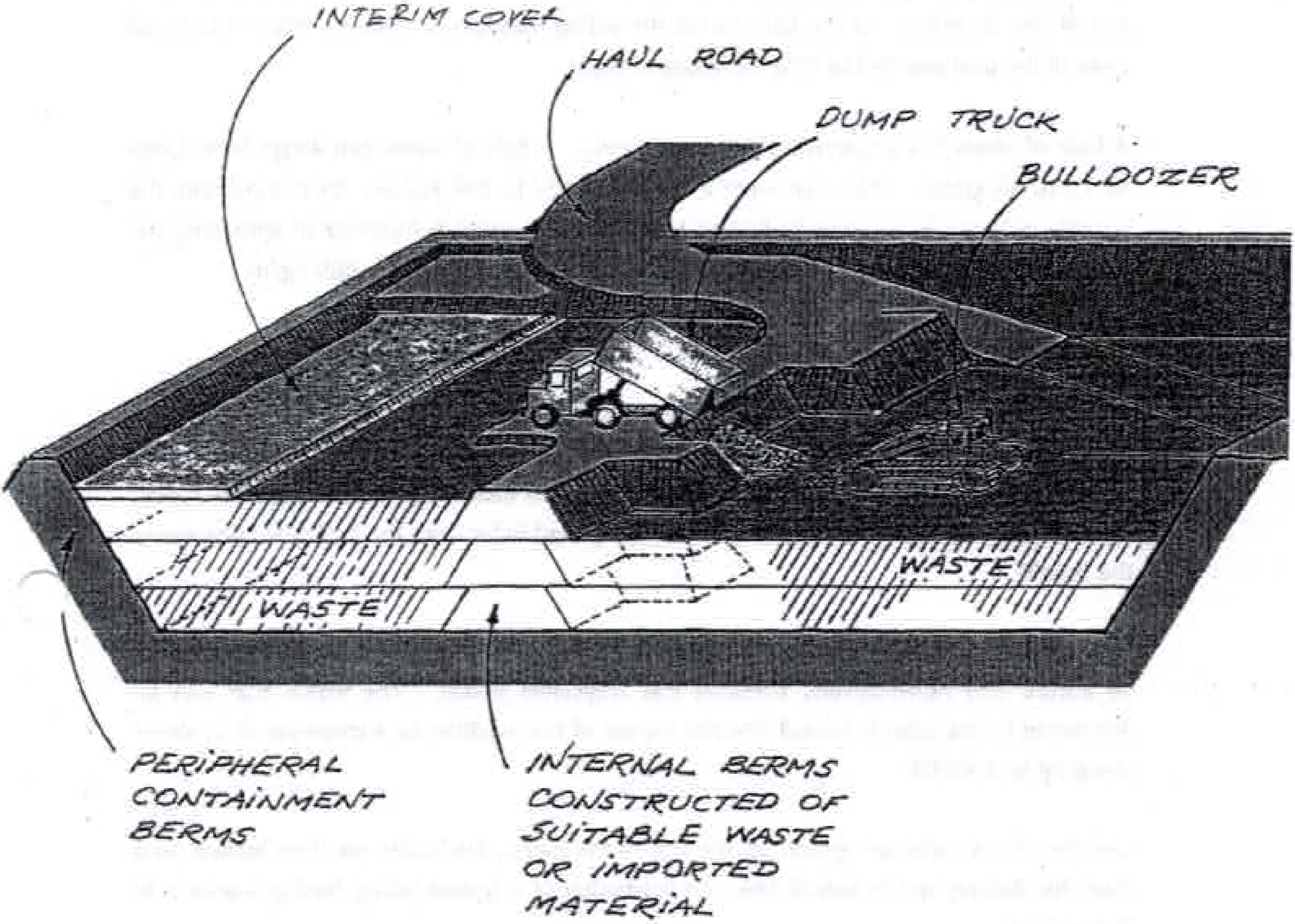


Figure 4. 22

SCHEMATIC OF A TYPICAL SANITARY LANDFILL OPERATION

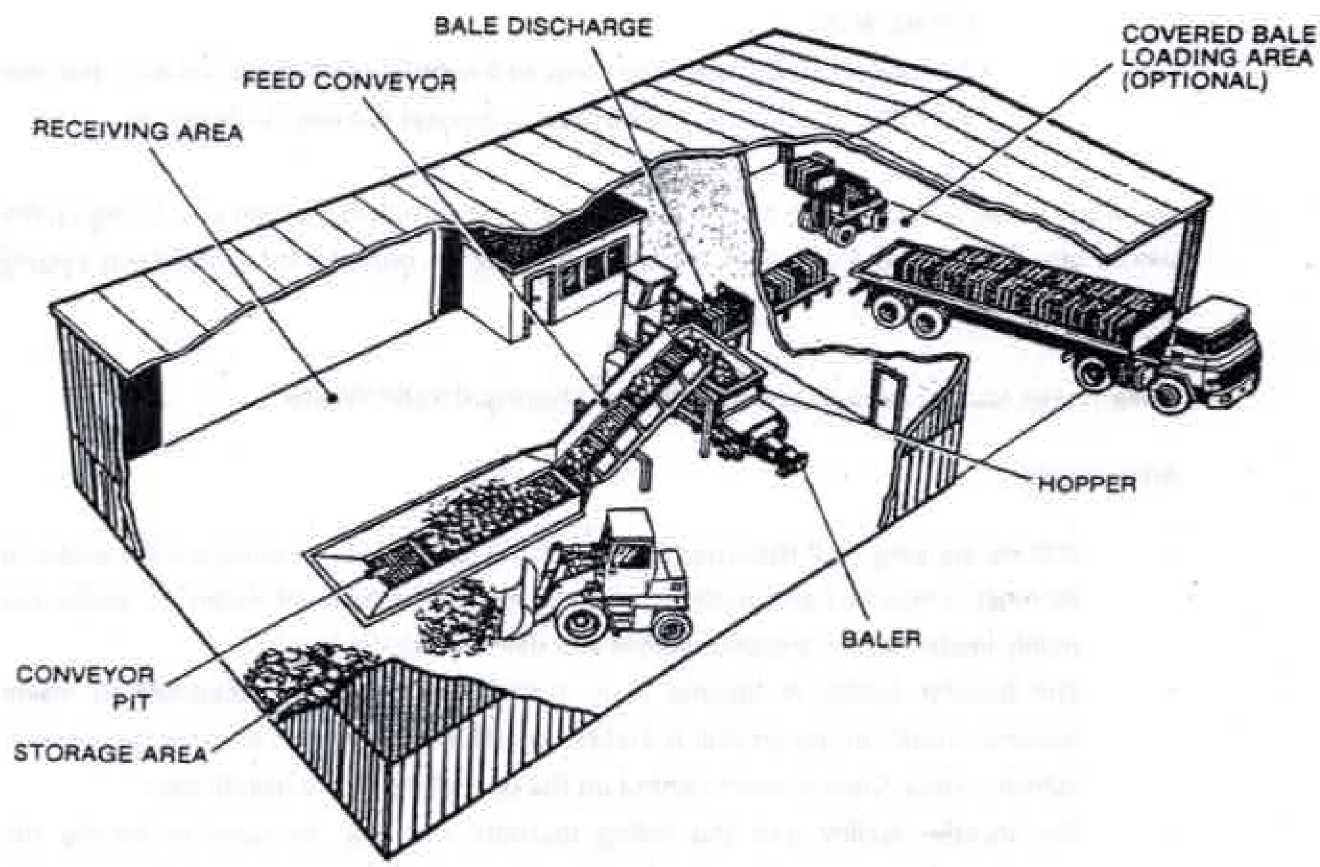


Figure 4. 23

ILLUSTRATION OF A TYPICAL BALING FACILITY

- High waste density is achieved in the bales coming from the baler. Densities up to 30% higher than normal sanitary landfill operations are normal with baling machines.
- Higher waste densities and less daily cover material result in longer site life.
- Dedicated compaction equipment at the site is not required.
- Balefill operation is simpler than landfill operation. Savings at the balefill site are achieved as a result of lighter equipment, less manpower and lower cover requirements.
- The life of equipment is extended when working in a balefill as opposed to a sanitary landfill. Delivery and placement equipment does not run over loose waste material which punctures tires or gets caught in the machinery and results in more wear and tear on the equipment.
- Baling minimizes fire hazards.
- Windblown debris and dust are greatly reduced.
- Scavenging by animals and birds is discouraged, greatly reducing the number of birds gathering at the site.
- Leachate concentration at a balefill is minimized since there is less material in contact with rainwater.
- Smaller metal objects such as appliances can be baled for shipment to recycling facilities if provisions are built into the baler specifications.
- Balefills have been successfully operated near major airports and in cold northern climates. The use of baling equipment is fairly commonplace in the United States. In Alaska, there are at least five municipalities using baling equipment and have been doing so for five to 10 years. In the southern states, baling equipment has rejuvenated many landfills, adding several years of life to an existing site at a time when locating and permitting landfills has become an expensive and time consuming task.

Disadvantages

- Dependant upon local conditions, purchase and operation of the baler and associated equipment are generally more expensive than conventional landfilling.
- A building is required to house the baler and the materials handling equipment.

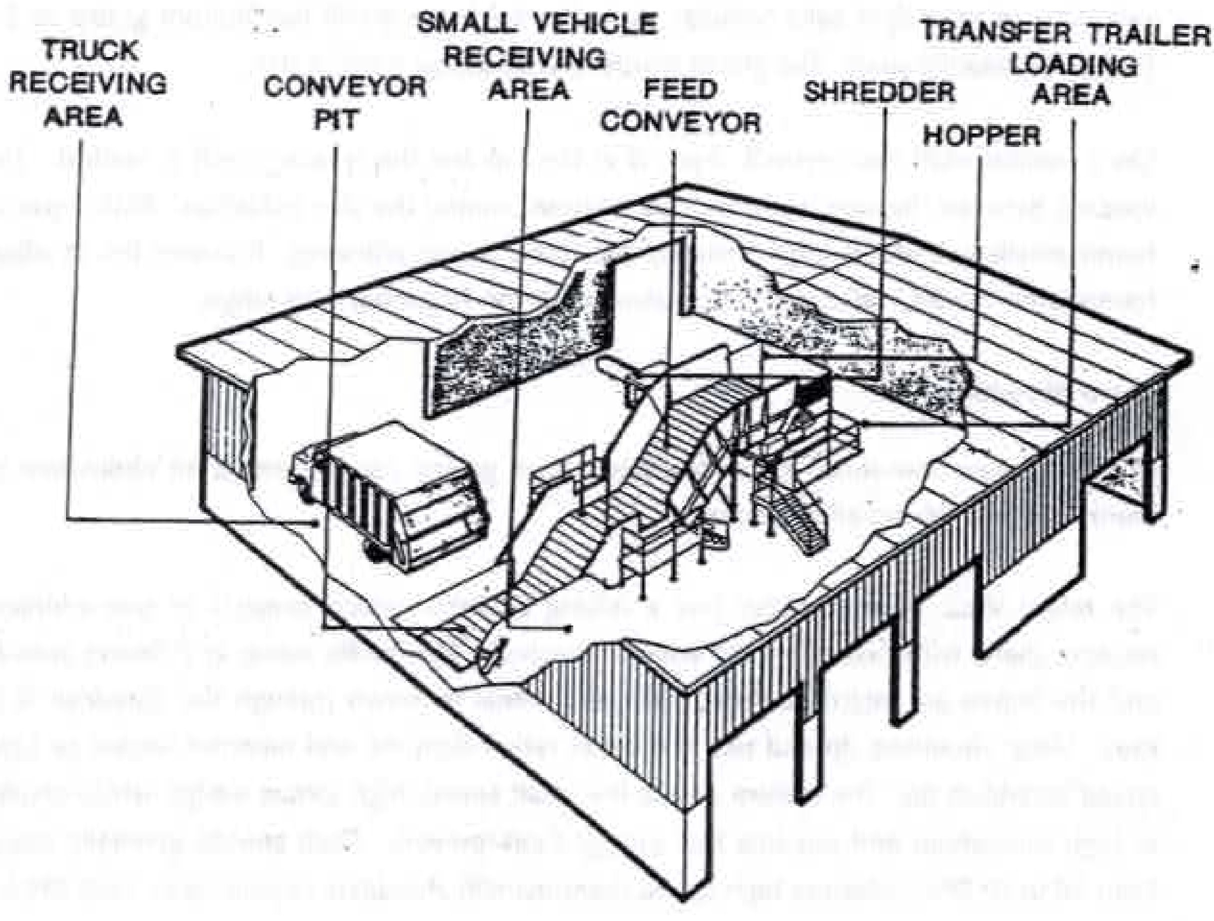


Figure 4.24

ILLUSTRATION OF A TYPICAL SHREDDING FACILITY

Trends in Shredding Wastes

In the 1970's, the most common type of shredder was the high-speed hammermill. Hammermills are efficient and capable of reducing wastes to a small size, but operating and maintenance problems made the use of this technology expensive and unreliable (machine component wear, high power requirements, internal damage due to processing of large objects). The shredding technology preferred today is the high torque, low-speed shear shredder. Component wear and power requirements are considerably lower than for hammermills and shear shredders can be equipped with a rejection feature that stops the shredder or causes it to back up if fed with objects too large or difficult to handle.

Shear shredders can comfortably achieve particle size reduction to about 20 cm in a single operation without excessive power requirements. If the required particle size is further reduced, power requirements increase substantially. For RDF production for example, a two stage shredding operation is often required to achieve the desired size reduction.

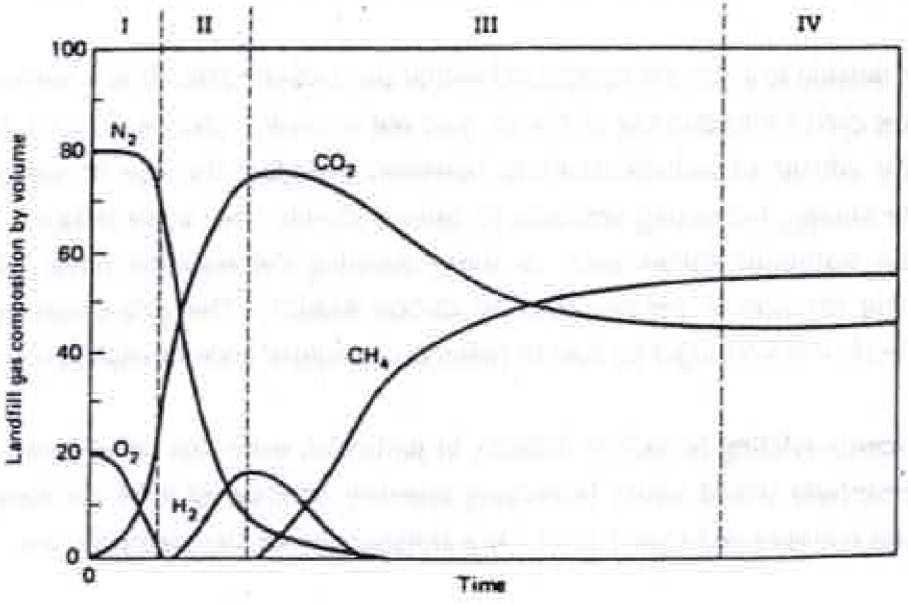
The City of Edmonton has operated three high-speed shredders at transfer stations since 1972. The shredders process around 30,000 tonnes of MSW annually in a primary shredding operation. Machine availability of about 85% has been reported .

Advantages of Shredding MSW:

- Up to 30% reduction in landfill waste volume can be achieved at a lower level of compaction effort.
- Landfill cover requirements are substantially reduced. Some studies even suggest that daily cover and interim cover material is unnecessary.
- Landfill operations are simplified. Shredded waste is easily distributed and compacted and equipment operating hours can be reduced up to one third. Unshreddable, reclaimable waste, such as vehicle bodies can be placed in segregated areas for future reclamation.
- The fire hazard at the landfill site is reduced. Properly shredded and compacted waste is unlikely to burn.
- Wind blown litter and dust are practically eliminated.

4.9.8 Landfill Gas Emissions

The organic fraction of waste which has been landfilled decomposes over time within an anaerobic environment. The decomposition process proceeds through several distinct biochemical phases, going from an open aerobic phase, through an intermediate phase of transition, to the anaerobic phase after landfill site, or section, completion and covering. Anaerobic decomposition may last well over 100 years at some landfills, depending largely on the site setting, climate (atmospheric) and waste characteristics (nature, quantity and moisture content). Typical decomposition and gas production patterns are well documented in the published landfill literature and generally follow a trend such as shown below:



Landfill gas production patterns.

Municipal waste landfills can generate carbon dioxide and methane in significant quantities. Typical landfill gas will contain about 45 to 60% methane, and from 40 to 55% carbon dioxide. Trace organic gases are also present in landfill emissions, including vinyl chloride, benzene, carbon tetrachloride, di- and tri-chloroethanes, and a vast array of other potentially toxic organic compounds.

The major greenhouse gases known to be of concern in addition to carbon dioxide and methane, are chlorofluorocarbons and nitrous oxide. The relative effectiveness of all of these gases for trapping of heat was presented at a 1990 symposium on municipal waste disposal and energy production, as being the following:

GREENHOUSE GAS CHARACTERISTICS

GAS	EFFECTIVENESS FACTOR PER MOLECULE*
CO_2	1
CH_4	25
N_2O	250
CFC-11	17,500
CFC-12	20,000
CFC-13	25,000

* Effectiveness of one molecule of a "greenhouse" gas compared to a molecule of CO_2. Thus, a molecule of N_2O is approximately 250 times more effective at trapping heat than a molecule of CO_2.

It has been estimated that approximately 7% of the worldwide methane emissions are contributed by landfills. Considering that 75% of methane in the atmosphere is naturally occurring and difficult to control, landfill gas emissions are responsible for approximately 25% of the controllable methane sources. This information coupled with greenhouse gas characteristics, clearly indicates the relative importance of methane, as an abundant landfill gas, to the overall protection contribution of the greenhouse effect.

Landfill Gas Control

Landfill gas migration is not typically a serious problem at landfills in Canada. Most landfills are situated in relatively remote settings, although some large municipal sites servicing mainly urban areas can be located near, or adjacent to, commercial, industrial and/or residential areas.

- Brock West Landfill Gas Project, Pickering, Ontario, a 23 MW steam power plant;
- Richmond Landfill Gas Project, Richmond, B.C., a low supply of medium Btu fuel to Canada LaFarge Cement Plant; and
- Kitchener Landfill Gas Utilization Project, Kitchener, Ontario, a low supply of medium Btu fuel to the Bestpipe Cement Plant.

In the U.S.A., where it has been estimated that landfills produce approximately 200 billion cubic feet of methane annually, the landfill gas extraction industry began to flourish in the mid 1970's during the initial "energy crisis", when alternate energy sources were being tapped. Today, it is estimated that there are more than 155 methane recovery projects either in operation, under construction, or in advanced planning.

4.10 ENERGY RECOVERY

4.10.1 General

Combustion or energy recovery is an important environment issue tor communities considering alternatives to landfills and is the logical final step in the 4-R's hierarchy of waste management. After the solid waste stream has been reduced and reused to the greatest extent possible, and recycling and composting programs have extracted as much material as possible, there will be a significant portion of the waste stream (50% or more) that contains some energy value suitable for extraction by combustion. The energy produced can be recovered and used in lieu of conventional fuels (such as coal and gas) for heating or the generation of electricity. In addition to the recovery of energy, the volume of the residue is significantly reduced (by around 90%), resulting in an absolute minimization of residue requiring landfill disposal, thereby conserving landfill capacity.

In spite of its obvious place in an integrated waste management system, waste combustion remains controversial. The work "incineration" conveys mental images of dark smoke being released into a clean sky. Needless to say, incineration of refuse has a bad consequently has pushed suppliers of products to reduce the amount of waste produced. In addition to packaging initiatives, there are drop off bins in most communities for commonly recycled materials and in some jurisdictions, the segregated collection of organics is becoming mandatory (for composting). In spite of all these measures, it has been recognized by the government officials in Germany that 40% to 80% of the waste will not be recycled and can only be further reduced by using energy from waste plants.

In addition, the German parliament recently approved a environmental law (TA Siedlungsabfall-Technical Regulation for Municipal Waste) which requires that prior to landfilling, domestic waste must be treated to ensure that groundwater contamination and air pollution are avoided. This basically implies that those wastes not recycled or composted will in all likelihood have to be combusted, making them suitable for landfilling. There are over 35 new large scale municipal waste combustors being planned in the next ten years in Germany.

In Japan, 70 percent of the solid waste is already treated at EFW facilities and in Switzerland it is over 80%. In North America there is still a trend towards landfilling rather than Energy From Waste plants (EFW), which is dictated primarily by economics (landfilling still costs less than EFW).

Recycling and composting programs would actually compliment an EFW facility, as the removal of certain wastes from the total waste stream would improve overall combustion performance. Glass and metals have no heating value, and create maintenance problems with slagging and lodging in a combustion system. Yard wastes are another category of waste that can cause operational problems, as it has a wide variability in heating value and requires greater operator attention to control. Even if all the glass, metals, newspapers and corrugated cardboard (whereby newspaper and corrugated cardboard have heating values of around 17,500 KJ/kg (7,500 Btu/lb)) were removed, the overall lost energy value would be insignificant. In fact, combustion facilities in areas with high recycling rates have experienced a net overall increase in the heating value of the waste arriving at the facility.

4.10.2 Waste Combustion Without Preprocessing

An Energy From Waste (EFW) plant consists of three major components. The first is the combustion system, which thermally treats the waste. The second component is the waste heat boiler, which recovers the heat in the form of steam (or sometimes hot water) and cools the flue gases. The third component is the flue gas cleaning equipment, which removes any remaining contaminants in the flue gases so that they meet CCME emission guidelines. Regardless of the up front combustion technology selected, the heat recovery equipment and flue gas cleaning system will be essentially similar in both technology and costs.

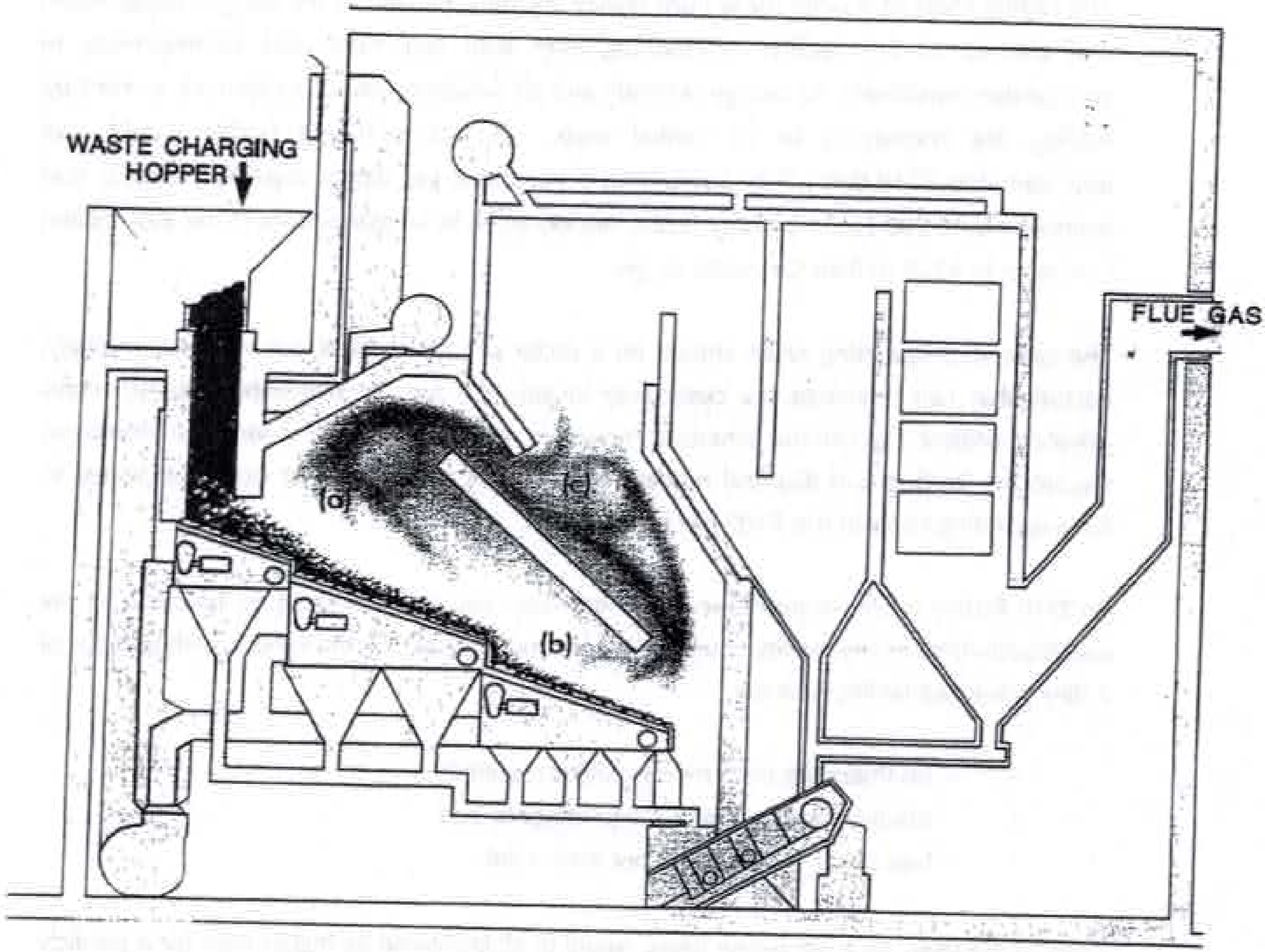
Various technologies are available on the market that will accept mixed municipal solid waste for combustion without any or minimal preprocessing. Some of the more common combustion technologies include:

- mass burn combustion;
- rotary kiln systems; and
- multi-staged controlled air combustion.

Mass burn combustion systems are generally used to process larger waste quantities, whereas rotary kiln and multi-staged controlled air systems are used for smaller waste quantities (less than 50 tonnes/day). The major difference between these systems is how the waste materials are transported, agitated, and controlled during the combustion process. Otherwise, they all achieve the same results: a flue gas effluent and a residue ash.

Mass Burn Combustion Systems

The term "mass burn combustion" describes the process of burning bulk, heterogeneous solid waste without pretreatment or presorting. The mass burn technology has been used and refined for over 50 years and is now considered state-of-the-art for large volume plants (200 tonnes/day and more). A limited amount of presorting is performed to remove



a) PRIMARY COMBUSTION ZONE

b) SECONDARY COMBUSTION ZONE

c) AFTERBURNING CHAMBER

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Figure 4.25

MASS BURN COMBUSTION

Rotary Kiln Combustion Systems

The rotary kiln system is suitable for most types of waste material and functions well in a wide range of sizes. The unit has gained considerable popularity in industry for the treatment of hazardous waste and to a lesser extent, by institutions for biomedical wastes. In principle, the system is simple and consists of a refractory lined horizontal cylinder, which turns about its horizontal axis. The cylinder turns, and is kept at a slight angle to the horizontal, resulting in the movement of wastes from one end to the other. Adjustment of the rake and turning speed allow control of waste retention time.

The waste feed ash removal, and secondary chamber of a rotary kiln system would be similar to that of the multi-staged controlled air combustor. A rotary kiln is illustrated in Figure 4.26. The main advantages of the rotary kiln over the controlled air (fixed hearth) design are the continuous agitation of waste and exposure to heat and oxygen in the gas stream, simplicity of operation, and control of the residence time to achieve a good burn out. Disadvantages include higher maintenance costs due to additional moving parts (large turning drum) and difficulties in sealing the drum ends against the ingress of air.

Rotary kiln systems are best suited to continuous operation. Intermittent operation can cause high refractory maintenance costs. The U of A Hospital in Edmonton have been operating two rotary kiln combustion systems since 1982 and indicate refractory breakdown and ash discharge problems as the major maintenance items.

Multi-Staged Controlled Air Combustion Systems

Multi-staged controlled air combustors are generally defined as having a fixed hearth and consisting of two (i.e.: a primary and secondary chamber) or more refractory lined chambers.

The primary chamber of a multi-stage system is designed so that introduced waste is burned to thermally break down and release the volatile materials at a controlled rate and temperature and then continue to burn out the remaining combustible materials. Solids within the chamber are moved by a series of transfer rams to break up the waste materials and to continue the thermal decomposition process, before the ash and unburnable residues are removed from the chamber. State of the art controlled air combustors are equipped with mechanical waste charging systems (ram feed) and automatic ash removal systems that allow continuous operation.

The volatile gases from the primary chamber are fully combusted in the secondary chamber under controlled temperature, turbulence and time conditions. In this chamber temperature and residence time requirements for the flue gas are achieved (i.e.: 1,000 °C for 1 second). From there the hot gases go on to the heat recovery and air pollution control systems. Figure 4.27 shows a typical controlled air combustion system being used for burning municipal solid waste.

The controlled-air technology has evolved considerably since being developed in the 1960's. Until fairly recently a properly designed and operated controlled air incinerator could pass existing particulate emission tests without particulate removal equipment (HCl removal scrubbers have been required in Alberta since the early 1980's). This was considered one of the strengths of this technology, but with the stricter emissions standards (CCME limits), no known incinerator type, including the controlled air, can operate without an HCl scrubber and an efficient particulate removal system.

Controlled air combustors are ideal and well proven for smaller waste throughputs. The systems have capacities that are normally in the 10 to 20 tonne per unit per day range. For greater waste capacities the units are typically operated in parallel.

An example of small scale incineration in Alberta is the Wainwright project. An Energy From Waste plant is being built there using a controlled air combustor, waste heat recovery boiler and dry scrubber/baghouse air pollution control equipment. The planned 20 tonne/day system was sized to handle the needs of a population base of 10,000 and will require a capital expenditure of about $5 million. After the extraction of revenues from steam sales, the operating costs will be around $65 per tonne. If capital recovery is added, the operating costs go up to $110 per tonne.

4.10.3 Refuse Derived Fuel

The principal of refuse derived fuel helps to overcome one of the major draw backs of burning a municipal waste on an as received basis. The composition of municipal waste varies significantly from day to day from region to region and from time of year to time of year. Depending on these factors and where the load is coming from, it can be wet with a low BTU value or very combustible. This places extremely high demands on the combustion system and makes it difficult to design equipment to meet all conditions, especially when they change rapidly.

Refuse derived fuel is processed municipal solid waste. When certain undesirables, such as metals and glass have been removed, and recyclables (where possible) have been taken out, the burnable fraction of the waste is shredded. In some cases the burnable fraction is pelletized before it is combusted. This results in a more homogeneous fuel that can be fired in industrial or utility boilers (although they often have to be dedicated or especially prepared for this type of fuel). Refuse derived fuel has a fairly consistent heating value and can be stored for several days in the form of shredded fluff or several weeks if pelletized. Due to the composition of refuse derived fuel, health concerns prevent longer term storage of the material.

Refuse derived fuel (RDF) also has the advantage that it can be produced locally and then shipped for combustion where it is needed or can be used. Thus, it is theoretically possible to produce RDF in the southern Alberta region and send it to a combustion system outside of the region.

During the 1970's, numerous RDF plants were built in the United States and central Canada. Many of these failed because of problems with materials handling technology and because of problems co-firing this waste in existing boilers. Most of these problems have now been overcome and those plants that are left (only a small fraction) seem to be operating well. The emissions from combusting the RDF would require similar monitoring

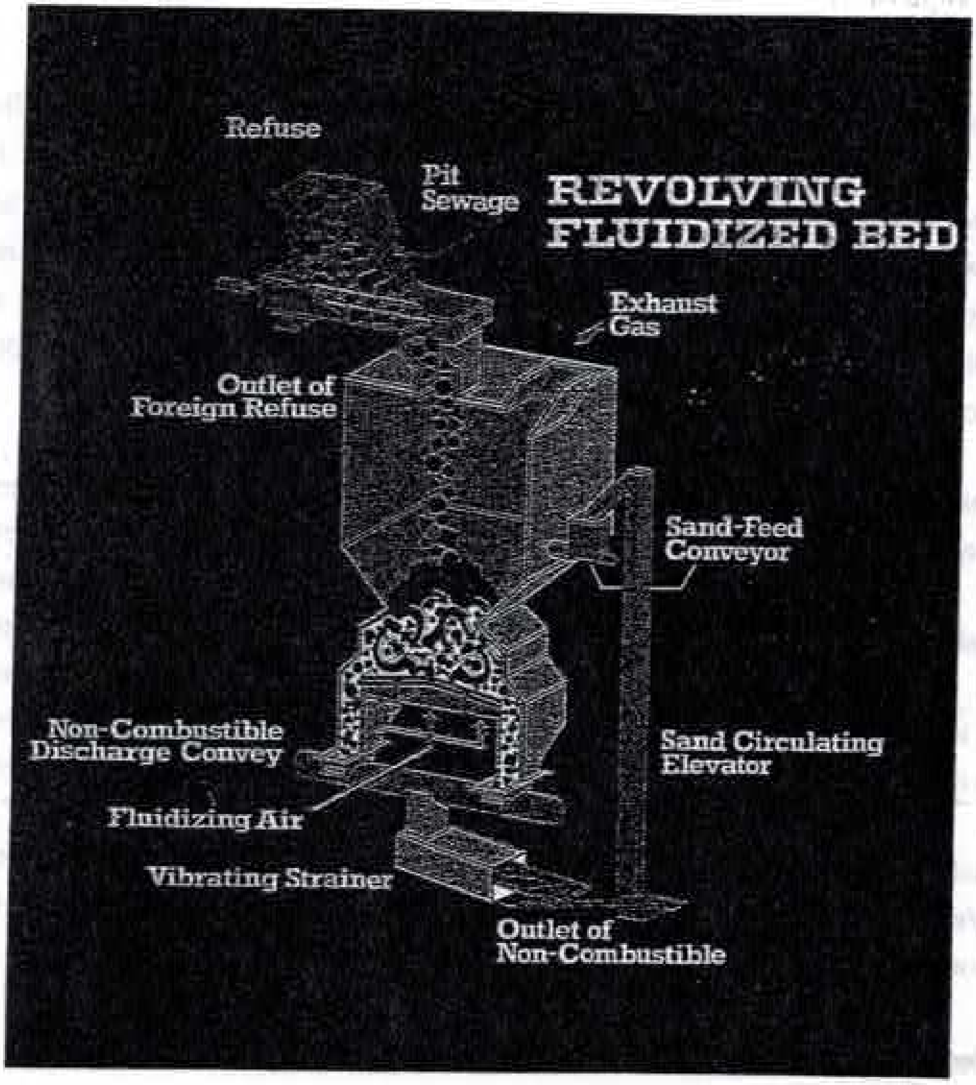

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FIGURE 4.28

FLUIDIZED BED COMBUSTION

Under the Alberta Clean Air Act, the Department of Environment issued **"Guidelines for Design and Operation of Refuse Incineration in Alberta"**, which have been in effect since 1983. The guideline addresses air emissions from incinerators burning solid wastes and is not intended for special waste or large mass burn systems, which are regulated separately. Most incinerators built and tested under this guideline were for hospital or industrial wastes.

While the emission limits set by this 1983 guideline were considered low at the time, further developments in the understanding of air pollution, its measurement and its control have made significant advances in the last 10 years. It is now possible to limit air emissions even further.

In June 1989, a final report was released by the **Canadian Council of Ministers of the Environment (CCME)** entitled **"Operating and Emission Guidelines for Municipal Solid Waste Incinerators"**. These CCME guidelines provide much stricter limits on key stack emissions from municipal waste combustion systems and will require the application of best available control technology (BACT) for air pollution equipment. These new limits have been adopted by Alberta Environmental Protection in their new standards. The limits are also being applied to all new biomedical waste incineration systems in the Province. Table 4.4 provides a comparison of new and old emission limits.

With these new limits the most significant change is in the area of particulates. Reducing allowable particulates by a factor of approximately 13 will require special removal systems for particulates more efficient than traditional wet scrubbers. By comparison, one of the newer controlled air incinerators in operation is at the Queen Elizabeth II Hospital in Grande Prairie. Its particulate emissions range from 0.02 to 0.05 kg/1,000 kg (approximately 30 mg/Rm^3 to 70 mg/Rm^3), which is one tenth to one quarter of the old limit, but on average, still slightly above the new particulate emission limit of 20 mg/Rm^3. This facility uses a quench/packed tower wet scrubber, which is suitable for HCl and large particle removal, but does not provide significant particulate reduction in the sub micron size range.

Carbon monoxide, polychlorinated dibenzo-p-dioxins (PCDD's) and polychlorinated dibenzofurans (PCDF's) emissions can be reduced through proper combustion control techniques. However PCDD's and PCDF's can reform after the incinerator and it has been found that they have an affinity to particle surfaces. A dry scrubber/baghouse system has been proven to meet the new PCDD's and PCDF's emission limits. A stand alone wet scrubbing system however, could have problems meeting the PCDD's and PCDF's emission limits, since wet scrubbers are not as effective in removing particulate matter (dioxins and furans have an affinity to collect on particles).

In addition to the emission limits, there are guidelines for temperature and retention time in the secondary chamber of the incinerator (1,000°C for 1 second), oxygen content at the boiler outlet (6% to 12% O_2), and a maximum particulate matter control device temperature of 140°C to ensure condensation of trace organic and metallic species.

Regulations on ash quality have not yet been developed and thus are not considered at this time. It is anticipated that future ash regulations will limit the carbon content of ash (a measure of burn-out efficiency) and also require leachability tests for metals prior to landfilling. Bottom and fly ash may contain some metals, but based on current EPA standards, it can generally be expected that incinerator ash from municipal solid waste systems will pass these tests to allow disposal at a sanitary landfill.

Typically, fly ash accounts for approximately 10% by weight of the total ash residue. It is important to note that bottom ash from the grate and fly ash from the baghouse should be tested separately before disposal. Bottom ash is considered to have chemical and physical properties that is believed to cause no problems in a leachability test and this usually permits its disposal in a municipal landfill. The bottom ash could have other uses, where for example in Hamburg, Germany, 90% of its bottom ash is used in road building materials. Fly ash could have trace organics and metallic species present which could make further treatment necessary before landfilling or disposal to a secure landfill.

semi-wet system. The dry system appears to be the most suitable for small applications and is being used primarily by those firms offering small scale dry scrubbing systems.

The preferred particulate removal device on a dry scrubber system after neutralization of the HCl is the fabric filter (baghouse). A baghouse is essentially a series of permeable bags which allow the passage of flue gases, but catch particle matter, utilizing the growth of captured particulate on the bag surface to catch even smaller particles. They provide the greatest particulate removal efficiency, especially in the sub micron range.

To remove collected particulates from the bags, an automatic control sequence is used which begins a cleaning cycle when the buildup of particulate raises the pressure differential across the bags above a preset level. To remove the buildup of particulate on bags, many baghouses use a pulsed compressed air system which travels the bag length, causing it to snap outward. The pulses dislodge particles from the outer surface of the bags, where they fall into a hopper and are collected for removal.

One of the disadvantages with dry scrubbing systems is their limited ability to reduce acid gases. According to scrubber manufacturers, achieving a reduction of HCl to 75 mg/Rm^3 is by no means a certainty if the initial HCl loading in the flue gas is high. Normal HCl production is a function of the amount of PVC plastics combusted. With biomedical wastes for instance the HCl emissions are on average more than twice as high as those for municipal solid wastes and is due to the typically high PVC plastic content in biomedical wastes (i.e.: average municipal waste HCl emissions are around 300 to 400 ppm, with peaks of 1,000 ppm, whereas average biomedical waste HCl emissions are 700 to 1,500 ppm, with peaks of 2,500 ppm).

Other potential problems with dry scrubbing systems are blinding of fabric filter bags and corrosion. The calcium chloride reaction product formed ($CaCl_2$) in the dry scrubber is very hygroscopic (which can lead to clogging of the filter bags), while any unreactive hydrogen chloride is very corrosive. Both can cause damage in areas of the scrubber vessel or particulate control device where cooling and water vapour condensation occur. Fabric filters can also deteriorate rapidly if operating and maintenance conditions are not carefully

4.11 SUMMARY

The following table outlines the potential solid waste management systems and processes described in Section 4, and summarize the advantages and disadvantages (see Table 4.5).

AT [illegible]CE WASTE REDUCTION [Combined Potential Waste Reduction of Reduce and Re-use: 5[illegible]%]

Waste Minimization Options	COSTS	ADVANTAGES	DISADVANTAGES
Home Waste Audits	• Low cost.	• If persons reduce waste at home they will likely do the same at work.	• Best administered by home visits and supported by some incentive.
Business Waste Audits	• Main cost is the labour cost. • Can be financed by increased tipping fees for priority items, such as cardboard. • Reduced disposal costs.	• Management tool to improve overall business performance. • Reduces costs through reducing inefficiencies. • Provides business with a marketable "green" image. • Saves waste fees and handling costs. • Can be extended to include water and energy.	• Requires a close relationship with business. • Onsite visits are most effective. • Requires business to implement recommendations • Incentive may be necessary, increased disposal costs if waste over a certain baseline is generated.
Landfill Materials Ban (for specific waste streams such as cardboard, tires batteries)	• Low Cost.	• Encourages persons not to buy wasteful items in the first place. • Encourages individuals to recycle the materials rather than dispose of them. • Reduces material to be dealt with at waste management facilities. • Helps keep "problem" materials out of landfills.	• Must be phased in over time along with a slow increase of tipping fees, before a material ban is achieved. • Education is needed to explain the benefits of this option. • Enforcement costs (Can be minimized by increased education efforts). • A recycling or alternative system must be in place to accept the banned items. (Even with an intensive reduction strategy the residue will need to be dealt with). • May initially cause some illegal dumping (Education will minimize this).
Increase Tipping Fees - for waste above a certain baseline and/or for specific waste streams.	• Low Cost.	• Revenue from increased tipping fees. • Strong economic incentive to reduce waste generation, or to recycle.	• See landfill materials ban above.

OR[illegible]C MANAGEMENT TECHNIQUES

[Potential Waste Reduction: 5% [illegible] %]

Waste Minimization Options	COSTS	ADVANTAGES	DISADVANTAGES
Home Composting	• Inexpensive.	• By reducing waste at source, the amount spend on transportation and processing correspondingly is reduced. • Easy to implement at any time.	• Outdoor style attracts wildlife so is allowed in part of study area, vermicomposters would need to be supported. • Largely a public communication effort. • Improper management and public information can lead to pest and odour problems.
Yard Waste Program (Windrow) Compostables from a Drop Off Site.	• $20-40/tonne.	• Can be combined in the same program as home composting. • Drop off sites can display demonstrations of home composting.	• Only yard waste is accepted initially, not food waste. • Requires strong planning and implementation skills. • Collection is more costly than a drop off site. • Siting, planning, and operational conditions must address public health concerns.
Composting Facility (In-vessel containerized system)	• $75-$125/tonne	• Can handle most organic wastes. • Extends landfill life. • Possible future source of revenue if a market is found (normally community gives compost away or uses it themselves).	• Requires education program. • Requires additional operational and capital costs. • Requires additional land. • Costs more than landfill.

SECTION 5.0
DEVELOPMENT OF COMPONENT COSTS

5.0 DEVELOPMENT OF COMPONENT COSTS

5.1 GENERAL

In the previous sections, various waste management system components were presented and discussed. In this section, estimated costs have been developed for these components. Detailed explanations and rationale for the proposed technologies discussed in this section area provided in Section 4.

5.1.1 Level of Service

In arriving at workable systems, a suitable level of service must be selected. In terms of waste management, level of service may be described in terms of three factors: hours of operation, travel distance, and material handling capability.

Hours of Operation and Supervision

Hours of operation must be assessed in light of the choice between a supervised site or an unsupervised site. Whereas the first has limited hours of access, the latter is open continuously. In the case of transfer stations, certain types of stations, such as push pit and compaction, require supervision for safety reasons.

The following analysis is based upon the premise that the transfer stations, which are being recommended, will be supervised. **Supervision offers economic benefits in terms of a more efficiently operated system through the control of the wastes, and the reduction of vandalism.**

Waste Management Authorities with operating experience have found that for small rural transfer stations, operation two days a week with convenient hours to residents (i.e. some evening hours) provides an acceptable level of service. Larger urban transfer station can be open 4 or 5 days a week, again with convenient hours to residents.

With respect to regional landfills, all are supervised, however; some sites are open five or six days a week, while others are open only one day a week. For the former situation,

Material Handling Capability

The mandate of a regional system is essentially to handle and dispose of all non-hazardous wastes produced in the jurisdiction. Public acceptance of the new system is not improved if the facilities cannot accept a good percentage of their normal wastes without forcing them to either haul a greater distance to a site which will accept them, or arrange for private disposal.

5.2 COLLECTION

Under the proposed integrated waste management plan, residential and commercial collection in the Towns and Cities will remain the responsibility of the Town or City. However, it is essential to evaluate the existing collection system and to integrate this component into the plan.

Each proposed transfer station has been conceptually chosen with the existing Town collection vehicles in mind.

5.3 WASTE MINIMIZATION PROGRAMS

Education plays a key role in the effect and efficiency of a waste minimization program. Residents will have to be informed of the programs (recycling, composting, transfer stations, regional landfill, etc.) which are planned for the study area. Using brochures, pamphlets, and/or articles in the local newspaper, they can be informed of the true cost of landfilling and waste reduction programs. The program can also encourage them to reduce the amount of waste they generate at work and at home. Brochures and pamphlets could be distributed through the post office or made available at various establishments through out the study area. Of course those jurisdictions within the study area which have already implemented such programs, will attempt to increase participation in their programs and to encourage the residents continued support.

An annual budget of $50,000 has been included in the strategies outlined in Section 6 to supplement the cost of some of these programs. Depending on the participation rate and

In Alberta, oil, as a flammable material, must be stored in tanks which are ULC (Underwriter Laboratories Commission) approved, and must be registered with the Management of Underground Storage Tanks (MUST) Program. The used oil storage tank has been specified to meet these guidelines (Alberta Fire Code, Part 4). The tanks must be double walled with the outer wall 10% larger than the inner wall, and the inner wall can hold no more than 2500 litres (500 gallons) (ULC Standards).

Although revenues are not foreseen for the recyclables collected and marketed, it is imperative to realize the benefits of diverting these materials from the landfills, in order to preserve natural resources for the production of new materials and to extend the life of the landfill.

Tables 5.1 through 5.5 provide an overview of the estimated capital expenditures required to expand the recycling program. Table 5.1 estimates the costs associated with recycling at the transfer stations, Table 5.2 summarizes the costs for a depot system in Medicine Hat similar to that in Lethbridge and Table 5.3 summarizes the costs for regional processing centers for recyclables in Lethbridge and Medicine Hat. Tables 5.4 and 5.5 summarize the costs associated with a Material Recovery Facility (MRF) (for Lethbridge and Medicine Hat respectively).

Although G.P.S. Recycling is already operating, it is doubtful, whether they could continue operating at their existing facility under the proposed scenarios. Therefore, estimated capital and operating costs have been included for a new facility.

TABLE 5.1
RECYCLING COMPONENT CAPITAL COSTS

RECYCLING CAPITAL COSTS - TRANSFER STATIONS/LANDFILL	
ITEM	**COST**
• Mobile Recycling Trailer	$20,000

SOUTHERN ALBERTA INTEGRATED WASTE MANAGEMENT STUDY

Table 5.3: Recycling Component Capital Costs
Recyclables Processing Centre From Depot System
Lethbridge and Medicine Hat (15 Tonnes/Day)

Component	Quantity	Cost Per Unit	Cost
Building	15,000 sq.ft	$45/sq.ft.	$675,000
Carts for Separation of Recyclables	60	$500	$30,000
Loader/Forklift	1	$30,000	$30,000
Scale	1	$10,000	$10,000
Conveyor System to Baler (48" wide)	1	$45,000	$45,000
Baler Horizontal (1800 lb) & Fluffer	1	$110,000	$110,000 *
Sub-total			$900,000
Engineering and Design (15%)			$135,000
Contingency (15%)			$135,000
Total Estimated Cost Per Recyclables Processing Centre			**$1,170,000**

* Based on budgetary cost estimates from suppliers

Table 5.5: Estimated Capital Costs of a Material Recovery Facility (MRF) For Dry Residential Wastes From Two-Stream Collection Program City of Medicine Hat (35 tonnes/day)

Component	Quantity	Cost Per Unit	Cost
Building			
- Receiving (7,500 sq ft)	7,500	$45	$337,500
- Processing (15,000 sq ft)	15,000	$45	$675,000
- Storage (7,500 sq ft)	7,500	$45	$337,500
Site Development (1 acres)			$25,000
Equipment			*
- Sorting Stations (16 total)			$150,000
- Aluminum Separator			$55,000
- OCC Pre-sort (Pit/Conveyor)			$85,000
- Balers			$120,000
- Baler Feed Conveyors			$60,000
Forklift	1		$40,000
Skid Steer Loaders	1		$40,000
Miscellaneous Costs			$25,000
Sub-total			$1,950,000
Engineering and Installation (15%)			$293,000
Contingency (15%)			$293,000
Total Estimated Costs for a MRF Facility for Medicine Hat			**$2,536,000**

* Based on budgetary cost estimates from suppliers

Table 5.7: Estimated Operating Costs of a Material Recovery Facility (MRF) For Dry Residential Wastes From Two-Stream Collection Program City of Lethbridge (55 tonnes/day)

Item	Quantity	Cost Per Unit	Cost
Labour (including O/H, and benefits)			
- Plant Manager	1	$50,000	$50,000
- Scale/Bookkeeper/Clerk	2	$25,000	$50,000
- Foreman/Machine Operators	2	$35,000	$70,000
- Forklift Operators	2	$35,000	$70,000
- Maintenance Worker	1	$25,000	$25,000
- Sorters	15	$25,000	$375,000
Utilities			$60,000
Maintenance and Repairs (10% of Capital)			$266,000
Sub-total			$966,000
Depreciation			
- Equipment (10 years)			$81,000
- Building (20 years)			$92,500
Contingency (10%)			$96,600
Total Estimated Operating Costs of a MRF at Lethbridge			**$1,236,000**

* Based on USEPA Handbook: Material Recovery Facilities for Municipal Solid Waste (EPA/625/6-91/031, September 1991)

Table 5.9: Annual Operating Cost for the Recyclables Collection Vehicle from the Drop-off Depots in Medicine Hat & Lethbridge

Item	Costs per Unit
Labour (including O/H and benefits)	
- Driver (part-time)	
(52 weeks/year, 15 hours/week x $15/hour)	$15,600
Vehicle Maintenance (10% of capital)	$5,000
Tires, Fuel, Insurance, etc. (5% of Capital)	$2,500
Sub-total	$23,100
Depreciation (6 years)	$8,400
Contingency (10%)	$2,300
Total Estimated Operating Cost for Collection Vehicle	**$33,800**

SOUTHERN ALBERTA INTEGRATED WASTE MANAGEMENT STUDY

Table 5.10: Composting Component Capital Costs
Windrow Composting Facility For
Lethbridge and Medicine Hat (475 to 625 Tonnes/Year)
(Costs Per Site)

Component	Quantity	Costs per Unit	Cost
Windrow Turner (pulled behind a farm tractor)	1	$25,000	$25,000
Compost Thermometer	1	$250	$250
Site Development	3 acre site		$20,000
Groundwater Monitoring Wells			
Installation, initial sampling, and report	3	$2,500	$7,500
Sub-total			$53,000
Engineering and Design (15%)			$7,900
Contingency (15%)			$7,900
Total Estimated Costs for Windrow Composting Facility at Lethbridge and Medicine Hat (Costs per Site)			**$69,000**

* Based on budgetary cost estimates from suppliers

SOUTHERN ALBERTA INTEGRATED WASTE MANAGEMENT STUDY

Table 5.10a: Composting Component Capital Costs
Windrow Composting Facility For Taber
(1,200 to 1,500 Tonnes/Year)

Component	Quantity	Costs per Unit	Cost
Windrow Turner (pulled behind a farm tractor)	1	$25,000	$25,000
Compost Thermometer	1	$250	$250
Site Development	10 acre site		$75,000
Groundwater Monitoring Wells			
Installation, initial sampling, and report	3	$2,500	$7,500
Sub-total			$108,000
Engineering and Design (15%)			$16,200
Contingency (15%)			$16,200
Total Estimated Costs for Windrow Composting Facility at Taber			**$140,000**

* Based on budgetary cost estimates from suppliers

SOUTHERN ALBERTA INTEGRATED WASTE MANAGEMENT STUDY

Table 5.12: Estimated Capital Costs for In-vessel Containerized Composting of Residential Organic Wastes For the City of Medicine Hat (40 tonnes/day)

Component	Quantity	Cost Per Unit	Cost
Loader	1		$85,000
Mixer/Shredder/Grinder	1		$70,000
Containers	35	$7,000	$245,000
Air Delivery and Control System			$70,000
Container Unloading System			$70,000
Trucks	1	$45,000	$45,000
Pre-processing			
- Concrete Mixing Pad (15,000 sq ft)			$45,000
- Mixing Building (4,000 sq ft)			$120,000
Feed, Surge, and Amendment Hoppers	3		$60,000
Conveyors			$60,000
Compost Screen/Hopper Conveyors			$60,000
Biofilter System			$55,000
Water reuse, storage, control			$20,000
Utilities, Water, Electric, Sewer			$60,000
Fencing			$12,000
Site Preparation			$60,000
Office and Administration Area			$60,000
Personnel Training			$20,000
Covered Compost Curing Area			$55,000
Sub-total			$1,272,000
Engineering and Design (15%)			$190,800
Contingency (15%)			$190,800
Total Estimated Costs for In-Vessel System @ Medicine Hat			**$1,654,000**

Notes:

1. Based on a 2 acre site.

* Based on budgetary cost estimates from suppliers

SOUTHERN ALBERTA INTEGRATED WASTE MANAGEMENT STUDY

Table 5.14: Estimated Annual Operating Costs for In-vessel Containerized Composting of Residential Organic Wastes For the City of Lethbridge (55 tonnes/day)

Item	Quantity	Cost Per Unit	Cost
Labour (includes O/H & benefits)			
- Skilled Labour	5	$31,200	$156,000
- General Labour	1	$16,600	$16,600
- Project Manager	1	$41,600	$41,600
Utilities			
- Equipment			$50,000
- Office			$8,000
Fuel			$187,200
Maintenance (10% of Capital)			$185,000
Testing			$97,200
Sub-total			$742,000
Depreciation (10 years)			$185,000
Contingency (10%)			$74,200
Total Estimated In-vessel System Operating Costs @ Lethbridge			**$1,001,000**

* Based on budgetary cost estimates from suppliers

5.6 TRANSFER STATIONS AND WASTE TRANSFER

5.6.1 General

The strategies that are presented in Section 6, are based on using green-box, drop-box, push pit, and compaction transfer systems.

Recent Costs for the transfer component for wastes, as well as for the transfer stations, are presented in this section.

5.6.2 Haul Costs

All haul costs will be based on the distance from the community (or area) being serviced to the disposal site. The analyses allow for the period of time spent for loading and unloading of wastes.

For the purposes of this report, it has been assumed that the equipment is being fully depreciated with no salvage value over a eight year life period. After the eight year period, if the vehicle is still operable, the depreciation costs will be eliminated, however, maintenance costs would likely increase to offset this saving. Tables 5.16 through 5.20 contain a detailed breakdown of the costs for each type of transfer equipment. Different depreciation periods could be considered to suit actual operating conditions. These have not been considered at this stage.

Green Box

Unit haul costs have been developed for a front-end loader (gross vehicle weight of 60,000 lbs, 260 hp engine, and automatic transmission). The compaction unit would have a capacity of 38 yd^3, with a compaction capacity of 750 lb/yd^3. Green boxes for the transfer stations have a capacity of 8 yd^3, and can be purchased for $900.

Haul costs were developed on the basis of an average 8 tonne load for the vehicle. The average travel speed, including an allowance for the loading of the bins and dumping time at the landfill, is estimated at 60 km/hr. The vehicle is assumed to have 1 (one) operator, and be used 40 hours per week. Hourly costs for this equipment are estimated at $40.61,

Push Pit - Semi-Trailer Transfer Vehicles for Push Pits

Haul costs for this system are based upon the hourly cost for a single axle highway tractor, pulling a trailer with a bobcat situated on a specially made platform. The average load is based on 8 tonnes, and the average haul speed is estimated to be 60 km/hr to account for loading and unloading time at the disposal point. The vehicle is assumed to have 1 (one) operator and work 40 hours per week for a life expectancy of 8 years. The hourly cost for a highway tractor and trailer has been estimated at $42.77. The total haul cost per tonne per kilometer, based on the one way distance to the site, has been calculated at $0.18. Table 5.19 outlines the transfer/haul operating costs for the push pit transfer station system. A depreciation factor has been included in the annual operating costs for eventual replacement of the vehicle.

Large Compaction Transfer Station Vehicles & Trailer

Haul costs for this system are based upon the hourly cost for a tandem axle highway tractor, pulling a trailer. The average load is based on 16 tonnes, and the average haul speed is estimated to be 60 km/hr to account for loading and unloading time at the disposal point. The vehicle is assumed to have 1 (one) operator and work 40 hours per week for a life expectancy of 8 years. The hourly cost for a highway tractor has been estimated at $47.61. The total haul cost per tonne per kilometer, based on the one way distance to the site, has been calculated at $0.10. Table 5.20 outlines the transfer/haul operating costs for the large compaction transfer station system. A depreciation factor has been included in the annual operating costs for eventual replacement of the vehicle.

TABLE 5.17
TRANSFER/HAUL OPERATING COSTS
FOR DROP BOX TRANSFER STATION SYSTEM

Capital Cost of Transfer Vehicle (Tilt frame truck for open bins)	$140,000

ITEM	COSTS/HOUR OF OPERATION
Vehicle	
• Depreciation	
- Capital Cost [1]	$ 8.41
• Fuel	10.23
• Maintenance and Tires	5.52
• Insurance	0.55
Subtotal	**$24.71**
Operator (including O/H & benefits)	15.00
Total	**$39.71**
To calculate cost per tonne/kilometre	
Divide by Average Load	5 tonnes
Divide by Average Speed	60 km/hour
Multiply by 2 for Round trip	
Cost per tonne/km	**$ 0.26**

Notes
[1] Based on 2080 hours per year, 8 year life.
* Based on budgetary cost extimates from suppliers.

TABLE 5.19
TRANSFER/HAUL OPERATING COSTS
FOR PUSH PIT TRANSFER STATION SYSTEM

Capital Cost of Transfer Vehicle (Tractor, Trailer, and Bobcat)	$160,000

ITEM	**COSTS/HOUR OF OPERATION**
Vehicle	
• Depreciation	
- Capital Cost (1)	$ 9.62
• Fuel	10.23
• Maintenance and Tires	7.20
• Insurance	0.72
Subtotal	**$27.77**
Operator (includes O/H & benefits)	15.00
Total	**$42.77**
To calculate cost per tonne/kilometre	
Divide by Average Load	8 tonnes
Divide by Average Speed	60 km/hour
Multiply by 2 for Round trip	
Cost per tonne/km	**$ 0.18**

Notes

(1) Based on 2080 hours per year, 8 year life.

* Based on budgetary cost extimates from suppliers.

5.7 Transfer Stations

Capital Costs

The transfer stations proposed for the study area have been conceptually developed to serve the population within the area of service. Peak times of the year have been taken into consideration when the capacities were calculated. Some of the transfer stations could be located at reclaimed modified landfill sites, while land may have to be purchased for the other stations.

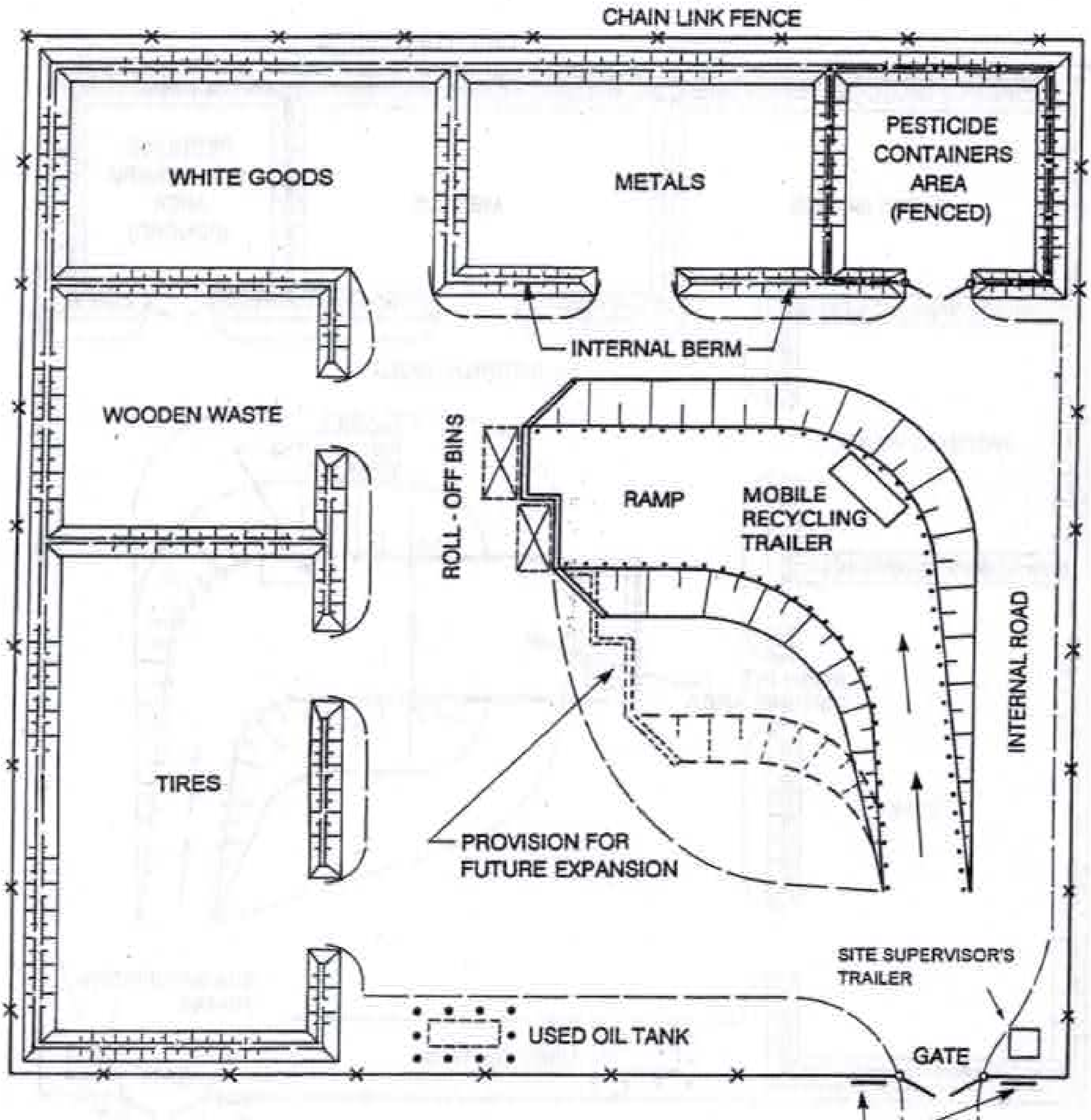
The transfer station capital costs have been estimated based on recently tendered stations and actual construction costs. The cost for the stations do not include an allowance for land costs or for upgrading County or M.D. access roads outside the transfer site. Cost estimates are presented in Tables 5.21 through 5.27 for the transfer stations. Table 5.21 summarizes the capital costs for a green box transfer station, Table 5.22 for a drop box transfer station, Table 5.23 for a compaction transfer station, Tables 5.24 through 5.26 for the push pit transfer stations, and Table 5.27 for the large walking floor compaction transfer stations. Plan view of the various transfer stations are illustrated in Figures 5.2 through 5.5.

Operating Costs

Operating and maintenance costs for transfer stations are based on the assumption that these stations will be supervised and will be open 2 days per week, 4 hours a day. These costs are summarized in Tables 5.28 through 5.32. Table 5.28 summarizes the operating costs for a green box transfer station, Table 5.29 for a drop box transfer station, Table 5.30 for a compaction transfer station, Table 5.31 for the push pit transfer stations, and Table 5.32 for the large walking floor compaction transfer stations.

Depreciation Fund for Transfer Stations

A depreciation fund for each transfer station has been developed to be added to the annual operating cost analyses. This fund covers the eventual replacement of the components, and ultimately the station (25 years).



NOTE :

SCHEMATIC DRAWING - NOT TO SCALE

Figure 5.3

DROP BOX TRANSFER STATION PLAN VIEW

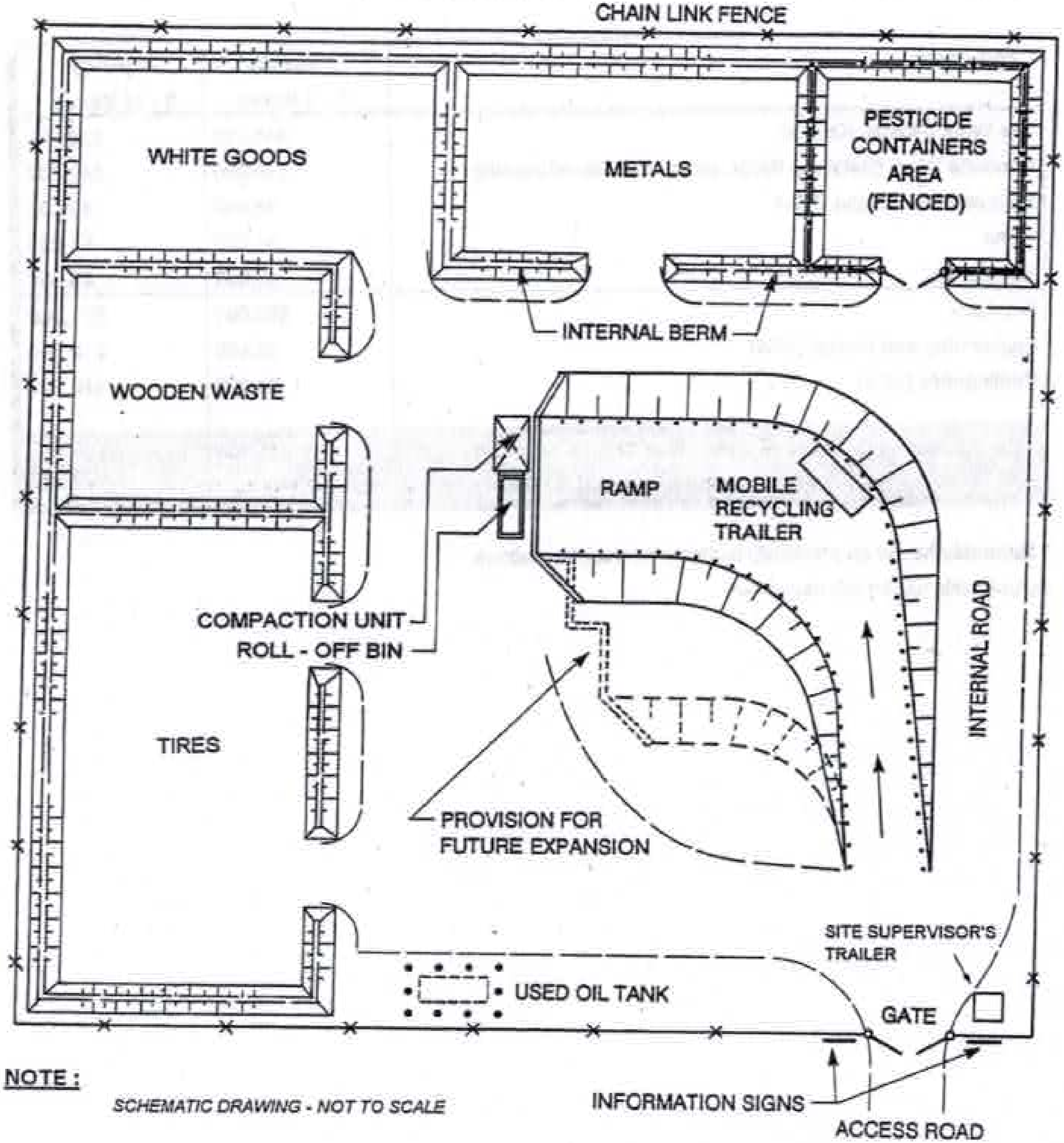


Figure 5.5

COMPACTION TRANSFER STATION PLAN VIEW

SOUTHERN ALBERTA INTEGRATED WASTE MANAGEMENT STUDY

Table 5.22: Capital Cost for Drop Box Transfer Station

Component	Capacity		
	1 Box	2 Box	3 Box
Site Work (Roads, Ramps)	$15,000	$20,000	$30,000
Concrete Work (Retaining Walls, slabs, and miscellaneous)	$25,000	$30,000	$35,000
Perimeter Fence and Gates	$5,000	$5,000	$5,000
Signs	$1,000	$1,000	$1,000
Site Trailer	$5,000	$5,000	$5,000
Sub-total	$51,000	$61,000	$76,000
Engineering and Design (15%)	$7,700	$9,200	$11,400
Contingency (15%)	$7,700	$9,200	$11,400
Total Estimated Costs For Drop Box Transfer Stations	**$66,400**	**$79,400**	**$98,800**

* Estimates based on previously constructed transfer stations.
Actual costs will be site dependent.

Table 5.24: Capital Cost for a Rural Push Pit Transfer Station

- Two sites to serve the villages, and surrounding areas around Milo and Mossleigh
- Single bay transfer station to serve a population less than 1000

Component	Cost
Site Preparation (clearing & stripping, earth work, culvets, etc.)	$75,000
Concrete Work (Retaining Walls, Slabs, etc.)	$60,000
Building (1200 sq ft)	$31,000
Fencing (Paige Link)	$7,500
On-site Roads	$15,000
Signs	$1,000
Waste Oil Storage Tank	$3,000
Pesticide Container Site	$6,000
Site Office Trailer	$5,000
Sub-total	$203,500
Engineering and Design (15%)	$30,500
Contingency (15%)	$30,500
Estimated Total Costs for a Push Pit Transfer Station	**$264,500**

* Estimates based on previously constructed transfer stations.
Actual costs will be site dependent.

Table 5.25: Capital Cost for a Rural Push Pit Transfer Station

- One site to serve the Champion/Carmangay villages and surrounding areas
- Two bay transfer station to serve a population less than 1500

Component	Cost
Site Preparation (clearing & stripping, earth work, culvets, etc.)	$88,000
Concrete Work (Retaining Walls, Slabs, etc.)	$73,000
Building (2300 sq ft)	$48,000
Fencing (Paige Link)	$7,500
On-site Roads	$15,000
Signs	$1,000
Waste Oil Storage Tank	$3,000
Pesticide Container Site	$6,000
Site Office Trailer	$5,000
Sub-total	$246,500
Engineering and Design (15%)	$37,000
Contingency (15%)	$37,000
Estimated Total Costs for a Push Pit Transfer Station	**$320,500**

* Estimates based on previously constructed transfer stations.
Actual costs will be site dependent.

Table 5.27: Capital Cost for Large Walking Floor Compaction Transfer Station (Cost per Station)

	Regional Landfill Locations			
	Lethbridge	Medicine Hat	Cowley Claresholm Redcliff	North Forty Lomond
Capacity (tonne/hr)	30	10	3.5	1.5
Component				
Walking Floor Storage Bunkers				
- Capacity (ft3)	2 x 60,000	1 x 52,000	1 x 19,800	1 x 6,000
- Cost	$600,000	$240,000	$150,000	$60,000
Steel Apron Conveyors				
$3000/ft				
- Length Required	2 x 40 ft	40 ft	20 ft	15 ft
- Cost	$240,000	$120,000	$60,000	$45,000
Pre-Compaction Chamber				
Transpac Model TP150 (25 tons/hr)	$840,000 (2 Required)	$420,000 (1 Required)	$420,000 (1 Required)	$420,000 (1 Required)
Building				
- Size	2 x 15000 sq.ft.	15000 sq.ft.	7500 sq.ft.	4500 sq.ft.
- Cost ($40/sq.ft.)	$1,200,000	$600,000	$300,000	$180,000
Scale	$110,000	$55,000	$55,000	$55,000
Scale House	$58,000	$29,000	$29,000	$29,000
Sub-total	$3,048,000	$1,464,000	$1,014,000	$789,000
Engineering and Design (15%)	$457,200	$219,600	$152,100	$118,400
Contingency (15%)	$457,200	$219,600	$152,100	$118,400
Total Estimated Capital Costs For Large Walking Floor Transfer Stations	**$3,962,400**	**$1,903,200**	**$1,318,200**	**$1,025,800**

* Based on budgetary cost estimates from suppliers (converted from US$ dollars).

SOUTHERN ALBERTA INTEGRATED WASTE MANAGEMENT STUDY

Table 5.29: Annual Operating Cost for a Drop Box Transfer Station

Item	Costs
Labour (including O/H and benefits)	
Site Supervisor (Per Site)	
(52 weeks/year, 2 days/week, 4 hours/day x $15/hour)	$6,200
Vehicle Allowance for Supervisor	$1,000
Site Maintenance (10% of capital)	$7,600
Sub-total	$14,800
Depreciation (20 years)	$3,800
Contingency (10%)	$1,500
Total Estimated Operating Costs For a Drop Box Transfer Station	**$20,100**

Note:

1. Supervision based on existing rural landfill operation.
2. Depreciation on concrete, roads, signs, & trailer.

Table 5.31: Annual Operating Cost for a Push Pit Transfer Station

- To serve a rural village, or hamlet, and surrounding area
- Single bay transfer station to serve a population less than 1000

Item	Cost
<u>Labour (including O/H and benefits)</u>	
Site Supervision	
- (2 days/week, 4 hours/day x $15/hr)	$6,200
Vehicle Allowance For Supervision	$1,000
Site Maintanence (10% of Capital)	$24,600
Sub-total	$31,800
Depreciation (20 years)	$12,000
Contingency (10%)	$7,600
Total Estimated Operating Costs for a Push Pit Transfer Station	**$51,400**

Notes:
1. Supervision based on existing rural landfill operation.
2. Depreciation on concrete, building, roads, signs, and trailer.

5.8 REGIONAL LANDFILLS

Cost estimates have been developed for supervised regional sanitary landfills. The regional landfills would be open 5 to 6 days a week. The capital costs have been developed in Tables 5.33 through 5.37. Table 5.33 summarizes the capital costs associated with a regional landfill at Lethbridge, Table 5.34 summarizes the capital costs associated with a regional landfill at Medicine Hat, Table 5.35 summarizes the capital costs associated with a regional landfill at Claresholm, Table 5.36 summarizes the capital costs associated with a regional landfill at Taber, and Table 5.37 summarizes the capital costs associated with a regional landfill at Lomond.

Operating costs for the regional facilities are presented in Tables 5.38 through 5.42. Table 5.38 summarizes the operating costs associated with a regional landfill at Lethbridge, Table 5.39 summarizes the operating costs associated with a regional landfill at Medicine Hat, Table 5.40 summarizes the operating costs associated with a regional landfill at Claresholm, Table 5.41 summarizes the operating costs associated with a regional landfill at Taber, and Table 5.42 summarizes the capital costs associated with a regional landfill at Lomond.

A depreciation fund for the regional landfills has been included to the annual operating cost analyses. This fund accounts for the costs associated with the development of a landfill.

Dry Disposal Sites

Capital costs associated with the developing disposal sites have been summarized in Table 5.43, while the operating costs have been summarized in Tables 5.44 and 5.45 (for urban and rural area sites respectively).

TABLE 5.33: COST ESTIMATE FOR REGIONAL LANDFILL (25 Year Life) IN WESTERN SECTION OF STUDY AREA (NEAR LETHBRIDGE)

CELL COSTS PER YEAR COMPONENT				COSTS
STRIP TOPSOIL		95,430 cu. m. @	$2.00	$190,900
SCARIFY AND RECOMPACT CLAY BASE		47,710 cu. m. @	$2.50	$119,300
CLAY LINER 600 mm THICK		187,920 cu. m. @	$10.00	$1,879,200
BASE AND BERMS	CUT	1,404,500 cu. m. @	$2.50	$3,511,300
	FILL	202,160 cu. m. @	$3.00	$606,500
INTERIOR ACCESS ROAD	FILL	25,000 cu. m. @	$3.00	$75,000
INTERNAL BERMS		50,000 cu. m. @	$3.00	$150,000
LEACHATE COLLECTION PIPE (8" DR 11 HDPE)		13,200 m. @	$30.00	$396,000
GEOTEXTILE MAT UNDER PIPE		13,200 sq. m. @	$3.00	$39,600
INSTALL GRAVEL DRAINAGE LAYER		75,000 cu. m. @	$30.00	$2,250,000
GEOTEXTILE ABOVE DRAINAGE LAYER		250,000 sq. m. @	$2.25	$562,500
LANDFILL CELL COST ESTIMATE SUB-TOTAL:				$9,780,300
CONTRACTOR MOBILIZATION FOR EQUIPMENT, BONDING, INSURANCE, ETC. (5%)				$489,000
CONTINGENCY (25%)				$2,445,100
ENGINEERING (10%)				$978,000
25 YEAR LANDFILL CELL COST ESTIMATES:				$13,692,400
ESTIMATED CELL COSTS PER YEAR:				$547,700

FUTURE CAP UPON CLOSURE COMPONENT			COSTS
FUTURE CAP UPON CLOSURE	280,900 cu. m. @	$5.00	$1,404,500
CONTRACTOR MOBILIZATION FOR EQUIPMENT, BONDING, INSURANCE, ETC. (5%)			$70,200
CONTINGENCY (25%)			$351,100
ENGINEERING (10%)			$140,500
FUTURE LANDFILL CAP COST ESTIMATES:			$1,966,300
ESTIMATED FUTURE CAP COSTS PER YEAR:			$81,900

LANDFILL DEVELOPMENT COSTS *Land Purchase Costs Not Incl.* COMPONENT			COSTS
SITE INVESTIGATION AND EVALUATION (PER SITE)			$150,000
DITCHING	2,260 m. @	$12.00	$27,100
FENCING (CHAIN LINK)	2,260 m. @	$66.00	$149,200
GATES	1 each @	$1,500.00	$1,500
SERVICE ROAD	600 m. @	$185.00	$111,000
OFFICE/SCALE HOUSE	1 each @	$28,775.00	$28,800
WEIGH SCALE (80 ft)	1 each @	$55,400.00	$55,400
MAINTENANCE BUILDING (12m x 12m)	144 sq. m. @	$500.00	$72,000
UTILITIES(POWER, WATER, PHONE, NAT. GAS)	1 each @	$75,000.00	$75,000
COMPACTOR & LOADER (CAT.#936&953)	2 units @	$443,000.00	$443,000
SUB-TOTAL:			$1,113,000
CONTRACTOR MOBILIZATION FOR EQUIPMENT, BONDING, INSURANCE, ETC. (5%)			$55,700
CONTINGENCY (25%):			$278,300
ENGINEERING (10%):			$111,300
ESTIMATED TOTAL DEVELOPMENT COSTS FOR A LANDFILL NEAR LETHBRIDGE:			$1,558,300

TONNES OF WASTE / YEAR	91,770	COST PER TONNE	$17.00
		1ST YEAR CELL COSTS:	$547,700
ESTIMATED TOTAL DEVELOPMENT AND 1ST YEAR CELL COSTS			$2,106,000
		$/TONNE WITH CELL COST	$22.90

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TABLE 5.34: COST ESTIMATE FOR REGIONAL LANDFILL (25 Year Life) IN EASTERN SECTION OF STUDY AREA (NEAR MEDICINE HAT)

CELL COSTS PER YEAR COMPONENT				COSTS
STRIP TOPSOIL		82,370 cu. m. @	$2.00	$164,700
SCARIFY AND RECOMPACT CLAY BASE		41,190 cu. m. @	$2.50	$103,000
CLAY LINER 600 mm THICK		161,850 cu. m. @	$10.00	$1,618,500
BASE AND BERMS	CUT	1,200,500 cu. m. @	$2.50	$3,001,300
	FILL	186,960 cu. m. @	$3.00	$560,900
INTERIOR ACCESS ROAD	FILL	20,500 cu. m. @	$3.00	$61,500
INTERNAL BERMS		50,000 cu. m. @	$3.00	$150,000
LEACHATE COLLECTION PIPE (8" DR 11 HDPE)		7,430 m. @	$30.00	$222,900
GEOTEXTILE MAT UNDER PIPE		7,430 sq. m. @	$3.00	$22,300
INSTALL GRAVEL DRAINAGE LAYER		63,480 cu. m. @	$30.00	$1,904,400
GEOTEXTILE ABOVE DRAINAGE LAYER		211,600 sq. m. @	$2.25	$476,100
LANDFILL CELL COST ESTIMATE SUB-TOTAL:				$8,285,600
CONTRACTOR MOBILIZATION FOR EQUIPMENT, BONDING, INSURANCE, ETC. (5%)				$414,300
CONTINGENCY (25%)				$2,071,400
ENGINEERING (10%)				$828,600
25 YEAR LANDFILL CELL COST ESTIMATES:				**$11,599,900**
ESTIMATED CELL COSTS PER YEAR:				**$464,000**

FUTURE CAP UPON CLOSURE COMPONENT			COSTS
FUTURE CAP UPON CLOSURE	240,100 cu. m. @	$5.00	$1,200,500
CONTRACTOR MOBILIZATION FOR EQUIPMENT, BONDING, INSURANCE, ETC. (5%)			$60,000
CONTINGENCY (25%)			$300,100
ENGINEERING (10%)			$120,100
FUTURE LANDFILL CAP COST ESTIMATES:			**$1,680,700**
ESTIMATED FUTURE CAP COSTS PER YEAR:			**$70,000**

LANDFILL DEVELOPMENT COSTS *Land Purchase Costs Not incl.* COMPONENT			COSTS
SITE INVESTIGATION AND EVALUATION (PER SITE)			$150,000
DITCHING	2,100 m. @	$12.00	$25,200
FENCING (CHAIN LINK)	2,100 m. @	$66.00	$138,600
GATES	1 each @	$1,500.00	$1,500
SERVICE ROAD	500 m. @	$185.00	$92,500
OFFICE/SCALE HOUSE	1 each @	$28,775.00	$28,800
WEIGH SCALE (80 ft)	1 each @	$55,400.00	$55,400
MAINTENANCE BUILDING (12m x 12m)	144 sq. m. @	$500.00	$72,000
UTILITIES(POWER, WATER, PHONE, NAT. GAS)	1 each @	$75,000.00	$75,000
COMPACTOR & LOADER (CAT.#936&953)	2 units @	$443,000.00	$443,000
SUB-TOTAL:			$1,082,000
CONTRACTOR MOBILIZATION FOR EQUIPMENT, BONDING, INSURANCE, ETC. (5%)			$54,100
CONTINGENCY (25%):			$270,500
ENGINEERING (10%):			$108,200
ESTIMATED TOTAL DEVELOPMENT COSTS FOR A LANDFILL NEAR MEDICINE HAT:			**$1,514,800**

NNES OF WASTE / YEAR	50,460	COST PER TONNE	$30.00
		1ST YEAR CELL COSTS:	$464,000

ESTIMATED TOTAL DEVELOPMENT AND 1ST YEAR CELL COSTS		$1,978,800
	$/TONNE WITH CELL COST	$39.20

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TABLE 5.35: COST ESTIMATE FOR REGIONAL LANDFILL (25 Year Life) IN WESTERN SECTION OF STUDY AREA (NEAR CLARESHOLM)

CELL COSTS PER YEAR COMPONENT				COSTS
STRIP TOPSOIL		24,200 cu. m. @	$2.00	$48,400
SCARIFY AND RECOMPACT CLAY BASE		12,100 cu. m. @	$2.50	$30,300
CLAY LINER 600 mm THICK		45,720 cu. m. @	$10.00	$457,200
BASE AND BERMS	CUT	312,500 cu. m. @	$2.50	$781,300
	FILL	95,760 cu. m. @	$3.00	$287,300
INTERIOR ACCESS ROAD	FILL	10,000 cu. m. @	$3.00	$30,000
INTERNAL BERMS		15,000 cu. m. @	$3.00	$45,000
LEACHATE COLLECTION PIPE (8" DR 11 HDPE)		2,770 m. @	$30.00	$83,100
GEOTEXTILE MAT UNDER PIPE		2,770 sq. m. @	$3.00	$8,300
INSTALL GRAVEL DRAINAGE LAYER		14,520 cu. m. @	$30.00	$435,600
GEOTEXTILE ABOVE DRAINAGE LAYER		48,400 sq. m. @	$2.25	$108,900
LANDFILL CELL COST ESTIMATE SUB-TOTAL:				$2,315,400
CONTRACTOR MOBILIZATION FOR EQUIPMENT, BONDING, INSURANCE, ETC. (5%)				$115,800
CONTINGENCY (25%)				$578,900
ENGINEERING (10%)				$231,500
25 YEAR LANDFILL CELL COST ESTIMATES:				$3,241,600
ESTIMATED CELL COSTS PER YEAR:				$129,700

FUTURE CAP UPON CLOSURE COMPONENT			COSTS
FUTURE CAP UPON CLOSURE	62,500 cu. m. @	$5.00	$312,500
CONTRACTOR MOBILIZATION FOR EQUIPMENT, BONDING, INSURANCE, ETC. (5%)			$15,600
CONTINGENCY (25%)			$78,100
ENGINEERING (10%)			$31,300
FUTURE LANDFILL CAP COST ESTIMATES:			$437,500
ESTIMATED FUTURE CAP COSTS PER YEAR:			$18,200

LANDFILL DEVELOPMENT COSTS *Land Purchase Costs Not Incl.* COMPONENT			COSTS
SITE INVESTIGATION AND EVALUATION (PER SITE)			$150,000
DITCHING	1,140 m. @	$12.00	$13,700
FENCING (CHAIN LINK)	1,140 m. @	$66.00	$75,200
GATES	1 each @	$1,500.00	$1,500
SERVICE ROAD	250 m. @	$185.00	$46,300
OFFICE/SCALE HOUSE	1 each @	$28,775.00	$28,800
WEIGH SCALE (80 ft)	1 each @	$55,400.00	$55,400
MAINTENANCE BUILDING (12m x 12m)	72 sq. m. @	$600.00	$43,200
UTILITIES(POWER, WATER, PHONE, NAT. GAS)	1 each @	$75,000.00	$75,000
TRACK TYPE LOADER (CAT.#953)	1 units @	$175,000.00	$175,000
SUB-TOTAL:			$664,100
CONTRACTOR MOBILIZATION FOR EQUIPMENT, BONDING, INSURANCE, ETC. (5%)			$33,200
CONTINGENCY (25%):			$166,000
ENGINEERING (10%):			$66,400
ESTIMATED TOTAL DEVELOPMENT COSTS FOR A LANDFILL NEAR CLARESHOLM:			$929,700

ONNES OF WASTE / YEAR	11,920	COST PER TONNE	$78.00
		1ST YEAR CELL COSTS:	$129,700
ESTIMATED TOTAL DEVELOPMENT AND 1ST YEAR CELL COSTS			$1,059,400
		$/TONNE WITH CELL COST	$88.90

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TABLE 5.36: COST ESTIMATE FOR REGIONAL LANDFILL (25 Year Life) IN CENTRAL SECTION OF STUDY AREA (NEAR TABER)

CELL COSTS PER YEAR COMPONENT				COSTS
STRIP TOPSOIL		25,930 cu. m. @	$2.00	$51,900
SCARIFY AND RECOMPACT CLAY BASE		12,970 cu. m. @	$2.50	$32,400
CLAY LINER 600 mm THICK		49,180 cu. m. @	$10.00	$491,800
BASE AND BERMS	CUT	338,000 cu. m. @	$2.50	$845,000
	FILL	99,560 cu. m. @	$3.00	$298,700
INTERIOR ACCESS ROAD	FILL	10,000 cu. m. @	$3.00	$30,000
INTERNAL BERMS		15,000 cu. m. @	$3.00	$45,000
LEACHATE COLLECTION PIPE (8" DR 11 HDPE)		2,770 m. @	$30.00	$83,100
GEOTEXTILE MAT UNDER PIPE		2,770 sq. m. @	$3.00	$8,300
INSTALL GRAVEL DRAINAGE LAYER		15,870 cu. m. @	$30.00	$476,100
GEOTEXTILE ABOVE DRAINAGE LAYER		52,900 sq. m. @	$2.25	$119,000
LANDFILL CELL COST ESTIMATE SUB-TOTAL:				$2,481,300
CONTRACTOR MOBILIZATION FOR EQUIPMENT, BONDING, INSURANCE, ETC. (5%)				$124,100
CONTINGENCY (25%)				$620,300
ENGINEERING (10%)				$248,100
25 YEAR LANDFILL CELL COST ESTIMATES:				$3,473,800
ESTIMATED CELL COSTS PER YEAR:				$139,000

FUTURE CAP UPON CLOSURE COMPONENT			COSTS
FUTURE CAP UPON CLOSURE	67,600 cu. m. @	$5.00	$338,000
CONTRACTOR MOBILIZATION FOR EQUIPMENT, BONDING, INSURANCE, ETC. (5%)			$16,900
CONTINGENCY (25%)			$84,500
ENGINEERING (10%)			$33,800
FUTURE LANDFILL CAP COST ESTIMATES:			$473,200
ESTIMATED FUTURE CAP COSTS PER YEAR:			$19,700

LANDFILL DEVELOPMENT COSTS *Land Purchase Costs Not Incl.* COMPONENT			COSTS
SITE INVESTIGATION AND EVALUATION (PER SITE)			$150,000
DITCHING	1,180 m. @	$12.00	$14,200
FENCING (CHAIN LINK)	1,180 m. @	$66.00	$77,900
GATES	1 each @	$1,500.00	$1,500
SERVICE ROAD	250 m. @	$185.00	$46,300
OFFICE/SCALE HOUSE	1 each @	$28,775.00	$28,800
WEIGH SCALE (80 ft)	1 each @	$55,400.00	$55,400
MAINTENANCE BUILDING (12m x 12m)	72 sq. m. @	$600.00	$43,200
UTILITIES(POWER, WATER, PHONE, NAT. GAS)	1 each @	$75,000.00	$75,000
TRACK TYPE LOADER (CAT.#953)	1 units @	$175,000.00	$175,000
SUB-TOTAL:			$667,300
CONTRACTOR MOBILIZATION FOR EQUIPMENT, BONDING, INSURANCE, ETC. (5%)			$33,400
CONTINGENCY (25%):			$166,800
ENGINEERING (10%):			$66,700
ESTIMATED TOTAL DEVELOPMENT COSTS FOR A LANDFILL NEAR TABER:			$934,200

TONNES OF WASTE / YEAR	12,950	COST PER TONNE	$72.10
		1ST YEAR CELL COSTS:	$139,000
ESTIMATED TOTAL DEVELOPMENT AND 1ST YEAR CELL COSTS			$1,073,200
		$/TONNE WITH CELL COST	$82.90

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TABLE 5.37: COST ESTIMATE FOR REGIONAL LANDFILL (25 Year Life) IN NORTHERN SECTION OF STUDY AREA (NEAR LOMOND)

CELL COSTS PER YEAR COMPONENT				COSTS
STRIP TOPSOIL		13,740 cu. m. @	$2.00	$27,500
SCARIFY AND RECOMPACT CLAY BASE		6,870 cu. m. @	$2.50	$17,200
CLAY LINER 600 mm THICK		24,880 cu. m. @	$10.00	$248,800
BASE AND BERMS	CUT	162,000 cu. m. @	$2.50	$405,000
	FILL	69,160 cu. m. @	$3.00	$207,500
INTERIOR ACCESS ROAD	FILL	9,000 cu. m. @	$3.00	$27,000
INTERNAL BERMS		15,000 cu. m. @	$3.00	$45,000
LEACHATE COLLECTION PIPE (8" DR 11 HDPE)		1,980 m. @	$30.00	$59,400
GEOTEXTILE MAT UNDER PIPE		1,980 sq. m. @	$3.00	$5,900
INSTALL GRAVEL DRAINAGE LAYER		6,750 cu. m. @	$30.00	$202,500
GEOTEXTILE ABOVE DRAINAGE LAYER		22,500 sq. m. @	$2.25	$50,600
LANDFILL CELL COST ESTIMATE SUB-TOTAL:				$1,296,400
CONTRACTOR MOBILIZATION FOR EQUIPMENT, BONDING, INSURANCE, ETC. (5%)				$64,800
CONTINGENCY (25%)				$324,100
ENGINEERING (10%)				$129,600
25 YEAR LANDFILL CELL COST ESTIMATES:				**$1,814,900**
ESTIMATED CELL COSTS PER YEAR:				**$72,600**

FUTURE CAP UPON CLOSURE COMPONENT			COSTS
FUTURE CAP UPON CLOSURE	32,400 cu. m. @	$5.00	$162,000
CONTRACTOR MOBILIZATION FOR EQUIPMENT, BONDING, INSURANCE, ETC. (5%)			$8,100
CONTINGENCY (25%)			$40,500
ENGINEERING (10%)			$16,200
FUTURE LANDFILL CAP COST ESTIMATES:			**$226,800**
ESTIMATED FUTURE CAP COSTS PER YEAR:			**$9,500**

LANDFILL DEVELOPMENT COSTS *Land Purchase Costs Not Incl.* COMPONENT			COSTS
SITE INVESTIGATION AND EVALUATION (PER SITE)			$150,000
DITCHING	860 m. @	$12.00	$10,300
FENCING (CHAIN LINK)	860 m. @	$66.00	$56,800
GATES	1 each @	$1,500.00	$1,500
SERVICE ROAD	200 m. @	$185.00	$37,000
OFFICE/SCALE HOUSE	1 each @	$28,775.00	$28,800
WEIGH SCALE (80 ft)	1 each @	$55,400.00	$55,400
MAINTENANCE BUILDING (12m x 12m)	72 sq. m. @	$600.00	$43,200
UTILITIES(POWER, WATER, PHONE, NAT. GAS)	1 each @	$75,000.00	$75,000
TRACK TYPE LOADER (CAT.#953)	1 units @	$175,000.00	$175,000
SUB-TOTAL:			$633,000
CONTRACTOR MOBILIZATION FOR EQUIPMENT, BONDING, INSURANCE, ETC. (5%)			$31,700
CONTINGENCY (25%):			$158,300
ENGINEERING (10%):			$63,300
ESTIMATED TOTAL DEVELOPMENT COSTS FOR A LANDFILL NEAR LOMOND:			**$886,300**

ONNES OF WASTE / YEAR	5,090	COST PER TONNE	$174.10
		1ST YEAR CELL COSTS:	$72,600
ESTIMATED TOTAL DEVELOPMENT AND 1ST YEAR CELL COSTS			**$958,900**
		$/TONNE WITH CELL COST	$188.40

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TABLE 5.39: ESTIMATED OPERATING COSTS FOR REGIONAL LANDFILL IN EASTERN SECTION OF STUDY AREA (NEAR MEDICINE HAT)

ITEM					COSTS
LABOUR (INCLUDING O/H AND BENEFITS)					
SUPERVISOR	52 WEEKS	5 DAYS/WK	10 HRS/DAY	$25.00	$65,000
EQUIPMENT OPERATORS	104 WEEKS	6 DAYS/WK	10 HRS/DAY	$20.00	$124,800
WEIGH SCALE OPERATOR	52 WEEKS	6 DAYS/WK	8 HRS/DAY	$15.00	$37,400
CASUAL LABOUR	26 WEEKS	3 DAYS/WK	8 HRS/DAY	$15.00	$9,400
EQUIPMENT MAINTENANCE	7% OF COMPACTOR & LOADER EQUIPMENT COSTS				$31,010
FUEL FOR EQUIPMENT	5% OF COMPACTOR & LOADER EQUIPMENT COSTS				$22,150
UTILITIES FOR BUILDINGS					$15,000
MISCELLANEOUS RENTALS/CONTRACTS (EXCAVATING, HAULING, VARIOUS TOOLS)					$25,000
OPERATING COST SUB-TOTAL					$329,760
DEPRECIATION ON LANDFILL DEVELOPMENT COSTS (10 YEARS)					$108,200
CONTINGENCY (10%)					$33,000
FUTURE CAP UPON CLOSURE					$70,000
CELL COSTS PER YEAR					$464,000
ESTIMATED TOTAL OPERATING COSTS OF A REGIONAL LANDFILL NEAR MEDICINE HAT					$1,004,960

TONNES OF WASTE / YEAR	50,460	OPERATING COSTS PER TONNE	$19.90

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TABLE 5.41: ESTIMATED OPERATING COSTS FOR REGIONAL LANDFILL IN CENTRAL SECTION OF STUDY AREA (NEAR TABER)

ITEM					COSTS
LABOUR (INCLUDING O/H AND BENEFITS)					
SUPERVISOR	52 WEEKS	6 DAYS/WK	8 HRS/DAY	$25.00	$62,400
EQUIPMENT OPERATORS	52 WEEKS	5 DAYS/WK	8 HRS/DAY	$20.00	$41,600
CASUAL LABOUR	52 WEEKS	3 DAYS/WK	8 HRS/DAY	$15.00	$18,700
EQUIPMENT MAINTENANCE	7% OF TRACK TYPE LOADER EQUIPMENT COSTS				$12,250
FUEL FOR EQUIPMENT	5% OF TRACK TYPE LOADER EQUIPMENT COSTS				$8,750
UTILITIES FOR BUILDINGS					$6,000
MISCELLANEOUS RENTALS/CONTRACTS (EXCAVATING, HAULING, VARIOUS TOOLS)					$7,500
OPERATING COST SUB-TOTAL					$157,200
DEPRECIATION ON LANDFILL DEVELOPMENT COSTS (10 YEARS)					$66,700
CONTINGENCY (10%)					$15,700
FUTURE CAP UPON CLOSURE					$19,700
CELL COSTS PER YEAR					$139,000
ESTIMATED TOTAL OPERATING COSTS OF A REGIONAL LANDFILL NEAR TABER					$398,300

TONNES OF WASTE / YEAR	12,950	OPERATING COSTS PER TONNE	$30.80

SOUTHERN ALBERTA INTEGRATED WASTE MANAGEMENT STUDY

TABLE 5.43: COST ESTIMATE FOR DRY WASTE DISPOSAL LANDFILL ASSUMING ONE DRY WASTE SITE IN EACH COUNTY OR M.D.

COMPONENT	QUANTITY	COST PER UNIT	COST
PREPARE TRENCHES	2,000 cu. m. @	$2.50	$5,000
DITCHING	100 m. @	$12.00	$1,200
FENCING	300 m. @	$66.00	$19,800
GATES	1 each @	$1,500.00	$1,500
SERVICE ROAD	100 m. @	$185.00	$18,500
OFFICE TRAILER	1 each	$2,000.00	$2,000
SUB-TOTAL:			$43,000
CONTRACTOR MOBILIZATION FOR EQUIPMENT, BONDING, INSURANCE, ETC. (5%)			$2,200
CONTINGENCY (25%):			$10,800
ENGINEERING (10%):			$4,300
TOTAL DEVELOPMENT COSTS FOR A DRY WASTE DISPOSAL LANDFILL:			$60,300

5.9 ENERGY FROM WASTE

Based on the estimated waste quantities that would be arriving at the proposed EFW facility in Scenarios III and IV (which are discussed in Sections 6.4 and 6.5), a 500 tonne/day and 345 tonne/day facility would be required. An EFW facility would operate 24 hours/day, 7 days a week.

In the 500 tonne/day capacity range, the mass burn combustion technology is the most proven technology on North America. The technology is considered state-of-the-art for volumes in excess of 200 tonne/day and in 1992, there were 68 mass burn plants operating in the U.S. and Canada, with a daily capacity of around 68,000 tonnes. Most modular combustors on the other hand, are normally in the 20 tonne per unit per day range, whereby units can be operated in parallel for greater capacities.

An EFW facility consists of three (3) main components:

- the combustion system;
- the energy recovery system; and
- the air pollution control system.

The combustion component of an EFW facility would receive the waste (including waste receiving area and refuse pit), transport the waste to the combustor (including feed crane, feed hopper and ram feeder), combust the waste at high temperatures in the combustion chamber (including combustion grate, auxiliary burner, and combustion air fan) and then remove the bottom ash to a storage area (including ash conveyors and metals recovery).

The energy recovery system would recover heat in the flue gases with a boiler to produce superheated steam (watertube boiler), which is used to drive a turbine generator to produce electricity (including cooling tower, condensers and electrical switchyard).

The air pollution control system designed to meet CCME emission limits would treat flue gases exiting the boiler, first by neutralizing acid gases in the dry scrubber, then

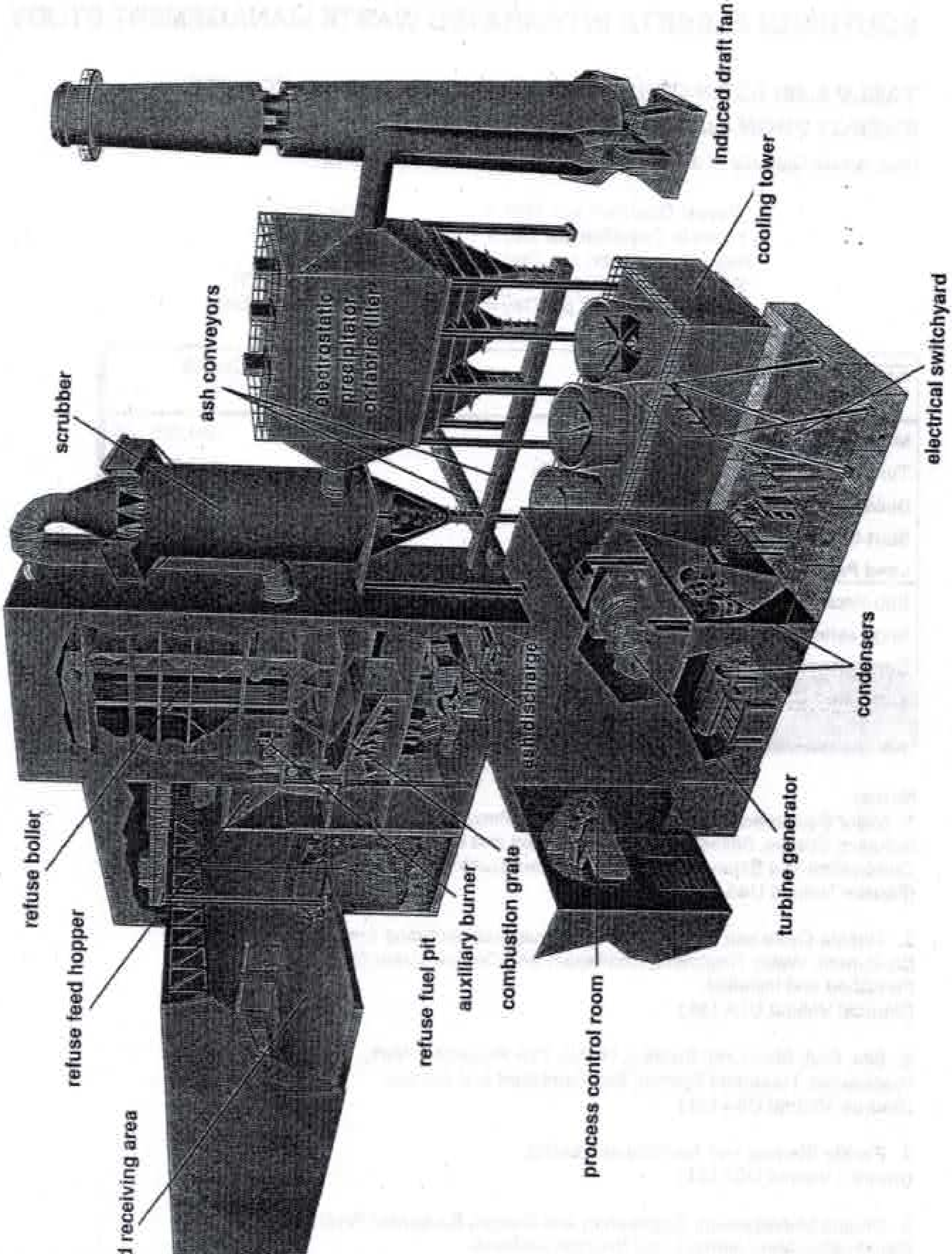

Photo Courtesy of Wheelabrator Environmental Systems Inc.

Figure 5.6

TYPICAL EFW SYSTEM

TABLE 5.47: ESTIMATED CAPITAL COSTS FOR A 345 TONNE/DAY ENERGY FROM WASTE SYSTEM

(Nameplate Capacity of the EFW Facility Would be 400 Tonne/Day)

Days in Operation per Year =	355 Days/Yr
Hours in Operation per Day =	24 Hrs/Day
Hours in Operation per Year =	8,530 Hrs/Yr
Waste Incinerated per Year =	123,000 Tonnes/Yr
Waste Incinerated per Day =	345 Tonnes/Day

EFW Components	Costs
Major Equipment (Note 1):	$32,000,000
Turbine and Electrical Equipment (Note 2):	$8,700,000
Building and Site Work (Note 3):	$13,100,000
Start-Up and Acceptance Testing (Note 4):	$3,500,000
Land Purchase (15 acres):	$0
Sub-total:	$57,300,000
Engineering and Project Management @ 15% (Note 5):	$8,600,000
Contingency @ 15%:	$8,600,000
Estimated Capital Costs For a 345 tonne/day EFW Facility:	**$74,500,000**

Notes:

1. Major Equipment Includes Refuse Cranes through Stack Equipment, Including Cranes, Boiler/Furnaces, Scrubbers and Baghouses, Ash Handling, Combustion and Balance-of-Plant Equipment Controls; Furnished and Erected. (Source: Volund USA Ltd.)

2. Turbine Cycle and Balance-of-Plant Equipment Including Electrical Equipment, Water Treatment, Condenser and Cooling Tower Systems; Furnished and Installed. (Source: Volund USA Ltd.)

3. Site, Civil, Structural, Building, HVAC, Fire Protection Work, Wastewater Treatment System, Etc. Furnished and Erected. (Source: Volund USA Ltd.)

4. Facility Start-up and Acceptance Testing. (Source: Volund USA Ltd.)

5. Project Management, Engineering and Design, Equipment Procurement, Construction Management, and Erection Advisors. (Source: Volund USA Ltd.)

Ogden Martin Systems Inc. has recently been awarded the contract to construct a EFW facility in Dartmouth, Nova Scotia. Construction Cost for the 500 tonne/day facility which includes the Martin refuse stoker, ash handling system, waste heat recovery system, (expected to generate approximately 17 MW), dry scrubber/baghouse, NO_x removal system, mercury abatement and a continuous emissions monitoring system (CEMS) is $99.6 million, excluding the site development costs. The facility is projected to start commercial operations in 1996 and an artist's rendering of the facility, which would be similar to a EFW facility for the southern Alberta region is shown in Figure 5.7.

An EFW facility is usually open to accept solid waste during normal delivery hours, Monday through Saturday, except holidays. The facility is designed to operate and combust the wastes 24 hours per day, 7 days per week. Similarly sized EFW facilities maintain a staff of approximately 40 employees for a 500 tonne/day facility and approximately 30 employees for a 345 tonne/day facility, which would include all daytime support staff (administration, secretarial, waste delivery. etc.). The actual number of personnel required to operate the facility would only be 5 to 7 staff per shift.

Operating costs of the proposed EFW facility would be for the actual operation of the facility including personnel, equipment maintenance, utilities and chemicals, and for the depreciation of equipment. The operational cost without the depreciation portion would be in the $25 - $35/tonne range.

Using a typical heating value for municipal solid wastes of 10,470 KJ/kg (4,500 Btu/lb), the proposed EFW facility would generate approximately 400 KWhr/tonne (net) at the rated capacity. This would relate to around 70,000,000 KWhr/year (net) for the 500 tonne/day facility and around 50,000,000 KWhr/year (net) for the 345 tonne/day facility. An alternate to the production of electricity would be to produce steam for sale to a industrial facility which requires steam for their process. The location of the EFW facility for this alternative would however be limited to locations near potential steam users.

The sale of electricity at an EFW facility would act as a credit on the overall operating costs. For each 1¢/KWhr received for the electricity sold to utilities, there would be an operating credit of around $5 - $6/tonne.

Estimated operating costs for the EFW facilities have been summarized in Tables 5.48 and 5.49 (500 tonne/day and 345 tonne/day facility respectively). Operating cost estimates for EFW facilities with smaller capacities are summarized in Tables 5.49a, 5.49b and 5.49c.

In general, the estimated total operating costs shown on a dollar per tonnes ($/tonne) basis can vary substantially. Factors that can influence the costs may include the type of ownership (public versus private), project repayment schedule, revenues from the sale of energy, environment regulations (testing and ash disposal requirements), etc.

SOUTHERN ALBERTA INTEGRATED WASTE MANAGEMENT STUDY

TABLE 5.49: ESTIMATED ANNUAL OPERATING COSTS FOR A 345 TONNE/DAY ENERGY FROM WASTE FACILITY

Days in Operation per Year =	355 Days/Yr
Hours in Operation per Day =	24 Hrs/Day
Hours in Operation per Year =	8,530 Hrs/Yr
Waste Incinerated per Year =	123,000 Tonnes/Yr
Waste Incinerated per Day =	345 Tonnes/Day

Item		Costs
Labour (Including O/H and Benefits)		
Workers per Shift (3 shifts/day) =		8
Total Hourly Compensation ($/Hr) =	$15.00	$1,024,000
Steam Engineer Wages (minimum 2/shift, an extra $12.50/Hr)		$426,000
Supervision and Administration @ % =	25.0%	$363,000
Yearly Equipment Maintenance (Note 1) =		$1,145,000
Stack Emission Testing (Note 2) =		$100,000
Utilities: Fuel (Natural Gas) =		$135,000
Power & Water =		$225,000
Ash Disposal (Incinerator and Scrubber Residue) (Note 3) =		$0
Chemicals (Pebble Lime) =		$230,000
Net Electricity Generated (kWhr/tonne) =	400	
Electricity Credit ($/Yr @ $15/MWr) (Note 4)	$15.00	($740,000)
Chemicals for Boiler Water =		$125,000
Sub-total =		$3,033,000
Depreciation (15 years) =		$3,820,000
Contingency (10 %) =	10.0%	$300,000
Estimated Annual Operating Cost of 345 tonne/day EFW =		**$7,153,000**
Cost per Tonne ($/tonne) =		**$58.20**

Notes:

1. Maintenance items include contracted services for inspections, cleaning and repair, as well as supplies, spare parts and a reserve sinking fund.

2. Emission testing will include testing for HCl, NOx, CO, Particulate Matter and PCDD's/PCDF's.

3. Ash disposal costs are included in the landfill operating costs.

4. Electricity credit is based on receiving $0.015/kWhr.

SOUTHERN ALBERTA INTEGRATED WASTE MANAGEMENT STUDY

TABLE 5.49b: ESTIMATED ANNUAL OPERATING COSTS FOR A 170 TONNE/DAY ENERGY FROM WASTE FACILITY

Days in Operation per Year =	355 Days/Yr
Hours in Operation per Day =	24 Hrs/Day
Hours in Operation per Year =	8,530 Hrs/Yr
Waste Incinerated per Year =	60,000 Tonnes/Yr
Waste Incinerated per Day =	170 Tonnes/Day

Item		Costs
Labour (including O/H and Benefits)		
Workers per Shift (3 shifts/day) =		7
Total Hourly Compensation ($/Hr) =	$15.00	$896,000
Steam Engineer Wages (minimum 2/shift, an extra $12.50/Hr)		$426,000
Supervision and Administration @ % =	25.0%	$331,000
Yearly Equipment Maintenance (Note 1) =		$850,000
Stack Emission Testing (Note 2) =		$100,000
Utilities: Fuel (Natural Gas) =		$95,000
Power & Water =		$150,000
Ash Disposal (Incinerator and Scrubber Residue) (Note 3) =		$0
Chemicals (Pebble Lime) =		$110,000
Net Electricity Generated (kWhr/tonne) =	400	
Electricity Credit ($/Yr @ $15/MWr) (Note 4)	$15.00	($360,000)
Chemicals for Boiler Water =		$90,000
Sub-total =		$2,688,000
Depreciation (15 years) =		$2,180,000
Contingency (10 %) =	10.0%	$270,000
Estimated Annual Operating Cost of 170 tonne/day EFW =		**$5,138,000**
Cost per Tonne ($/tonne) =		**$85.60**

Notes:

1. Maintenance items include contracted services for inspections, cleaning and repair, as well as supplies, spare parts and a reserve sinking fund.

2. Emission testing will include testing for HCl, NOx, CO, Particulate Matter and PCDD's/PCDF's.

3. Ash disposal costs are included in the landfill operating costs.

4. Electricity credit is based on receiving $0.015/kWhr.

5.10 TWO STREAM COLLECTION

Capital costs associated with the two stream collection scheme have been itemized in Table 5.50, while operating costs have been summarized in Table 5.51.

5.11 TRANSFER COMPONENT

Operating costs associated with the transfer component of the transfer station systems have been itemized Tables 5.52, 5.53 and 5.54. Table 5.52 illustrates the costs associated with Scenarios I and II, which will be discussed in Sections 6.2 and 6.3 respectively, while Table 5.53 illustrates the costs associated with Scenarios III and IV which will be discussed in Sections 6.4 and 6.5 respectively. Table 5.54 illustrates the transfer costs associated with Scenarios IIIA and IVA.

Table 5.51: Estimated Operating Costs for Two-Stream Collection

Item	Quantity	Cost Per Unit	Cost
labour (including O/H and benefits)			
Collection Vehicles/Drivers (1)			
- Lethbridge	10	$40,000	$400,000
- Medicine Hat	8	$40,000	$320,000
Vehicle Maintenance (2)			
- Lethbridge	10	$15,500	$155,000
- Medicine Hat	8	$15,500	$124,000
Fuel, Tires, Insurance, etc. (3)			
- Lethbridge	10	$7,750	$77,500
- Medicine Hat	8	$7,750	$62,000
Sub-total			$1,138,500
Depreciation (6 years)			$1,197,400
Contingency (10%)			$113,900
Estimate Total Operating Costs for Two-Stream Collection			**$2,449,800**

Notes:

1. Collection vehicle drivers $20/hr plus 30% (O/H, benefits, admin).
2. Vehicle Maintenance - 10% of Vehicle Cost (Manufacturer Suggests).
3. Fuel, Tires, Insurance, etc. - 5% of Vehicle Cost ((Manufacturer Suggests).

TABLE 5.53: TRANSFER STATION TRANSPORTATION COSTS TO TABER FOR SCENARIOS III & IV

Proposed Main Transfer Stations	Transfer Station Locations	Population	Annual Production (tonnes/year)	Distance (km)	Transportion Cost ($/yr)*
Cowley	M.D. of Pincher Creek (No.9)				
	Town of Pincher Creek	3,660	2,822		
	Mun. of Crowsnest Pass	7,102	4,581		
	Village of Cowley	277	232		
	Cowley (rural)	3,108	2,225		
	TOTAL COWLEY	14,147	9,860	151	$186,106
Claresholm	M.D. of Willow Creek (No.26)				
	Granum	1,058	873		
	Fort MacLeod	4,132	3,424		
	Nanton	2,114	1,757		
	Stavely	1,317	1,095		
	Claresholm	3,297	2,730		
	Claresholm (rural)	1,665	1,382		
	TOTAL CLARESHOLM	13,583	11,260	124	$174,530
Lomond	County of Vulcan (No.2)				
	Carmangay/Champion	1,162	963		
	Milo	631	527		
	Mossleigh	902	750		
	Lomond	167	140		
	Lomond (rural)	576	476		
	Vulcan	2,691	2,224		
	TOTAL LOMOND	6,129	5,080	100	$63,502
Taber	M.D. of Taber (No.14)				
	Enchant	768	244		
	Grassy Lake/Purple Springs	948	411		
	Vauxhall	2,392	1,349		
	Taber	6,660	5,550		
	Taber (rural)	2,864	1,016		
	TOTAL TABER	13,652	8,570		DIRECT HAUL
Lethbridge	County of Warner (No.5)				
	Coutts	582	291		
	Hwy 500/501	324	257		
	Milk River	1,280	927		
	New Dayton	1,222	731		
	Warner	939	598		
	Total	4,347	2,804		
Lethbridge	Chief Mountain Regional Solid Waste Authority				
	Cardston	4,578	2,111		
	Magrath	2,846	782		
	Raymond	3,777	1,409		
	Stirling	1,120	313		
	Waterton Lakes		382		
	Standoff	4,013	600		
	Glenwood	1,380	357		
	Welling	321	104		
	Spring Coulee	234	92		
	Mountain View	606	116		
	Del Bonita	329	50		
	Jefferson	369	59		
	Total	19,573	6,336		
Lethbridge	County of Lethbridge				
	Nobleford	2,102	463		
	Picture Butte	1,559	1,085		
	Iron Springs	1,012	218		
	Coaldale	8,832	3,228		
	Coalhurst	1,322	724		
	Barons	262	120		
	Total	15,089	5,838		
	City of Lethbridge	60,974	62,820		
	TOTAL LETHBRIDGE	99,983	77,799	56	$544,590
Bow Island	Bow Island	1,484	1,700		
	Burdett	239	70		
	Bow Island (rural)	1,025	591		
	TOTAL BOW ISLAND	2,748	2,361	56	$16,528
Medicine Hat	County of Forty Mile (No.8)				
	Etzikom	437	252		
	Foremost	1,175	862		
	Orion/Manyberries	358	206		
	Skiff	473	273		
	Total	2,443	1,593		
	City of Medicine Hat	43,625	36,125		
	TOTAL MEDICINE HAT	46,068	37,718	127	$598,777
Redcliff	M.D. of Cypress (No.1)				
	Hilda/Schuler	536	450		
	Irvine	1,220	1,026		
	Total	1,756	1,476		
	Redcliff/Cypress Regional Waste Authority				
	Dunmore	1,611	1,364		
	Seven Persons	856	722		
	Suffield	695	588		
	Redcliff	3,768	6,199		
	Redcliff (rural)	370	290		
	Total	7,300	9,163		
	TOTAL REDCLIFF	9,056	10,639	114	$151,600
	TOTAL STUDY AREA	205,368	163,287		$1,735,635

* - Based on a cost of $0.10/tonne*km for large scale transfer system and a 25% contingency fee.

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SECTION 6.0
INTEGRATED WASTE MANAGEMENT SCENARIOS

6.0 INTEGRATED WASTE MANAGEMENT SCENARIOS

6.1 GENERAL

The population of the southern Alberta study area is primarily urban-based with approximately 72% of the population residing in urban areas. The populations of the cities of Lethbridge and Medicine Hat comprise approximately 50% of the total population of the study area and make up approximately 65% of the waste generated in the study area. As a result, the scenarios outlined in the following sections will focus on reducing waste generated primarily in urban areas, while providing acceptable levels of service to rural areas with opportunities for waste minimization.

In order to meet the CCME's goal of 50% waste reduction, changes will have to be made to existing waste management practices. The cooperation of industries, businesses and individuals is essential.

6.1.2 Waste Streams

Under each scenario described in section 6, the waste stream will be comprised of four major components: Municipal Solid Waste (MSW), Industrial, Commercial and Institutional (IC&I) Waste, Heavy Industrial Waste, and Construction and Demolition (C&D) Waste. From Section 2.3, the following estimated annual quantities of wastes are generated in the study area:

MSW(incl. prov. parks)	77,000 tonnes/yr
IC&I	88,600 tonnes/yr
Heavy Industrial	37,800 tonnes/yr
C&D Waste (10%)	20,400 tonnes/yr
Total:	223,800 tonnes/yr

The estimated quantity of C&D waste is based upon a percentage figure of 20% of the total waste stream (for RMOC) and 18% (for Edmonton), which would apply to the Cities of Medicine Hat and Lethbridge. However, the quantity of C&D waste produced in rest of the study area would be significantly lower than 20%. Therefore the total amount of C&D waste generated in the study area was estimated to be 10% of the total waste produced.

IV. Fully Integrated Waste Management System with an Energy From Waste Facility

- combination of Scenarios II and III (i.e. similar to Scenario II with respect to aggressive waste collection and minimization practices, but with a similar system of large transfer stations, one (1) Energy From Waste facility and a regional landfill as outlined in Scenario III. Scenario IVA considered two (2) Energy From Waste facilities, one near Lethbridge and one near Medicine Hat.

Public education programs encouraging reduction and re-use would be implemented in all four scenarios (I, II, III, and IV).

All scenarios have been developed assuming full participation by all counties, M.D.'s, authorities and commissions in the study area and that all waste management facilities described can be approved and sited. All existing recycling and composting programs would not be forced to join the integrated system and would continue to operate as they choose. As previously described, benefits could be realized by amalgamating the programs to have a larger impact on potential markets. Also, commercial recycling and composting could be added to the integrated system at a later date.

Waste flow diagrams have been developed for each of the scenarios along with the associated costs on treatment for each component.

The detailed explanation and rationale for the proposed technologies outlined in this section are provided in Sections 4 and 5.

6.2 SCENARIO I-BASIC INTEGRATED WASTE MANAGEMENT SYSTEM

6.2.1 General Description of Scenario I

In this scenario all existing modified landfills would be closed and transfer stations would try to be sited at most of the former modified landfill locations. In addition to the existing regional landfills at Redcliff, Cowley, and Bow Island (North Forty Mile), five new landfills would be sited near Lomond, Claresholm, Medicine Hat, Lethbridge, and Taber. The

City of Medicine Hat. The location to which these wastes are brought could be changed depending on the capacities of the regional landfills in the vicinity of south Forty Mile at the time of implementation.

6.2.3 Landfilling C&D Waste

All modified landfills within the study area would cease to be used. These sites would be reclaimed as per the requirements for landfill closure as established by Alberta Environmental Protection.

In each County or M.D., an existing modified landfill that meets the Waste Management Regulations as set by the *Public Health Act,* could be converted into a dry waste disposal site.

The conversion would ensure that the site and its operation is in accordance with the Waste Management Regulations under the *Public Health Act.*

As with sanitary landfills, each site would have access control, run-off and run-on drainage control and internal roads for access.

6.2.4 Transfer Stations

A network of transfer stations would be established throughout the study region to supplement the existing stations. For the most part they would try to be sited at former modified landfill locations. In general, former landfill sites are more acceptable to the public as transfer station locations. A variety of transfer station types would be used and would depend on such factors as waste generation, location (rural/urban) and compatibility with existing systems. The transfer station types include compaction, drop box, green box and push pit.

TABLE 6.1 Continued
TRANSFER STATION LOCATIONS

Transfer Station	Population Services	Type of Station	Regional Landfill
<u>**EXISTING LOCATIONS**</u>			
Lethbridge Regional Solid Waste Authority			
Nobleford	2364	Compaction	Lethbridge
Picture Butte	3012	Compaction	Lethbridge
Iron Springs	1453	Compaction	Lethbridge
Coaldale*	3522	Compaction	Lethbridge
Chief Mountain Regional Solid Waste Authority			
Cardston	4578	Push Pit	Lethbridge
Magrath	2525	Push Pit	Lethbridge
Raymond	3777	Push Pit	Lethbridge
Stirling	1242	Push Pit	Lethbridge
Waterton	N/A	Push Pit	Lethbridge
Standoff	4013	Push Pit	Lethbridge
Glenwood/Hillspring	1380	Push Pit	Lethbridge
Welling	321	Push Pit	Lethbridge
Spring Coulee	234	Push Pit	Lethbridge
Mountain View	606	Push Pit	Lethbridge
Del Bonita	329	Push Pit	Lethbridge
Jefferson	369	Push Pit	Lethbridge
Redcliff Cypress Regional Waste Authority			
Dunmore	1611	Drop Box	Redcliff
Seven Persons	856	Drop Box	Redcliff
Suffield	695	Drop Box	Redcliff
County of Vulcan (No. 2)			
Vulcan**		Drop Box	Lomond
County of Warner (No. 5)			
Milk River Rural	830	Drop Box	Lethbridge
New Dayton	813	Drop Box	Lethbridge

* Towns hauling directly to landfill

** Milk River, Irvine and Vulcan population service totals included with other transfer station in that location.

Recycling programs would accept the following recyclables:

- old newspapers (ONP);
- old corrugated cardboard (OCC);
- mixed paper;
- magazines (OMG);
- clear glass;
- ferrous cans; and
- HDPE (#2) plastics.

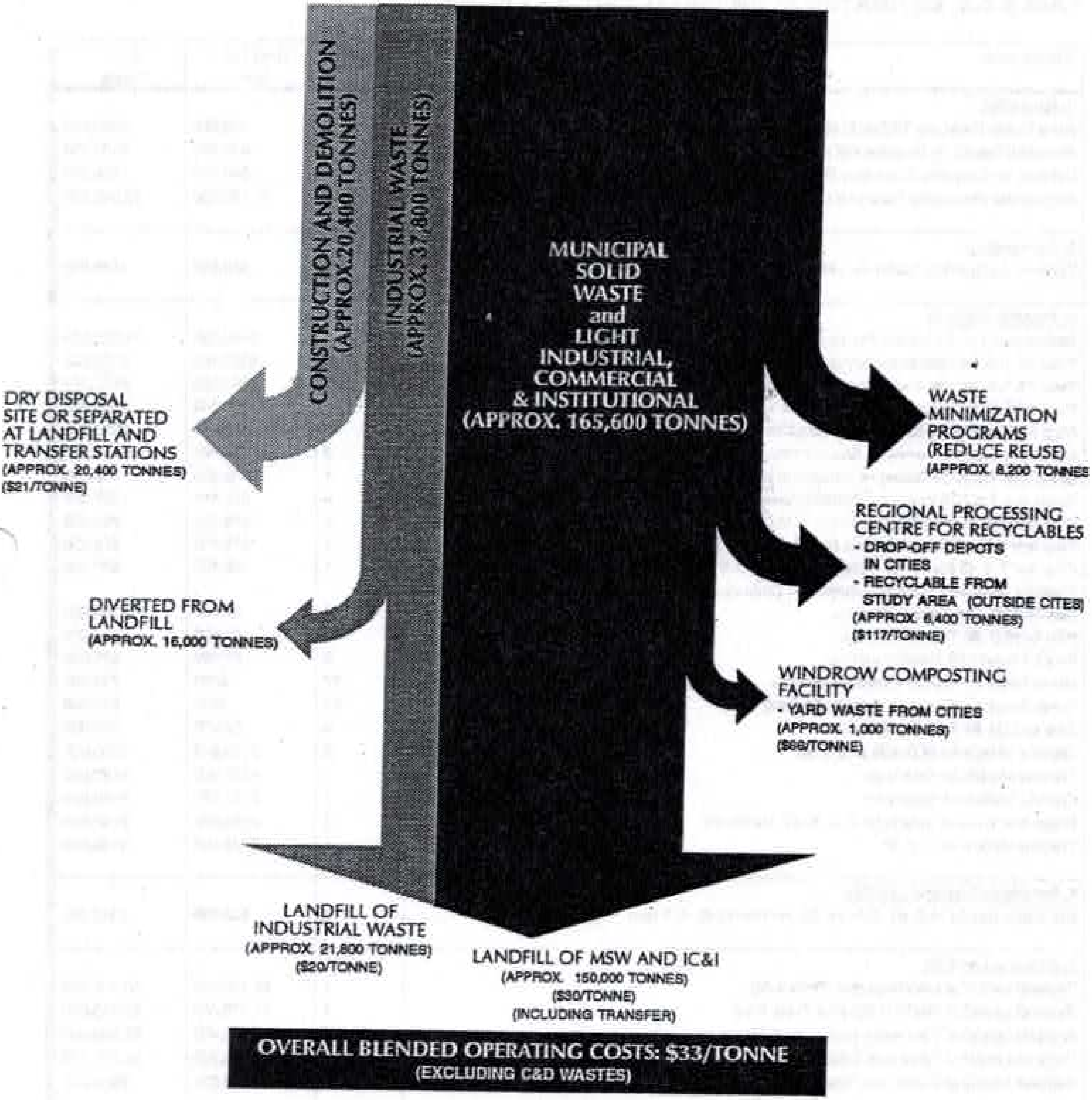
These recyclables would continue to be collected and processed as long as markets exist and/or it remains economically feasible.

The processing centre for recyclables would consist of a tipping area, processing area, storage area, and an administrative area. Equipment would consist of a manual sorting process, storage carts, a baler, a scale, a loader, and ancillary equipment. Two processing centres would be required: one at Medicine Hat and one at Lethbridge.

On an annual basis, Hazardous Waste Round-ups would be held to assist in removing household hazardous waste from the municipal waste stream. With the aid of an education program, residents would become familiar with the annual event. Round-ups could be held in-conjunction with other environmental programs, such as Environment Week or Earth Day.

6.2.6 Recycling - Rural

Rural recycling would be encouraged by placing mobile depots in Towns, Villages, or transfer stations. These trailers would service a particular area and when full, would deliver recyclables to the nearest processing centre, which would either be in Lethbridge or Medicine Hat.



NOTE: BASED ON 1992 ANNUAL WASTE QUANTITIES EXCLUDING COLLECTION COSTS

Figure 6.2 - SCENARIO I WASTE FLOW DIAGRAM

SOUTHERN ALBERTA INTEGRATED WASTE MANAGEMENT STUDY

TABLE 6.3: ESTIMATED SCENARIO I OPERATING COSTS

Components	Quantity	Cost	Cost Totals
1. Recycling			
Rural Mobile Recycling Trailers in M.D. #1,6,9,14,26 & County #2,5,8,26 in T.S. Costs	10		
Recyclables collection Vehicle for Recycling Depot (see Table 5.9)	1	$33,800	$33,800
Recyclables Processing Centre for Lethbridge & Medicine Hat (see Table 5.6)	2	$355,900	$711,800
Waste Minimization Education Programs	1	$50,000	$50,000
2. Composting			
Windrow Composting Facility for Lethbridge & Medicine Hat (see Table 5.13)	2	$32,800	$65,600
3. Transfer Stations			
Compaction T.S. for Nanton,Stavely,Granum,Ft. MacLeod in M.D. #26 (see Table 5.30)	4	$69,200	$276,800
Push Pit T.S. for Champion/Carmangay in County #2 (see Table 5.31)	1	$51,400	$51,400
Push Pit T.S. for Milo & Mossleigh in County #2 (see Table 5.31)	2	$51,400	$102,800
Push Pit T.S. for Vulcan in County #2 (see Table 5.31)	1	$51,400	$51,400
Drop Box T.S.(1 Box) for Warner,Coutts,Milk River,Hwy. 500/501 in County #5 (see Table 5.29)	4	$20,100	$80,400
Green Box T.S.(1-8 Boxes) for Enchant,Grassy Lake/Purple Springs in M.D. #14 (see Table 5.28)	2	$19,300	$38,600
Green Box T.S.(9-15 Boxes) for Vauxhall in M.D. #14 (see Table 5.28)	1	$19,300	$19,300
Green Box T.S.(1-8 Boxes) for Etzikom,Foremost,Orion/Many.,Skiff in County #8 (see Table 5.28)	4	$19,300	$77,200
Drop Box T.S. (1 Box) for Irvine Urban in M.D. #1 (see Table 5.29)	1	$20,100	$20,100
Drop Box T.S. (2 Boxes) for Irvine Rural in M.D. #1 (see Table 5.29)	1	$20,100	$20,100
Drop Box T.S. (3 Boxes) for Hilda/Schuler in M.D. #1 (see Table 5.29)	1	$20,100	$20,100
Existing Compaction T.S. for Lethbridge Regional Waste Management Commission	4	$40,000	$160,000
Existing Push Pit T.S. for Chief Mountain Regional Solid Waste Authority	12	$30,000	$360,000
Existing Drop Box T.S. for Redcliff/Cypress Regional Waste Management Authority	3	$20,000	$60,000
Existing Drop Box T.S. at Vulcan, New Dayton and Milk River	3	$20,000	$60,000
Transfer Bins and Transfer Equipment (Vehicles) Included Transfer Costs			
4. Dry Waste Disposal Landfills			
Dry Waste Site for M.D. #1 and County #26 (see Table 5.44)	2	$97,940	$195,880
Dry Waste Site for M.D. #6, 9, 14, 26 and County #2, 5, 8 (see Table 5.45)	7	$33,040	$231,280
5. Regional Landfills			
Regional Landfill at Lethbridge (see Table 5.38)	1	$1,103,660	$1,103,660
Regional Landfill at Medicine Hat (see Table 5.39)	1	$1,004,960	$1,004,960
Regional Landfill at Claresholm (see Table 5.40)	1	$387,200	$387,200
Regional Landfill at Taber (see Table 5.41)	1	$398,300	$398,300
Regional Landfill at Vulcan (see Table 5.42)	1	$296,700	$296,700
Existing Regional Landfill at Cowley	1	$150,000	$150,000
Existing Regional Landfill at Bow Island	1	$50,000	$50,000
Existing Regional Landfill at Redcliff	1	$100,000	$100,000
6. Transfer of Wastes to Regional Landfills			
For Existing Transfer Stations (see Table 5.52)	1	$274,400	$274,400
For Proposed Transfer Stations (see Table 5.52)	1	$239,200	$239,200
Total Estimated Scenario I Operating Costs			**$6,890,980**

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Scenario II is summarized below:

1. Waste within the Towns and Villages would be taken directly to the transfer stations, and then transferred to one of the regional landfills. Towns and Villages may participate in the two stream collection program, however costs have not been included.

2. Residential waste collection within the Cities (Lethbridge and Medicine Hat) would be taken directly to the Material Recovery Facilities (MRF's) and centralized composting facilities. Rejects would be taken to the regional landfills.

Figure 6.3 shows the fully integrated regional waste management system recommended in Scenario II. This scenario uses the same proposed system of transfer stations and sanitary landfills as described in Scenario I.

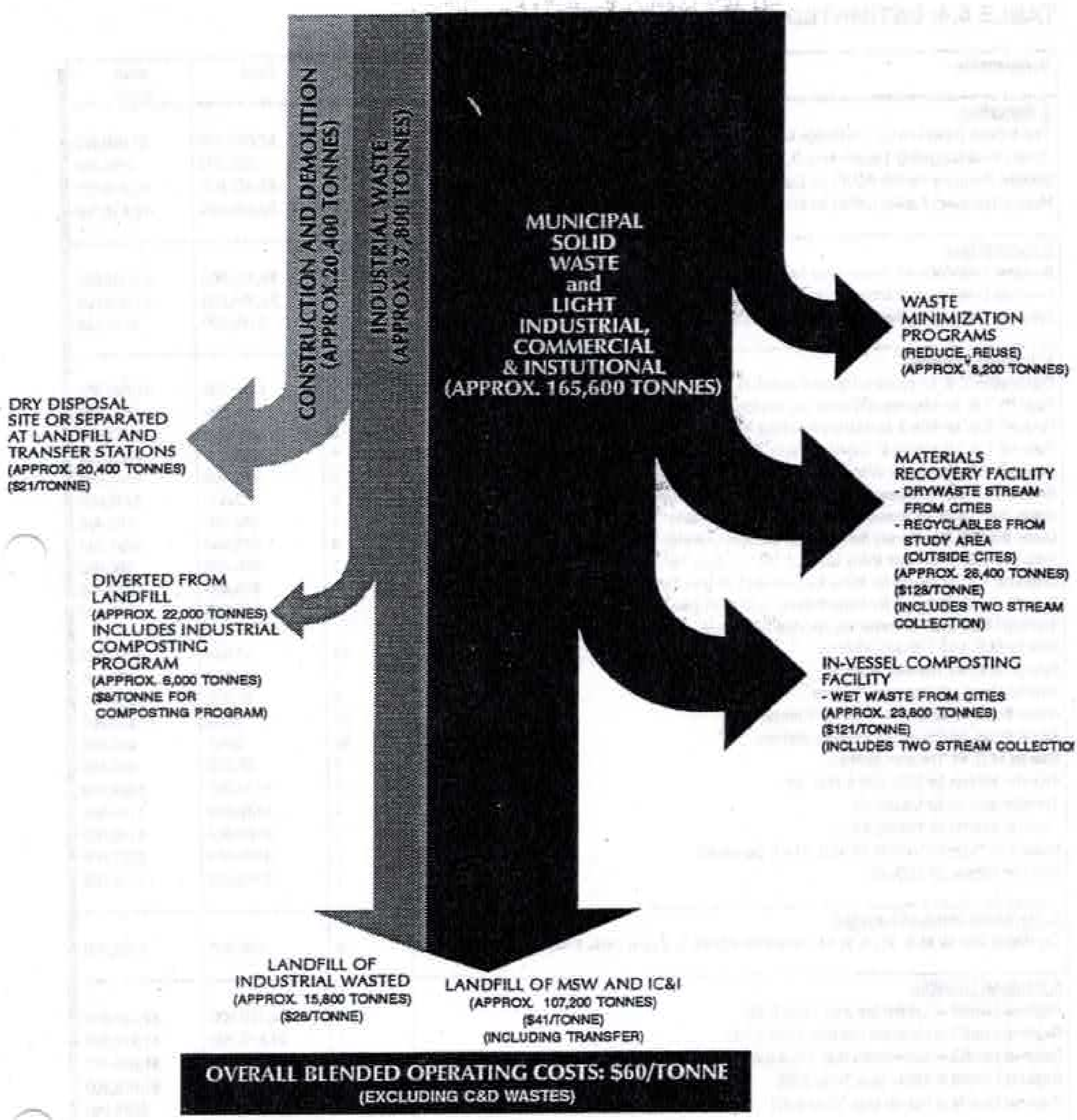
6.3.2 Recycling

The major difference between Scenarios I and II is the method of waste collection used. In Scenario II, a two stream method of collection would be used for single family dwellings in Medicine Hat and the City of Lethbridge. This method of collection optimizes the amount of recyclables that can be recovered from the waste stream. Recycling depots would be available for residents who live in multi-family dwellings. MRF's would be located in Lethbridge and Medicine Hat. They would accept dry wastes from city collection, as well as materials collected from the various recycling depots located in the Cities, Towns, transfer stations, and landfills from the rest of the study area.

Mobile recycling depots would service at all transfer stations and villages as in Scenario I.

6.3.3 Composting

Centralized composting facilities would be located in Medicine Hat and Lethbridge. These facilities would use large scale in-vessel systems and would receive the wet waste stream collected from city residents, and accept compostables from industries located in the cities.



NOTE: BASED ON 1992 ANNUAL WASTE QUANTITIES EXCLUDING COLLECTION COSTS

Figure 6.4 - SCENARIO II WASTE FLOW DIAGRAM

SOUTHERN ALBERTA INTEGRATED WASTE MANAGEMENT STUDY

TABLE 6.5: ESTIMATED SCENARIO II OPERATING COSTS

Components	Quantity	Cost	Cost Totals
1. Recycling			
Two Stream Collection for Lethbridge & Medicine Hat (see Table 5.51)	1	$2,449,800	$2,449,800
Rural Mobile Recycling Trailers in M.D. #1,6,9,14,26 & County #2,5,8,26 in T.S. Costs	10		
Material Recovery Facility (MRF) for Lethbridge (See Table 5.7)	1	$1,236,000	$1,236,000
Material Recovery Facility (MRF) for Medicine Hat (See Table 5.8)	1	$852,000	$852,000
Waste Minimization Education Programs	1	$50,000	$50,000
2. Composting			
In-vessel Containerized Composting for Lethbridge (See Table 5.14)	1	$1,001,000	$1,001,000
In-vessel Containerized Composting for Medicine Hat (See Table 5.15)	1	$707,000	$707,000
Windrow Composting Facility for Taber (Table 5.13a)	1	$49,300	$49,300
3. Transfer Stations			
Compaction T.S. for Nanton,Stavely,Granum,Ft. MacLeod in M.D. #26 (see Table 5.30)	4	$69,200	$276,800
Push Pit T.S. for Champion/Carmangay in County #2 (see Table 5.31)	1	$51,400	$51,400
Push Pit T.S. for Milo & Mossleigh in County #2 (see Table 5.31)	2	$51,400	$102,800
Push Pit T.S. for Vulcan in County #2 (see Table 5.31)	1	$51,400	$51,400
Drop Box T.S.(1 Box) for Warner,Coutts,Milk River,Hwy. 500/501 in County #5 (see Table 5.29)	4	$20,100	$80,400
Green Box T.S.(1-8 Boxes) for Enchant,Grassy Lake/Purple Springs in M.D. #14 (see Table 5.28)	2	$19,300	$38,600
Green Box T.S.(9-15 Boxes) for Vauxhall in M.D. #14 (see Table 5.28)	1	$19,300	$19,300
Green Box T.S.(1-8 Boxes) for Etzikom,Foremost,Orion/Many.,Skiff in County #8 (see Table 5.28)	4	$19,300	$77,200
Drop Box T.S. (1 Box) for Irvine Urban in M.D. #1 (see Table 5.29)	1	$20,100	$20,100
Drop Box T.S. (2 Boxes) for Irvine Rural in M.D. #1 (see Table 5.29)	1	$20,100	$20,100
Drop Box T.S. (3 Boxes) for Hilda/Schuler in M.D. #1 (see Table 5.29)	1	$20,100	$20,100
Existing Compaction T.S. for Lethbridge Regional Waste Management Commission	4	$40,000	$160,000
Existing Push Pit T.S. for Chief Mountain Regional Solid Waste Authority	12	$30,000	$360,000
Existing Drop Box T.S. for Redcliff/Cypress Regional Waste Management Authority	3	$20,000	$60,000
Existing Drop Box T.S. at Vulcan, New Dayton and Milk River	3	$20,000	$60,000
Transfer Bins and Transfer Equipment (Vehicles) Included in Transfer Costs			
4. Dry Waste Disposal Landfills			
Dry Waste Site for M.D. #1 and County #26 (see Table 5.44)	2	$97,940	$195,880
Dry Waste Site for M.D. #6, 9, 14, 26 and County #2, 5, 8 (see Table 5.45)	7	$33,040	$231,280
5. Regional Landfills			
Regional Landfill at Lethbridge (see Table 5.38)	1	$1,103,660	$1,103,660
Regional Landfill at Medicine Hat (see Table 5.39)	1	$1,004,960	$1,004,960
Regional Landfill at Claresholm (see Table 5.40)	1	$387,200	$387,200
Regional Landfill at Taber (see Table 5.41)	1	$398,300	$398,300
Regional Landfill at Vulcan (see Table 5.42)	1	$296,700	$296,700
Existing Regional Landfill at Cowley	1	$150,000	$150,000
Existing Regional Landfill at Bow Island	1	$50,000	$50,000
Existing Regional Landfill at Redcliff	1	$100,000	$100,000
6. Transfer of Wastes to Regional Landfills			
Existing Transfer Stations (see Table 5.52)	1	$274,400	$274,400
Proposed Transfer Stations (see Table 5.52)	1	$239,200	$239,200
Total Estimated Scenario II Operating Costs			**$12,174,880**

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- available equipment sizes for the rated capacity; and
- optimum utilization of combustion equipment.

Using the waste quantity data presented in Section 2.3 and assuming that approximately (15,600 tonnes/year) would be diverted (as estimated in Scenario I), approximately 150,000 tonnes/year of MSW and IC&I, and 21,800 tonnes/year of industrial waste will be available for combustion annually. Larger EFW facilities are designed for continuous 24 hour/day operation and have an annual plant throughput availability of around 85% of the design capacity. Based on the annual waste quantities and the operating assumptions, an EFW facility would have an estimated design capacity of 550 tonnes/day, but on average would normally handle around 500 tonnes/day of waste.

The EFW facility would be constructed with the latest pollution control technologies as described in Section 4.10.5.

Figure 6.5 illustrates Scenario III - the basic integrated waste management system with one Energy From Waste facility.

All C&D debris would be sent to dry disposal sites as described in Section 6.2.4.

6.4.2 Waste Flow in Scenario III

Waste flow in Scenario III is illustrated in Figure 6.6. In this scenario it was assumed that the same quantities of waste would be diverted from waste minimization practices as in Scenario I. The amount of waste going to a landfill would be significantly reduced, however through the treatment of the waste at the EFW facility (from around 171,800 tonnes/year (in Scenario I) to around 51,500 tonnes/year (in Scenario III). The costs per tonne for each component in Scenario III are also illustrated in the figure.

6.4.3 Capital and Operating Costs for Scenario III

Capital and operating costs for Scenario III have been summarized in Table 6.6 and 6.7, respectively. Estimated capital costs for Scenario III would be $123,211,000 and the estimated annual operating costs would be $17,950,460/year. For Scenario IIIA, the estimated capital costs would be $132,457,600 and the estimated annual operating costs would be $18,243,360/year and are summarized in Tables 6.6a and 6.7a respectively.

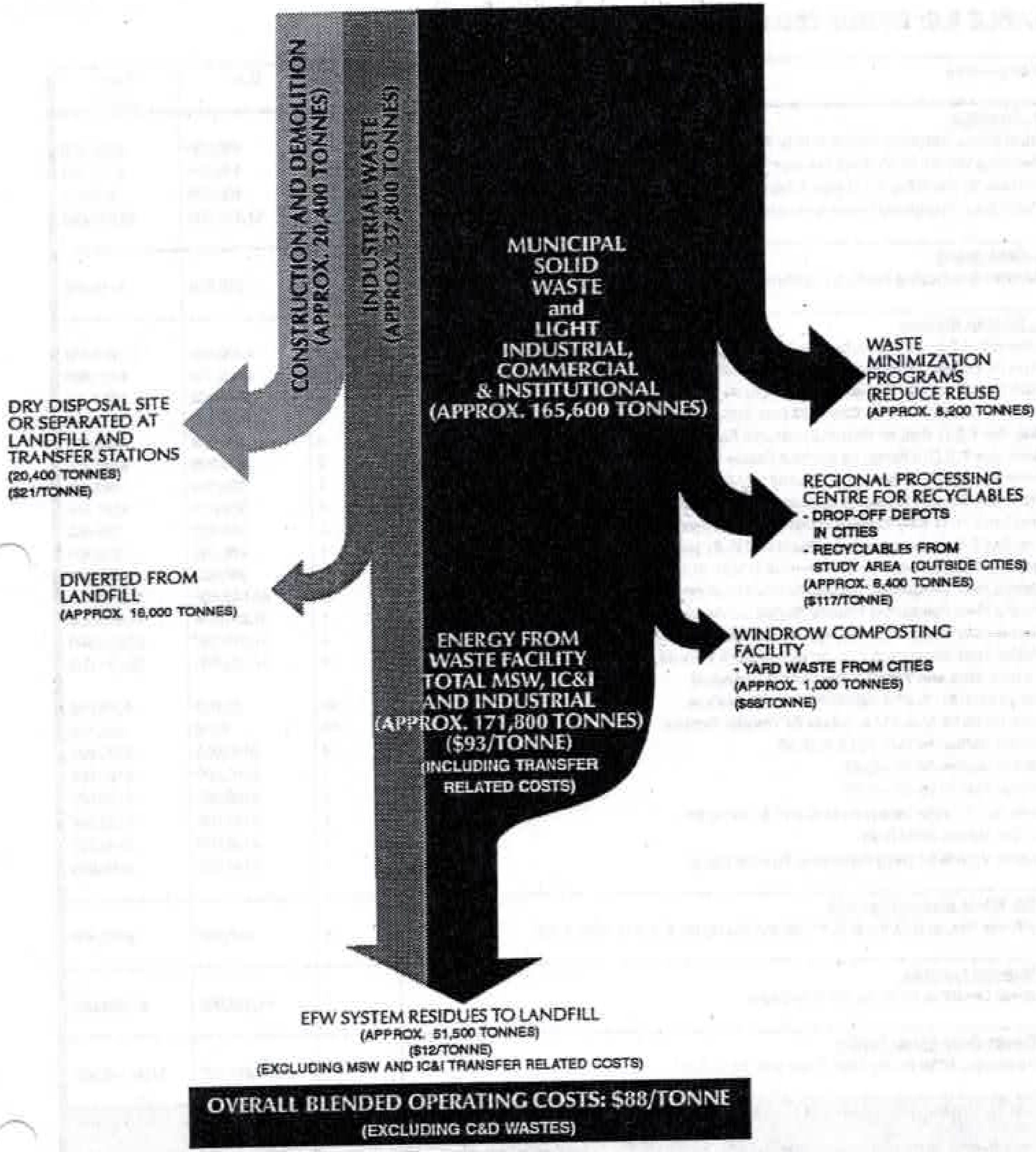

Figure 6.6 - SCENARIO III
WASTE FLOW DIAGRAM

NOTE: BASED ON 1992 ANNUAL WASTE QUANTITIES EXCLUDING COLLECTION COSTS

SOUTHERN ALBERTA INTEGRATED WASTE MANAGEMENT STUDY

TABLE 6.7: ESTIMATED SCENARIO III OPERATING COSTS

Components	Quantity	Cost	Cost Totals
1. Recycling			
Rural Mobile Recycling Trailers in M.D. #1,6,9,14,26 & County #2,5,8,26 in T.S. Costs	10		
Recyclables collection Vehicle for Recycling Depot (see Table 5.9)	1	$33,800	$33,800
Recyclables Processing Centre for Lethbridge & Medicine Hat (see Table 5.6)	2	$355,900	$711,800
Waste Minimization Education Programs	1	$50,000	$50,000
2. Composting			
Windrow Composting Facility for Lethbridge & Medicine Hat (see Table 5.13)	2	$32,800	$65,600
3. Transfer Stations			
Compaction T.S. for Nanton,Stavely,Granum,Ft. MacLeod in M.D. #26 (see Table 5.30)	4	$69,200	$276,800
Push Pit T.S. for Champion/Carmangay in County #2 (see Table 5.31)	1	$51,400	$51,400
Push Pit T.S. for Milo & Mossleigh in County #2 (see Table 5.31)	2	$51,400	$102,800
Push Pit T.S. for Vulcan in County #2 (see Table 5.31)	1	$51,400	$51,400
Drop Box T.S.(1 Box) for Warner,Coutts,Milk River,Hwy. 500/501 in County #5 (see Table 5.29)	4	$20,100	$80,400
Green Box T.S.(1-8 Boxes) for Enchant,Grassy Lake/Purple Springs in M.D. #14 (see Table 5.28)	2	$19,300	$38,600
Green Box T.S.(9-15 Boxes) for Vauxhall in M.D. #14 (see Table 5.28)	1	$19,300	$19,300
Green Box T.S.(1-8 Boxes) for Etzikom,Foremost,Orion/Many.,Skiff in County #8 (see Table 5.28)	4	$19,300	$77,200
Drop Box T.S. (1 Box) for Irvine Urban in M.D. #1 (see Table 5.29)	1	$20,100	$20,100
Drop Box T.S. (2 Boxes) for Irvine Rural in M.D. #1 (see Table 5.29)	1	$20,100	$20,100
Drop Box T.S. (3 Boxes) for Hilda/Schuler in M.D. #1 (see Table 5.29)	1	$20,100	$20,100
Walking Floor Compaction Transfer Station for Lethbridge (30 tonnes/hr) (see Table 5.32)	1	$932,500	$932,500
Walking Floor Compaction Transfer Station for Medicine Hat (10 tonnes/hr) (see Table 5.32)	1	$456,700	$456,700
Walking Floor Comp. T. S. for Claresholm, Cowley & Redcliff (3.5 tonnes/hr) (see Table 5.32)	3	$384,700	$1,154,100
Walking Floor Compaction T. S. for Bow Island & Lomond (1.5 tonnes/hr) (see Table 5.32)	2	$237,500	$475,000
Existing Compaction T.S. for Lethbridge Regional Waste Management Commission	4	$40,000	$160,000
Existing Push Pit T.S. for Chief Mountain Regional Solid Waste Authority	12	$30,000	$360,000
Existing Drop Box T.S. for Redcliff/Cypress Regional Waste Management Authority	3	$20,000	$60,000
Existing Drop Box T.S. at Vulcan, New Dayton and Milk River	3	$20,000	$60,000
Transfer Bins and Transfer Equipment (Vehicles) Included Transfer Costs			
4. Dry Waste Disposal Landfills			
Dry Waste Site for M.D. #1 and County #26 (see Table 5.44)	2	$97,940	$195,880
Dry Waste Site for M.D. #6, 9, 14, 26 and County #2, 5, 8 (see Table 5.45)	7	$33,040	$231,280
5. Regional Landfills			
Regional Landfill at Taber For EFW Residues	1	$630,000	$630,000
6. Energy From Waste Facility			
500 tonne/day EFW Facility Near Taber (see Table 5.46)	1	$9,880,000	$9,880,000
7. Transfer of Wastes to Regional Landfills			
For Existing and Proposed Transfer Stations (see Table 5.53)	1	$1,735,600	$1,735,600
Total Estimated Scenario III Operating Costs			**$17,950,460**

SOUTHERN ALBERTA INTEGRATED WASTE MANAGEMENT STUDY

TABLE 6.7a: ESTIMATED SCENARIO IIIA OPERATING COSTS

Components	Quantity	Cost	Cost Totals
1. Recycling			
Rural Mobile Recycling Trailers in M.D. #1,6,9,14,26 & County #2,5,8,26 in T.S. Costs	10		
Recyclables collection Vehicle for Recycling Depot (see Table 5.9)	1	$33,800	$33,800
Recyclables Processing Centre for Lethbridge & Medicine Hat (see Table 5.6)	2	$355,900	$711,800
Waste Minimization Education Programs	1	$50,000	$50,000
2. Composting			
Windrow Composting Facility for Lethbridge & Medicine Hat (see Table 5.13)	2	$32,800	$65,600
3. Transfer Stations			
Compaction T.S. for Nanton,Stavely,Granum,Ft. MacLeod in M.D. #26 (see Table 5.30)	4	$69,200	$276,800
Push Pit T.S. for Champion/Carmangay in County #2 (see Table 5.31)	1	$51,400	$51,400
Push Pit T.S. for Milo & Mossleigh in County #2 (see Table 5.31)	2	$51,400	$102,800
Push Pit T.S. for Vulcan in County #2 (see Table 5.31)	1	$51,400	$51,400
Drop Box T.S.(1 Box) for Warner,Coutts,Milk River,Hwy. 500/501 in County #5 (see Table 5.29)	4	$20,100	$80,400
Green Box T.S.(1-8 Boxes) for Enchant,Grassy Lake/Purple Springs in M.D. #14 (see Table 5.28)	2	$19,300	$38,600
Green Box T.S.(9-15 Boxes) for Vauxhall in M.D. #14 (see Table 5.28)	1	$19,300	$19,300
Green Box T.S.(1-8 Boxes) for Etzikom,Foremost,Orion/Many.,Skiff in County #8 (see Table 5.28)	4	$19,300	$77,200
Drop Box T.S. (1 Box) for Irvine Urban in M.D. #1 (see Table 5.29)	1	$20,100	$20,100
Drop Box T.S. (2 Boxes) for Irvine Rural in M.D. #1 (see Table 5.29)	1	$20,100	$20,100
Drop Box T.S. (3 Boxes) for Hilda/Schuler in M.D. #1 (see Table 5.29)	1	$20,100	$20,100
Walking Floor Comp. T.S. for Claresholm,Taber,Cowley&Redcliff (3.5 tonnes/hr) (see Table 5.32)	4	$384,700	$1,538,800
Walking Floor Compaction T. S. for Bow Island & Lomond (1.5 tonnes/hr) (see Table 5.32)	2	$237,500	$475,000
Existing Compaction T.S. for Lethbridge Regional Waste Management Commission	4	$40,000	$160,000
Existing Push Pit T.S. for Chief Mountain Regional Solid Waste Authority	12	$30,000	$360,000
Existing Drop Box T.S. for Redcliff/Cypress Regional Waste Management Authority	3	$20,000	$60,000
Existing Drop Box T.S. at Vulcan, New Dayton and Milk River	3	$20,000	$60,000
Transfer Bins and Transfer Equipment (Vehicles) Included Transfer Costs			
4. Dry Waste Disposal Landfills			
Dry Waste Site for M.D. #1 and County #26 (see Table 5.44)	2	$97,940	$195,880
Dry Waste Site for M.D. #6, 9, 14, 26 and County #2, 5, 8 (see Table 5.45)	7	$33,040	$231,280
5. Regional Landfills			
Regional Landfill For EFW Residues Near Lethbridge	1	$500,000	$500,000
Regional Landfill For EFW Residues Near Medicine Hat	1	$350,000	$350,000
6. Energy From Waste Facility			
345 tonne/day EFW Facility Near Lethbridge (see Table 5.49)	1	$7,153,000	$7,153,000
170 tonne/day EFW Facility Near Medicine Hat (see Table 5.49b)	1	$5,138,000	$5,138,000
7. Transfer of Wastes to Regional Landfills			
For Existing and Proposed Transfer Stations (see Table 5.54)	1	$402,000	$402,000
Total Estimated Scenario IIIA Operating Costs			**$18,243,360**

Recycling and composting programs would compliment the operation of an EFW facility, whereby removing certain wastes from the total waste stream, would improve overall combustion performance at the facility. Glass and metals have no heating value, and create maintenance problems with slagging and lodging in the EFW system. Yard waste is another category of waste that can cause operational problems, as it has a wide variability in heating value and requires greater operator attention to control. Even if all glass, metals, newspapers and corrugated cardboard (newspaper and corrugated cardboard have heating values of around 17,500 KJ/kg (7,500 Btu/lb)) were removed, the overall lost energy would be insignificant. In fact, EFW facilities in areas with high recycling rates have experienced a net overall increase in the heating value of the waste arriving at the facility.

An additional system of 22 transfer stations would be established in the region, with an additional regional system of large volume transfer stations as described in Scenario III. Mobile recycling trailers would be located at these transfer stations and at any Villages without transfer stations. Urban residents would use recycling drop off depots. In the Cities of Lethbridge and Medicine Hat, two stream (wet/dry) residential collection would be provided. MRF's would be built in Medicine Hat and Lethbridge along with in-vessel containerized composting facilities for the composting of the wet stream collection. Industries in these Cities would have the option of participating in composting program.

As discussed in Scenario III, the EFW facility could be sited in a centralized location in the western part of the M.D. of Taber.

6.5.2 Scenario IV Waste Flow

Figure 6.8 illustrates the waste flow for Scenario IV. The waste quantities diverted would be essentially the same as in Scenario II and would amount to around 35% of the total MSW and IC&I waste stream. After combustion of unrecoverable wastes, an estimated total of 36,900 tonnes/year of EFW system residuals would require landfilling.

Stanley

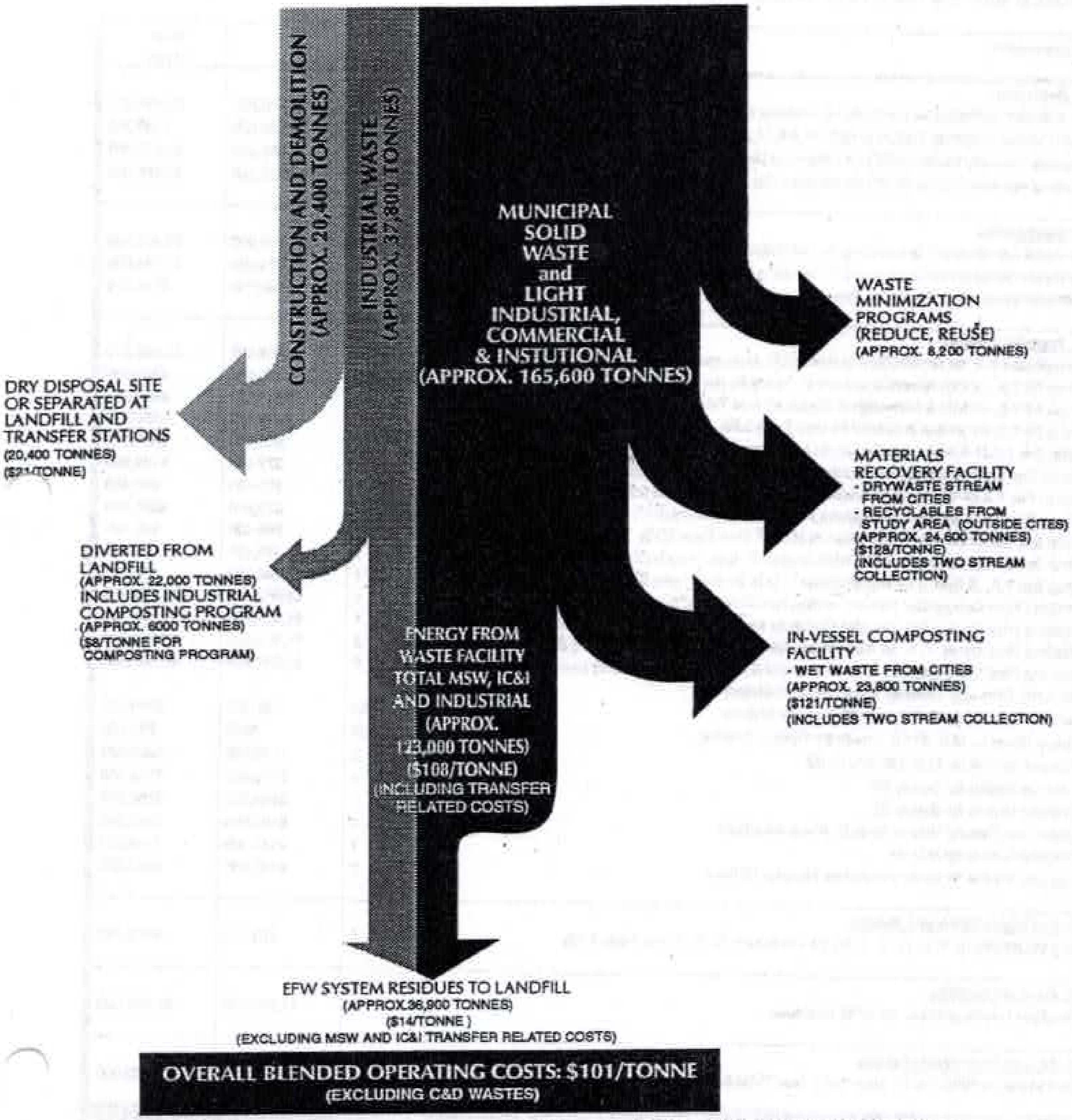

Figure 6.8 - SCENARIO IV WASTE FLOW DIAGRAM

NOTE: BASED ON 1992 ANNUAL WASTE QUANTITIES EXCLUDING COLLECTION COSTS

SOUTHERN ALBERTA INTEGRATED WASTE MANAGEMENT STUDY

TABLE 6.9: ESTIMATED SCENARIO IV OPERATING COSTS

Components	Quantity	Cost	Cost Totals
1. Recycling			
Two Stream Collection for Lethbridge & Medicine Hat (see Table 5.51)	1	$2,449,800	$2,449,800
Rural Mobile Recycling Trailers in M.D. #1,6,9,14,26 & County #2,5,8,26 in T.S. Costs	10		
Material Recovery Facility (MRF) for Lethbridge (See Table 5.7)	1	$1,236,000	$1,236,000
Material Recovery Facility (MRF) for Medicine Hat (See Table 5.8)	1	$852,000	$852,000
Waste Minimization Education Programs	1	$50,000	$50,000
2. Composting			
In-vessel Containerized Composting for Lethbridge (See Table 5.14)	1	$1,001,000	$1,001,000
In-vessel Containerized Composting for Medicine Hat (See Table 5.15)	1	$707,000	$707,000
Windrow Composting Facility for Taber (Table 5.13a)	1	$49,300	$49,300
3. Transfer Stations			
Compaction T.S. for Nanton,Stavely,Granum,Ft. MacLeod in M.D. #26 (see Table 5.30)	4	$69,200	$276,800
Push Pit T.S. for Champion/Carmangay in County #2 (see Table 5.31)	1	$51,400	$51,400
Push Pit T.S. for Milo & Mossleigh in County #2 (see Table 5.31)	2	$51,400	$102,800
Push Pit T.S. for Vulcan in County #2 (see Table 5.31)	1	$51,400	$51,400
Drop Box T.S.(1 Box) for Warner,Coutts,Milk River,Hwy. 500/501 in County #5 (see Table 5.29)	4	$20,100	$80,400
Green Box T.S.(1-8 Boxes) for Enchant,Grassy Lake/Purple Springs in M.D. #14 (see Table 5.28)	2	$19,300	$38,600
Green Box T.S.(9-15 Boxes) for Vauxhall in M.D. #14 (see Table 5.28)	1	$19,300	$19,300
Green Box T.S.(1-8 Boxes) for Etzikom,Foremost,Orion/Many.,Skiff in County #8 (see Table 5.28)	4	$19,300	$77,200
Drop Box T.S. (1 Box) for Irvine Urban in M.D. #1 (see Table 5.29)	1	$20,100	$20,100
Drop Box T.S. (2 Boxes) for Irvine Rural in M.D. #1 (see Table 5.29)	1	$20,100	$20,100
Drop Box T.S. (3 Boxes) for Hilda/Schuler in M.D. #1 (see Table 5.29)	1	$20,100	$20,100
Walking Floor Compaction Transfer Station for Lethbridge (30 tonnes/hr) (see Table 5.32)	1	$932,500	$932,500
Walking Floor Compaction Transfer Station for Medicine Hat (10 tonnes/hr) (see Table 5.32)	1	$456,700	$456,700
Walking Floor Comp. T. S. for Claresholm, Cowley & Redcliff (3.5 tonnes/hr) (see Table 5.32)	3	$384,700	$1,154,100
Walking Floor Compaction T. S. for Bow Island & Lomond (1.5 tonnes/hr) (see Table 5.32)	2	$237,500	$475,000
Existing Compaction T.S. for Lethbridge Regional Waste Management Commission	4	$40,000	$160,000
Existing Push Pit T.S. for Chief Mountain Regional Solid Waste Authority	12	$30,000	$360,000
Existing Drop Box T.S. for Redcliff/Cypress Regional Waste Management Authority	3	$20,000	$60,000
Existing Drop Box T.S. at Vulcan, New Dayton and Milk River	3	$20,000	$60,000
Transfer Bins and Transfer Equipment (Vehicles) Included in Transfer Costs			
4. Dry Waste Disposal Landfills			
Dry Waste Site for M.D. #1 and County #26 (see Table 5.44)	2	$97,940	$195,880
Dry Waste Site for M.D. #6, 9, 14, 26 and County #2, 5, 8 (see Table 5.45)	7	$33,040	$231,280
5. Regional Landfills			
Regional Landfill at Taber For EFW Residues	1	$530,000	$530,000
6. Energy From Waste Facility			
345 tonne/day EFW Facility Near Taber (see Table 5.48)	1	$7,153,000	$7,153,000
7. Transfer of Wastes to Regional Landfills			
Existing and Proposed Transfer Stations (see Table 5.53)	1	$1,735,600	$1,735,600
Total Estimated Scenario IV Operating Costs			**$20,607,360**

SECTION 7.0

ANALYSIS OF SCENARIOS

7.0 ANALYSIS OF SCENARIOS

7.1 SUMMARY TABLE OF SCENARIOS

To facilitate analyzing the scenarios, Table 7.1 provides summaries of the four scenarios (I, II, III and IV) and their alternatives (IIIA and IVA).

7.2 SCENARIO ADVANTAGES AND DISADVANTAGES

For each of the scenarios developed in Section 6, advantages and disadvantages have been compiled. Also, should the scenario be recommended, issues which require additional investigations have been listed for each scenario.

7.2.1 Scenario I - Basic Integrated Waste Management System

Advantages:

- Regional system of transfer stations and sanitary landfills would include existing regional systems plus proposed systems for unorganized regions (existing modified landfills would be closed);
- Operating costs of a regional sanitary landfill are less than if every municipality operated a sanitary landfill (on a $/tonne basis);
- Future park reserve and/or transfer station can be developed at a reclaimed landfill; and
- Compost can be useful as a soil conditioner, landfill cover, landscaping material, etc.

Disadvantages:

- NIMBY syndrome for siting landfills;
- Limited recovery of resources and energy (methane recovery potential only);
- System of volunteer drop off recycling and regional landfills provides minimal incentive to reduce solid wastes (compared to other recycling and composting initiatives as outlined in Scenarios II and IV);

- Does not naturally increase awareness of the Canadian Council of Ministers of the Environment (CCME) 50% waste reduction goal;
- Landfill emissions - (gas and leachate) could require treatment and/or management in the future; and
- Future liability for any landfill discharges.

Issues requiring additional investigations:

- Development of markets for recyclables and compost;
- Suitable landfill and transfer station sites need to be identified;
- Intensive public input, participation and education required for siting a landfill;
- Selected landfill sites will require extensive geological and hydrogeological investigations;
- Licensing and permitting requirements, once suitable sites have been found;
- Environmental impacts; and
- Adequate buffer zones for the landfills must be provided.

7.2.2 Scenario II - Fully Integrated Waste Management System

Advantages:

- Diverts more waste material from the landfill;
- Strives toward CCME's 50% waste reduction goal;
- Recovers resources;
- Economic diversification is created from the new recycling and composting industry;
- Co-composting could be investigated for disposal of sewage sludge (potential of heavy metal compounds in the compost may increase);
- Increases public awareness concerning solid waste and natural resources;
- Two stream collection reduces potential of heavy metal compounds in the compost; and
- Also see Scenario I advantages.

Disadvantages:

- Siting difficulty; NIMBY opposition must be expected from larger geographical area;
- Public perception of emissions from EFW facilities;
- Technically complex; i.e. pollution control systems are extremely sophisticated; requires technically trained staff;
- Higher operating and capital costs than Scenarios I and II;
- Ash disposal; fly ash could require additional treatment;
- Long construction period required ($2\frac{1}{2}$ to 3 years) for an EFW facility;
- May not increase public awareness concerning solid waste and resources; and
- An environmental impact assessment (EIA) would be required for an EFW facility.

Issues requiring additional investigations:

- Market survey for steam/power/electricity;
- Public education program outlining modern EFW facilities, MSW as an alternate fuel and the low pollution emitted compared with the different emission standards of traditional energy production facilities;
- Assess public opposition and/or approval to EFW facilities;
- Suitable landfill, transfer station and EFW facility sites need to be identified;
- Licensing and permitting requirements, once suitable sites have been found;
- Consider possibility of tighter emission standards in the future;
- Confirmation of EIA requirements; and
- Also see Scenario I, additional investigations.

Issues requiring additional investigations:

- Licensing and permitting requirements, once suitable sites have been found; and
- Also see Scenario II and III additional investigations.

7.3 EVALUATION CRITERIA FOR THE RECOMMENDATION

To provide further analysis of the advantages and disadvantages in Section 7.2, as well as to give consideration of costs involved in each scenario, five sets of criteria have been used in the evaluation process for making a recommendation. The five sets of criteria developed are as follows:

- Capital costs (What are the capital costs associated with each scenario?);
- Operating costs (What are the operating costs associated with each scenario?);
- Waste minimization potential (What percentage has the total waste stream been reduced in each scenario);
- Social acceptability (Considers the ease of siting the facility and the public perception of the risk associated with a waste management system); and
- Environmental benefits and long term liability (Considers the environmental emissions to the air, water, and soil, and the difficulty in mitigating the overall discharge impacts).

Waste Minimization Potential Criteria

Factor		Rating out of 10
0% - 10%	Reduction by Weight	1
10% - 20%	Reduction by Weight	2
20% - 30%	Reduction by Weight	3
30% - 40%	Reduction by Weight	4
40% - 50%	Reduction by Weight	5
50% - 60%	Reduction by Weight	6
60% - 70%	Reduction by Weight	7
70% - 80%	Reduction by Weight	8
80% - 90%	Reduction by Weight	9
90% - 100%	Reduction by Weight	10

Social Acceptability Criteria*

Factor	Rating out of 20
Readily Acceptable	15 - 20
Moderately Acceptable	8 - 14
Low Public Acceptance	1 - 7

Environmental Benefits/Long Term Liability Criteria*

Factor	Rating out of 20
Low	15 - 20
Medium	8 - 14
High	1 - 7

* These ratings reflect an arbitrary system of assigned values. They are based on experiences found in other areas of the province and country. Only after extensive public consultation can values be assigned which truly reflect the feeling of the southern Alberta region.

The scenarios and their overall ratings are presented in Table 7.2.

The assessment indicated that the preferred scenario, based on the ranking in Table 7.2, is scenario II (fully integrated waste management system), with Scenario IV (fully integrated waste management system with one EFW facility) and Scenario IVA (fully integrated waste management system with two EFW facilities) being equal as the next preferable option.

SOUTHERN ALBERTA INTEGRATED WASTE MANAGEMENT STUDY

TABLE 7.2: RANKING OF THE SCENARIO OPTIONS

	CRITERIA					
	Capital Costs	Operating Costs	50% CCME Waste (1) Minimization	Social Acceptance	Environ. Liability (Air / Water)	Total Score/ Percent
Possible Points	10	10	10	20	20	70 100%
Scenario I - Basic Integrated Waste Management System	10	7	2	8	8	35 50%
Scenario II - Fully Integrated Waste Management System	9	4	4	14	12	43 61%
Scenario III - Basic Integrated Waste Management System With 1 EFW Facility	4	2	8	8	16	38 54%
Scenario IIIA - Basic Integrated Waste Management System With 2 EFW Facilities	4	1	8	8	16	37 53%
Scenario IV - Fully Integrated Waste Management System With 1 EFW Facility	5	0	9	12	16	42 60%
Scenario IVA - Fully Integrated Waste Management System With 2 EFW Facilities	5	0	9	12	16	42 60%

(1) Does not include C&D waste diversion to a dry disposal site.

SECTION 8.0
CONCLUSIONS AND RECOMMENDATIONS

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.1 CONCLUSIONS

From the information presented in this report, the following conclusions can be drawn (which are based on 1992 data):

- The southern Alberta study area has a primarily agriculture related economy with major industries in the region being centered around the Cities of Lethbridge and Medicine Hat.
- The population within the study area is urban-based with approximately 72% of the population residing in Cities and Towns.
- It is estimated that a total of 165,600 tonnes/year of waste is produced by residents, parks, light industry, commercial businesses and institutions in the area. This amounts to a daily per capita generation rate of 2.2 kg/day. It is estimated that heavy industry generates an additional 37,800 tonnes/year of solid waste and that 20,400 tonnes/year of construction and demolition waste are generated.
- There are a number of existing waste minimization initiatives in the study area. They presently divert approximately 2% of the residential municipal solid waste stream.
- The existing waste management systems in the study area consist of five sanitary landfills, 31 modified landfills, 3 dry disposal landfills, 12 push pit transfer stations, 4 compaction transfer stations, 6 drop box transfer stations, and one hospital waste incineration system.
- Existing transfer stations would continue to operate and additional transfer stations should be sited (with the potential of being located at former modified landfill sites, as well as other locations). It is estimated that a total of 22 new transfer stations would be required (4 compaction, 4 push pit, 7 drop box and 7 green box), which are in addition to the 22 existing transfer stations.
- Existing modified landfills in the study area would be closed in each of the scenarios presented.

	Capital Cost	Operating Cost	% Waste Reduction by weight *
Scenario I • Regional system of landfills and transfer stations • Expanded recycling in urban and rural centres	$15,951,500	$6,691,000	16%
Scenario II • Regional system of landfills and transfer stations • Implementing recycling, composting and other minimization programs to strive towards CCME's 50% waste reduction goal	$32,465,000	$12,175,000	40%
Scenario III • Regional system of landfills and transfer stations • Expanded recycling in urban and rural centres • Energy from Waste facility	$123,211,000	$17,950,000	75%
Scenario IV • Regional system of landfills transfer stations • Implementing recycling, composting and other minimization programs to strive towards CCME's 50% waste reduction goal • Energy from Waste facility	$113,897,000	$20,607,000	82%

* Based on 203,400 tonnes/year MSW, IC&I and Heavy Industrial waste generated in the study area, excluding 20,400 tonnes/year C&D wastes.
Based on conservative estimates from participation in other existing programs, additional public participation could cause this value to increase.

Scenario II would have to be implemented in stages. Since this Scenario builds on most of the waste management systems of Scenario I, the first implementation step should be to regionalize waste management in southern Alberta. This would be accomplished with additional transfer stations and regional sanitary landfills in areas where there are no operating waste management authorities/commissions.

Concurrent with implementation of a waste management system to provide equal service levels, study area residents should be contacted and informed about fully integrated waste management systems. Residents in the southern Alberta region could be surveyed to determine their overall willingness to move to higher 3R waste diversion systems which aim to meet CCME's 50% waste reduction goal, or to move to 4R systems which would provide the most complete treatment of wastes and reduce the overall long term liability.

The scenario II option shoudl be seen as an initial goal, and if enough favorable responses are received which indicate that the southern Alberta region, or portions of the region, are willing to pay the costs associated with a fully integrated 4Rs waste management system, then the decision could still be made to incorporate an EFW facility into the long term implementation plan (Scenario III or IV).

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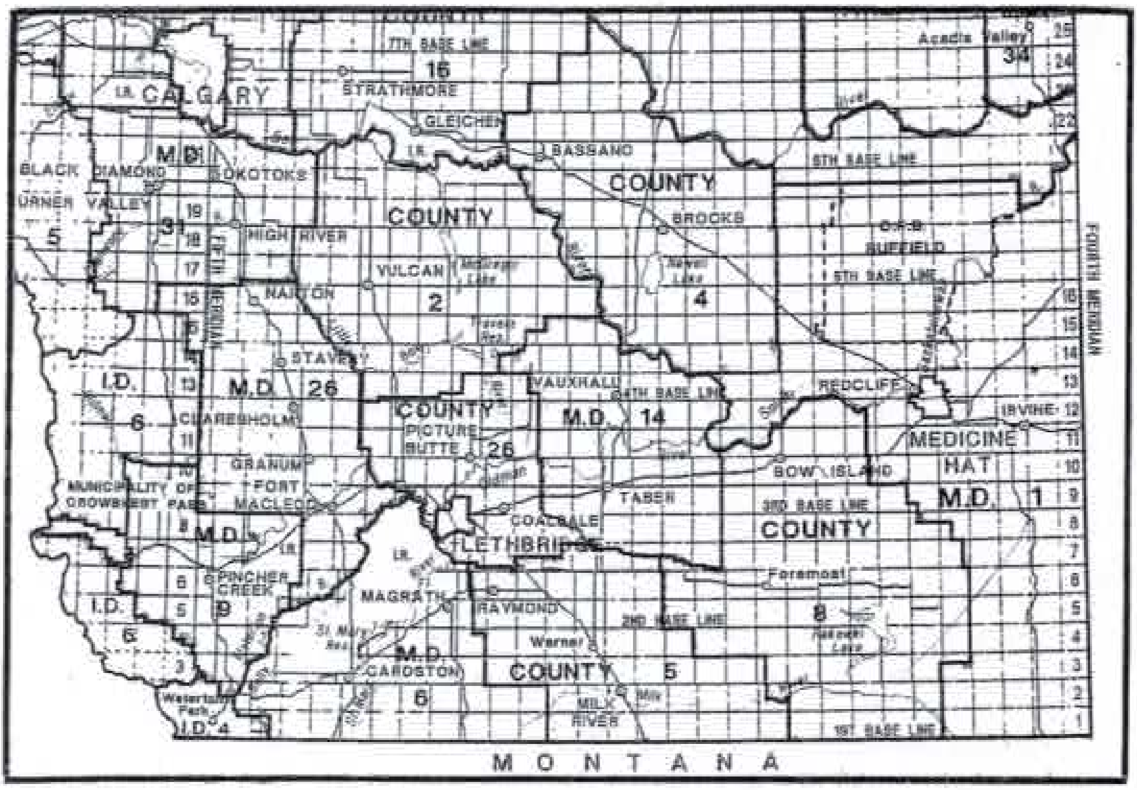

SOUTHERN ALBERTA INTEGRATED WASTE MANAGEMENT STUDY

APPENDICES

VOLUME 2 OF 2

March, 1994

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APPENDIX A
TERMS OF REFERENCE

SCHEDULE A

TERMS OF REFERENCE

ENERGY FROM WASTE

SOUTHERN ALBERTA

TRODUCTION

This study is to determine the feasibility of incinerating wastes in southern Alberta and converting the energy into ectricity or some other form of energy that can be controlled and used in the area.

The area being considered for this project includes the County of Forty Mile, the M.D. of Cypress, the M.D. of Taber, e County of Lethbridge, County of Warner, M.D. of Cardston, the M.D. of Willow Creek, County of Vulcan, the M.D. of ncher Creek and all the urban municipalities within the aforementioned rural municipalities. The existing regional waste anagement authorities and commissions that are operating within the area will be considered as participating in the new stem.

The consultant will determine the quality and quantity of solid wastes generated in the study area in the detail nsidered necessary for the proposed study. Further, the consultant will utilize existing information pertaining to mposition of wastes in Alberta. The unit processes necessary for operation of the system will be identified and nsidered. The disposal of all non-processable materials and different ashes will be addressed and considered. Costs ll be broken down and presented in a form that will be easily understood by all participants. It is important the consultant nsider present costs for waste management at the different municipalities, regional authorities and operating commissions. ne consultant will estimate the costs for replacing facilities that will require upgrading, change and construction to make e transfer of municipal solid wastes more efficient. The consultant will present projected costs for disposal of the on-processables and the residues generated in the energy-from-waste system and their impact on the operating cost. ne final report will present all the information developed during the conduct of the study.

T

Successful completion of this study will produce a report that develops a plan for integrated waste anagement in southern Alberta and addresses the following:

1) A definition of the areas considered in the study as well as a definition of the most economical area that could support the activity under consideration.

2) Determine the quality and quantity of solid wastes generated in the study area including such sources as population centres, agricultural operations, federal/provincial/municipal parks, and rural and urban industrial operations. The quality of the wastes will address waste composition. Review and utilize existing data pertaining to waste composition and which has been generated in Alberta.

3) Identify solid waste generation rates for the study area based on field surveys and/or available records and information. Predictions of future waste generation based on known development plans and population projections for the area. Available records from existing operating facilities shall be used for comparison.

4) Determine the types and quantities of industrial wastes generated within the study area. Identify those wastes that must be directed to Swan Hills for treatment and disposal because they are hazardous wastes.

5) Determine and present the procedures, equipment, personnel, and costs of existing municipal and industrial waste storage, collection and disposal systems operating within the study area. Various parameters of the existing systems, such as: operating costs, projected life span, environmental acceptability, and adequacy of service will be documented. This will provide pertinent information to the decision makers.

a) Capital - a review of the alternatives identified in section 7 shall include any or all of the following depending on their applicability to the alternative:
   - access and on-site road construction
   - fencing, gates and signs
   - weigh scales
   - operating equipment required
   - equipment maintenance building
   - landscape screening
   - litter control
   - site drainage
   - environmental control
   - land acquisition

b) Operation - The operating review for the alternatives identified in section (7) shall include any or all of the following, depending on their applicability to the alternative:
   - staffing
   - utilities
   - daily operating procedures that will be required to conform to governing standards and regulations
   - repair, maintenance, ammortization and operating costs for the necessary equipment (both mobile and stationary)
   - weigh scales and record keeping
   - handling of problem materials
   - recommendations concerning overall management responsibility

9) A recommendation must be made for the implementation of one integrated waste to energy system including estimated capital and operating costs. The cost analysis should take into consideration municipal versus contract operation. The recommended system shall include:
   a) a compilation of all mobile and stationary equipment required to implement the system including cost estimates;
   b) a compilation of all on-site construction that will be required including such items as access ramps, roadways, including cost estimates;
   c) routing of transfer vehicles or direct haul routes for the entire region;
   d) continuance plans for solid waste transportation in the event the implemented system becomes incapacitated;
   e) an estimate of the annual operating costs of the recommended solid waste system and the means of apportioning the costs in an equitable manner. System replacement costs must be considered in the operating cost analysis;
   f) identification of the regulatory agencies, including the local health units and the regulations governing the project;
   g) recommendations for local government regulations for the handling and disposal of waste materials. Recommendations as to preferred methods and penalties of dealing with violators of the regulations;
   h) impact of the energy from waste system on the "clean air strategy".

10) The consultant will present recommendations regarding the process and/or methodology for determining acceptability of the facility to study area residents.

11) The consultant will consider a number of public/private funding scenarios.

The consultant and other pertinent people working on the project shall meet with municipal representatives m the study area initially, to introduce the study and, subsequently, no less than five times to inform the representatives study progress. Feedback shall be considered in the production of the draft final report and fifty (50) copies of a draft al report shall be printed and submitted to the committee and the Waste Assistance Branch, Alberta Environment for ie This draft final report must be presented at a meeting with municipal representatives.

Comments made by the participants in the study must be incorporated in the generation of the final report. e hundred (100) copies of the final report will be submitted to the participants in the study.

APPENDIX B

LEGISLATIVE REVIEW

B.0 LEGISLATIVE FRAMEWORK

This section includes overviews of the federal and Alberta provincial environmental legislation and guidelines, as well as a summary of Alberta's municipal framework as it relates to existing or proposed waste management facilities.

B.1 FEDERAL LEGISLATION, GUIDELINES AND INITIATIVES

The management of wastes generally falls within provincial jurisdiction. There are, however, exceptions which would give federal jurisdiction to the management of wastes. Federal jurisdiction would apply to waste management facilities where the facility involves any of the following:

- cross-border pollution;
- transportation (particularly navigation and shipping);
- federal subsidy or funding of the project;
- federal lands;
- fisheries; and
- peace, order, and good government of the country.

B.1.1 Legislation

Canadian Environmental Protection Act (R.S.C. 1985, c. 16)

The *Canadian Environmental Protection Act* ("CEPA") is Canada's principal environmental statute. It provides the federal government with the authority to control toxic substances, effluents and emissions from cradle to grave, including but not limited to the:

- authority to control the introduction of substances new to Canada;
- authority to obtain information and to require testing of new substances as well as substances that are currently in Canadian commerce;
- authority to control all aspects of a toxic substance's lifecycle, including destruction and disposal; and
- authority to regulate fuels and components of fuels;

Canadian Environmental Assessment Act

The Canadian Environmental Assessment Act ("CEAA") received Royal Assent in June, 1992, but has not yet been proclaimed as the draft regulations are under review. The Act provides for the replacement of the Federal Environmental Assessment Review Office (FEARO) by the Canadian Environmental Assessment Agency. The Act replaces the *Environmental Assessment and Review Process* (EARP) *Guidelines*. The main features of the CEAA include:

1. The federal government must integrate environmental considerations into all aspects of planning.

2. Projects will be grouped into four main types; those that require mandatory study; projects that can be excluded; class assessment lists; and all other projects.

3. Stakeholders may intervene in the process at several stages in the process including; setting the terms of reference; hearings; and mediation.

4. Public Review Panels will be independent of government and will be given full subpoena power.

The environmental assessment process established by the Act is triggered for projects where the federal government makes decisions as: a proponent; a land manager; a provider of funding, or a regulatory authority[1], or if the project is included on the Comprehensive Study List or the Law List. The Comprehensive Study List is a listing of those projects which are likely to have significant adverse environmental effects and which thus warrant an assessment more thorough than a screening.

Permanent waste management facilities for the storage, treatment, incineration or disposal of hazardous waste, including biomedical and infectious waste will be included on the Comprehensive Study List Regulation.

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1 The decision making exercised by the federal government as a regulatory authority is defined under Paragraph 5(1) d. It provides for an assessment to be undertaken if a permit, licence, or approval or any other action for the purposes of enabling the project is to be carried out.

CCME National Packaging Protocol and the Canadian Code of Preferred Packaging Practices

The National Task Force on Packaging, established at the request of the CCME, has developed a National Packaging Protocol. The Protocol, released in 1992, establishes six policies aimed at minimizing the environmental effects of packaging and at achieving a significant reduction in the amount of packaging sent for disposal. The protocol calls for a target 20 per cent reduction of waste by industry and government by 1992, 35% by December 1996, and 50% by December 2000.

The Code of Preferred Packaging Practices has been adopted by the National Task Force on Packaging and all of its members - various levels of government, the packaging industry, and environmental and consumer organizations. It represents a firm commitment, but not a guarantee, to meet the goals contained in the National Packaging Protocol. The Code's guiding principle for disposal of packages is as follows:

> "After all opportunities for waste diversion have been identified and implemented, it remains the responsibility of the package user to ensure that any materials which must be disposed of are capable of being disposed of safely and with minimum effect on the environment."

CCME Guidelines for the Management of Biomedical Waste in Canada

The CCME Biomedical Waste Guidelines, outline a biomedical waste management program which encompasses: reduction, segregation, packaging, use of re-usable containers and single-use containers, colour coding and labelling, in-house movement of wastes, and storage of wastes. The program also addresses treatment options (such as steam autoclaving, chemical decontamination, and other new technologies), disposal options (landfill, sanitary sewer, or incinerator), transportation of these wastes, and occupational health and safety policies and procedures.

Portions of the guidelines may be included in future amendments to the *Transportation of Dangerous Goods Regulations*.

Recycling - Initiative to develop national standards, guidelines, policies and legislation that cover the reduction, re-use and recycling components of the waste stream.

Hazardous Wastes - Initiative to reduce the amount of hazardous waste produced and to ensure the proper handling and disposal of these wastes. It is proposed that the federal government in conjunction with provincial governments will complete guidelines that ensure the safe management of hazardous waste streams.

B.2 PROVINCIAL LEGISLATION AND GUIDELINES

This section is an overview of the relevant provincial legislation and guidelines that impact the development, construction or operation of waste management facilities in Alberta. Alberta's new environmental legislation, the *Alberta Environmental Protection and Enhancement Act*, is discussed as well as the existing legislative frame work.

B.2.1 LEGISLATION

Environmental Protection and Enhancement Act (Assented to June 26, 1992, c. E-13.3)

Environmental impact assessment legislation in Alberta as it relates to the approval of major projects has undergone considerable change in the last two years. The most important legislative initiative has been the *Environmental Protection and Enhancement Act* ("EPEA"), which was passed in the legislature in June, 1992.

EPEA consolidates and replaces nine existing acts: *Agricultural Chemicals Act*; *Clean Air Act*; *Beverage Container Act*; *Ground Water Development Act*; *Clean Water Act*; *Hazardous Chemicals Act*; *Land Surface Conservation and Reclamation Act*; *The Litter Act*; and some sections of the current *Department of the Environment Act*. *The Water Resources Act* will also become part of the consolidated environmental legislation, however it is being revised separately and will be incorporated into EPEA later.

Under EPEA the environmental impact assessment of a major project is now compulsory. The EIA process will allow for public notice of all projects under review and the opportunity for all interested parties to participate in public hearings required for major or controversial projects. The Act also stipulates the contents of environmental impact assessment reports.

(i) that is engaged only in the storage of hazardous recyclables and is not engaged in any other aspect of recycling them, and

(ii) at which

(A) a hazardous recyclable is stored for a continuous period of more than 365 days, or

(B) more than 10,000 litres of hazardous recyclables is stored at any one time;

(g) the construction, operation or reclamation of a facility

(i) that is engaged only in the storage of hazardous waste and is not engaged in any other aspect of the treatment of the waste, and

(ii) at which

(A) a hazardous waste is stored for a continuous period of more than 365 days, or

(B) more than 10,000 litres of hazardous waste is stored at any one time;

(h) notwithstanding clause (g), the construction, operation or reclamation of a facility where hazardous waste is stored and some or all of the hazardous waste is produced by a person other than the owner of the facility;

(i) the construction, operation or reclamation of a facility for processing hazardous recyclables, except a facility for processing

(i) spent process and lube oil filters for volume reduction and liquid removal by compaction or draining, or

(ii) recyclables in an amount less than 10 tonnes per month;

(j) the construction, operation or reclamation of a landfill where hazardous or industrial waste is disposed of;

(k) the construction, operation or reclamation of a facility for cleaning empty containers as defined in the Hazardous Waste Regulation where the nominal capacity of the facility is greater than 10,000 litres per day combined volume;

(l) the burning of prohibited debris by means of an open fire.

Waste Management Regulation (Alta. Reg. 250/85)

The *Waste Management Regulation* originates under the auspices of the *Public Health Act*. Approvals and permits to operate a waste management facility must be obtained from a local board of health. In the case of a sanitary landfill that is to be owned or operated by two or more municipalities and will serve a population of 10,000 or more, a local board must have the consent of the Minister of Health in order to issue an approval to construct or permit to operate.

A waste management facility is defined in the *Waste Management Regulation* as: a sanitary landfill, a modified sanitary landfill, a dry waste site, a waste storage site, a waste sorting station, and a waste transfer station. In addition to permits to construct and operate, where the operation of a waste management facility involves incineration, a permit for incineration must also be obtained from the local health board.

It is stated in the *Waste Management Regulation* that every municipality is responsible for the provision, operation and supervision of one or more waste management facilities for the safe and sanitary disposal of all waste created in the municipality.

Nuisances and General Sanitation Regulations (Alta. Reg. 242/85)

Under the enabling powers of the *Public Health Act*, *Nuisances and General Sanitation Regulations* have been made which prohibit various nuisances including polluted gutters, ditches and water courses, dangerous or offensive trades, deposit of offensive matter and emission of smoke in such quantity or manner as to be injurious or dangerous to health. The regulations also empower health officers or inspectors to enter premises and abate nuisances. As with the *Waste Management Regulation*, enforcement authority under the *Nuisances and General Sanitation Regulations* is delegated to local health boards.

Pursuant to s. 15(1), the Special Waste Management Corporation may establish and operate, and enter into agreements with other persons to establish and operate any hazardous waste management facilities it considers necessary. No person other than the Corporation or a person with whom the Corporation has entered into an agreement shall store hazardous waste, operate a facility for the collection of hazardous waste, treat hazardous waste, or dispose of hazardous waste.. The storing, treatment, or disposal of hazardous wastes on the property where it has been generated, however, is not prohibited under this Act (s.15.1).

Where in the Minister's opinion a person has contravened s.15.1 of the Act, the Minister may issue an enforcement order to that person to stop or shut down an undertaking permanently or for a specified period, and/or to cease the construction or operation of any undertaking.

Transportation of Dangerous Goods Control Act (R.S.A. 1982, c. T-6.5)

The *Transportation of Dangerous Goods Control Act* of Alberta prescribes terms and methods for the transportation of dangerous goods within the province. Certain wastes may be prohibited or regulated under this Act where those wastes meet criteria within the definition of "hazardous waste".

Also pursuant to s. 17(1), a local authority, i.e. municipality, is empowered to make by-laws with respect to highways under its direction, control and management which designate the route and time of travel of vehicles transporting dangerous goods, and prohibit the carriage of dangerous goods on certain highways. By-laws made pursuant to this section will not come into force unless approved by the Minister.

Public Lands Act (R.S.A 1980, c. P-30)

The *Public Lands Act* applies to all Alberta government owned lands. S. 51(1) of the Act prohibits interalia the accumulation of garbage on public lands, or the disturbance of land in any manner which may result in injury to surrounding watercourses.

Guidelines for Land Treatment of Industrial Waste

The Department's objective in the preparation of this document is to establish minimum requirements for the design and operation of a land treatment facility. Approvals for land treatment facilities are required from Alberta Environmental Protection under provisions of EPEA. The guideline outlines the primary criteria which are considered by the Department in reviewing these applications. Included within the document are guidelines for site restrictions, wastes suitable for land treatment, design and operation of a facility, monitoring and reporting, and closure of a land treatment facility.

Guidelines for Industrial Landfills

These guidelines contain the primary criteria considered by Alberta Environmental Protection when it is reviewing applications for the construction or operation of an industrial landfill, as required by EPEA. This document also provides the basis for the approval of municipal landfills which receive industrial or hazardous waste.

The guidelines list the approval requirements related to the construction or operation of an industrial landfill. Further, landfill types are categorized (Class I, II, and III) and the types of wastes that may be accepted for disposal by each landfill class, along with design criteria, are given. Site restrictions, operating requirements, monitoring and reporting requirements, and closure and post-closure requirements are also addressed within the *Guidelines for Industrial Landfills*.

Class I industrial landfills are authorized to accept hazardous and liquid hazardous wastes, except for those hazardous wastes which are prohibited by regulation from disposal in a landfill. Class II industrial landfills may not accept for disposal any liquid hazardous waste or hazardous waste containing free liquids, <u>or</u> hazardous wastes prohibited by regulation from landfill. Class III industrial landfills are restricted to inert solid wastes. No hazardous waste, waste containing free liquid, or putrescible wastes may be disposed of at a Class III site.

B.3.2 Improvement Districts

Improvement districts are created by the Minister of Municipal Affairs pursuant to the *Improvement Districts Act* (R.S.A. 1980, c. I-1), for the purpose of improving the area. They incorporate any lands specified by the Minister. Where construction of a waste management facility is considered within an improvement district, the Minister of Municipal Affairs, rather than a council, will regulate dealings within the area. The Minister is empowered to provide for the doing of anything a council may by by-law or resolution enact to be done under the *Municipal Government Act*, the *Planning Act*, or the *Historical Resources Act*.

Similar to a municipality, an improvement district also has the power to enter into an agreement for the making of a waste management authority.

B.3.3 Land Use By-laws

Municipalities control development by passing land use by-laws and through the control/issuance of development permits. The *Planning Act* (R.S.A. 1980, c. P-9), which governs the planning, use and development of land in the province, gives municipalities this authority. Under the *Planning Act* municipalities are then given the authority to appoint a person to act as development officer. It is the development officer's duty to review applications for development permits. The municipality may also appoint a municipal planning commission, which may take over some of the duties of the development officer, such as reviewing applications for a development of a discretionary use. In some instances, councils of more than one municipality will together appoint a joint municipal planning commission, which will review development applications within each of the municipalities.

Land use by-laws set up zoning districts (residential, commercial, public use, institutional, industrial, etc.) and then designate permitted and discretionary land uses for each zone. The land use by-laws of every municipality involved in a development must be examined, as distinctions in the listed permitted and discretionary uses, and in the rights and responsibilities of development officers exist. There may also be express prohibitions within the land use by-law which are applicable to a particular development.[3]

3 Landfill sites are expressly prohibited on airport zoned land in the land use by-law of the Town of Fort MacLeod.

Many other distinctions between the land use by-laws of municipalities are possible. For instance, in some municipalities, the municipal planning commission is authorized in the land use by-law to use its discretion in reviewing an application for a development permit even when that application does not comply with the land use by-law, or when the proposed development does not fall under a permitted or even a discretionary use for that particular zone.[6] Conditions requiring that such a proposed development will not materially interfere with the use or enjoyment of neighbouring properties may also be attached.

Land use by-laws for municipalities located within the study region which were available at the Government of Alberta Municipal Affairs Library were reviewed. These include the following: Lethbridge, Fort MacLeod, Arrowwood, Bow Island, Foremost, Raymond, Stirling, Milk River, Manyberries, Taber, Vauxhall, Grassy Lake, Vulcan, Nobleford, Glenwood, and Warner.

B.3.4 Regional Planning Commissions

A regional planning commission assists the development officer or municipal planning commission with planning decisions, and may also assist municipalities in the creation of their land use by-laws. The regional planning commission is also responsible for the preparation of a regional development plan. When the establishment of a waste management facility is considered, the regional plan should be consulted, as it may have provisions in relation to waste management for the region.

Regional planning commissions are established through regulation by the Lieutenant Governor in Council, pursuant to s. 21(1) of the *Planning Act*. A regional planning commission is also a corporation, and has powers to make orders, decisions and approvals, and issue notices.

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6 An example of such an authorization is found in the Village of Arrowwood Land Use By-law, s. 20.

Unlike a waste management authority created pursuant to s. 113 of the *Municipal Government Act*, a regional services commission is a corporation. It therefore has all of the powers of a corporation, including the ability to contract, to sue, to have perpetual succession, to acquire and hold real and personal property, and to regulate its own procedure and business.[8] A corporation also provides a shield from personal liability for its individual members.

8 Interpretation Act, R.S.A. 1980, c. I-7, S. 16.

APPENDIX C
ENVIRONMENTAL GROUP SURVEY

Environmental Group Survey

Dave Whitfield of Alberta Environment's Recycling Branch
Phone: 297-8262
March 18

What environmental groups/communities in southern Alberta are working on Resource Recovery Grant Applications?

He is working with 20 communities south of Red Deer.

What are the materials that communities want to accept?

Lethbridge now has a recycling project on stream. GPS has a MRF and can accept virtually anything. GPS has a person on the road to promote the Resource Recovery Grant Program and GPS.

What do you perceive to be the biggest waste management concerns of the communities?

People are generally more informed than they were in the recent past. They are interested in the markets for commodities and waste reduction. There is some resistance to incineration, and it seems to be strongest in the Banff area.

The municipalities seem to be better informed and are taking a more active role in the projects than they used to. There are still people who were "burned" by the markets, but markets for paper (but not for plastic and glass) have improved and there are long-term paper contracts being offered.

What do you perceive as being the waste management priorities of the citizens of southern Alberta?

1. reduction
2. reuse
3. recycling
4. composting
5. can't gauge which is preferred - landfilling or incineration

Comments

When the cost of waste is known then recycling is more defensible to the taxpayers and council; it becomes more than a "do-gooder" idea.

hazardous products and their alternatives
water conservation

They also do environmental puppet shows for schools.

They give talks on vermi-composting and environmentally-friendly business practises.

They also have a good library with information on a variety of topics. The library is operated by volunteers, and when volunteers don't show up it is not open.

They are also involved in the "endangered spaces" campaign to let people know about Alberta's endangered natural areas.

The ERC Friendly Store sells environmentally-friendly products.

What are the future plans of your group?

Hopefully they will go out of business because they are not going to be needed!

Teaching people about living happily with less.

What are your group's main waste management concerns?

1. packaging
2. composting
3. recycling
4. refilling

What would your group like to see in terns of waste management?

What are your waste management priorities?

1 reduction
2 reuse
3 Recycling
4 Composting - regular and
   - at landfills hardwood pallets are left at the ravine as are tree branches. They could be shredded and composted.
5 Landfilling
6 Energy from Waste
   She is very knowledgeable about the problems associated with incineration (i.e. medical problems).

Do you have any other comments?

Landfills should be sited near population centres to "bring home" waste management.

There should be permanent hazardous waste collection areas near population centres.

The following communities have expressed interest in establishing a program with GPS.

- Carmangay
- Barons
- Chief Mountain Waste Management Authority
- Coaldale
- Elkford
- Sparwood
- Claresholm
- Strathmore

What are your markets for materials?

newsprint - Newstech (Coquitlam, B.C.)
cardboard - IG
clear glass - Canasphere
plastics - Polymont
plastic film - Wild Rose or markets in the U.S.A.
tin - Navajo Metals
office paper - Paperboard Industries

What would you like to see in terms of waste management in Alberta?

Recycling is the way of the future.

What would you __not__ like to see in terms of waste management in Alberta?

He doesn't want to see big composting operations. He would prefer to see an emphasis on backyard composting.

What do you perceive as being the waste management priorities of the citizens of southern Alberta?

1. Recycling and Backyard Composting

He has not considered which is better - landfilling or energy from waste

__Grant Harrington:__ They are working on regional programs. They expect the other small towns will be on stream within the next one to two years. School drop offs are not being paid (i.e. Picture Butte, Coalhurst, Coaldale, Vulcan and a number of others) because they are not being weighed. They make six month contracts with the Towns that are on stream. They don't pay for recyclables collected in Lethbridge. The Towns are all waiting for their grant money for the trailers.

GPS began their operation on September 1, 1992 and between September 1 and January 1, 864 tonnes of material were collected. The tonnage is increasing each month. In March 1993 they took in 140 tonnes, and March was the first month that they reached that level. They have collected more than 100 tonnes of newsprint each month. GPS charges for collection from businesses, but not for materials that are dropped off.

Environmental Group Survey

Coaldale Ecology Club
Phone: 345-3344
Debbie Totinka
March 19

What activities do you currently undertake?

> There is currently no recycling program in Coaldale, but the Town of Coaldale has asked the Club to provide some input into planning a recycling project for the Town. The Town is currently assessing interest in recycling - cost, ease of use, volunteer input, etc.
>
> The CEC is also involved in waste management as the Town has asked them about garbage truck purchases and the upcoming County landfill and community composting. She believes that the Town is more comfortable with recycling than with community composting.

Does your group do any public education activities?

> The Club was established to educate the public. They are involved in providing input to the Town on environmental issues, Environment Week presentations, Earth Day celebrations, and waste management demonstrations.

What are the future plans of your group?

> They will continue to be involved in public education and providing input to the Town on environmental issues.

What are your group's main waste management concerns?

> They are actively promoting waste reduction. They promote reusing shopping bags, rejecting excess packaging, conserving water, composting, encouraging backyard wildlife (with Birds of Prey Centre), managing electricity efficiently.

What would your group like to see in terms of waste management?

What are your waste management priorities?

1 Reduce
2 Reuse
3 Recycling/Composting
4 Landfilling: There is the potential for reusing the land, and the resources put in the landfill aren't lost forever. Landfills can be mined
5 Energy from Waste: She prefers clean air and clean skies. She believes that incineration provides no incentive for waste reduction because they NEED waste to continue producing energy. Furthermore, she is concerned about the toxic ash.

Do you have any other comments?

> None

They try to persuade people to purchase recycled paper. Government and other offices should use paper containing post-consumer waste. Their biggest beef is people continuing to live as they currently live and then expect the Government to pick up after them. The focus should be on the front end of the line, on the garbage coming in to the home. Manufacturers of products should be responsible for recycling their own packaging.

Flyers are over-used. People should be invited to pick up only the flyers that want or need.

People should be encouraged to reuse their grocery bags.

Everyone in the public should visit a landfill and see where the plastic bags go. And a link between deforestation and paper should be made with general public.

She suggests deposits on all packaging.

Free compost bins should be given out to householders. Summer students could be hired to make these free bins out of the pallets in the landfills.

Before the spring clean-ups, used goods should be displayed and people can take what they want from their neighbour's unwanted goods.

In Hornby Island there is a free store full of things rescued from the garbage (i.e. fridges, appliances, cutlery). She thinks this is a good idea.

APPENDIX D

CITIES, TOWNS & VILLAGES

Questionnaire for Cities, Towns and Villages

ARROW WOOD: Denise Kuntz, Secretary Treasurer for the Village - March 16, 1993

What quantities of waste are generated?

Unknown

What percentage of the waste collected is residential, industrial/commercial/institutional, agricultural or special?

Unknown

How is waste collected? What kind of truck is used for collection? How much does it hold? Does is compact? What other types of equipment do you use for garbage collection?

They have a landfill site for the Village and rural people surrounding the Village. The Village operates the landfill. The Village doesn't collect garbage, and there is no tipping at the landfill. The landfill is open and supervised between 10-noon and 1 - 3 on Tuesdays and Saturdays between 9:00 - 2:00 This is a recent development. People must sign in when dropping off wastes. They have no equipment, except a pick-up truck, which is used for a variety of town projects, such as taking the employee out to the landfill, and providing an "office" for him when supervising the landfill. They don't have a backhoe.

What are the costs of your current waste management system?

Expenditures for 1992 were $2133. The bulk of that is wages. The rest was for a retaining fence and padlock with chain.

Is there a recycling program operating in your area? Please explain the current system.

There is no formal recycling program.

What do you foresee in terms of changes to your waste management system?

The Village is working with the County of Vulcan's Waste Management Committee and through this committee they are looking into building transfer stations in the area (but Arrow Wood is not on the plan for a transfer station). The life expectancy of current landfill is limited. The Village Council is doing some preliminary investigations into establishing a transfer station for Village residents. They are unsure of where they will take the waste. The are investigating the possibility of contracting with an organization to take the waste to Foothills Landfill.

Questionnaire for Cities, Towns and Villages

BOW ISLAND: Kenneth J. Hollinger - March 12, 1993

BOW ISLAND: Wayne Gilbertson of The Lions Club - March 18

BOW ISLAND: Lyle Tuscherer, The County of 40 Mile School - March 26

What quantities of waste are generated?

Unknown. They do not have a scale or records.

What percentage of the waste collected is residential, industrial/commercial/institutional, agricultural or special?

Residents - 60%
ICI - 10%
Agriculture - 30%
Special - Mr. Hollinger was not certain, but remembers that last year **The County of 40 Mile School District** (Phone: 548-1440) held a Toxic Round-Up.

How is waste collected? What kind of truck is used for collection? How much does it hold? Does is compact? What other types of equipment do you use for garbage collection?

Town of Bow Island and Village of Burdett have their own trucks (one each) and garbage is picked up once a week and taken to the North 40 Mile Regional Landfill. Both trucks are compactors. Bow Island's truck is two ton truck. The truck collects three days per week and every trip to the landfill is full. By extrapolation we can estimate that approximately 6 tonnes a week is collected for landfilling from the Town of Bow Island.

The North 40 Mile Regional Landfill is open on Tuesdays, Thursdays and Saturdays from 10 am until 3 pm. The Landfill is also open on special occasions such as the spring clean-up.

What are the costs of your current waste management system?

The system costs $12 per capita per year, or $35,000 per year in total. In 1993 they have budgeted $35,000 for the landfill (for a population of 4000 people). The collection costs are about $8.00 a month per household. Some institutional collection costs are higher. The major institutional producers are the schools, the hospital and the Provincial Building.

Is there a recycling program operating in your area? Please explain the current system.

Wayne Gilbertson (Phone: 545-2577) of The Lions Club says that they collect newsprint, mixed paper, ledger, computer and corrugated cardboard. They take it to Calgary. The loads are usually about 10 tonnes. Last year they shipped:

Comments: Metal and white goods are recycled at the landfilled by the landfill operator who has the salvage rights. A compactor was hired last year to take the white goods to Regina.

Wood is burned in a pit at the landfill.

Pesticide containers are accepted at the landfill site and collected by the Province. The Province brought a shredder to the site and removed the shredded containers.

Questionnaire for Cities, Towns and Villages

CARDSTON: Gregory Burt, Town Administrator - March 12 and July 7, 1993

CARDSTON: Doug Fox, Waste Hauler - March 22, 1993

CARDSTON: Richard Bengry - Cardston District Association for the Handicapped - March 19

What quantities of waste are generated?

> According to the Chief Mountain Solid Waste Management Authority's Solid Waste Management Report, Cardston generated 2,245,532 kg of waste in 1991 and 2,110,733 kg in 1992.

What percentage of the waste collected is residential, industrial/commercial/institutional, agricultural or special?

> Residents - 60%
> ICI - 40% (mostly cardboard)
> Agriculture - The Town doesn't collect waste from farmers
> Special - The Town recommends that people take their special wastes to Lethbridge's Toxic Round-Up. There is a Pesticide Container Collection Site at the local transfer station.

How is waste collected? What kind of truck is used for collection? How much does it hold? Does is compact? What other types of equipment do you use for garbage collection?

> The Town belongs to the Chief Mountain Waste Management Authority. The Town collects from residents and commerce once a week. Some businesses, like the food store, get more frequent collection.
>
> The Contractor for garbage collection is Mr. Doug Fox. **Mr. Fox** indicated that he has a 20 cubic yard wedge pack truck. The transfer site is 1 mile from Town limits. Some commercial businesses are collected every day others less often.
>
> The transfer station is open 24 hours per week year-round.

What are the costs of your current waste management system?

> The Town pays $50,000 per year for collection of wastes, and $38,000 is paid each year to the Waste Management Authority.
>
> Because the Chief Mountain Waste Management Authority runs landfill, and the Town contracts out the garbage collection, they incur no capital expenditures. The transfer station supervisor is paid $20,000 per year. The transfer station is 1/4 mile out of town.

Is there a recycling program operating in your area? Please explain the current system.

> **Richard Bengry (phone: 653-3766) from the Cardston and District Association for the Handicapped/Cardston Recycles/Cardston Training (these are all subsidiaries of the same company)** says that Doug Fox works for the Town as a

Questionnaire for Cities, Towns and Villages

CARMANGAY: Darrell Garceau, Town Manager -- March 12

CARMANGAY: Larry Lyckman, Public Works -- March 15 and July 7

What quantities of waste are generated?

They collect about 2 tons per week. Collection is on a weekly basis.

What percentage of the waste collected is residential, industrial/commercial/institutional, agricultural or special?

Residents - Approximately 90%
ICI - Approximately 10%
Agriculture - They haul their own or use burn barrels
Special - There is Pesticide Chemical Container Site at the landfill and they encourage that people take their special wastes to Lethbridge or Vulcan.

How is waste collected? What kind of truck is used for collection? How much does it hold? Does is compact? What other types of equipment do you use for garbage collection?

They have one one ton truck, and it is filled twice per week.

They used to leave their landfill unattended and open 7 days a week, but they have recently locked it to prevent non-residents from dumping wastes. Residents can get the key to the landfill from a variety of Village officials.

The only equipment that they have is the truck and a backhoe.

There are no landfill records, however they collect approximately 2000 lb per week.

What are the costs of your current waste management system?

Residents are charged for garbage collection - $14.90 for two months. This is placed on utility bills. As everybody pays the same amount and people have free access to landfills, burn barrels aren't encouraged, but some people still use their burn barrels.

Questionnaire for Cities, Towns and Villages

CHAMPION: Marjorie Robinson, Town Manager - March 12, 1993

What quantities of waste are generated?

Unknown

What percentage of the waste collected is residential, industrial/commercial/institutional, agricultural or special?

Unknown

How is waste collected? What kind of truck is used for collection? How much does it hold? Does is compact? What other types of equipment do you use for garbage collection?

Residents and businesses haul their own wastes. The Village does not own a garbage truck. There is no private hauler.

The Village recommends that people take their pesticide containers to the landfill containment area.

What are the costs of your current waste management system?

Champion landfill site accepts their wastes. It is open two days per week. The system costs $4,000 per year in salaries. They don't keep track of equipment costs.

Is there a recycling program operating in your area? Please explain the current system.

No, some residents take materials to the recycling depot in Vulcan.

What do you foresee in terms of changes to your waste management system?

They are involved in the County of Vulcan Waste Management Authority. She is unsure of the status of this project.

What information do you have on the 1992 Toxic Round-Up that your municipality took part in?

More could have been collected if there hadn't been a big storm that day. DBS in Lethbridge worked with them and has information on the quantities collected.

DBS Environmental said that 150 litres were collected in Claresholm

There is nothing in place. Sunrise Bottle Depot accepts newspaper (**Carla Martin - Phone: 345-4586**). They are trying to implement a program, especially for newspaper and cardboard, in conjunction with the Bottle Depot.

Carla Martin of The Sunrise Bottle Depot says that they accept newspaper, but they don't have compactor so they must ship it in boxes (5 foot by 5 foot) that were supplied to them by Paperboard Industries. This is a recent project and they haven't yet sent any paper. They intend to send it to Calgary in the future. They are amazed by the response of the public; over five boxes were collected in just over a month! They intend to supply their own trailers and pay for transit. They have not calculated the costs and benefits of the project yet.

Questionnaire for Cities, Towns and Villages

COALHURST: Dave Veres, 381-3648
Will not talk over the phone.

What quantities of waste are generated?

What percentage of the waste collected is residential, industrial/commercial/institutional, agricultural or special?

Residents -- only domestic waste is collected
ICI -- Drop off their own wastes at the landfill
Agriculture --
Special

How is waste collected? What kind of truck is used for collection? How much does it hold? Does is compact? What other types of equipment do you use for garbage collection?

What are the costs of your current waste management system?

Is there a recycling program operating in your area? Please explain the current system.

What do you foresee in terms of changes to you waste management system?

Questionnaire for Cities, Towns and Villages

COWLEY: Laurie Wilgosh, Town Administrator -- March 12

What quantities of waste are generated?

> The Town generates approximately 3 tons per week. According to the Crowsnest Pass - Pincher Creek Waste Management Authority Report, the Village of Cowley deposited 232 tonnes of waste at the regional landfill in 1992.

What percentage of the waste collected is residential, industrial/commercial/institutional, agricultural or special?

> Residents - 50%
> ICI - 50% (cardboard predominantly)
> Agriculture - no pick up for them
> Special - The Town doesn't have a Toxic Round-Up or Pesticide Container Site nearby.

How is waste collected? What kind of truck is used for collection? How much does it hold? Does is compact? What other types of equipment do you use for garbage collection?

> Waste is collected once a week by a Town employee. Their truck is a three ton compactor truck. It is usually full when taken to landfill. Waste is taken directly to the Crowsnest Pass-Pincher Creek Regional Landfill. The landfill is open 9 - 4:30 every day. (Landfill phone: 628-3849). The landfill is ten miles from town.

What are the costs of your current waste management system?

> They pay $870 to the Regional Waste Management Authority each year plus a $12 per tonne disposal fee. There is no transfer station in the area. The truck driver is paid, but as he collects waste one day a week and performs other duties for the Town throughout the week, the salary component is not charged to waste management budget.
>
> Their capital costs include the purchase of the truck and maintenance, as well as fuel. The Town official estimates that this costs about $1000 per year.

Is there a recycling program operating in your area? Please explain the current system.

> The Pincher Creek Elks operate a recycling program for the area. Please see Pincher Creek for more information on the materials accepted.

What do you foresee in terms of changes to your waste management system?

> The Regional Board is looking into increasing the recycling that is undertaken.

Going Green has applied for a Resource Recovery Grant. The recycling equipment would be rented to the bottle depot. If community recycling is undertaken, Going Green would then change its focus to educating the community about recycling.

Going Green currently does not have a bailer, so their materials are not in a form that markets are willing to pay for so they donate their materials to local projects that have bailers (i.e. Pincher Creek Elks). They are interested in working with the Pincher Creek Elks.

On July 9, I spoke with Cheryl Cann and Wray Kenney. Pass Beverages (the Bottle Depot) is now accepting the materials (corrugated cardboard, newsprint, mixed paper and #2 plastics) and shipping them to Pincher Creek's depot. This project is new and representative tonnages are not yet available, however they believe that they are included in the Pincher Creek Elks totals.

Pass Beverages is also accepting tin cans, which they take to Calgary whenever they can.

What do you foresee in terms of changes to your waste management system?

None were reported.

What information do you have on the 1992 Toxic Round-Up that your municipality took part in?

John Kapalka sent a fax indicating that they collected 1,799 litres of hazardous waste in 1992.

Questionnaire for Cities, Towns and Villages

FORT MACLEOD -- Lane McLaren, Town Secretary -- March 12 amd July 7

FORT MACLEOD - Kelly O'Sullivan of O'Sullivan Construction - March 23

What quantities of waste are generated?

The Town generates about 30 - 35 tonne per week. It is hauled to the local landfill.

What percentage of the waste collected is residential, industrial/commercial/institutional, agricultural or special?

Residents - 50%
ICI - 50%
Agriculture - bring in their own
Special - There is a Pesticide Container Depot at the landfill and a Toxic Round-up is held each year.

How is waste collected? What kind of truck is used for collection? How much does it hold? Does is compact? What other types of equipment do you use for garbage collection?

O'Sullivan Construction uses one rear-loading packer truck that holds 20 cubic yards.

What are the costs of your current waste management system?

O'Sullivan Construction, the contractor, operates the landfill site. This service costs $58,000 per year. The same contractor collects garbage and that costs $65,000 per year. No other costs are incurred.

O'Sullivan Construction collects once a week. The landfill is open 40 hours a week. The landfill is located about 3 miles from Town.

The Town has no equipment.

Is there a recycling program operating in your area? Please explain the current system.

Yes, they just got a Resource Recovery Grant for a recycling project. They are applying for another grant to purchase a compactor trailer for cardboard collection.

The Town hopes that an altruistic semi-retired person will volunteer to haul the wastes to GPS. They will be reimbursed for out-of-pocket expenses.

The oil recycling project has closed down, but UFA accepts used oil for re-refining.

Members of the environment committee have taken courses in composting and assist residents with backyard composting.

Twice a week they collect between 900 and 1000 kg of recyclable materials, therefore approximately 2000 kg of recyclable materials are dropped off at the depot each week.

Questionnaire for Cities, Towns and Villages

GLENWOOD: Bonnie Law, Town Administrator - March 15 and July 7

What quantities of waste are generated?

According to the Chief Mountain Solid Waste Management Authority's Solid Waste Management Report, Glenwood generated 300,657 kg of waste in 1991 and 357,401 kg in 1992.

What percentage of the waste collected is residential, industrial/commercial/institutional, agricultural or special?

Unknown

How is waste collected? What kind of truck is used for collection? How much does it hold? Does is compact? What other types of equipment do you use for garbage collection?

Village is involved in the Chief Mountain Waste Management Authority. Residents take their garbage to the transfer station which located is 7 miles west of the village. No waste collection services are provided.

There is some burning and separation at the transfer station, but it is a transfer station, not a landfill. The transfer station is open from 10 am until 4 pm Wednesdays and Saturdays, for a total of 12 hours a week. The waste from the transfer station is hauled to Kedon. The MD of Cardston and the Villages of Hill Spring and Glenwood operate this transfer station.

What are the costs of your current waste management system?

The Village pays $3.30 per household per month to the Landfill Authority. There are 84 households in the Village of Glenwood, therefore the monthly cost is $277.20 for waste management. This charge covers salaries and miscellaneous expenses. Quite a large part of the population (75% to 80%) use burn barrels.

Is there a recycling program operating in your area? Please explain the current system.

They occasionally have a recycling drive; a paper collection day. Volunteers take the paper to Cardston. Recently a councillor encouraged the Village to enquire about a provincial grant so they could acquire a trailer.

The Village used to operate a paper recycling project. It has been closed because the markets were hard to access. They have applied for a Resource Recovery Grant, but are not sure whether they will receive it yet. If they receive a grant they will be working with GPS.

What do you foresee in terms of changes to your waste management system?

The Village Administrator mentioned that the Village is interested in compacting waste at the transfer station. They are also interested in increasing recycling opportunities. Some residents compost while others plow organics into the soil and the gardens.

Questionnaire for Cities, Towns and Villages

HILL SPRING: Karen Folsom, Town Administrator, March 16 & July 8

HILL SPRING: Dennis Gibb, Boy Scout Leader, July 9

What quantities of waste are generated?

Unknown

What percentage of the waste collected is residential, industrial/commercial/institutional, agricultural or special?

Unknown

How is waste collected? What kind of truck is used for collection? How much does it hold? Does is compact? What other types of equipment do you use for garbage collection?

The Village of Glenwood, MD of Cardston and the Blood Indian Reserve use the same transfer station. The Blood Indians aren't formally involved, but they use the transfer station. In fact, some people from the MD of Pincher Creek use this transfer station. This transfer station is part of the Chief Mountain Regional Waste Management Authority.

There is no garbage collection in the Village. Everyone is responsible for hauling their own garbage. In Hill Spring the local Boy Scouts haul garbage as a fund raising venture. About 10 household use this service on a weekly basis. This just started a couple of months ago. The contact is Dennis Gibb (phone: 626-3275).

Mr. Gibb indicated that the Boy Scouts collect from 7 households every week. He estimates that they collect 1000 lb each time they collect waste in their horse trailer. Most people in the community use burn barrels, however the Boy Scout's customers don't.

What are the costs of your current waste management system?

Hill Spring is involved in the Chief Mountain Regional Waste Management Authority. The Village of Hill Spring households pay $6.00 per month to the Authority. This covers the supervision of the transfer station, the running of the landfill and all operational costs. The operating costs are taken care of by the Chief Mountain Regional Solid Waste Management Authority.

Is there a recycling program operating in your area? Please explain the current system.

Recycling was considered at the Wednesday, March 17, 1993 council meeting. Council opted not to become involved in recycling because the population is so small and the funding was not available to cover all the costs involved in taking on a recycling program.

What do you foresee in terms of changes to your waste management system?

She is not aware of any waste management planning, except for recycling.

Questionnaire for Cities, Towns and Villages

IRVINE: Joanne Lambert, Town Administration, March 17

IRVINE: Jeff, Town Administration, July 9

What quantities of waste are generated?

Unknown.

What percentage of the waste collected is residential, industrial/commercial/institutional, agricultural or special?

Residents - The Town only collects residential waste.
ICI - Businesses must drop off their own wastes at the landfill.
Agriculture - The Town doesn't collect from the farmers. The M.D. of Cypress number 1 pays Irvine $150 per month for letting the farmers use the landfill
Special Wastes - There are separate areas for scrap metals, chemical containers and wood.

Residential and commercial wastes go into the pit. No oil dumping is allowed.

How is waste collected? What kind of truck is used for collection? How much does it hold? Does is compact? What other types of equipment do you use for garbage collection?

The Town of Irvine operates a landfill. Once a week garbage is collected by the Town, and the landfill is open (and supervised) to the public on Saturdays and Sundays. The Town truck is a 3/4 ton truck which usually takes about 2 loads per week to the landfill.

What are the costs of your current waste management system?

Currently it costs about $7000 per year for collection and landfilling.

As the same town truck is used for a variety of Town jobs, costs aren't separated, so capital costs cannot be determined. A guard shack, heating and new pits costs are the only expenses that they incur.

Is there a recycling program operating in your area? Please explain the current system.

Since April, 1993, the Town of Irvine has been hauling 60-70 bundles (each bundle is approximately 10 lb) of newspaper and magazines to Reddy Enterprises in Medicine Hat. The transportation costs are not known because the paper is hauled in the town truck and expenses come out of general revenue. As they drop off their papers in Medicine Hat, Irvine's materials are included in Medicine Hat's totals. They are going to evaluate the operation and hopefully begin tin can recycling.

What do you foresee in terms of changes to your waste management system?

The Town is considering a tin can recycling project. They are not considering joining a waste management authority.

Questionnaire for Cities, Towns and Villages

LOMOND: Tracy Doram, Town Administrator, March 16, 1993

What quantities of waste are generated?

Unknown.

What percentage of the waste collected is residential, industrial/commercial/institutional, agricultural or special?

Residents - 90%
ICI - 10%
Agriculture - They haul their own
Special -- There is a Pesticide Container Site at the Landfill. Paint cans go in the same area.

How is waste collected? What kind of truck is used for collection? How much does it hold? Does is compact? What other types of equipment do you use for garbage collection?

Garbage is collected twice per month. By extrapolation it can be inferred that approximately 4 tons a month (or a bit less) of waste is generated. The landfill is half a mile south of Lomond. It is not supervised.

One non-compactor one ton truck collects and delivers two loads of waste to the landfill every two weeks.

What are the costs of your current waste management system?

In 1992 garbage collection and disposal cost $6,876. There were no capital expenses in 1992.

Is there a recycling program operating in your area? Please explain the current system.

They are in the process of planning a recycling program. A lot of residents take recyclables to Vulcan. Vulcan accepts just paper.

What do you foresee in terms of changes to your waste management system?

To date they are not a member of the Vulcan Waste Management Authority. The proposed Vulcan Waste Management Authority Regional Landfill site is near Lomond so they believe that they will one day become a member of the Authority. They are working out the details at this time.

The Town is considering recycling. They are working with the Lions Club on this issue.

What do you foresee in terms of changes to your waste management system?

No changes are foreseen except for increased recycling.

What information do you have on the 1992 Toxic Round-Up that your municipality took part in?

Craig Bennett of the Fire Department says that the Fire Department and the Town have worked together to conduct Toxic Round-Ups. There wasn't one 1992, but Toxic Round-Ups were held in 1988 and 1990. In the 1990 Toxic Round-Up 1/2 of a 45 gallon drum was filled with waste. The 1988 Round-Up collected 1 full 45 gallon drum. It was mostly paint.

According to Karen of the Alberta Action on Waste Hotline, the following recycling opportunities are available to residents of Medicine Hat:

- BFI — Corrugated Cardboard (30-40 tonnes per month)
  White Office Paper (6 tonnes every 3-4 months)
- Catalyst Recycling — Solvents
- Dunsmore Road Esso — Used Oil
- Superior Propane — Used Propane Tanks
- Fountain Tire — Tires (for retreading and disposal)
- Hat Salvage and Steel — Lead-Acid Batteries, and Metals (except galvanized steel)
- The Post — Clothing and Household Items
- UFA — Used Oil (for members only)
  Plastic Oil Containers
- Husky — Used Oil
- Medicine Hat Christian School — Magazines (2.5% of 20 tonnes every 2 weeks)
  Newspapers (95% of 20 tonnes every 2 weeks.
  Books (2.5% of 20 tonnes every 2 weeks)

Gerry Makkinga of the Medicine Hat Christian School (phone 548-7179) says that they deliver a 20 tonne load of newsprint, books and magazines every two weeks to Allied Paper Savers in Edmonton. The Medicine Hat Christian School has 6 bins in Medicine Hat and 2 in Redcliff.

Lois from Reddy Enterprises (526-9344) says that they accept primarily beverage containers, however they do have bins for OCC, plastic bags and tin cans. They would like to have a bin for glass, but there is no market for it. The OCC is taken by BFI. The plastic bags are taken to the Co-op, and the tin cans are taken to Hat Salvage. Reddy Enterprises does not have information on quantities except on the bottles from the Depot.

What do you foresee in terms of changes to your waste management system?

They have requested proposals for developing a solid waste management plan. They would also like to have a permanent special waste collection facility near the City.

What information do you have on the 1992 Toxic Round-Up that your municipality took part in?

The 1991 Round-Up cost $19,000, the 1992 one $23,000 and they held one on June 5, 1993.

In 1992 they collected 65 barrels (220 litres each) of waste. In total they collected 14,300 litres.

What information do you have on the 1992 Toxic Round-Up that your municipality took part in?

> **Nine barrels of waste were collected in 1990. The Town is not holding one in 1993. In 1992 about 4 barrels were collected.**

On July 11, Grant Harrington of GPS indicated that Milo has recently started their project. One load of 2200 kg was collected after one month of operation. Old newspaper comprised between 65% and 70% of the load. GPS accepts newspaper, magazines, cardboard, mixed paper, tin cans, clear glass, and plastic from Milo and other communities.

What do you foresee in terms of changes to your waste management system?

They are part of the County of Vulcan Solid Waste Management Authority. They will close down the "dump" when the regional landfill is on-stream.

NEAS receive some assistance from the Town initially; the Town provided a location and insurance while volunteers ran the program and took the goods to market. NEAS covered the transportation costs incurred by volunteers hauling the materials to markets. Sometimes the gas costs exceeded the revenues from the recyclable materials.

NEAS has been working with Calgary markets, but they are intending to work with GPS in the future. In fact, materials collected during the March round-up were hauled to Lethbridge. They would like to access provincial government funding to purchase a "horse trailer" for hauling materials to GPS.

They switched from Calgary markets to GPS because they would be in a better position to cover transportation costs and (perhaps) break even. Currently they are not making any money. They received $1000 anonymous donation.

NEAS is hoping that the Town will provide a site for their horse trailer. Until they have the horse trailer they would like to maintain Town vehicles for use. They are not even sure if one horse trailer is enough. The relationship between the Town and NEAS is good.

On July 7, Janice Johnson indicated that the recycling round-ups were going well. Each month they collect approximately the same volume of materials, namely:

- 70 kg plastics (#1 and #2)
- 1800 kg old newspapers
- 400 kg of old corrugated cardboard
- 280 kg mixed paper
- 240 kg glass

What do you foresee in terms of changes to your waste management system?

NEAS is hoping that a local recycling facility or storage area will be established. They have no further waste management plans.

What information do you have on the 1992 Toxic Round-Up that your municipality took part in?

The 1992 Toxic Round-up was held by the Town and a hazardous waste disposal company (DBS Environmental). NEAS reported that they collected 1003 litres during the Toxic Round-Up.

Comment: Janice Johnson of NEAS is very interested in this study and would like to receive a copy of this report.

What do you foresee in terms of changes to your waste management system?

There no plans for change. They encourage composting, and would like to see some recycling undertaken. There are people in the Village that take their recyclable materials to Green's Pop Shoppe for recycling.

The Town collected $55000 in 1992 from residents and businesses for garbage collection. Revenue equalled expenses. The Commission was paid $32000 and the remainder covered wages, fuel and capital expenses.

Is there a recycling program operating in your area? Please explain the current system.

The Commission is looking into recycling, but no programs are currently in place.

What do you foresee in terms of changes to your waste management system?

There should be more recycling. They would like to have another compactor in Picture Butte to facilitate cardboard recycling. They have considered working with GPS on a recycling project and have applied for a Resource Recovery Grant. They would like to recycle plastic, paper, cardboard, etc.

What information do you have on the 1992 Toxic Round-Up that your municipality took part in?

The Regional Waste Management Commission held a Toxic Round-Up in 1992. In total, they collected 2948 litres. The Round-Up cost $2668, while disposal costs totalled $24,000.

Markets include IG, Paperboard Industries and Canadian Paper Recyclers. The amounts collected are variable and they don't know how many loads are taken to Calgary. This year they are trying to haul 300 tonnes. Because the project is operated by volunteers, they make a very small profit.

On July 9 Mr. Bourque provided a breakdown of the items collected. He says that about 40% of the waste is cardboard, 45% is newsprint and the remaining 15% is mixed paper and plastics. Statistics on Cowley and Lundbrecht extensions of the Elks project are included in the Elk's statistics. He has revised his estimate for the year - they now believe that they will haul 280 tonnes.

What do you foresee in terms of changes to your waste management system?

Its doing well right now. They are working with the Elks to expand the recycling program. They are currently accepting only paper, but would like to collect plastics, clear glass and metal.

What information do you have on the 1992 Toxic Round-Up that your municipality took part in?

Mr. Bourque said the June 18, 1992 Toxic Round-Up wasn't very successful as only fifty vehicles arrived at the site. A mobile unit (Duff Collection Services) collected the wastes. The Town of Pincher Creek paid for the service.

The Round-Up was held by the Town of Pincher Creek and the Town of Fort MacLeod (they shared the Round-Up). The total volume collected in Pincher Creek was 1,673 litres. The largest categories collected were:

- waste flammable liquids
- waste poisonous liquids
- miscellaneous

Mr. Bourque recommends that Toxic Round-Ups be held once every two years and an high visibility advertising program be used to promote Round-Ups.

Ryan and Ronna Wright pick up recyclable materials from homes once a week (Saturday mornings). They collect unsorted newsprint, tin cans, plastic, glass jars, magazines and cardboard which they sort and take to the Raymond Bottle Depot. The Bottle Depot hauls the materials to GPS. If the Wrights get a big a load, they may take it to GPS themselves. The Wrights charge participating families $10/month. They've been collecting recyclable materials for a year, but they are uncertain about tonnage. 30 - 40 families participate, each giving the Wrights about one full garbage bag a week.

What do you foresee in terms of changes to your waste management system?

They would like to see increased recycling, a spring clean-up campaign, and establishing a burning site.

Burning barrels are accepted and used a fair bit. There is more open burning than burn barrel usage.

What are the costs of your current waste management system?

Redcliff belongs to the Redcliff - Cypress Regional Landfill System. Although the landfill is called a regional landfill, the Town of Redcliff operates the landfill and covers any losses. Losses amount to approximately \$32000 per year.

In 1993, disposal will cost the Town of Redcliff \$80820, but that includes the operation of the regional landfill, and doesn't include collection costs. Collection, disposal, capital and regional landfill management system operation costs total \$95,970. This figure includes the Regional Landfill deficit.

Is there a recycling program operating in your area? Please explain the current system.

They don't have a recycling program at this time. There is a facility at landfill for used oil. The Town advertises that there is a used oil recycling centre at the landfill site.

What do you foresee in terms of changes to your waste management system?

The idea behind the bin system is facilitate recycling once the markets improve; its a natural offshoot. There is a potential paper recycling plant opening Redcliff. This would improve the markets and then they could begin collecting it through their bin garbage collection system.

They have gone through some changes in the past few years, and don't foresee any further changes.

Questionnaire for Cities, Towns and Villages

STIRLING: Greg Czeck, Village Manager, March 17

STIRLING: Gerry Solqys, Stirling Handicapped Opportunities - July 9

What quantities of waste are generated?

No collection system is in place. According to the Chief Mountain Solid Waste Management Authority's Solid Waste Management Report, Stirling generated 282,140 kg of waste in 1991 and 313,076 kg in 1992.

What percentage of the waste collected is residential, industrial/commercial/institutional, agricultural or special?

Unknown.

How is waste collected? What kind of truck is used for collection? How much does it hold? Does is compact? What other types of equipment do you use for garbage collection?

They don't have a collection system in place. Each resident must take his or her waste to the transfer station which is open on Tuesdays and Saturdays. They have no equipment of their own.

What are the costs of your current waste management system?

The operational costs, including the requisition to Chief Mountain Waste Management Authority, totals $8500 per year. The capital costs only relate to the transfer station site. This year the transfer station needs some maintenance.

Is there a recycling program operating in your area? Please explain the current system.

A private organization, Stirling Handicapped Opportunities, operates a recycling program. Their phone number 756-3057.

Stirling Handicapped Opportunities' Gerry Solqys says that they collect newspaper, computer paper, photocopy paper, cardboard, clear & white plastics, clear glass and tin cans. They take these materials to Calgary. Paperboard Industries accepts the paper products and plastics. Currently there is not market for glass. Tin cans are taken to National Salvage.

Mr. Solqys believes that his organization diverted approximately 5 tons of waste from the waste stream between October, 1992 and March 1993. They do not receive any financial support from the Village or any outside organizations. He believes that recycling is a good idea and that it is appreciated by the residents.

On July 9, Mr. Solqys was interviewed a second time. The Stirling Handicapped Opportunities group has taken in 15 tonnes of recyclable materials over the past six months which have been transported to Paperboard Industries in Calgary. A further 4 tonnes of glass and tin has been accumulated on site over the past six months, however a market for these materials has not yet been identified.

Questionnaire for Cities, Towns and Villages

TABER: Mr. Roger Miles, Director of Field Operations, Public Works Department - March 16, 1993

TABER: Taber Recycling - March 25

TABER: Ken Turner, Taber Recycling and Hostess Frito Lay - July 8

What quantities of waste are generated?

Taber itself generates 9,000 kg itself each week, just from residents and small businesses. The Town does not collect waste larger industries or food processing organizations and is not aware of the amount that they generate. There is no tipping fee for residents of the Town and Municipal District.

Waste is collected once per week from residents and commercial waste is collected as necessary. The landfill is just on the outskirts of Town.

What percentage of the waste collected is residential, industrial/commercial/institutional, agricultural or special?

Residents - 70%
ICI light industrial -30%
Agriculture - farmers haul their own wastes to the landfill
Special - There is an Agricultural Chemical Container Site at the landfill. They have a Toxic Round-Up every year. The MD and the Town share the costs of the Toxic Round-Up.

How is waste collected? What kind of truck is used for collection? How much does it hold? Does is compact? What other types of equipment do you use for garbage collection?

They have one 3 yard container truck for collecting commercial, industrial and apartment waste, and one 25 cubic yard truck for collecting residential waste. The trucks operate five days each week.

They have a compactor loader for compacting the landfill.

What are the costs of your current waste management system?

The Town of Taber and the MD of Taber pay for the landfill. It is not a regional landfill, but a modified landfill.

The waste management system costs the Town of Taber $320000 per year (not including the MD's portion of the costs). This figure includes truck rentals. Fleet is rented and staff are employed by the Town.

Questionnaire for Cities, Towns and Villages

VAUXHALL: Earla Wagar, Town Administrator, March 16 and July 7

VAUXHALL: Vauxhall Advance, July 7, 1993

What quantities of waste are generated?

Unknown. All figures refer to volume (see below).

What percentage of the waste collected is residential, industrial/commercial/institutional, agricultural or special?

Residents - 50%
ICI - 50%
Agriculture - They haul their own to the landfill.
Special - There is an Agricultural Chemical Container Site at the landfill. A Toxic Round-Up was held in 1992.

How is waste collected? What kind of truck is used for collection? How much does it hold? Does is compact? What other types of equipment do you use for garbage collection?

They have one 12 yard truck. The truck has minimal compaction. They take approximately 50 loads each week to the landfill. The landfill is one mile from town. Residential waste is collected once a week. Commercial waste is collected three times a week.

Their landfill is a modified sanitary landfill site. It is not regional. They are working on a regional system, and have been working on it for approximately 12 years.

They also have a backhoe and access to a load/compactor that they use on occasion. The backhoe was purchased by the Authority to extend the life of the Taber landfill until the regional system is operational.

What are the costs of your current waste management system?

Collection cost $52000 in 1992, and disposal cost $18500. They contract out the supervision of the landfill site.

Is there a recycling program operating in your area? Please explain the current system.

They are working toward a recycling program for newspaper and tins. Some materials are collected in Town by private groups (tin by United Church - Brent Woodard: 654-4231) (paper by Vauxhall Advance 654-2122).

The Vauxhall Advance delivers the newspapers that it collected to the Taber Lion's Club Recycling Project Depot in Taber. They deliver approximately half of a 1/2 ton truck load to the project each week (approximately 30 to 40 bundles of paper).

Wastes can be sorted at the landfill site into the following categories: white wares, car bodies, agricultural chemical containers and wire fencing materials. Wood must be separated out, and can be burned. Salvage is the right of the maintenance contractor.

Questionnaire for Cities, Towns and Villages

VULCAN: Harold Lewis, Town Foreman - March 17

VULCAN: Town Office - March 18

VULCAN: Lion's Club Recycling (Roger Miller and Brian Todd) - March 18

VULCAN: Harvey Beneteau of Recycled Rubber Products - March 18

VULCAN: Jim MacMichael of Laidlaw Waste Systems - March 24

VULCAN: Alan Hunt of Laidlaw Waste Systems - July 8

What quantities of waste are generated?

Between July 1992 and June 1993 Laidlaw collected 372.78 tonnes of residential waste from Vulcan. Laidlaw collects the waste and hauls it to a landfill in Calgary. Laidlaw bills the Town per pick-up per month, not by the amount of waste collected. There are no records of weight, but Laidlaw makes 620 pick-ups. No burn barrels are used - they are banned. There are about three people per household.

Jim MacMichael of Laidlaw says that they collect residential waste once a week in a 29 cubic yard box truck that compacts. They collect commercial waste once a week in a 40 cubic yard compactor truck. Wastes are hauled to the BFI landfill in Calgary, approximately 100 km from Vulcan. There is a transfer station on the outskirts of Vulcan, and Laidlaw hauls this waste to BFI too. Laidlaw handles almost all Vulcan's waste.

What percentage of the waste collected is residential, industrial/commercial/institutional, agricultural or special?

Residents - no idea
ICI - no idea - Laidlaw supplies them with bins, and bills according to the size of bins used.
Agriculture - They haul their own to landfill sites throughout the County.
Special - There is an Agricultural Chemical Container Collection Site in the outskirts of town. It is run by the County of Vulcan.

How is waste collected? What kind of truck is used for collection? How much does it hold? Does is compact? What other types of equipment do you use for garbage collection?

They don't have any equipment.

What are the costs of your current waste management system?

Taxpayers are billed on their utility bill for garbage collection and disposal. One of the receptionists at the Town Office said that residential pick-up costs $7.35 per month, but she thinks that it will be increased in the near future to $9.00 or thereabouts. Most of the commercial businesses have contracts with Laidlaw and are billed according to the size of bin used.

Questionnaire for Cities, Towns and Villages

WARNER: Gordon MacDonnell, Town Administrator, March 17 & July 8

WARNER: Gordon Evans, Fire Department, July 9

What quantities of waste are generated?

The Town of Warner referred to an report prepared by UMA Engineering which estimated that Warner generates 271 tonnes of waste per year, while the County of Warner generates 1,579 tonnes per year. The total waste generation by residents of the Town and County of Warner, including Milk River and Coutts, totals 2593 tonnes per year. The per capita waste generation rate was estimated to be 1.5 kg per capita.

According to the UMA report 4844 kg of residential waste is generated each week (10660 lb/week) for and 600 kg/week of industr al waste.

What percentage of the waste collected is residential, industrial/commercial/institutional, agricultural or special?

Residents - 4844 kg/week (The "dump" is only open to residents of the Village of Warner.)
ICI - 600 kg/week
Agriculture - The landfill is not open to farmers They must use their own landfill.
Special - There is no Agricultural Chemical Container Collection Site at the landfill. Every second year the Town holds a Toxic Round-Up.

How is waste collected? What kind of truck is used for collection? How much does it hold? Does is compact? What other types of equipment do you use for garbage collection?

Garbage is collected every Monday with a 6 ton M3 non-compactor truck, which collects 2 loads each week. The trench digging is contracted out. Fridges and metals are piled separately, as are tires. Burn barrels are collected once per month.

As of the first of March the landfill is only open from 9:00 until 5 pm. Key is no longer available at the Town Office.

What are the costs of your current waste management system?

The operational and capital costs of the waste management system total approximately $30,000 per year.

The Town owns a backhoe for use at the landfill.

APPENDIX E
LITERATURE REVIEW

Clipping Review

Topic: Burn Barrels

Articles: 5

Dates: 4 out of 5 are from 1993

Locations: 3 out of 5 are from Nanton.

Issues: Nanton, Picture Butte and Coaldale have restricted the days when burning can occur.

Two articles stress that there are better waste management alternatives to burn barrels.

One Nanton councillor wants to ban burn barrels. An editorialist from the Nanton News wrote in favour of burn barrels while the newspaper editorial was in favour of reducing burning through alternative waste management techniques such as composting and recycling.

One Alberta Government Advertisement on safe burning procedures for all types of fires.

Clipping Review

Topic:	Kedon Waste Services
Articles:	3
Dates:	April, 1992 and October, 1992
Locations:	Okotoks Western Wheel
Issues:	Provincial court dismissed a case launched by Kedon Waste Services against the Public Health Advisory Board because the Board ordered Kedon to contain 39,000 tonnes of contaminated waste dumped at the Foothills Landfill.

The second article made reference to Gerry Generoux of Stanley and Associates Engineering and Stanley's role in selecting and designing a containment cell for the contaminated waste at Foothills Landfill.

The third article refers to Kedon backing out on their promise to pay for building a cell for the contaminated soil and moving the soil into the it.

Clipping Review

Topic:	Derelict Vehicles
Articles:	3 articles, 1 photo
Dates:	February and March 1992
Locations:	Lethbridge and Claresholm
Issues:	One editorial on Derelict vehicles in Willow Creek. The cars were placed on creek to prevent erosion, but have now become pollution themselves. They should be recycled or landfilled. Two identical articles on Chinook Health Unit and Alberta Environment's reaction to the cars in Willow Creek were published in two different papers.

Clipping Review

Topic:	Tires
Articles:	56
Dates:	Throughout survey
Locations:	Assorted papers

Issues:

- 6 articles on small Alberta tire recyclers and alternative tire recycling technologies
- 13 articles on the advance disposal fee for tires
- 36 articles on the controversy surrounding the selection of the recipients of Alberta's tires and the tire advance disposal fee.

The main topics are as follows.

- The controversy regarding the selection of Alberta Environmental Rubber Products because Tom Rogers worked for Alberta Environment.

- The Town of Trochu promoting its tire recycling program and questioning the selection process.

- Tirecycle of Medicine Hat promoting its tire recycling program and questioning the selection process.

- The air emissions monitoring program during the test burns at Inland Cement.

- The advance disposal fee being collected before a tire recycling program is implemented.

Clipping Review

Topic:	Hazardous waste
Articles:	53
Dates:	Throughout survey
Locations:	29 articles from Medicine Hat News 13 articles and 1 photo from Lethbridge Herald 5 articles from Vulcan Advocate 4 articles from Nanton News 1 article from Claresholm local press 1 article from Pincher Creek Echo

Issues: Medicine Hat:

- 12 articles - Al-Tec Waste Sanitation Systems operated two hazardous waste storage sites in Medicine Hat. The facility was abandoned and the Alberta Government had to pay for the disposal of the chemicals and the clean-up of the site. Al-Tec's executives are being tried in court for illegal dumping of hazardous wastes.

- 3 articles - UniRoyal is cleaning up its abandoned contaminated site in Edmonton (and receiving a tax break for the property).

- 2 articles - Alberta Special Waste Treatment Centre may accept out-of-province wastes.

- 2 articles - Alberta may receive nuclear waste from an abandoned uranium mine in northern Saskatchewan near the Alberta Border. One article was neutral on the proposal and the other applauded the Alberta Government for considering managing the nuclear waste.

- 2 articles - Alberta's energy industry has generated a lot of waste in the past and has generally injected the materials into unlined pits. The industry is reviewing its processes and waste management procedures to reduce waste and the potential for contamination.

Hazardous wastes - continued

Lethbridge Herald - continued

- 3 articles - National/international articles on hazardous waste management programs and issues.

- 1 article - Nickel-cadmium and lithium battery manufacturers are trying to make their products less harmful to the environment. Currently household batteries are highly toxic and are not easily recyclable. Small generators of household batteries don't know how to dispose of their waste batteries.

- 1 article - (The identical article was published in Medicine Hat) residents of Big Valley are resisting CET Environmental Services plans to construct a second landfill for oilfield wastes.

- 1 article - Laidlaw has opened a hazardous waste storage facility and landfill in Ryley, Alberta.

- 1 article - The Coaldale Ecology Club published an article on handling hazardous wastes.

- 1 article - A profile of DBS Environmental Services, one of the companies that collects the waste that is accepted at Toxic Round-ups.

Vulcan and Nanton:

- (2 articles) Printed the Environmental Services Association of Alberta's News Release on the Hotline.

Vulcan:

- (4 articles published in November and December, 1991) Custom Environmental Services has proposed to establish a hazardous waste storage facility and transfer station in Vulcan. Custom Environmental Services organized several information meetings in Vulcan which were poorly attended. Council voted not to support the establishment of the facility in the Town. (See "combustion" section for more information.)

Clipping Review

Topic: Landfills

Articles: 63

Dates: Throughout survey

Locations: Predominantly Taber/Vauxhall, Vulcan and Warner

Issues: Taber/Vauxhall:

- In total, 41 articles were published on waste management in the M.D. of Taber. 19 articles and 1 photo were published in the Vauxhall Advance, 17 published in the Taber Times and 4 in the Lethbridge Herald.

- Most of the articles deal with more than one issue. The major issues include:
  - fires being set at the Vauxhall landfill;
  - the impending closure of the Vauxhall landfill;
  - the expansion of the Taber landfill;
  - the impending closure of the Taber landfill;
  - the activities of the Barons-Eureka Health Unit and the Taber and District Regional Landfill Authority; and
  - the search for a suitable site for the Regional Sanitary Landfill.

- M.D. of Taber Details:
  - UMA has been contracted to site and design the Taber and District Regional Landfill.
  - Purple Springs and Grassy Lake have closed their landfills.
  - Once the Regional Landfill is operational, small landfills at Hays and Enchant will be closed and transfer stations established.

Landfills - continued

Taber Details:

- The Town of Taber generates 75% of the waste generated in the M.D. of Taber.
- Brian Dalshaug is the Senior Public Health Inspector with the Barons Eureka Health Unit, the Sanitary Landfill Authority's Chairman is Murray Brown, and the Chairman of the Taber Water-Environment Committee is Town Councillor Ray Bryant.
- The Taber Landfill reached capacity faster than expected. The growth of the food industry in the Taber area may have increased the amount of waste being landfilled.
- In April, 1992, Taber received a $100,000 grant from Alberta Environment to extend the life of the local landfill.
- Some councillors in Taber are not fully committed to concept of the Regional Landfill, and may support a municipal landfill.
- Alberta Environment rejected an application for funding the remediation of a former dump on private property just outside of Barnwell.
- Citizens have complained that they have not been kept informed about the landfill situation.
- In July, 1992, the Barons-Eureka Health Unit gave the Town of Taber an approval to expand the Taber landfill under the condition that the waste was compacted, installation of litter fences, the construction of cells that are 1 1/2 metres above groundwater, daily covering of wastes, installation of a drainage system, road upgrading, a litter clean-up program as well as the only accepting waste from vehicles if it is loaded properly to reduce litter.

Landfills - continued

M.D. of Willow Creek (12 articles):

- The Granum landfill is scheduled for closure and reclamation in 1992. Waste will be hauled to a temporary landfill site which is located near the Claresholm airport for disposal. Stavely was accepted the same package last year.

- 45% of the waste in the Granum landfill was generated in the Town, the rest was generated in the M.D.

- The major landfills in the M.D. of Willow Creek are the Fort MacLeod and Claresholm landfills. The Fort MacLeod landfill is scheduled for closing and the Claresholm site has limited remaining capacity and does not meet government regulations.

- Councillor Zoetman of the M.D. mentioned that hauling waste to Kedon may be considered if a regional site cannot be located.

- In February, 1993, the Chairman of the Pincher Creek-Crowsnest Pass Regional Waste Management Authority mentioned that it is possible that waste from Granum and For MacLeod will be accepted after the Fort MacLeod Landfill closes in 1993. These communities will be charged a higher tipping fee than the other Authority members.

- In March 1993, Nanton Town Council approved the construction of a waste transfer station to serve residents of the northern section of the M.D. of Willow Creek. A tentative site is proposed for a site just south of Nanton, but sites near Stavely and Parkland are also being considered.

- Two of the eleven goals for 1993 set by Claresholm's Town Council involve waste management: purchasing a new garbage truck and reviewing the contract for the landfill site.

<u>Clipping Review</u>

Topic:	Recycling
Articles:	133
Dates:	Throughout survey
Locations:	Predominantly Lethbridge Herald, Medicine Hat News, Vulcan Advocate, Claresholm Local Press and Pincher Creek Echo/Herald

Issues:

Lethbridge:

- In 1991, Lethbridge residents generated 70,000 tonnes of waste.

- Each homeowner in Lethbridge is charged a $2.50 "line charge" on their utility bills for recycling. Apartment dwellers, businesses, and non-residents are <u>not</u> charged for recycling, even though they can drop off items at the six local depots (located at shopping or leisure centres) or GPS.

- The City has a 5 year contract with GPS to accept recyclable materials. The Lethbridge Depots accept newsprint, cardboard, boxboard, tin cans, aluminum cans, clear glass and high density polyethylene. GPS accepts newsprint, cardboard, boxboard, tin cans, aluminum cans, clear glass and high density polyethylene, white bond, colored bond, computer paper and magazines at its plant. They also offer collection services for an extra fee. GPS notes that public response to the program is good, however the volume of tin cans is lower than expected.

- The program appears to have been controversial. Some criticisms were leveled about the cost of the program to homeowners (not businesses, apartment dwellers and residents of nearby communities) and the accessibility of the bins. Some critics suggested that manufacturers should pay for the program, or that the City implement a differential landfilling fee - if the goods are recyclable, the tipping fee will be increased. Other propose a user-pay system for waste generation.

Recycling - continued

Magrath:

- Some of Magrath's schools are collecting paper and delivering it to GPS.

Coaldale:

- Some of Coaldale's schools are collecting paper and delivering it to GPS as well as composting.

Vauxhall:

- The Town of Vauxhall has received a request for $1 per capita to cover costs incurred by the Taber Lions Club recycling project.

Taber:

- In 1992, the Taber Lions Club received a provincial recycling grant for $27,100.

- The Taber Lions Club project was in financial trouble within months of receiving the grant. They have requested funding from the Municipal District of Taber, the Town of Taber and Town of Vauxhall, the Taber and District Regional Landfill Authority and may receive a portion of the funds provided to Taber for the expansion of their landfill. People in the northern end of the M.D. do not have easy access to this project and therefore do not want to pay the same amount for service that residents of Taber pay.

- Editorials note that it is a challenging issue to confront because neither the Town nor the Lions Club can afford the project at its current cost, but they need to extend the active life of the landfill through waste minimization. Some councillors have indicated that the recycling project is providing too high a level of service.

Clipping Review

Recycling - continued

Milo:

- Milo Community School received a $11,250 recycling grant to purchase equipment that will enable them to recycle newspapers, cardboard, tins, plastic and glass.

Fort MacLeod:

- The Town of Fort MacLeod received a $23,500 recycling grant to purchase equipment that will enable them to recycle newspapers, cardboard, tins, and glass. The Fort MacLeod Rotary Club intends to close its project and sell its equipment to the Town.

Crowsnest Pass:

- "Going Green", an environmental group, operates a small depot that accepts computer paper, tin cans and newsprint. Sometimes they have recycling blitzes where they accept mixed paper, glass jars, milk jugs and vinegar bottles.

- In July, 1992 they approached Crowsnest Pass Town Council to apply for a provincial recycling grant. The Town agreed. If money is received they intend to lease the equipment purchased with the grant money to Pass Beverages in Frank. As cardboard comprises 70% of the Pass's waste stream, it is their target material. Going Green is hoping to collect 8,000 pounds of newsprint and 6,000 pounds of cardboard each week at the depot.

Sparwood:

- There is a recycling project operating. Little information is available except for allusion to the project accepting computer paper, tin cans, newsprint, mixed paper, glass jars, milk jugs and vinegar bottles.

Recycling - continued

Refrigerators:

- The "Old Fridge Round-Up Program" is operated by TransAlta Utilities and the City of Lethbridge Electrical Department. Residents of Lethbridge, Fort MacLeod, Cardston, Crowsnest Pass as well as TransAlta customers in M.D. 1, 6, 9, 14, 21, Counties 5, 8, 26 and I.D. 4 and 6 can call a "hotline" number and a collector will pick up the old fridge at no charge. Freon and metal are recycled. Capacitors and insulation are sent to Swan Hills for disposal

Used Oil:

- Alberta Action on Waste is working on a province-wide recovery program for used oil, used oil filters and plastic oil containers.

- The UFA may not join the provincial initiative. UFA has been accepting used oil for recycling since 1991, however they do so at a financial loss of $.08 to $.10 per litre. The project was initiated in response to requests from members of the UFA cooperative. UFA also accepts empty oil containers.

- Recycle West is accepting used oil and oil filters for recycling and should improve markets for these commodities.

Aerosol cans:

- Recycle Systems of Nisku is accepting aerosol cans for recycling.

Pesticide Containers:

- Two articles were published on Wearmouth Waste-Tech's Pesticide Container recycling program. The Medicine Hat facility will be cleaning containers from Alberta and Saskatchewan, and shipping the containers to Edmonton for recycling into plastic fence posts.

Clipping Review

Recycling - continued

Plastic:

- 1 million plastic bags accepted at Safeways stores are shipped "cross-country" for recycling.

- Japan Camera stores across Canada sort wastes for recycling. They ship empty film containers, metal cannister, film boxes and single-use cameras to a "central recycling centre".

APPENDIX F

RMOC STUDY

SOLID WASTE ASSOCIATION OF NORTH AMERICA

16TH ANNUAL PRAIRIE CHAPTER CONFERENCE

MAY 5-7, 1993

SESSION F - MONITORING AND ASSESSMENT:

Case Study of Waste Characterization Study

Paper Presented By:

Kevin L. Metcalfe, B.Sc., P.Eng.

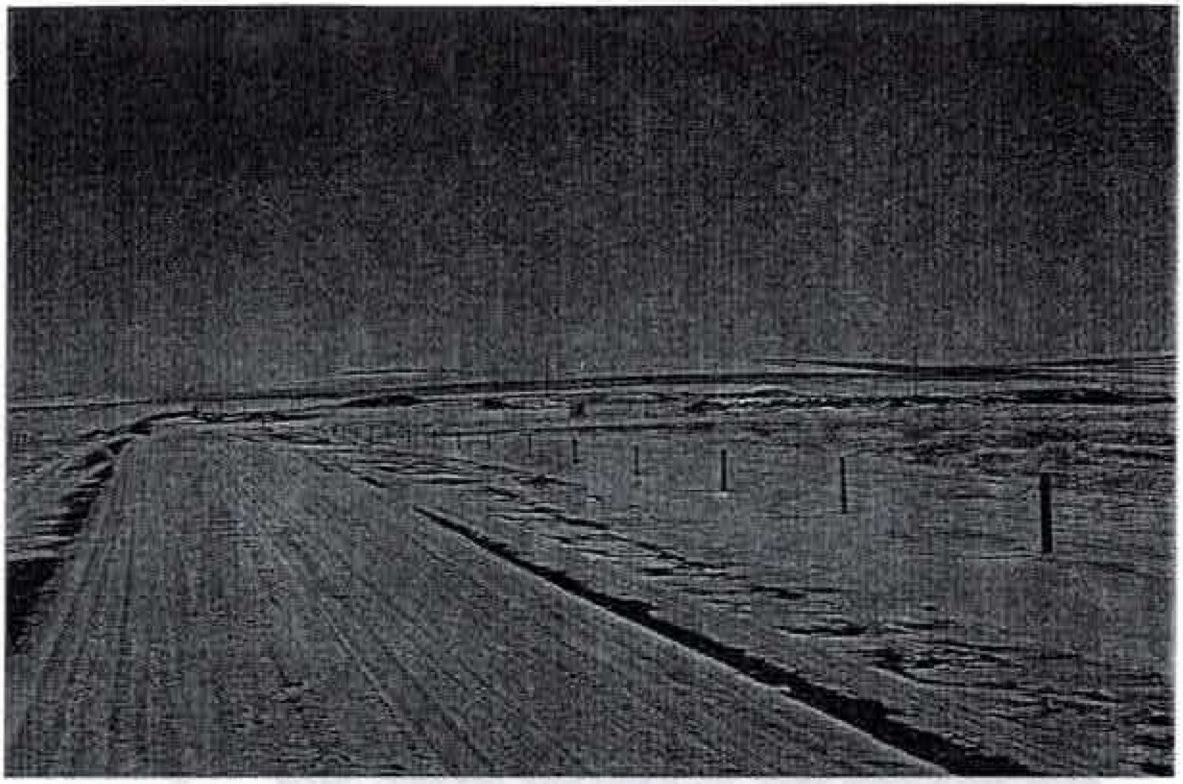
SENTAR Consultants Ltd.

Edmonton, Alberta

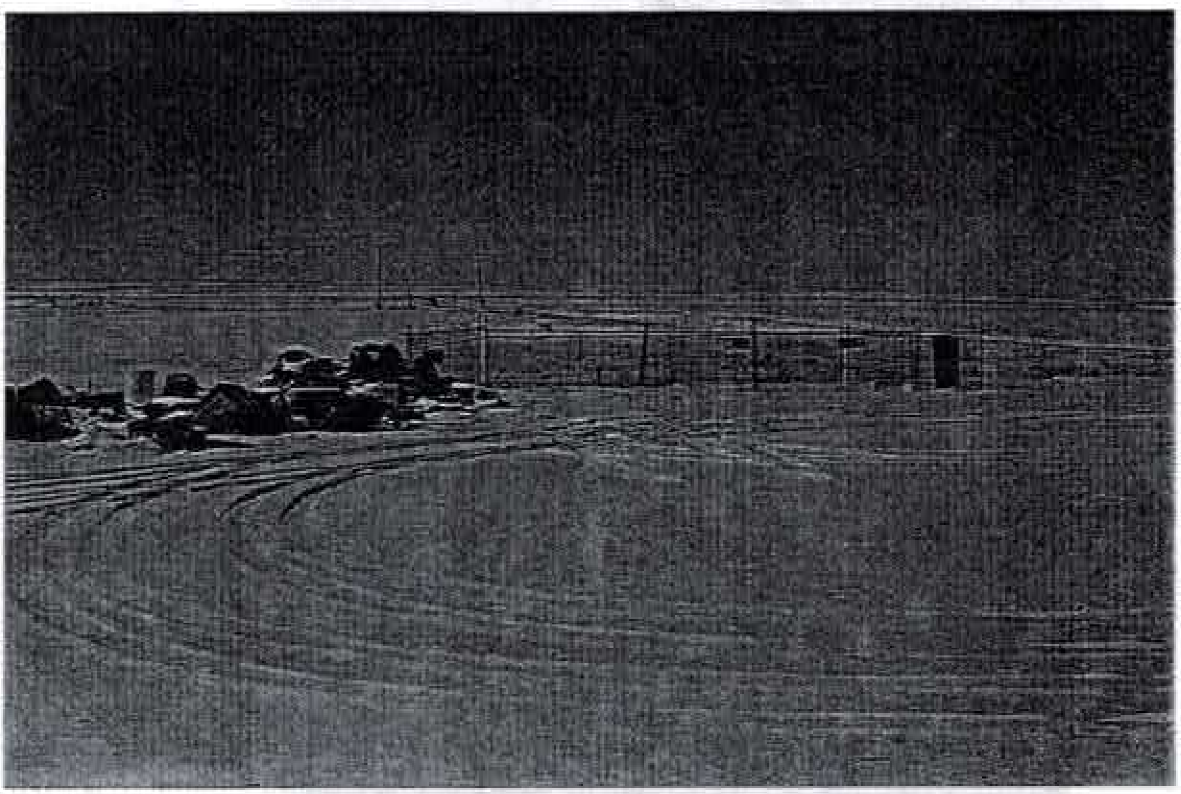
APPENDIX G

LANDFILL & TRANSFER STATION DATA SHEETS

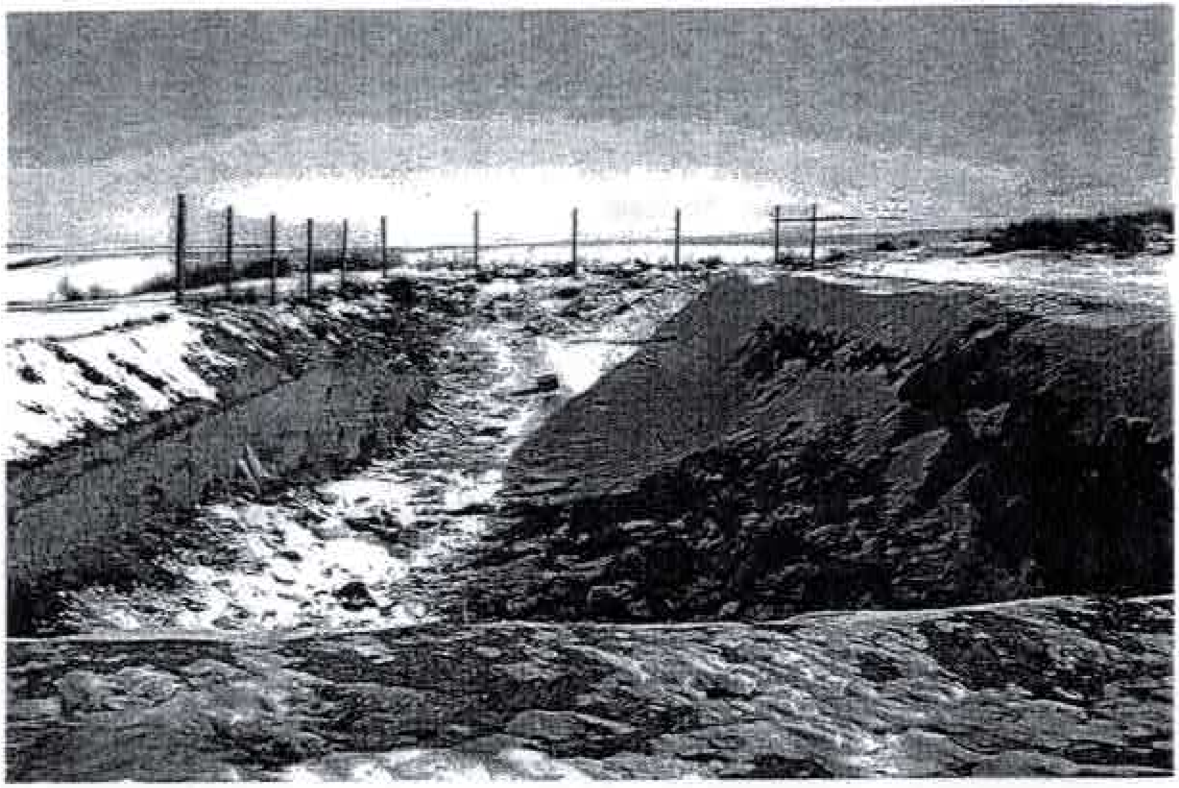
LANDFILLS	Arrowwood
QUANTITIES	• No scale
TYPE	• Modified sanitary landfill
LOCATION	• SW 1/4 -28-20-23-W4M
OPERATION PROCEDURES (frequency of cover, burn, etc.)	• Evidence of past burning
PERMIT CONDITIONS	• No known Permit - approval from Health Unit
OWNERSHIP	• County Regional Waste Authority
TYPES OF WASTES ACCEPTED	
LEVEL OF SERVICE (hours of operation)	• Effec. September 9, Tuesday 10-12, 1-3, Saturday 9-12, Supervised: Locked gate
ESTIMATED LIFE	
OTHER SERVICES PROGRAMS (separation of wastes)	• wood, metals, tires, white goods, pesticide containers
EXPANSION PLANS	
"OUTSIDE" WASTES ACCEPTED	
POPULATION SERVED	• Village of Arrowwood & surrounding County residents
GEOGRAPHIC BOUNDARIES	



ACCESS ROAD (Landfill in Background)



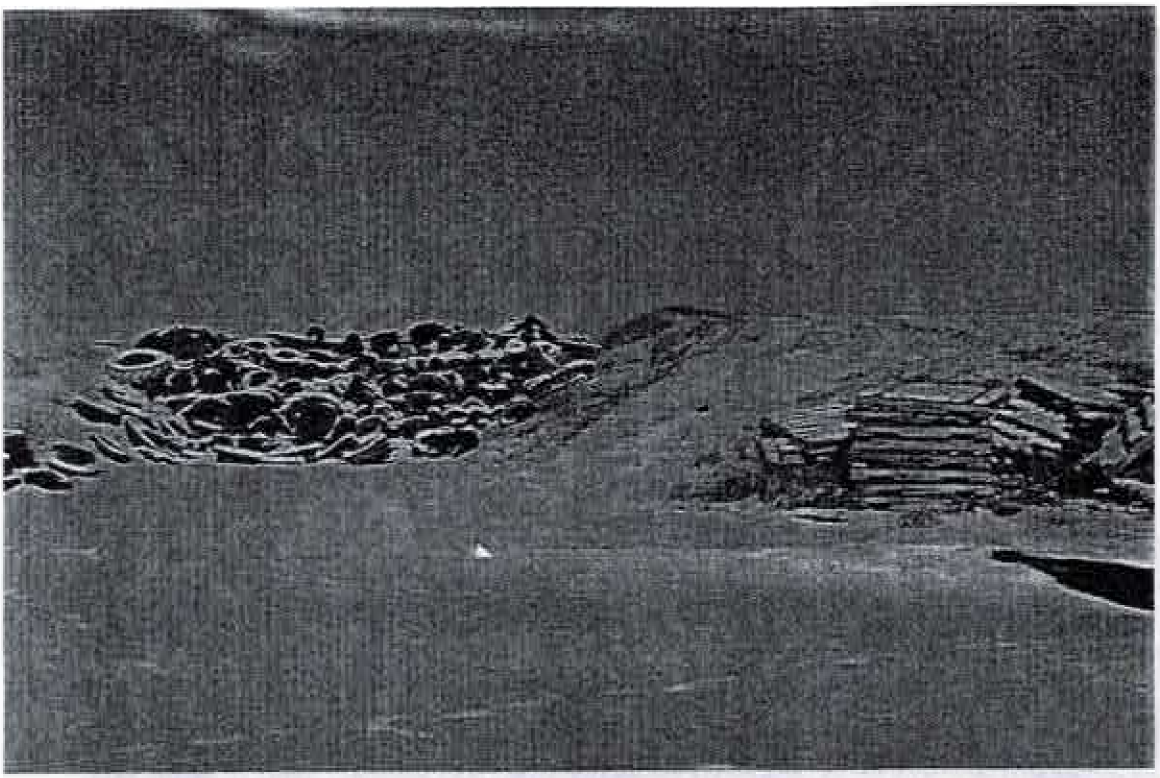
PESTICIDE CONTAINERS STORAGE



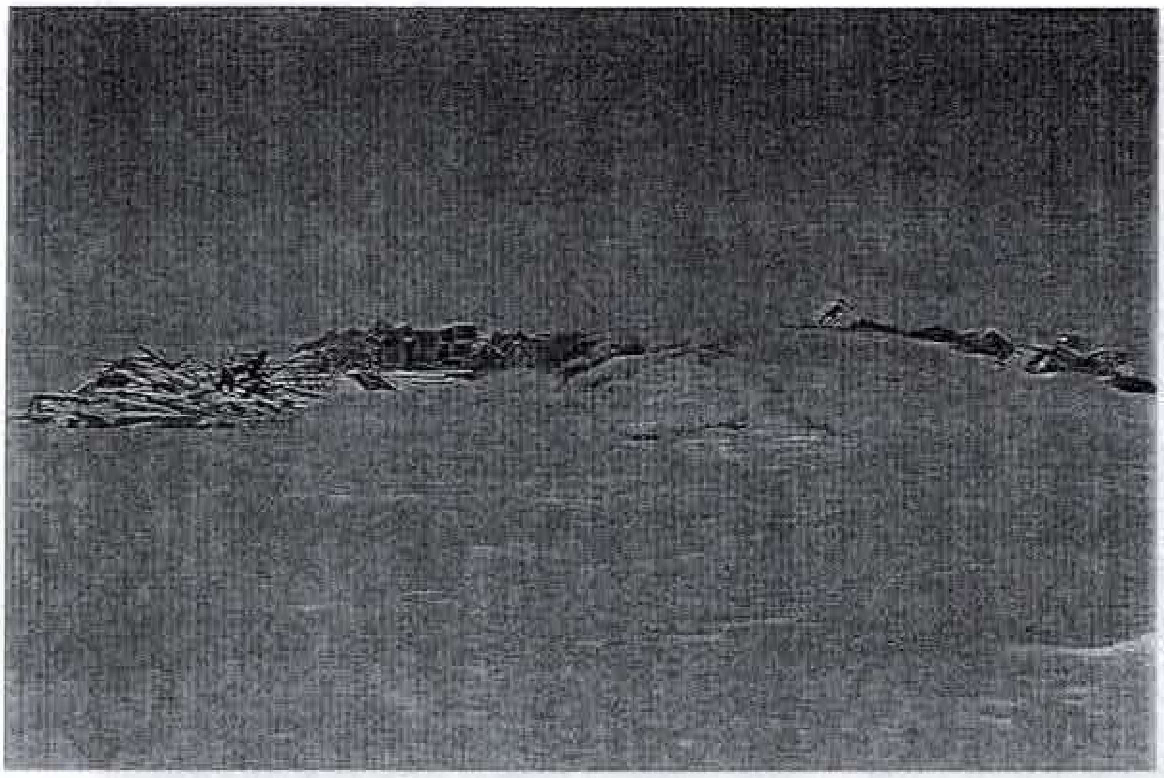
HOUSEHOLD WASTE PIT. WIND FENCE (Background)

WOOD WASTES

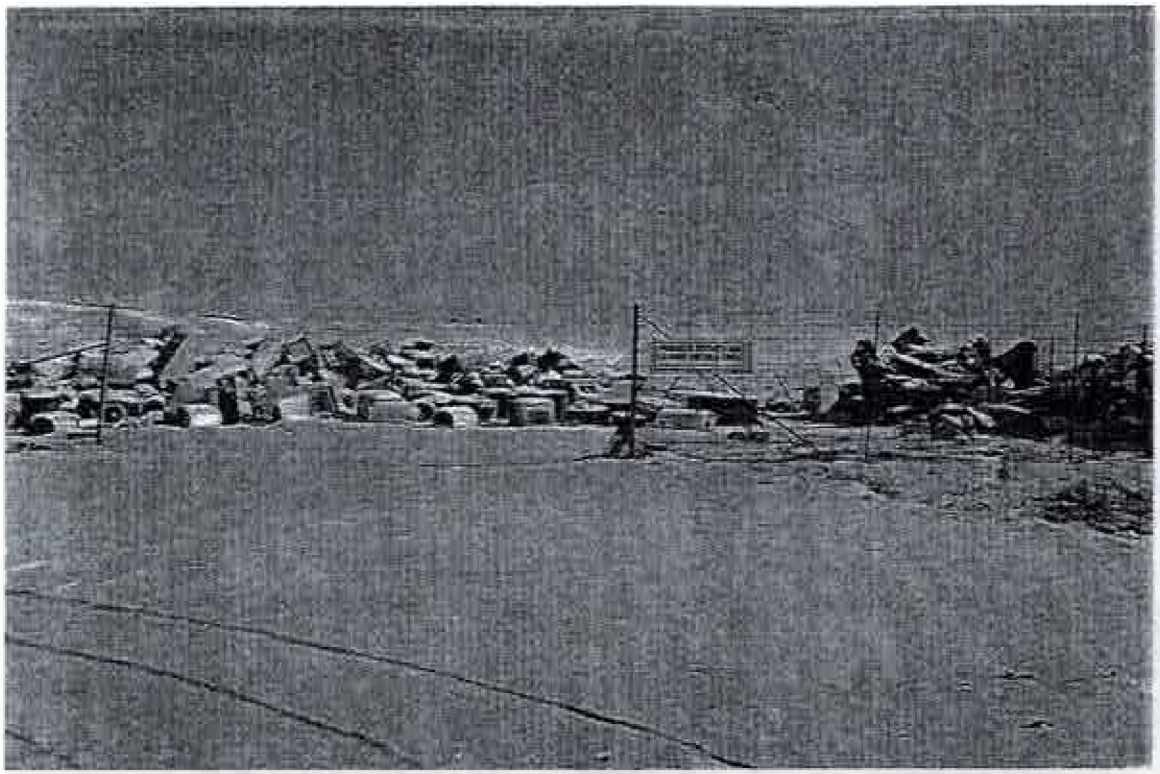
CAPITAL COSTS	• $394,000
OPERATING COSTS	• Approximately $12/capita ($72,000/year)
CONTAINMENT/STORAGE	• metals • pesticide containers • wood • white goods • used oil
ONSITE PROCESSING	• None
PAST/PRESENT/FUTURE DATA TO ESTABLISH TRENDS	



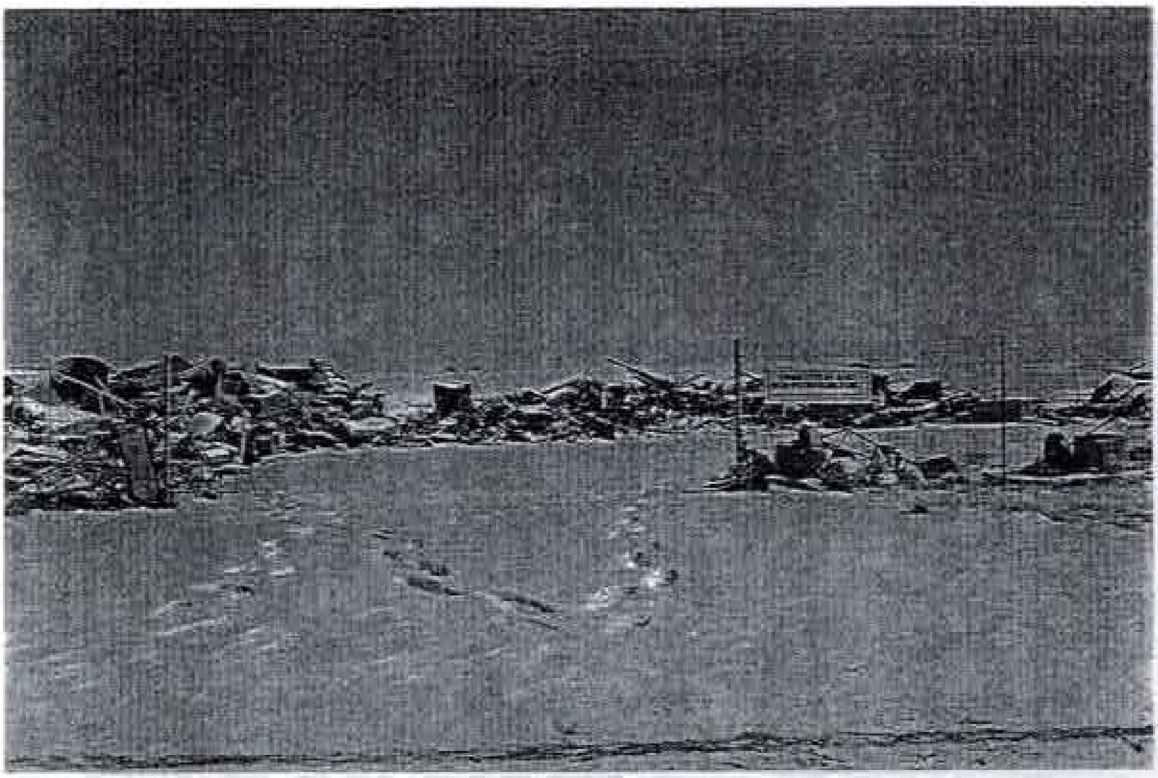
TIRES PIT PALLETS (Right)



PALLETS AND OTHER WOODEN WASTES CELL

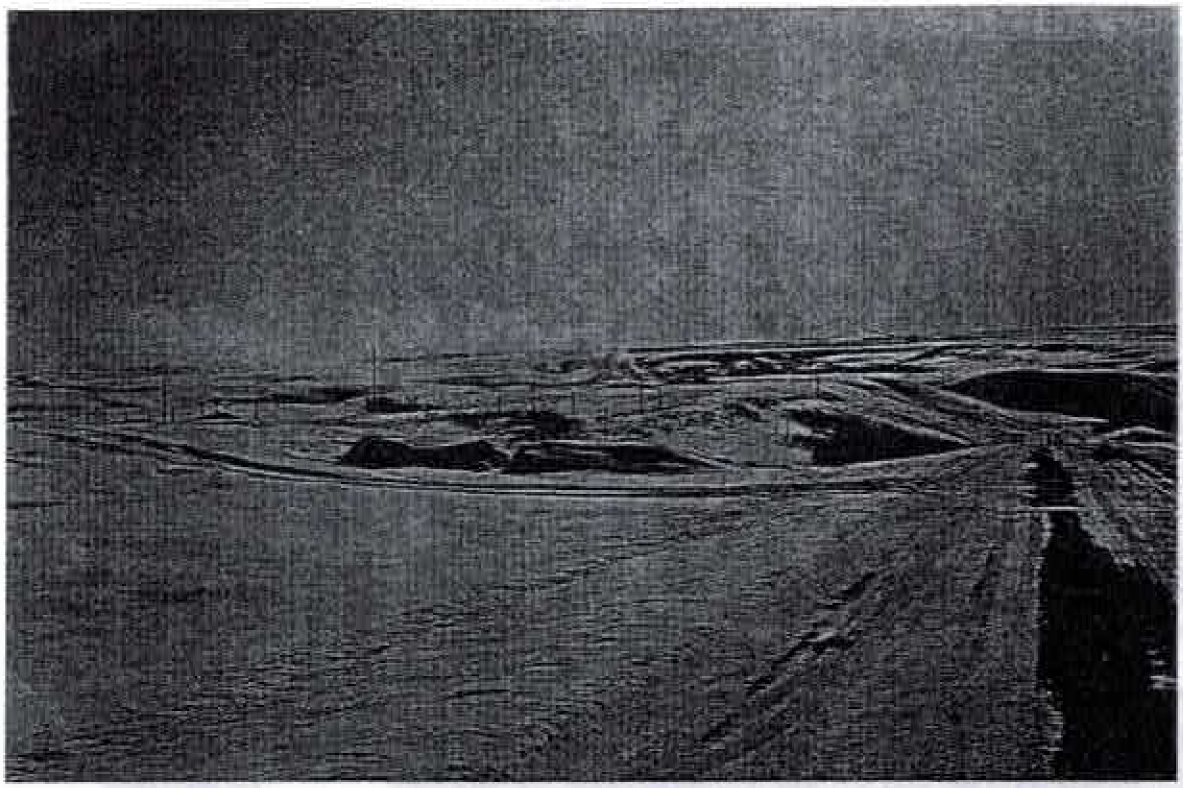


WHITE GOODS AND LARGE METALS FENCED AREA

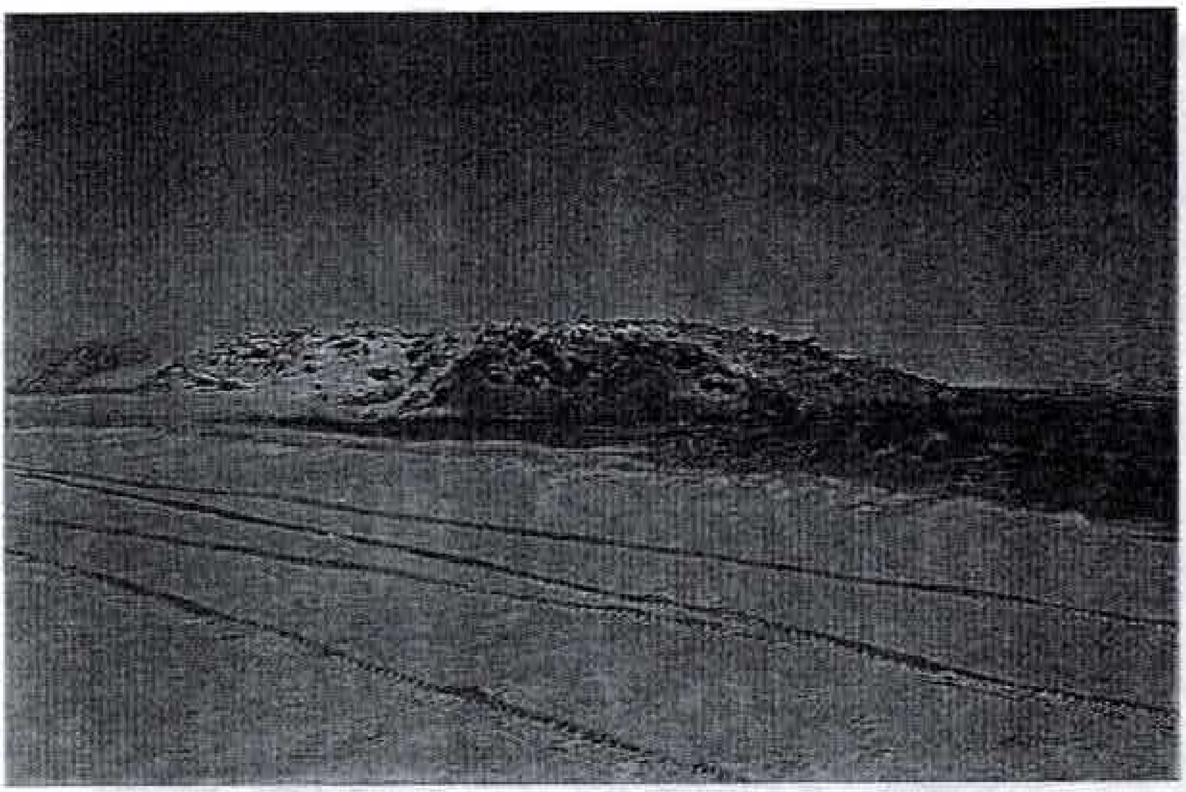


CONSTRUCTION AND DEMOLITION WASTES

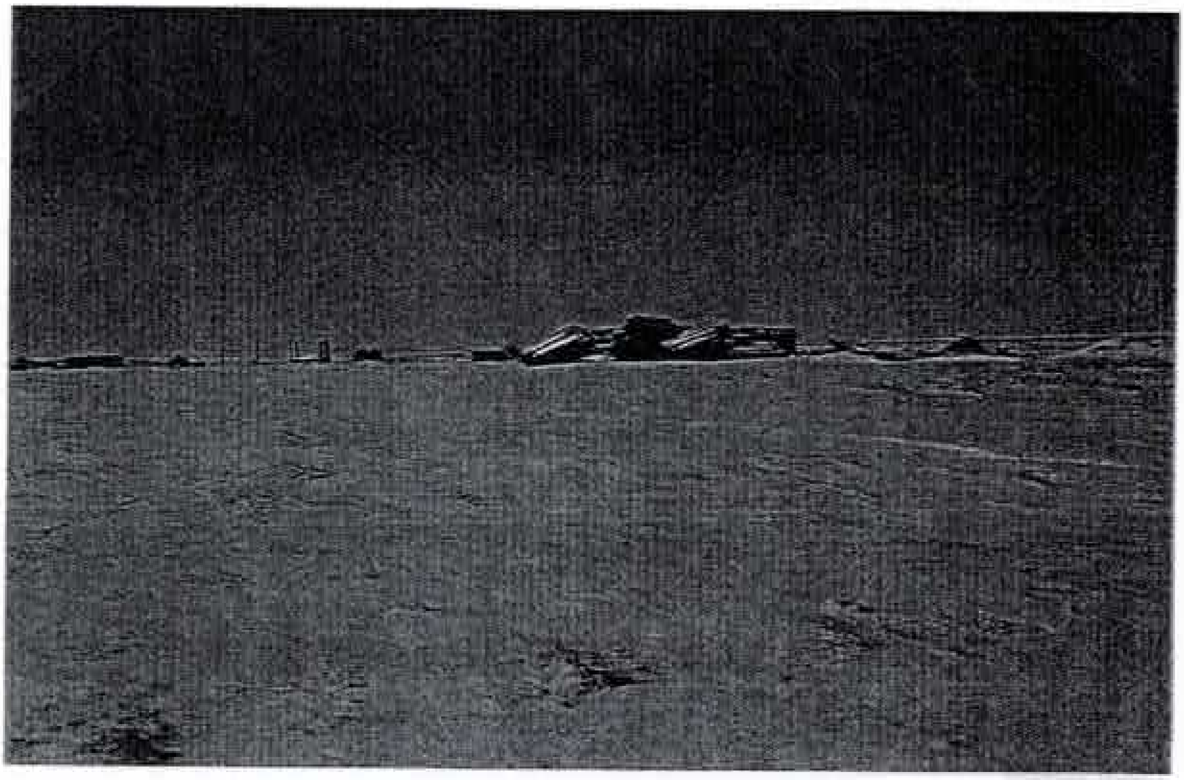
LANDFILLS	Little Bow Provincial Park
QUANTITIES	• No scales • 1 ton truck • 2-3 loads/wk • May-September
TYPE	• Modified Sanitary Landfill
LOCATION	• SW 1/4 -2-15-22-W4M
OPERATION PROCEDURES (frequency of cover, burn, etc.)	• Cover when full • Burning allowed until March 1993
PERMIT CONDITIONS	• No known Permit
OWNERSHIP	• Provincial Park
TYPES OF WASTES ACCEPTED	• Only park wastes
LEVEL OF SERVICE (hours of operation)	• Not open to park visitors
ESTIMATED LIFE	
OTHER SERVICES PROGRAMS (separation of wastes)	• grass, trees, branches
EXPANSION PLANS	
"OUTSIDE" WASTES ACCEPTED	• None
POPULATION SERVED	• Park visitors



ACCESS ROAD. LANDFILL IN BACKGROUND



FIRE WOOD PILE



STORAGE AREA

CAPITAL COSTS	• Front end loader plus land
OPERATING COSTS	• $2500 per year
CONTAINMENT/STORAGE	
ONSITE PROCESSING	
PAST/PRESENT/FUTURE DATA TO ESTABLISH TRENDS	

CASE STUDY OF WASTE CHARACTERIZATION STUDY

Introduction

This presentation will take the form of a case study based on the waste characterization audit which was completed in 1992 for the Regional Municipality of Ottawa-Carleton by SENTAR Consultants Ltd. and R.W. Beck and Associates. The study was the first of its kind in the Region, and one of only a few ever completed in Canada. The Regional Municipality of Ottawa-Carleton comprises five cities (including the City of Ottawa), one village, and five rural municipalities, and represents a population base of 670,000. (See Figure 1.)

Existing information on quantity and composition of solid waste is based on Canadian studies completed more than a decade ago, or on more recent American studies. The audit, which spanned a year and a half, provided the Region with information to efficiently operate existing waste management programs and proficiently design future programs.

The project included a sampling program to determine the composition of solid waste, as well as tasks to determine the 'gross' quantity of waste generated in the Region. Other assignments included interviews of commercial waste generators and recycling organizations, an analysis of the construction and demolition waste stream, and a review of regional planning initiatives and how they apply to waste management.

Sampling Programs and Waste Streams

Sampling programs were held in May, July, October, and January, to study the effects of the four seasons on residential and commercial waste. It was assumed that residential waste composition would vary with the seasons, while commercial waste would remain fairly constant.

The composition of solid waste varies depending on the source of generation. The term 'generator type' was used to classify the source of waste.

Therefore, municipal solid waste was divided into two broad generator types: residential, and commercial waste streams. This division distinguishes the significant differences in

Each commercial sample was obtained by hiring a waste hauler to specifically collect each category.

Protocol

A Protocol was written to define the methodologies and procedures to be used for each sampling program. This ensured a standard for consistency and accuracy. The protocol focused on areas such as:

- selection of vehicles for the sample,
- vehicle scheduling,
- sample size,
- selection of load cell,
- waste component categories,
- supervision and the sorting crew,
- sorting procedure, and
- equipment (sorting and safety).

Selection of Vehicles for the Sample

For the mixed residential samples, collection route numbers and maps were obtained from the waste haulers, and randomly generated numbers selected the vehicles from which the samples would be taken.

For the special residential analysis, a 'dedicated' collection vehicle was used to collect the municipal solid waste from the appropriate housing form. In this manner, 'pure' loads were obtained and increased the validity of the data collected. For each of these loads, an observer from the Project Team travelled with the collection vehicle to record the necessary information, such as number of households serviced in a load, and occupancy data for the apartment buildings.

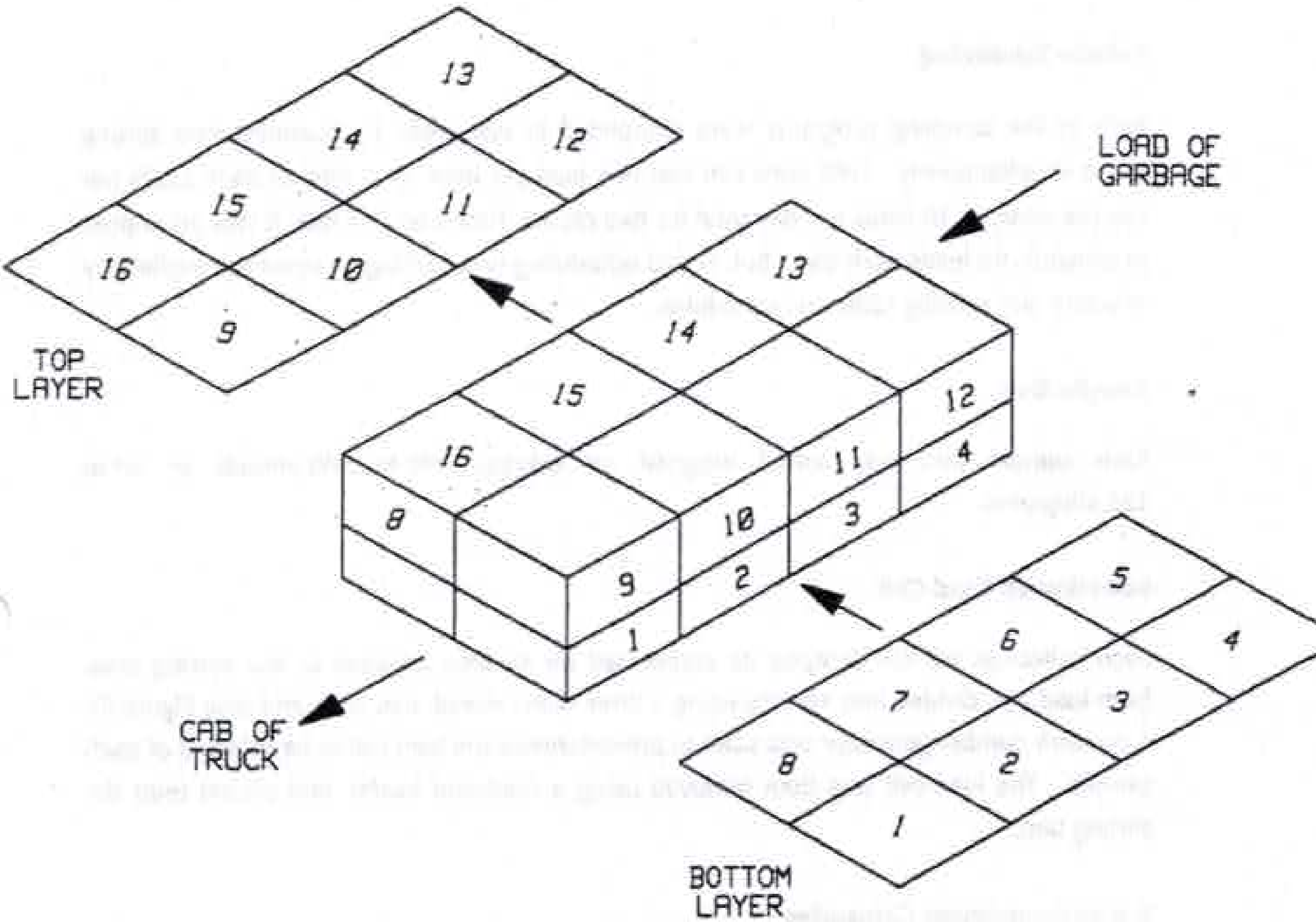


FIGURE 2

SCHEMATIC OF 16-CELL GRID

Supervision and the Sorting Crew

Each sampling program consisted of a Site Supervisor, two Crew Supervisors, and two Sorting Crews.

The Site Supervisor was responsible for overseeing the entire operation, selecting the samples from the loads, and ensuring proper procedures were followed for continuity and safety reasons.

The Crew Supervisors were responsible for quality control in the sorting procedure by their respective crew, ensure health and safety procedures were adhered to, weigh and record the data for each sample, and answer questions from their crew.

As previously mentioned, two sorting crews were operated simultaneously. Each crew, consisting of one crew leader and five or six sorters, would sort, on average, 8 loads, each day of the sampling program. Of course, at the beginning of the week, the process took longer until a learning curve was established. Another factor in the sorting time was the nature of the load. For example, an office building sample required more sorting time as the volume of paper to sort through was greater than that for an average household, and there where more paper categories in the sample.

Sorting Procedure

Each vehicle included in the Program was required to weigh-in and out at the landfill scale house, and then was directed to the Sort Site. After the collection vehicle emptied its entire contents onto the ground, the selected cell was taken by the front-end loader into the building and placed upon a tarp. At this point, a 'pull test' was performed to ensure a consistent amount of waste was sorted for each sample. The sorting crew would then sort the waste into the various categories by placing the components into baskets to be weighed and recorded (see sample report sheet on following page). The Crew Supervisor was responsible for this task, and a specific data sheet was designed to record the weights. Once the sorting was completed the waste was cleared from the floor by the front-end loader and was taken in a dedicated disposal truck to the landfill face.

Once the sample was sorted down to a homogeneous pile of waste components of a reasonable size (less than 2 square inches), the remaining material, referred to as a "supermix", was weighed and thoroughly mixed. To complete the sorting process, a representative sample (one fifth to one third) was extracted and sorted into the nine broad categories. Proportional percentages were then used to determine the composition of this mix.

Equipment (Sorting and Safety)

The following waste weighing and safety equipment were used on site:

Weighing Equipment included the following:

- Waste Weighing Scale,
- 10' x 12' sorting tarp,
- Plastic laundry baskets,
- Seats,
- Magnets and knives, and
- Clipboard.

Safety Equipment included the following:

- Polycoated Tyvek disposable coveralls,
- Chemical resistant gloves,
- Surgical gloves for liners,
- Hardhats,
- Earplugs,
- Safety glasses,
- Filter masks,
- Safety vests,
- A fire extinguisher,
- A first-aid kit, and
- A portable eyewash.

At this time I would like to show a few slides which illustrate the sampling program.

2. Rural residents disposed of more ferrous metal, particularly mixed metal products, than their urban or suburban counterparts.

3. Suburban residents disposed of more yard trimmings than either urban residents or rural residents.

Apart from these, there were no significant differences in the percentages of other materials among the special residential generators.

Commercial Waste

Concerning commercial waste, in general, corrugated cardboard and food waste were the materials which made up the largest percentages of the waste stream. This was evident in all seven generator types.

Seasonal Variation

One of the reasons for conducting the Study over four seasons, was to identify seasonal variation in the disposal of waste from residents.

The material with the most pronounced seasonal variation is, not surprisingly, yard trimmings. This variation could mask seasonal variations in other materials. When yard waste was excluded, primarily, food wastes and mixed recyclable paper proved to show some seasonal variation, and there was minimal seasonal variation for most materials.

Having just returned from China and studying the municipal waste stream in Shanghai, I have prepared a comparison of waste compositions from various countries and cities around the world, and compared them to Ottawa.

Notice if you will, Shanghai's organic component of 87%. This presents a waste management challenge most of you do not have to deal with. The table on the following page illustrates that every city and every country has its own distinctive waste composition profile depending on variables such as standard of living, and volume and type of industry.

Concluding Remarks

I trust this presentation has demonstrated there is more to determining the composition of solid waste than merely randomly opening a single bag of trash and 'guesstimating' or digging up a single sample from a completed cell in a landfill.

It is a method and a procedure which can allow you to more efficiently operate your existing waste management programs, and proficiently design future ones.

Thank you for your time.

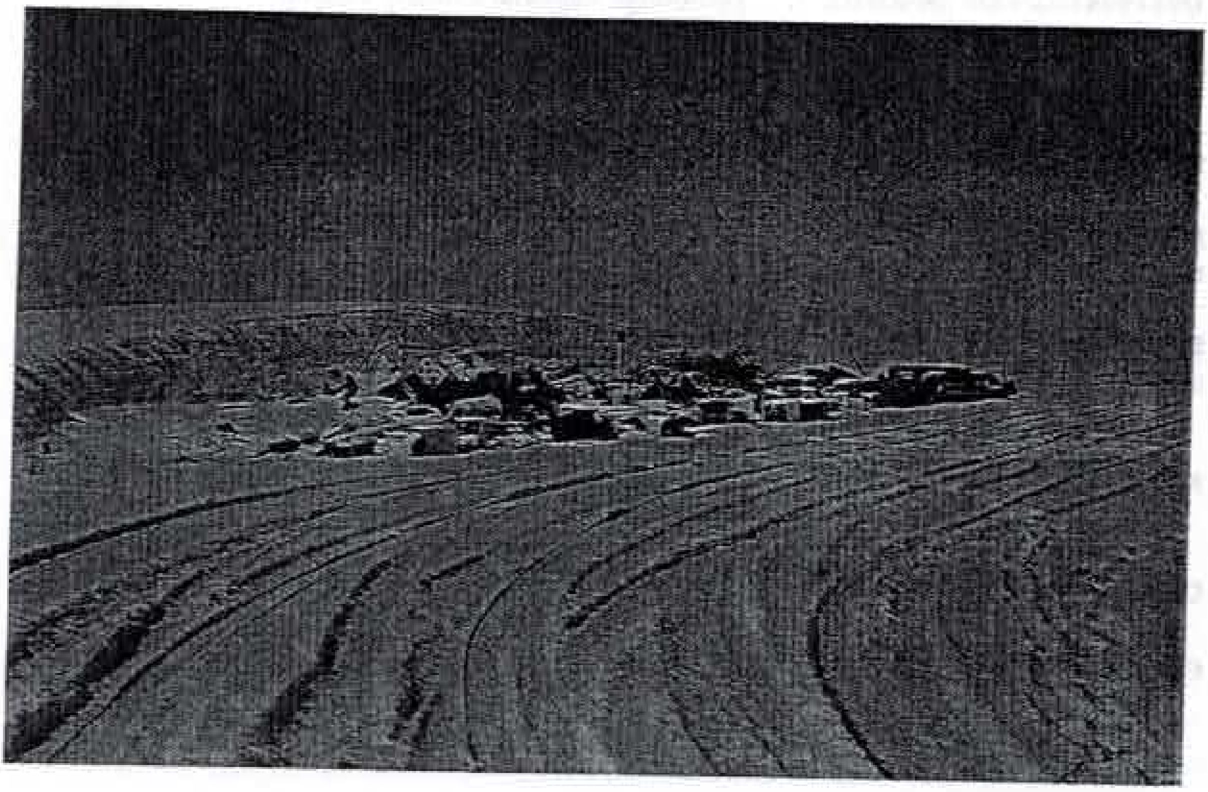
Note:
This paper is based on the following reports written for the project:
1. The Existing Solid Waste Management System
2. Description of the Waste Stream and Program Implications

LANDFILLS	Brant
TYPE	• Modified Sanitary Landfill
LOCATION	• NE 1/4-10-18-26-W4M
OPERATION PROCEDURES (frequency of cover, burn, etc.)	• Evidence of burning
PERMIT CONDITIONS	• No known Permit - approval from Health Unit
OWNERSHIP	• County Regional Waste Authority
TYPES OF WASTES ACCEPTED	• Municipal Solid Waste
LEVEL OF SERVICE (hours of operation)	• Wednesday 8-12, Saturday 1-5 Closed locked gate - 6' wire fence
ESTIMATED LIFE	
OTHER SERVICES PROGRAMS (separation of wastes)	• metals • pesticide containers
EXPANSION PLANS	
"OUTSIDE" WASTES ACCEPTED	
POPULATION SERVED	• Hamlets of Brant & surrounding County residents
GEOGRAPHIC BOUNDARIES	
CAPITAL COSTS	
OPERATING COSTS	• Supervision costs

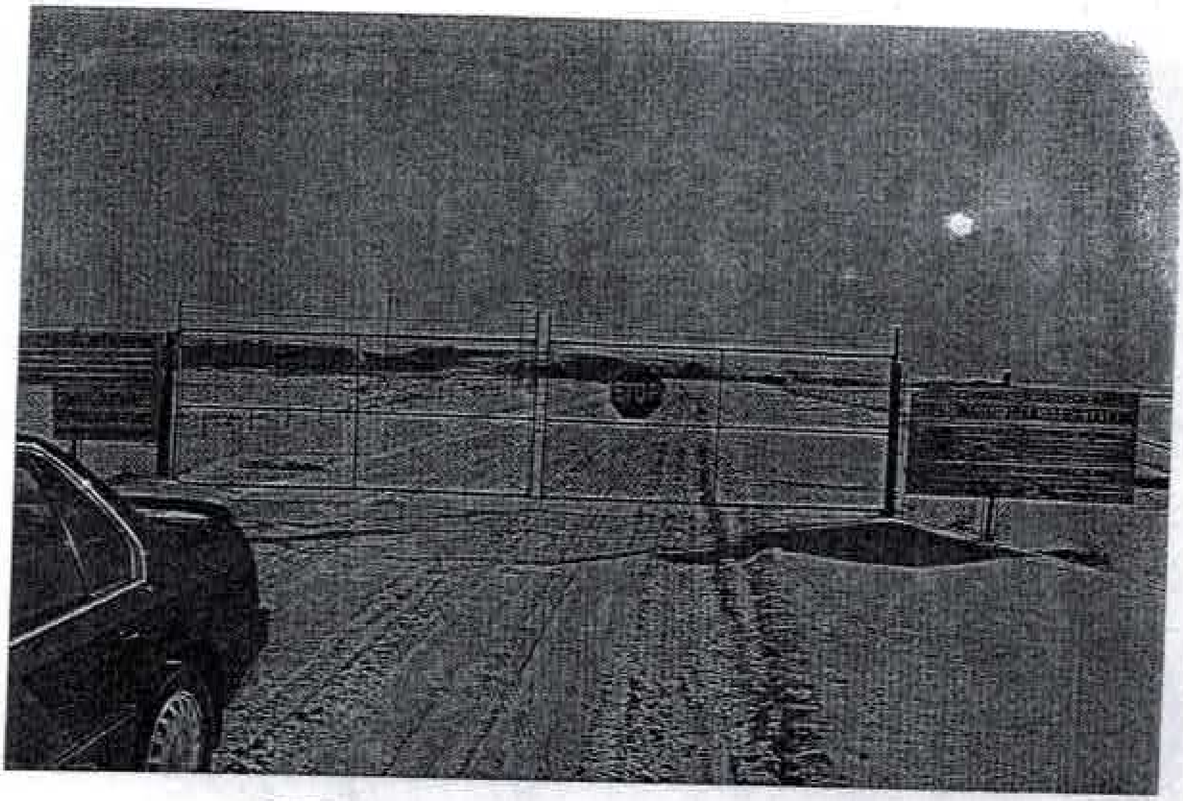
CONTAINMENT/STORAGE
- metals
- pesticide containers

ONSITE PROCESSING

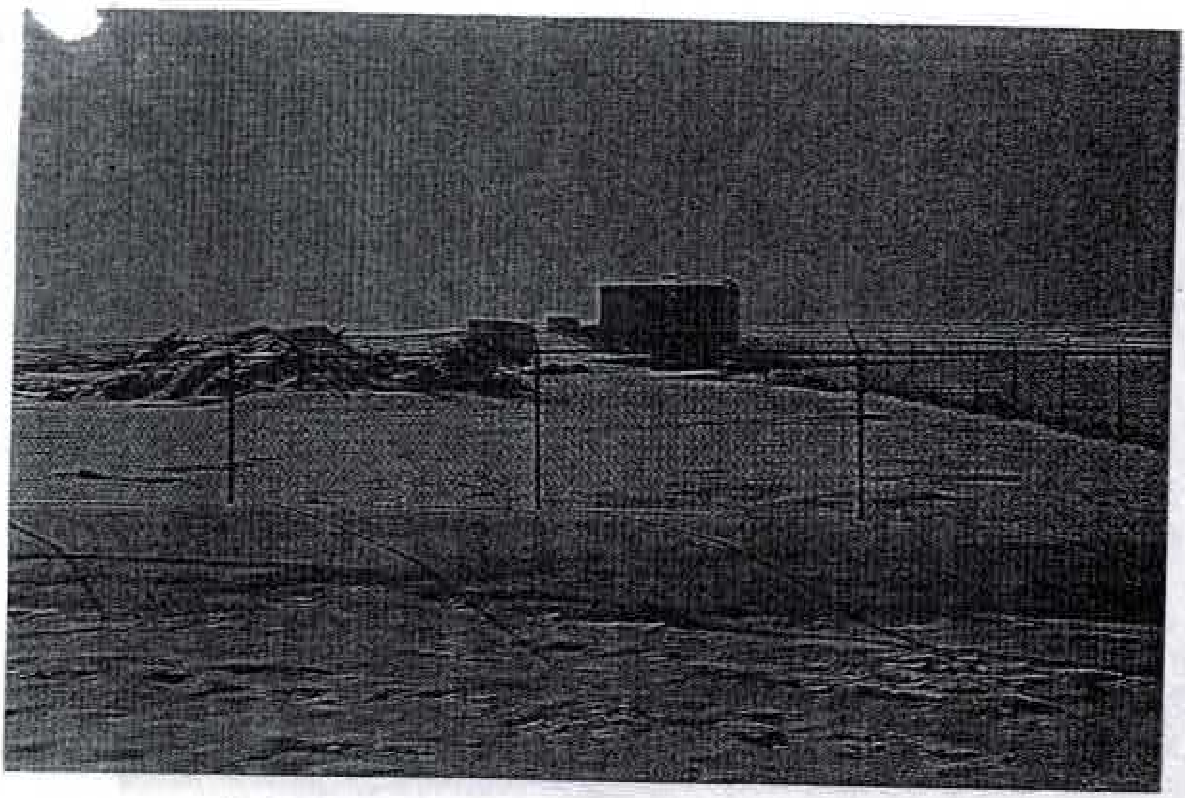
PAST/PRESENT/FUTURE DATA TO ESTABLISH TRENDS



WHITE GOODS, METALS AND WIRE PILE



ENTRANCE GATE WITH INFORMATION SIGNS



WOODEN WASTES AND OTHER BURNABLES (Left)

WHITE GOODS AND SCRAP METALS PILE

OPERATING COSTS

CONTAINMENT/STORAGE • Pesticide containers

ONSITE PROCESSING

PAST/PRESENT/FUTURE DATA TO ESTABLISH TRENDS

HOUSEHOLD WASTES IN PIT

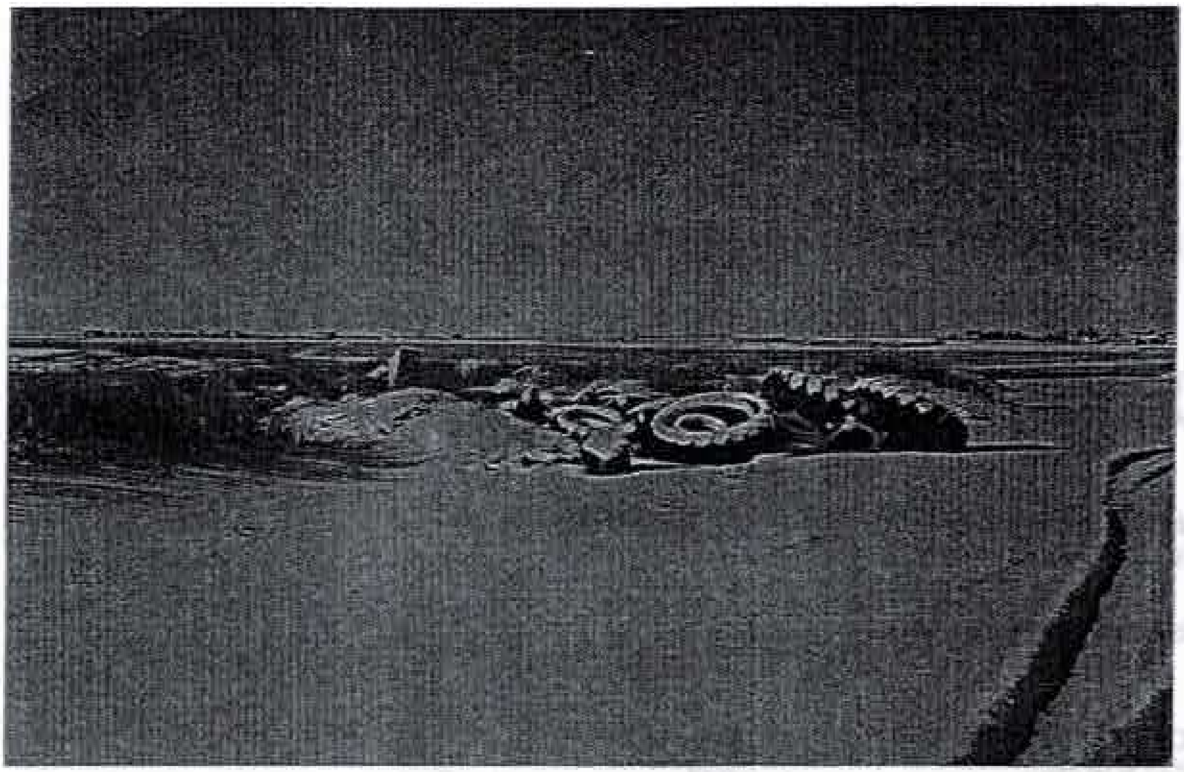
PESTICIDE CONTAINERS (Foreground)
TIRES PILE (Foreground)
METALS PILE (Background)

OPERATING COSTS

CONTAINMENT/STORAGE • Pesticide containers

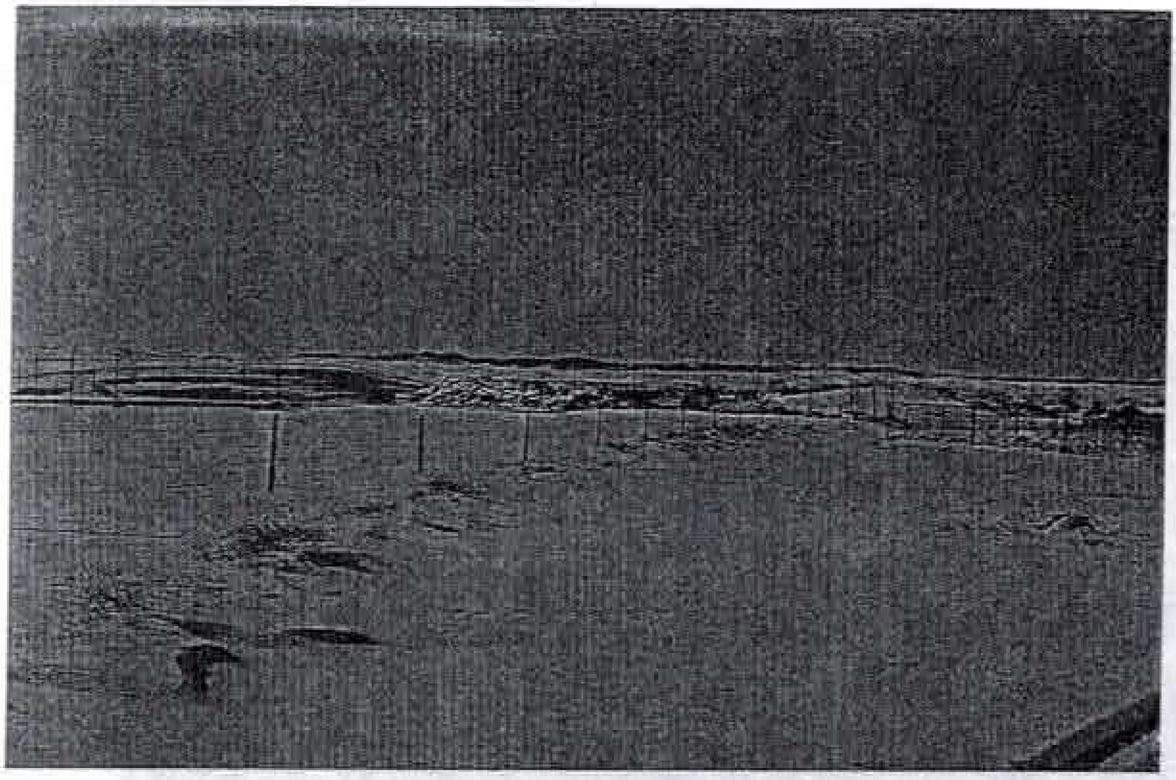
ONSITE PROCESSING

PAST/PRESENT/FUTURE DATA TO ESTABLISH TRENDS



TIRES PILE

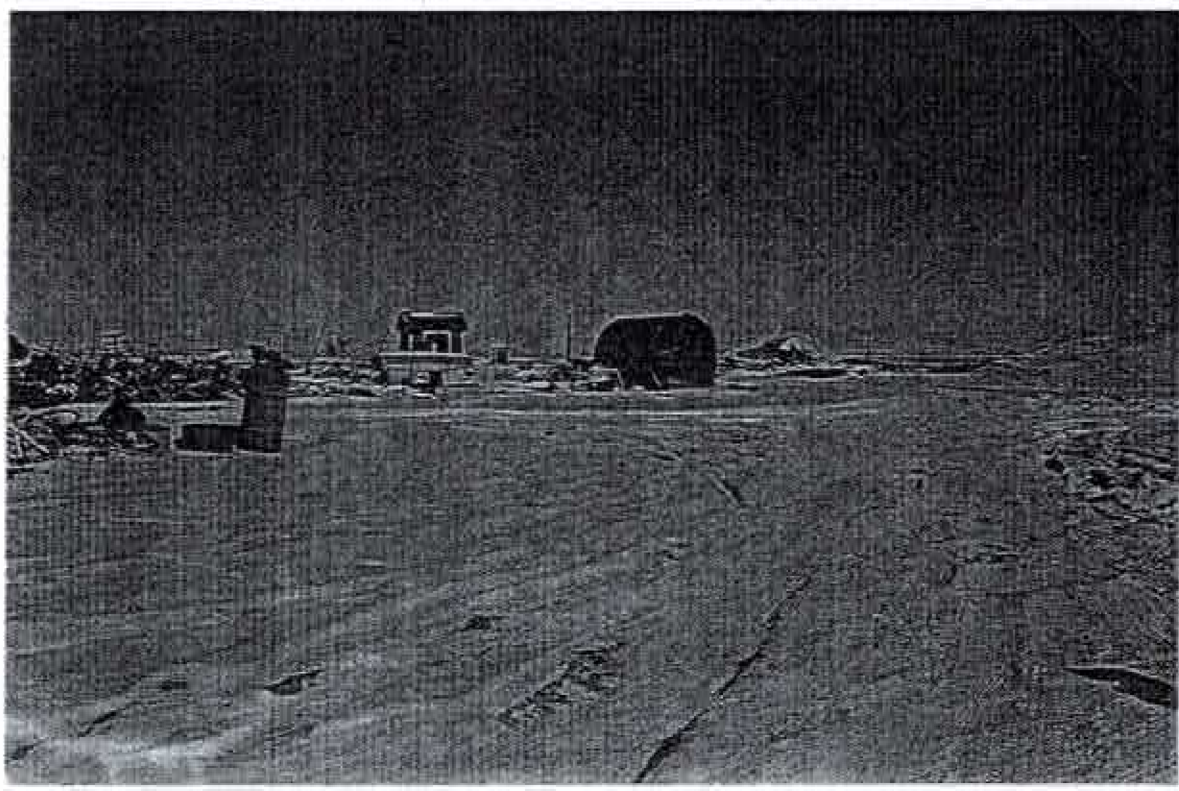
GEOGRAPHIC BOUNDARIES	
CAPITAL COSTS	
OPERATING COSTS	• $11,000/a pit (holds 10,000 cubic yards, lasts a year)
CONTAINMENT/STORAGE	• Pesticide containers
ONSITE PROCESSING	
PAST/PRESENT/FUTURE DATA TO ESTABLISH TRENDS	• Has been surveyed to become a transfer station • Pit 23.5 feet deep in clay



TIRES PILE

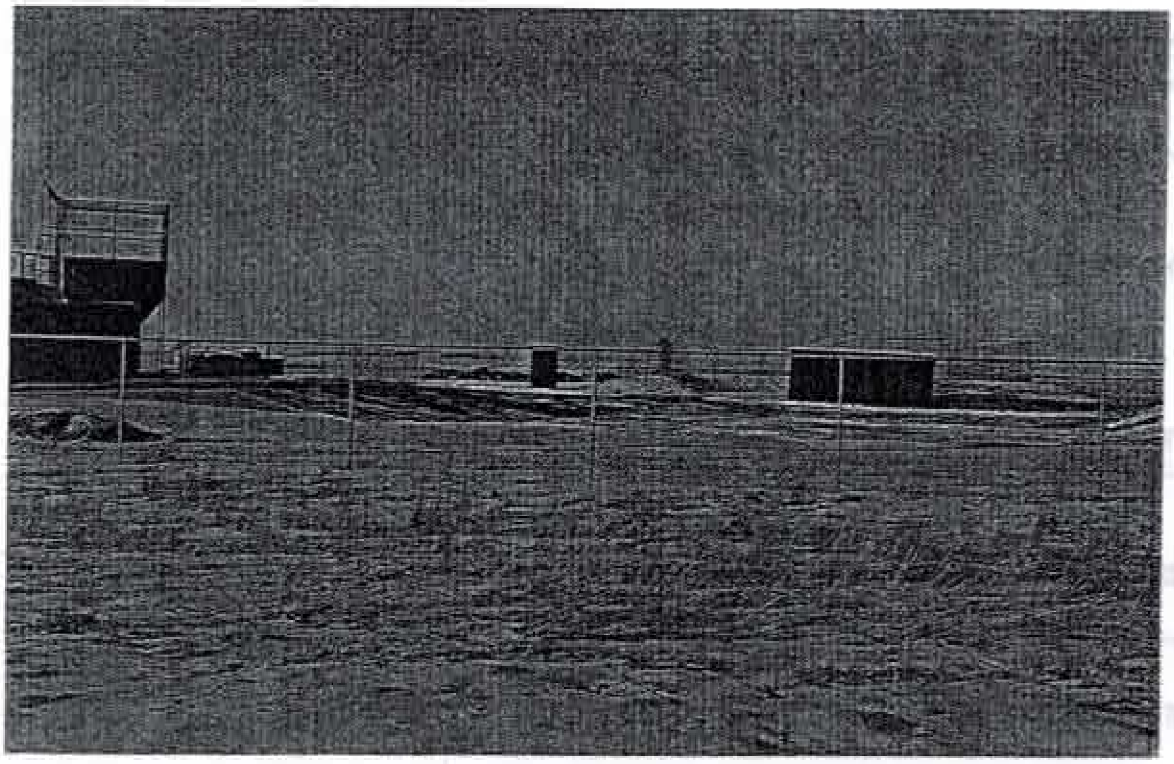
HOUSEHOLD WASTE PIT

LANDFILL OFFICE



SCRAP METALS AREA

TRANSFER STATION		Coaldale Transfer Station
LOCATION	•	SW 1/4-23-09-20-W4M
	•	Pt. Lot 1, Block 1, Plan 8610846
CAPACITY OF STATION		
FREQUENCY OF HAUL		
DESTINATION OF LANDFILL		
TYPE	•	Compaction
OWNERSHIP	•	Lethbridge Regional Waste Commission
LEVEL OF SERVICE (hours of operation)	•	Tuesday, Wednesday 10-6, Saturday 8:30-12:30 Supervised, locked entrance
RECYCLING, COMPOSTING, HAZARDOUS (separation of wastes)	•	Tires, chemical containers, used oil
POPULATION SERVED	•	Town of Coaldale & surrounding rural residents
GEOGRAPHIC BOUNDARIES		
CONTAINMENT/STORAGE	•	Pesticide containers



YARD VIEW

COMPACTION SYSTEM (Left)
TIRES PILE (Left)
PESTICIDES AREA (Right)

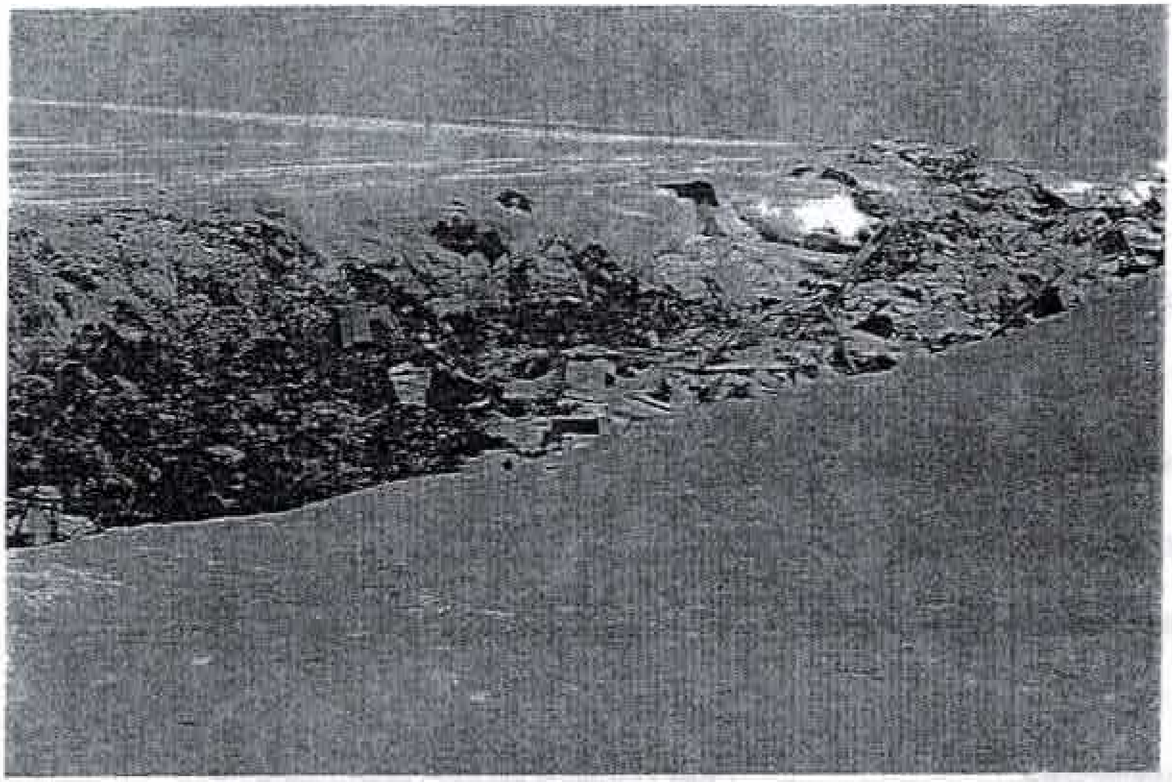
CAPITAL COSTS

OPERATING COSTS

CONTAINMENT/STORAGE

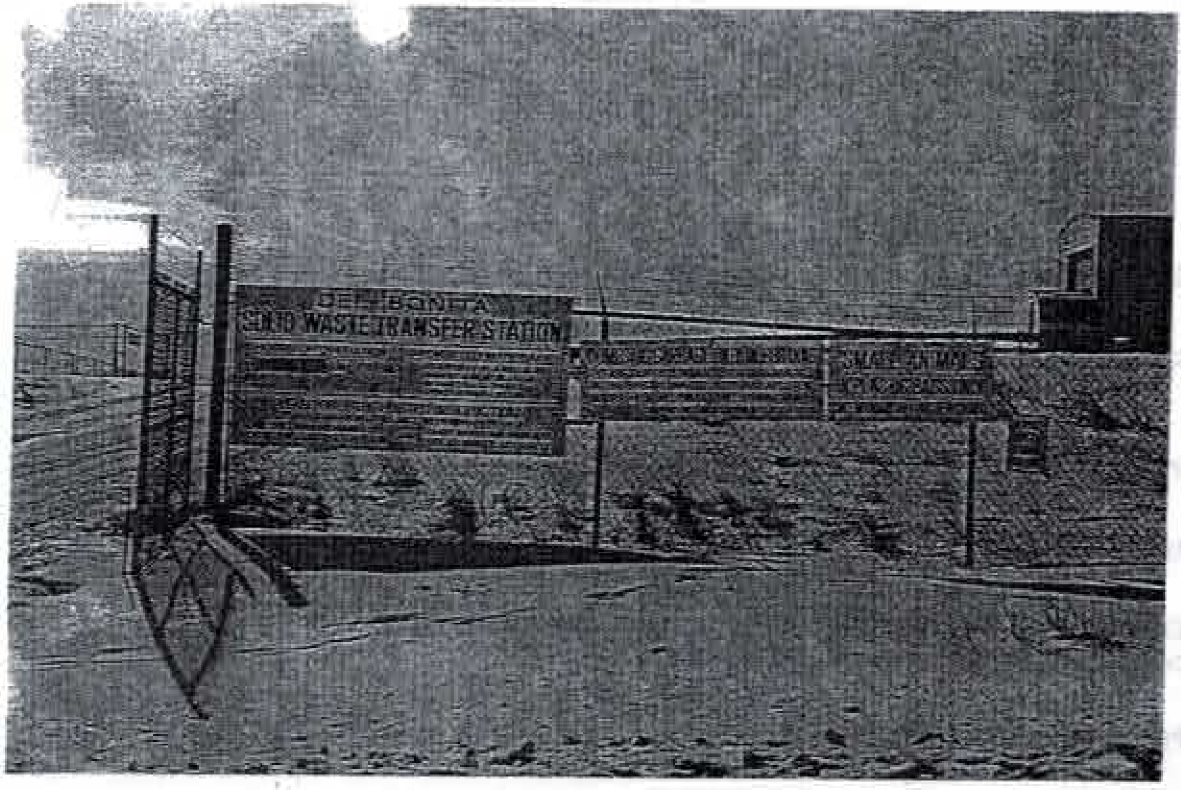
ONSITE PROCESSING • None

PAST/PRESENT/FUTURE DATA TO ESTABLISH TRENDS

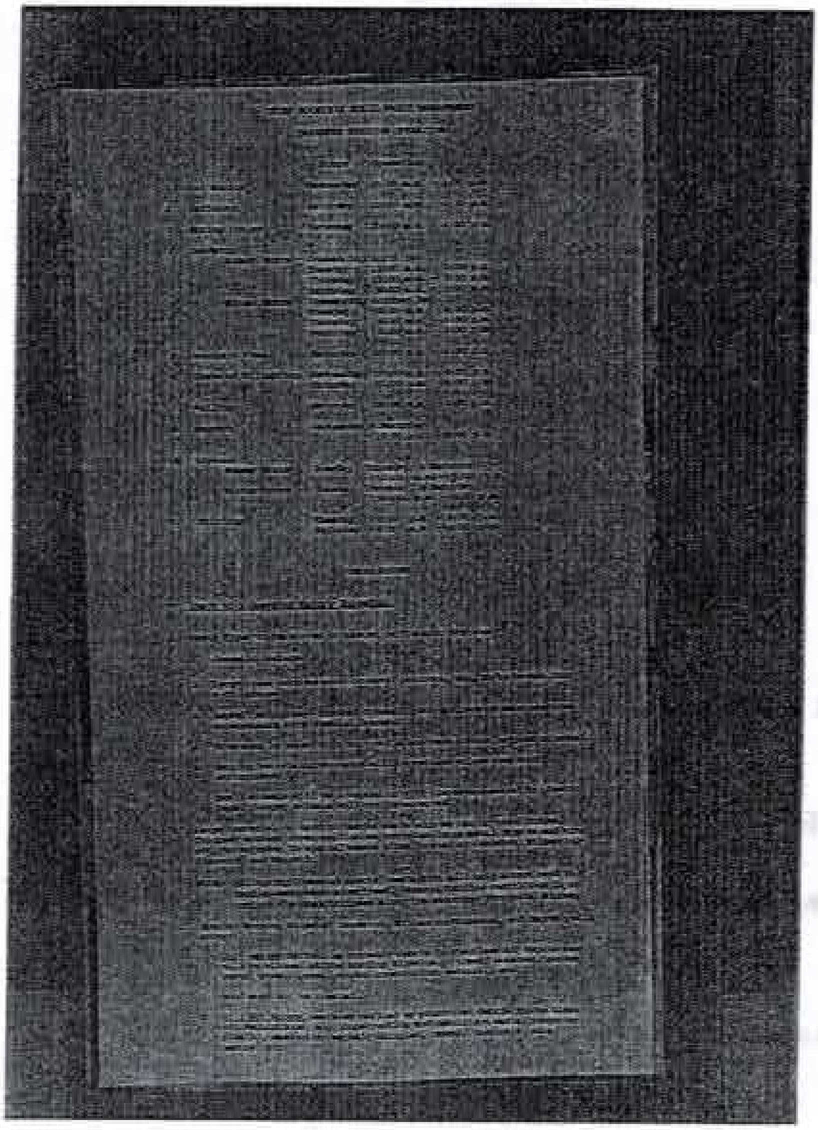


BURNING WASTE IN PIT

PIT WITH BURNING WASTE



ENTRANCE GATE WITH INFORMATION SIGNS



CHIEF MOUNTAIN SOLID WASTE MANAGEMENT

TRANSFER STATION OPERATION AND REGULATIONS

CAPITAL COSTS	
OPERATING COSTS	• $7,058.40 - Yearly cost of supervisor
CONTAINMENT/STORAGE	
ONSITE PROCESSING	• curshing & shredding of metal & plastic chemical containers
PAST/PRESENT/FUTURE DATA TO ESTABLISH TRENDS	

CAPITAL COSTS

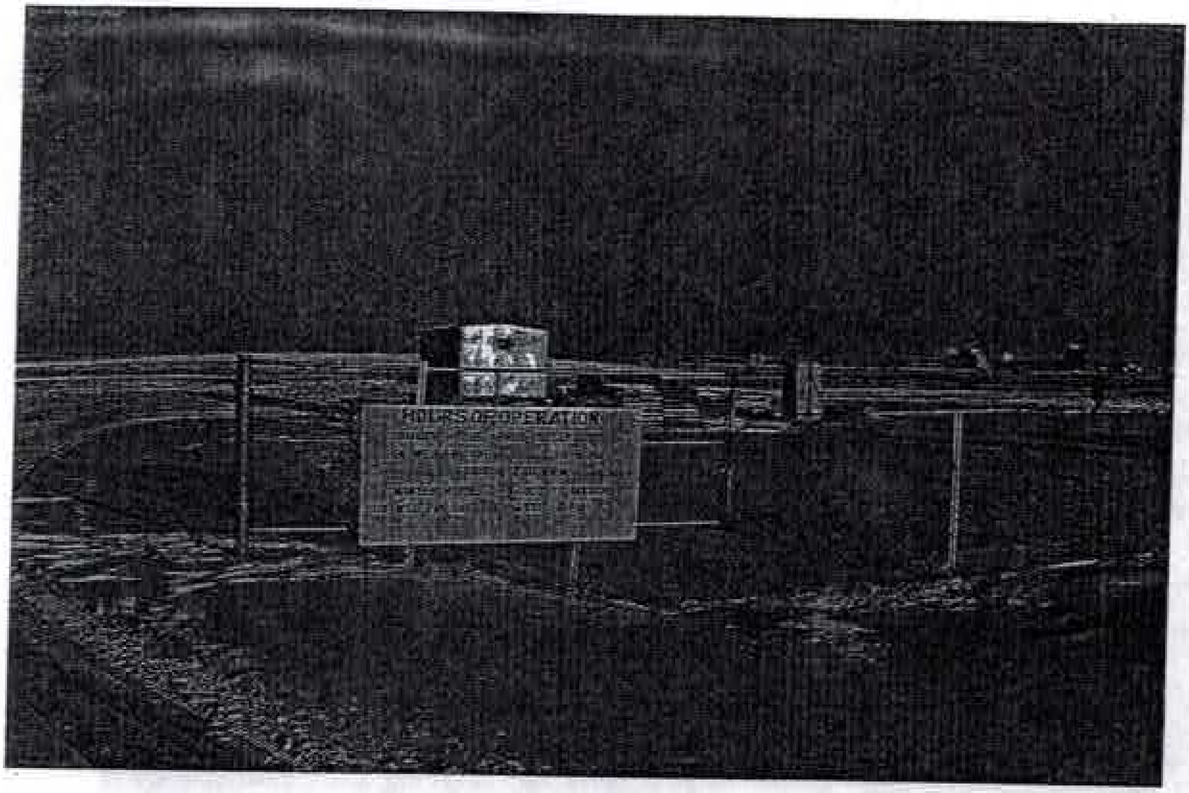
OPERATING COSTS

CONTAINMENT/STORAGE

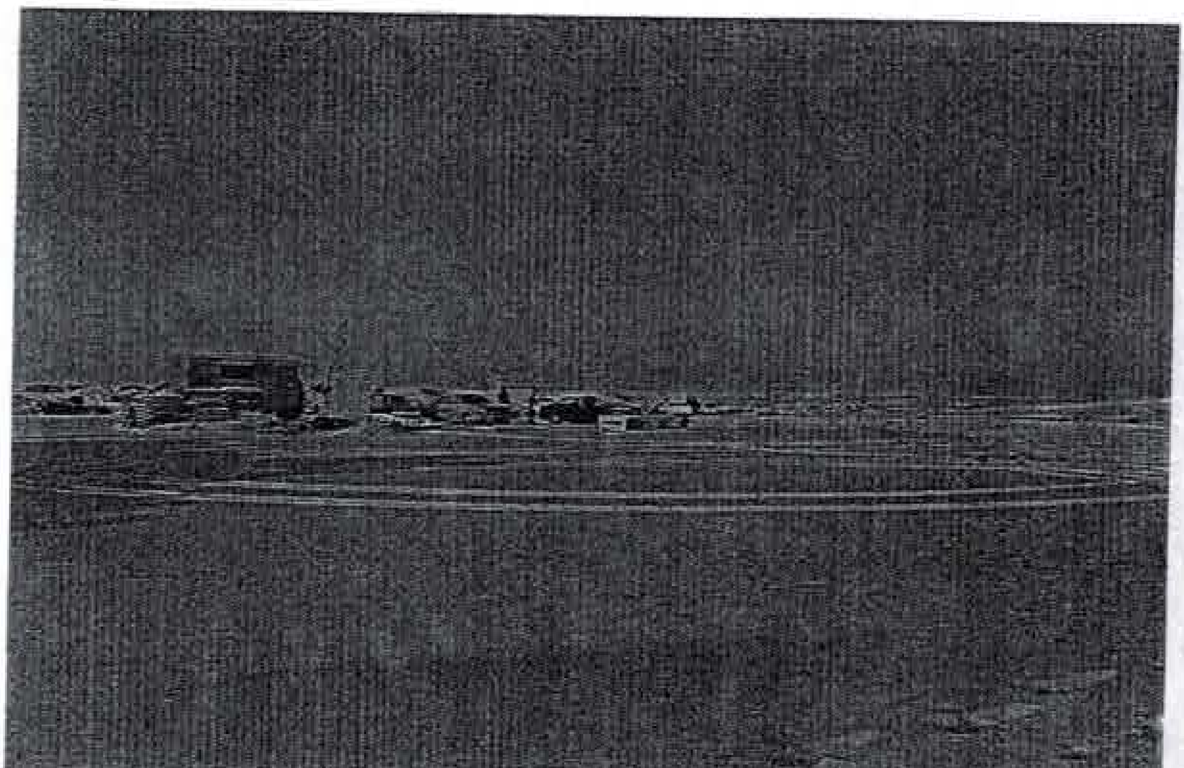
ONSITE PROCESSING • None

PAST/PRESENT/FUTURE DATA TO ESTABLISH TRENDS

LANDFILLS	Foremost
QUANTITIES	• No scale
TYPE	• Modified Sanitary Landfill
LOCATION	• NW-20-6-11-W4M
OPERATION PROCEDURES (frequency of cover, burn, etc.)	• Evidence of past burning • Cover when pit full
PERMIT CONDITIONS	• None
OWNERSHIP	• Village of Foremost
TYPES OF WASTES ACCEPTED	• Municipal Solid Waste
LEVEL OF SERVICE (hours of operation)	• Supervised: Sunday, Wednesday, Friday, Saturday (1-5 pm)
ESTIMATED LIFE	• Approximately 10 years
OTHER SERVICES PROGRAMS (separation of wastes)	• white goods • tires • wood • Metals • pesticide containers
EXPANSION PLANS	
"OUTSIDE" WASTES ACCEPTED	
POPULATION SERVED	• Village of Foremost & surrounding rural residents
GEOGRAPHIC BOUNDARIES	



INFORMATION SIGN AT THE ENTRANCE

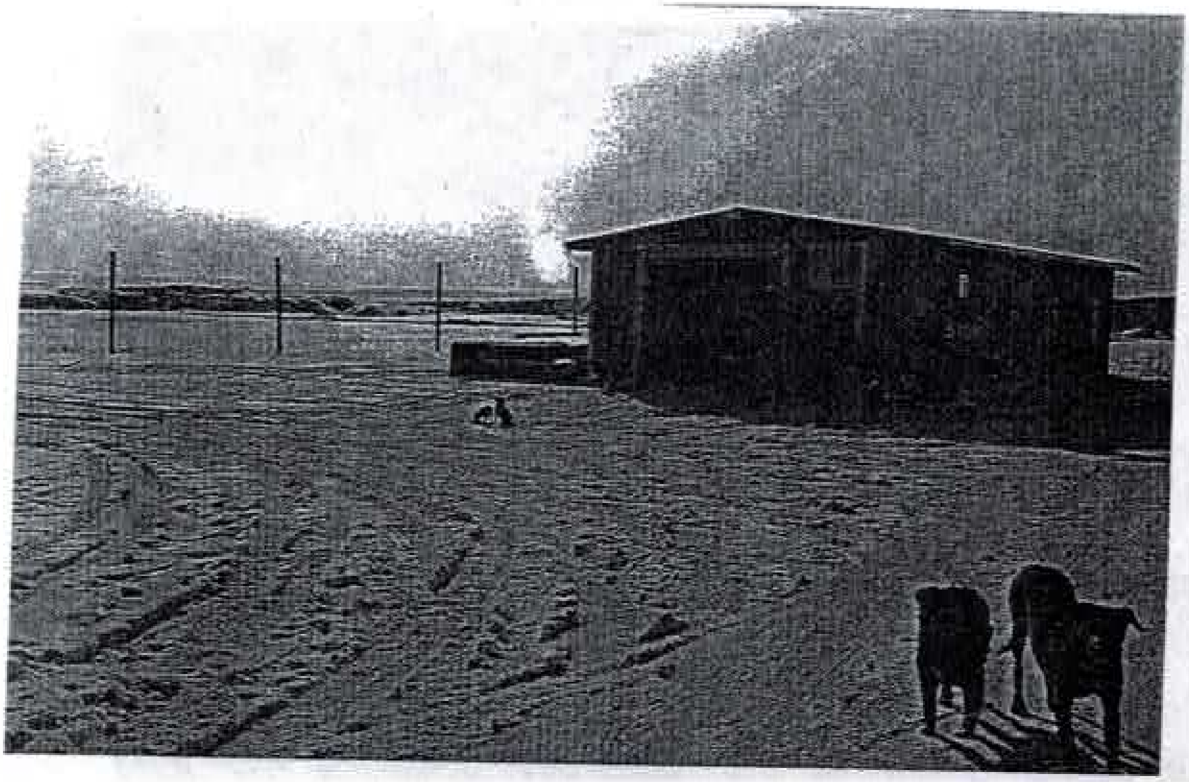


LANDFILL TRAILER (Pallets neatly stacked)

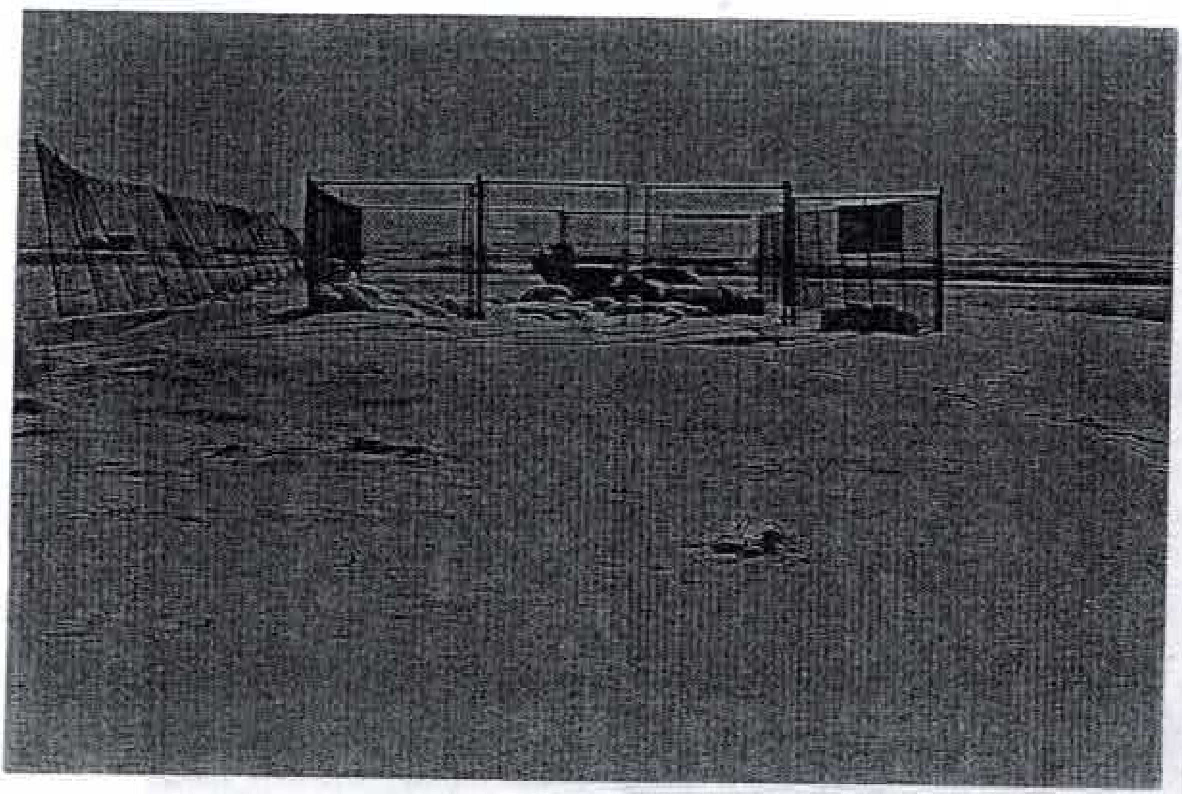
BURNABLE WASTES IN PIT

NON BURNING
HOUSEHOLD WASTE PIT

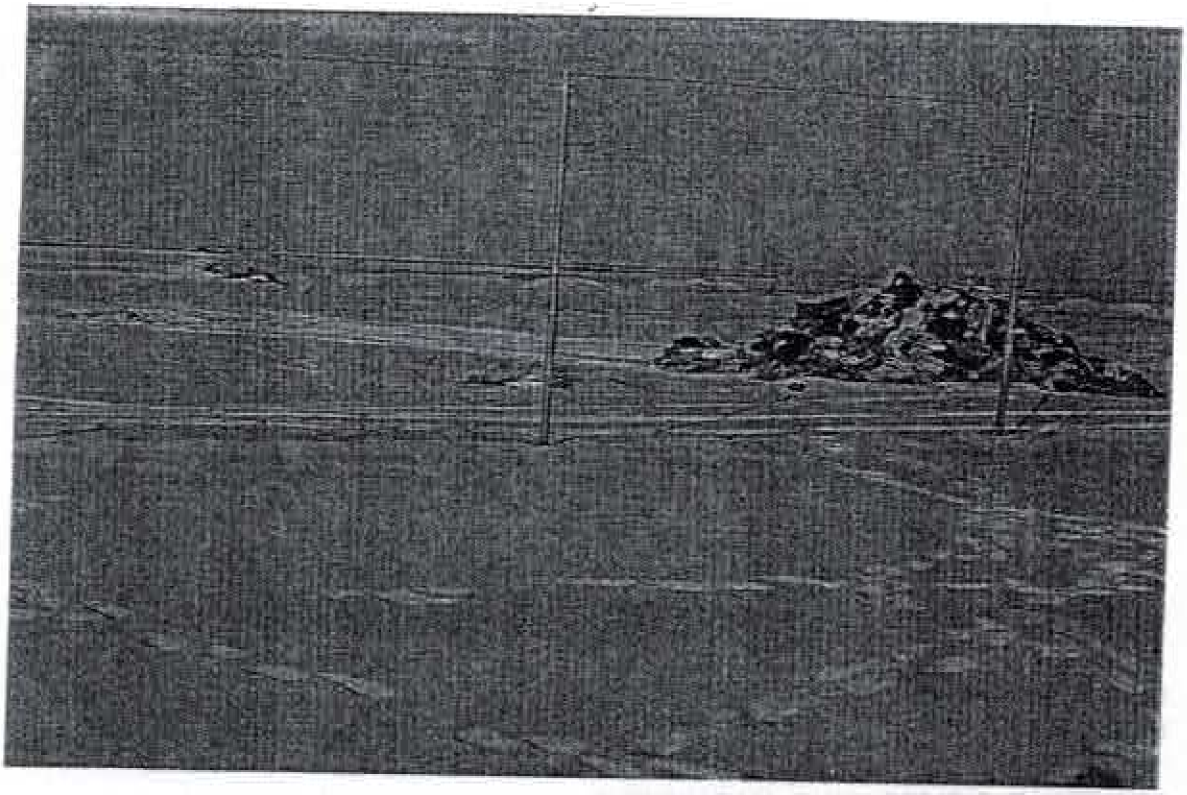
CAPITAL COSTS	
OPERATING COSTS	• O'Sullivan construction 5 yr. contract to dig new pits, cover and compact
CONTAINMENT/STORAGE	• Pesticide containers
ONSITE PROCESSING	
PAST/PRESENT/FUTURE DATA TO ESTABLISH TRENDS	



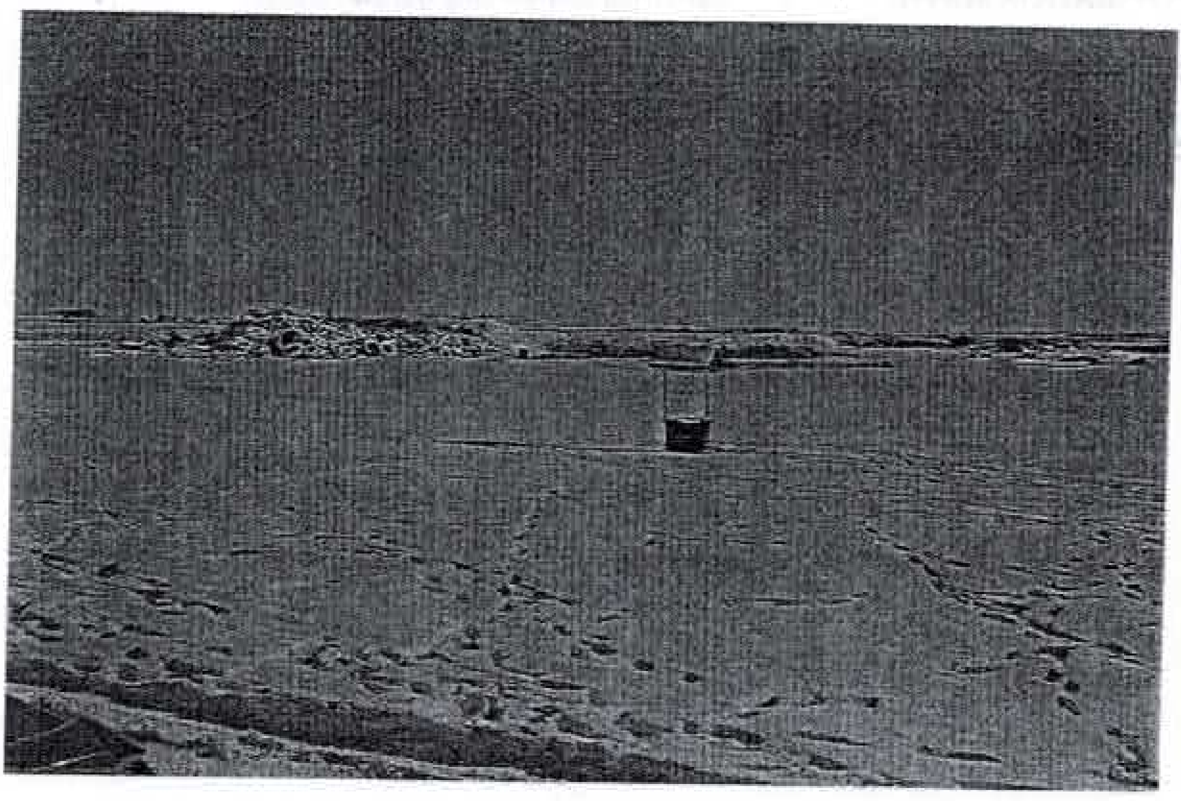
LANDFILL BUILDING



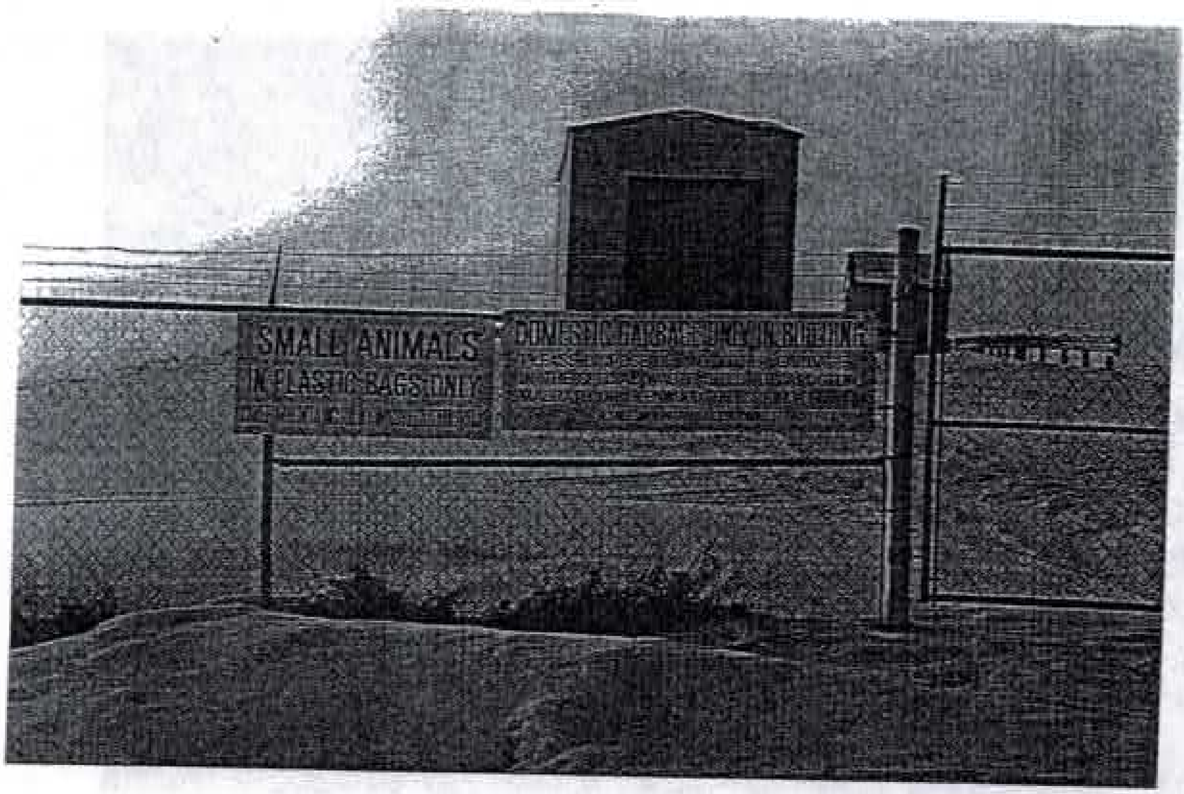
PESTICIDE CONTAINERS STORAGE AREA



DOMESTIC WASTE PILE



TIRES PILE

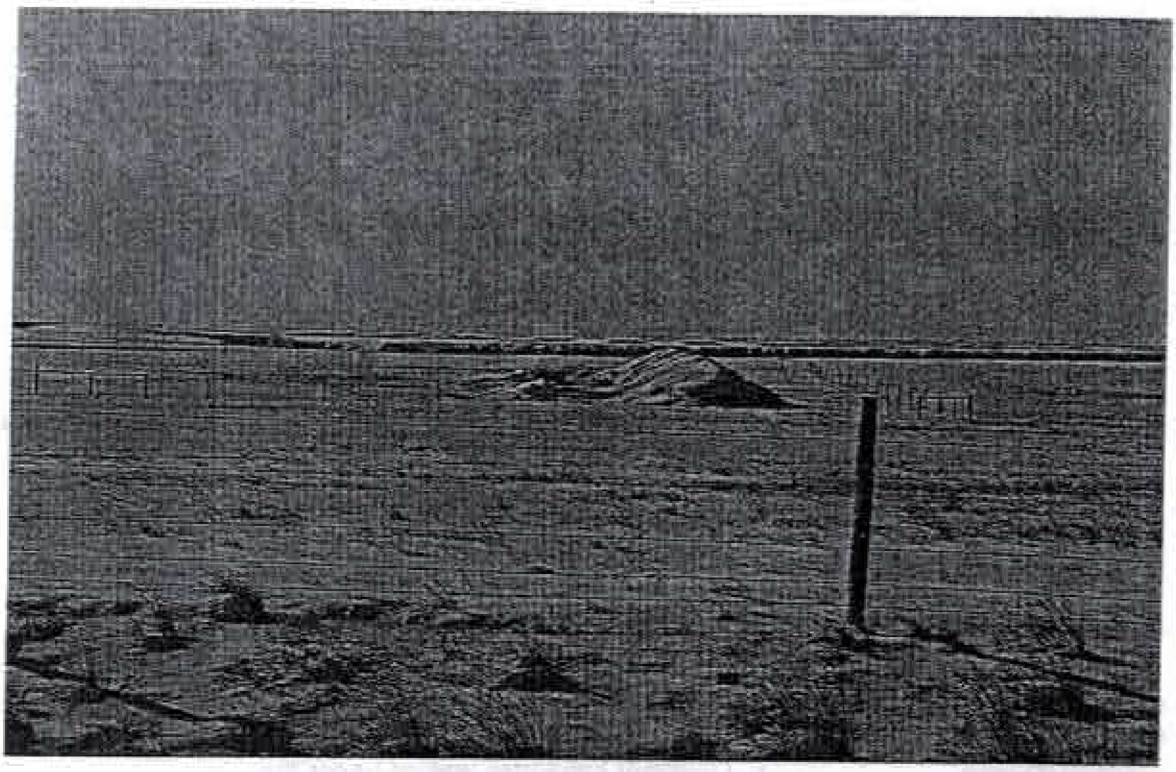


ENTRANCE GATE WITH INFORMATION SIGNS

INFORMATION SIGN

PESTICIDES AREA (Right)

LANDFILLS	Government of Canada, Deparment of Agriculture
QUANTITIES	• No scale
TYPE	• Modified Sanitary Landfill
LOCATION	• NW-6-9-22-W4M
OPERATION PROCEDURES (frequency of cover, burn, etc.)	
PERMIT CONDITIONS	• Permit R.D. #650, June 9, 1983
OWNERSHIP	• Government of Canada Department of Agriculture Animal Disease Reseach Institute Lethbridge, Alberta
TYPES OF WASTES ACCEPTED	• Materials from the institute & homes located on property • Municipal Solid Waste taken by BFI to Lethbridge Regional Sanitary Landfill
LEVEL OF SERVICE (hours of operation)	• None, Locked gate
ESTIMATED LIFE	
OTHER SERVICES PROGRAMS (separation of wastes)	
EXPANSION PLANS	
"OUTSIDE" WASTES ACCEPTED	• None
POPULATION SERVED	• Government of Canada, Department of Agriculture, Animal Disease Research Institute only



GENERAL VIEW OF WASTE PIT

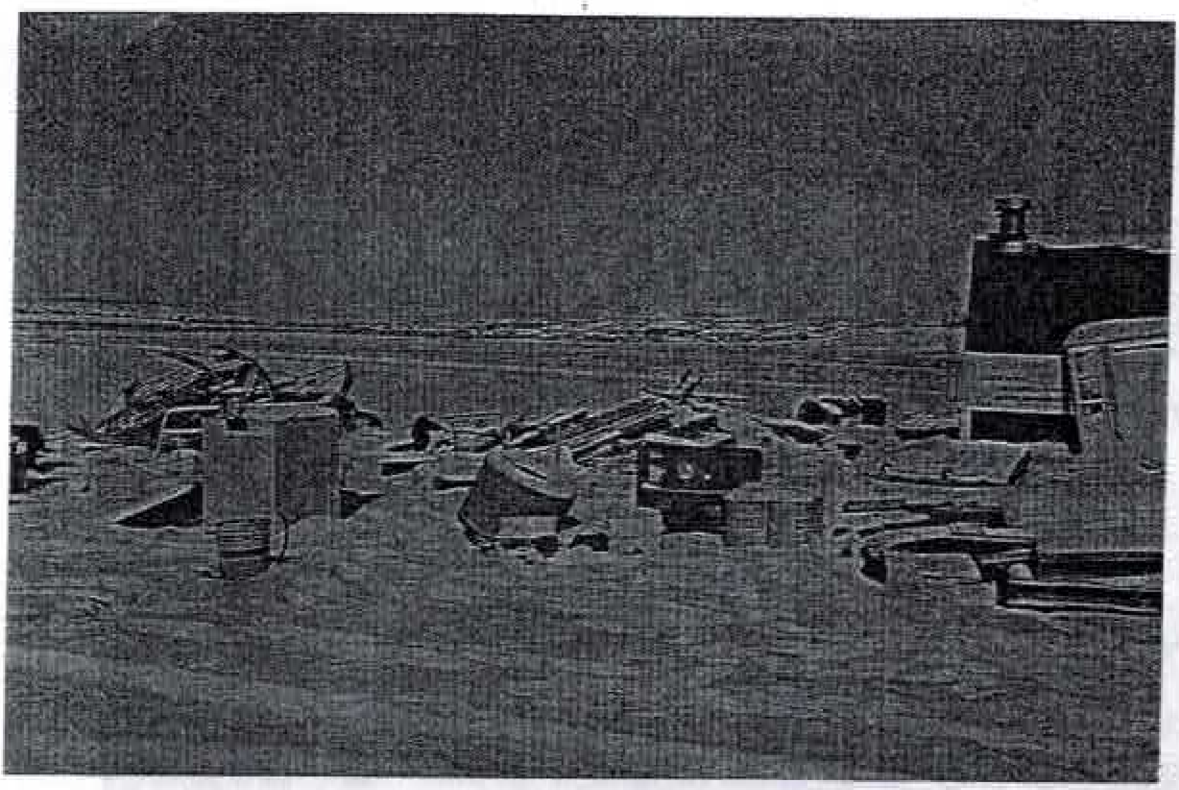
CAPITAL COSTS

OPERATING COSTS
- $10,000/year for supervision

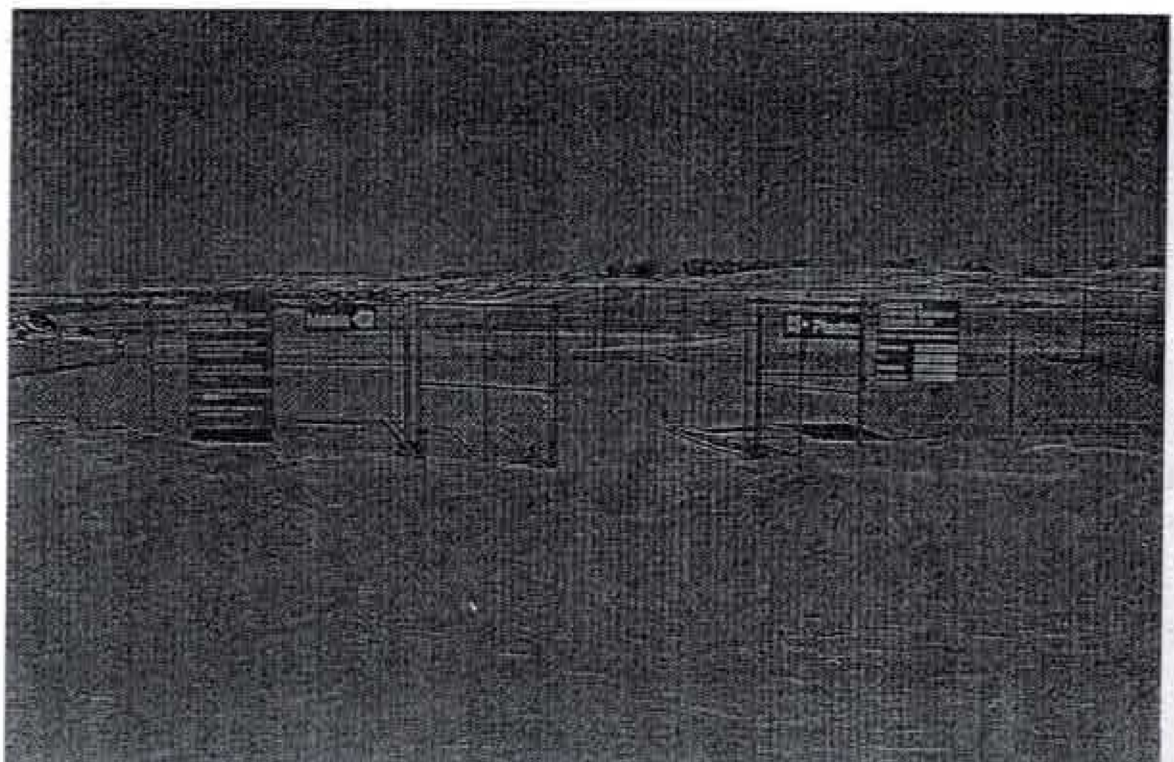
CONTAINMENT/STORAGE
- Chemical container site

ONSITE PROCESSING
- Crushing and shredding of metal and plastic chemical containers

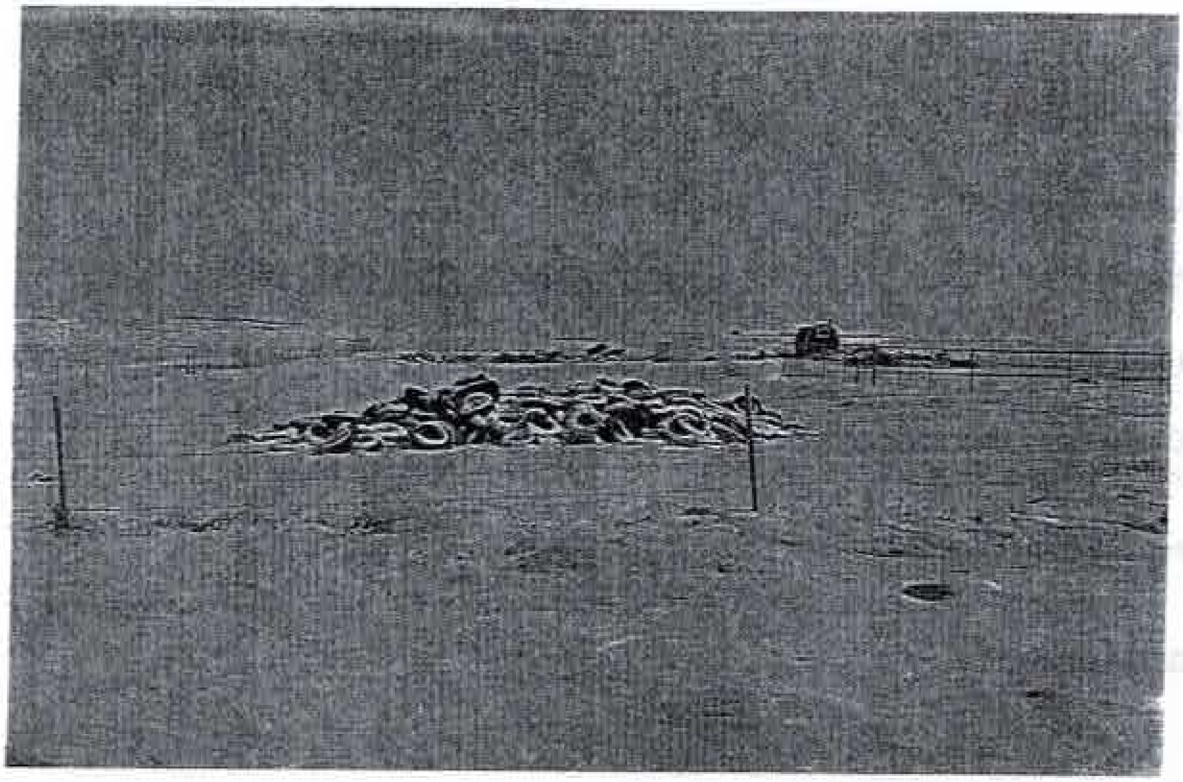
PAST/PRESENT/FUTURE DATA TO ESTABLISH TRENDS



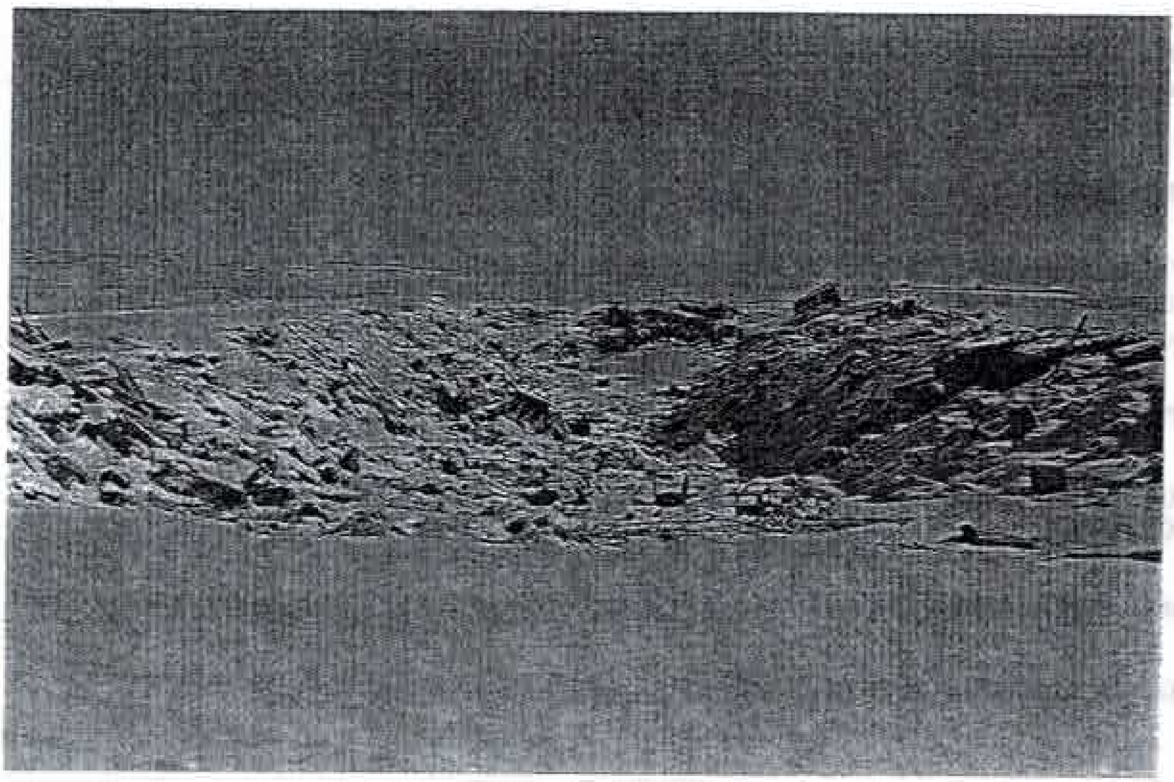
WHITE GOODS, METALS
AND WOOD WASTE



PESTICIDE CONTAINERS STORAGE

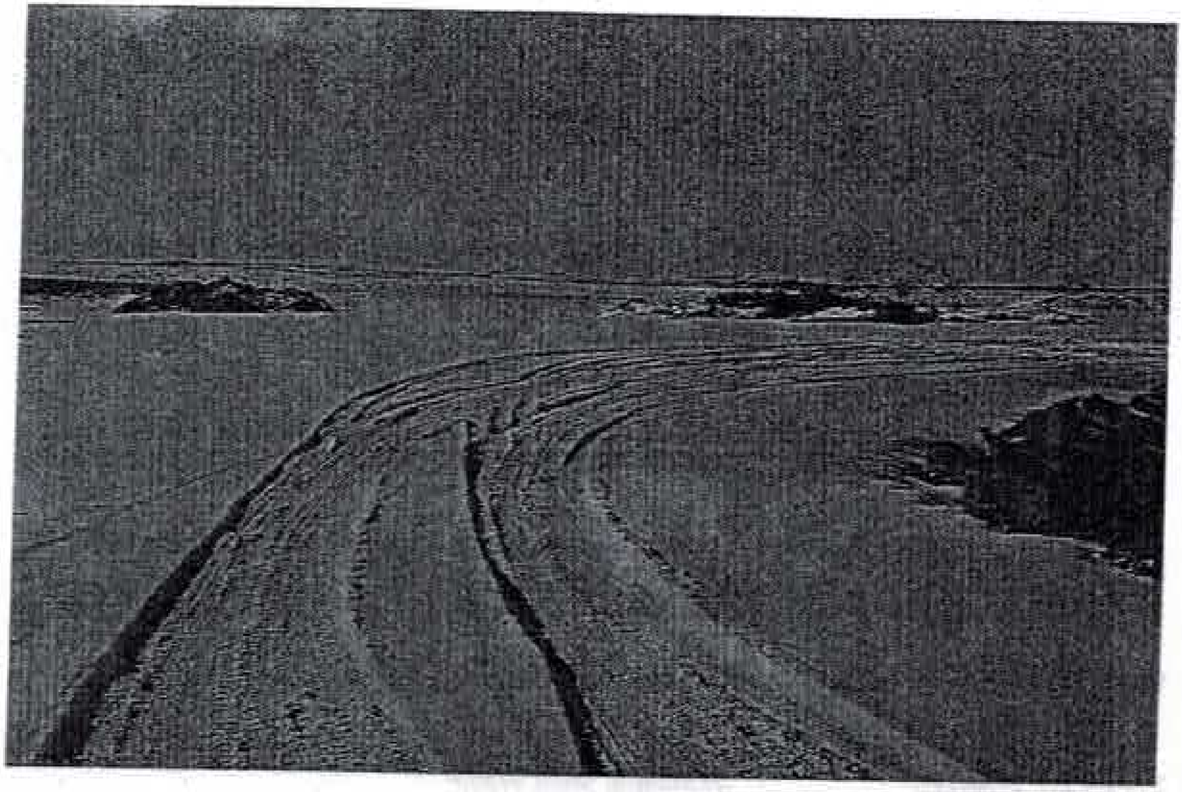


TIRES PILE

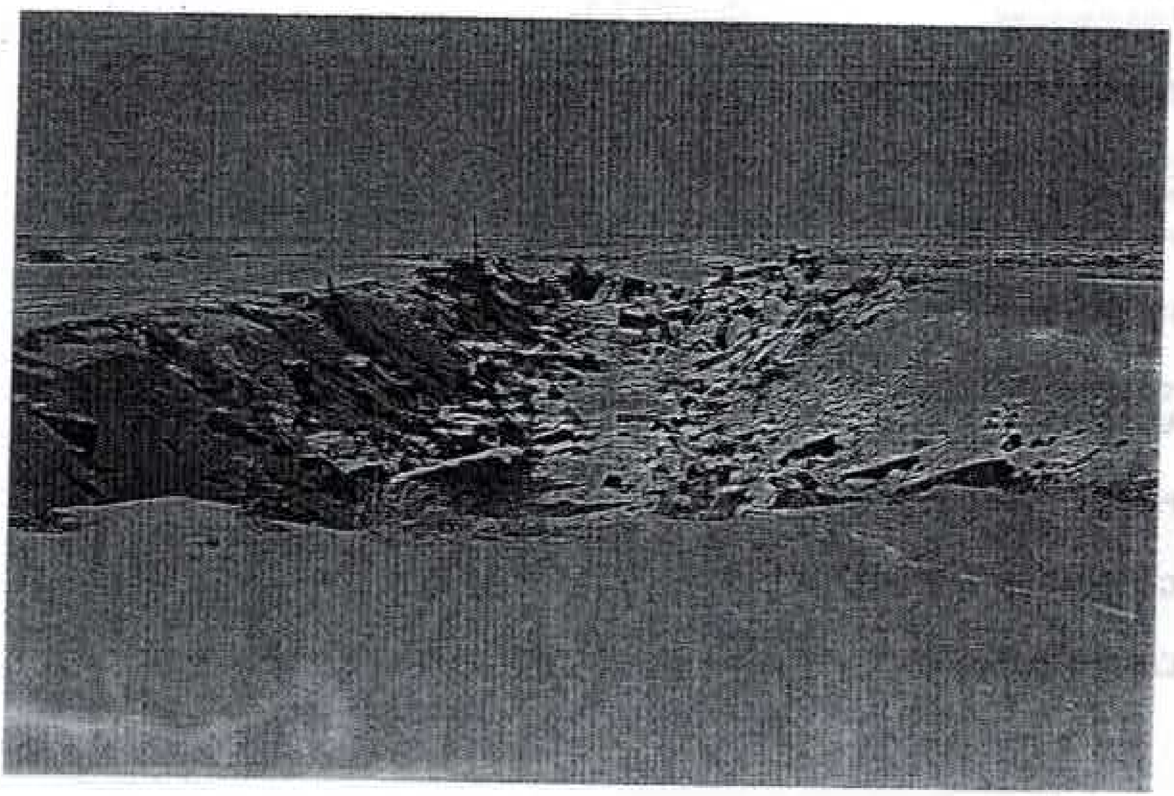


DOMESTIC WASTE PIT

CAPITAL COSTS	
OPERATING COSTS	• $9600.00 yearly cost of supervisor
CONTAINMENT/STORAGE	
ONSITE PROCESSING	
PAST/PRESENT/FUTURE DATA TO ESTABLISH TRENDS	• Problems with ground water level



TIRES PILE (Left) WOODEN WASTE (Right)



DOMESTIC GARBAGE PIT

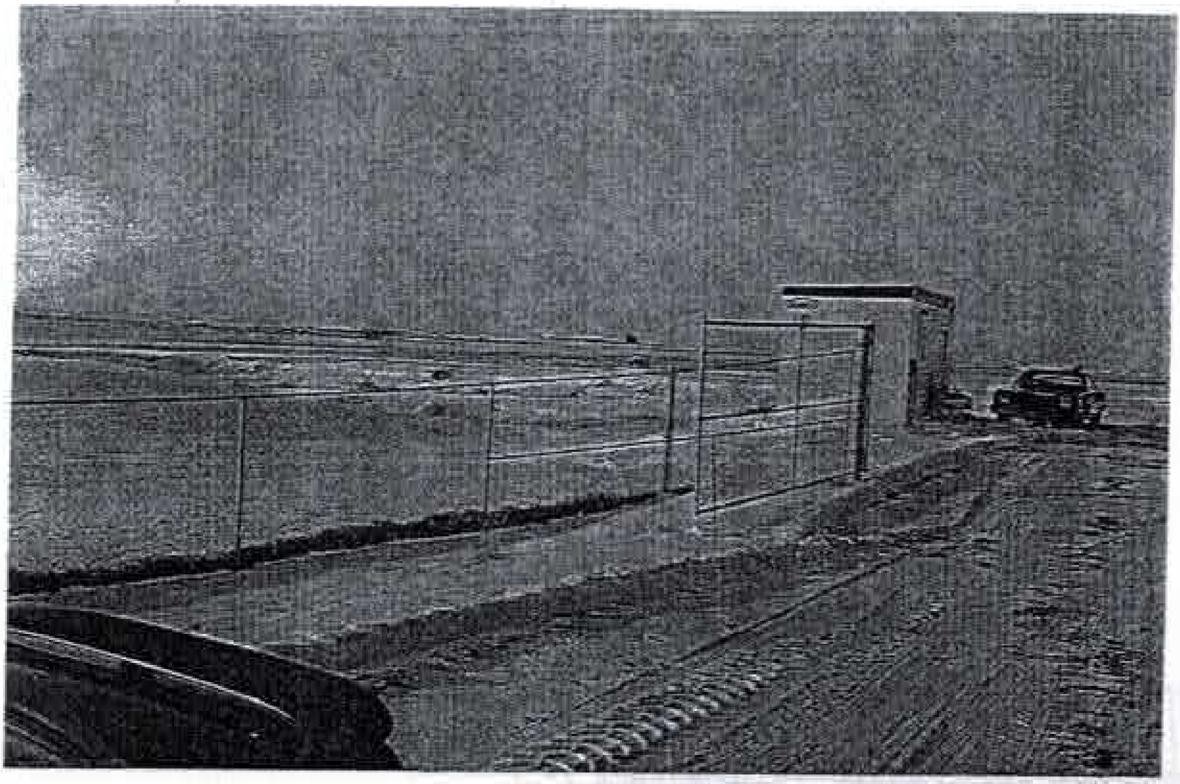
OPERATING COSTS

CONTAINMENT/STORAGE

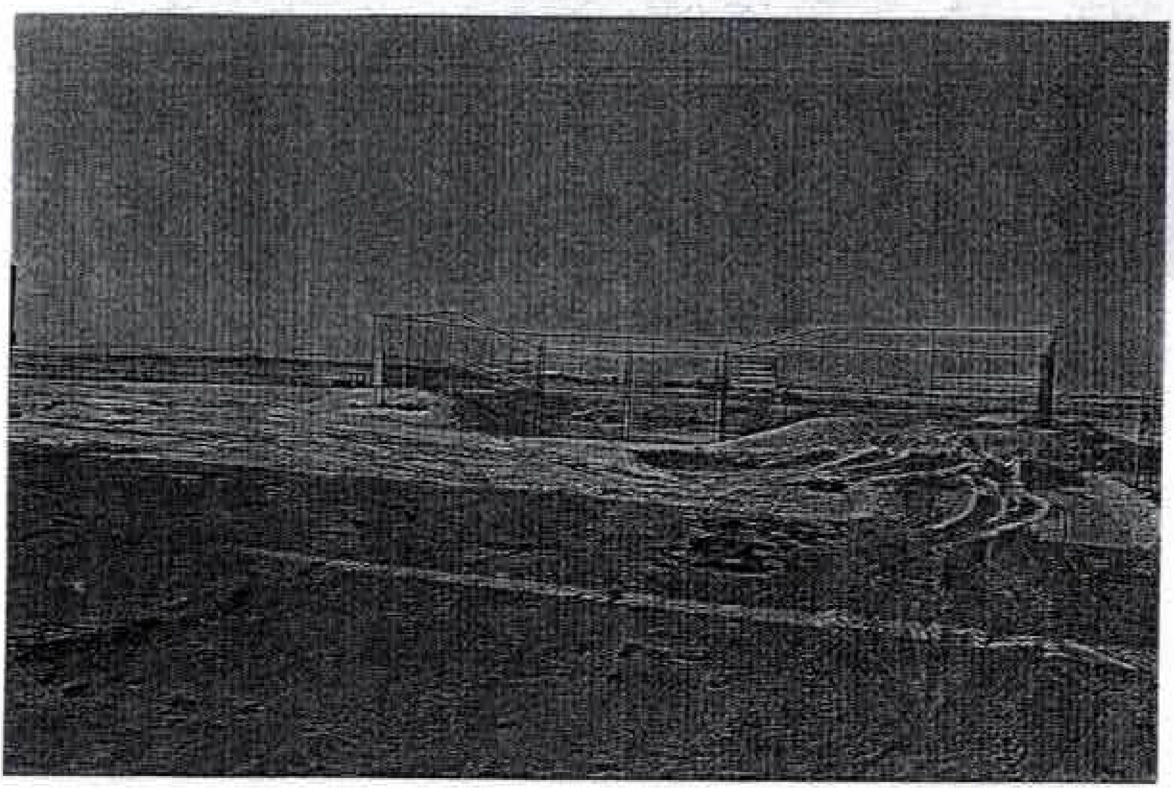
ONSITE PROCESSING

PAST/PRESENT/FUTURE DATA TO ESTABLISH TRENDS

TRANSFER STATION		Iron Springs
LOCATION	•	SW-27-11-20-W4M
CAPACITY OF STATION		
FREQUENCY OF HAUL		
DESTINATION OF LANDFILL	•	Lethbridge Regional Sanitary Landfill
TYPE	•	Compaction
OWNERSHIP	•	Lethbridge Regional Waste Commission
LEVEL OF SERVICE (hours of operation)	•	Supervised, Locked fence Thursday, Friday 10:00-6:00 pm Saturday, 2:00-4:00 pm
RECYCLING, COMPOSTING, HAZARDOUS (separation of wastes)	•	Rubble, scrap metal, pesticide, wood waste, tires
POPULATION SERVED	•	Iron Springs & surrounding rural area
GEOGRAPHIC BOUNDARIES		
CONTAINMENT/STORAGE	•	Pesticide containers



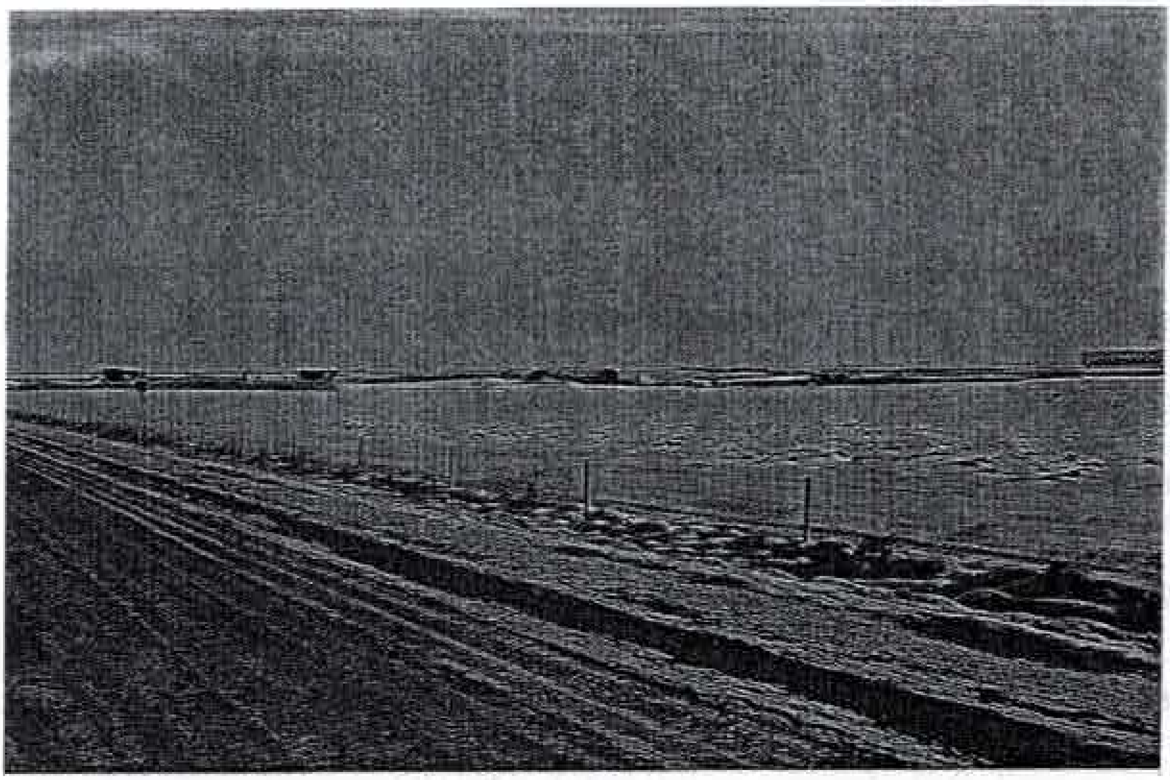
DRY DISPOSAL SITE (Background)



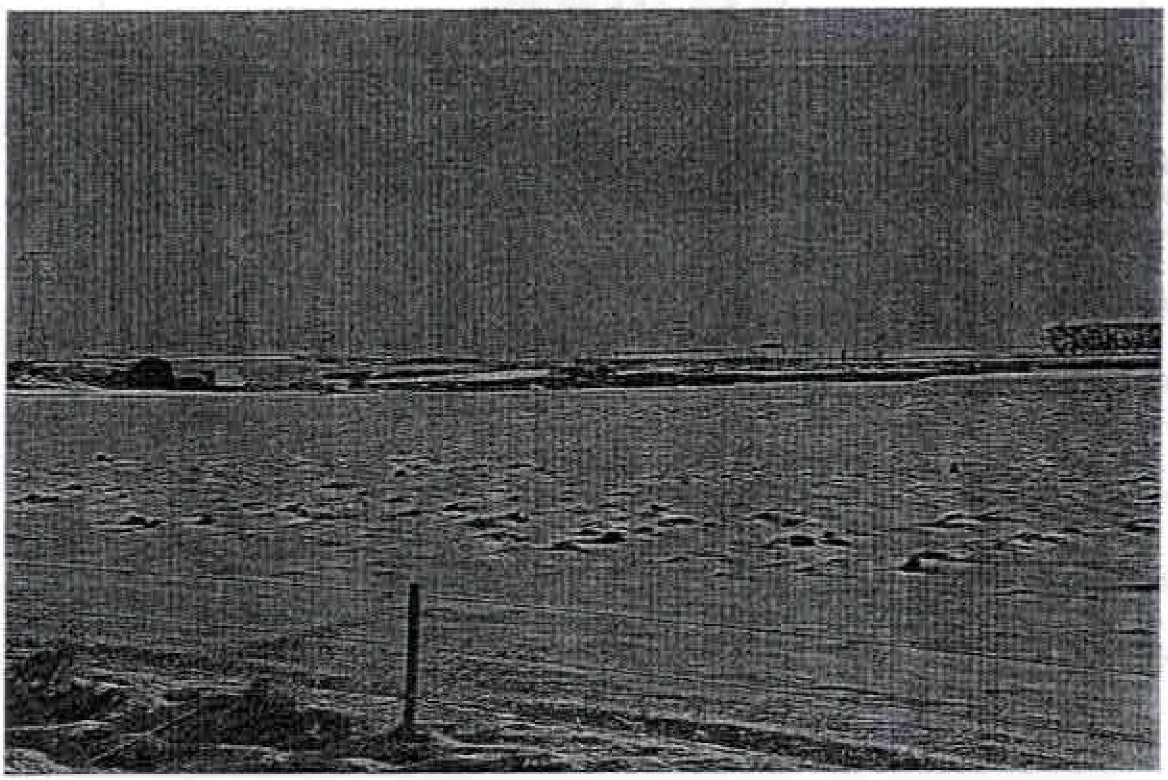
PESTICIDES STORAGE AREA

TRANSFER STATION		Jefferson
LOCATION	•	SW6-2-23-W4M
CAPACITY OF STATION		
FREQUENCY OF HAUL		
DESTINATION OF LANDFILL	•	Lethbridge Regional Sanitary Landfill
TYPE	•	Push Pit
OWNERSHIP	•	Chief Mountain Regional Waste Authority
LEVEL OF SERVICE (hours of operation)	•	Wednesday 10-4:30 - Supervised
RECYCLING, COMPOSTING, HAZARDOUS (separation of wastes)	•	Pesticide Containers
POPULATION SERVED	•	Rural area
GEOGRAPHIC BOUNDARIES		
CONTAINMENT/STORAGE	•	Pesticide Container

LANDFILLS	Lethbridge Regional Sanitary Landfill	
QUANTITIES	• Not available	
TYPE	• Sanitary Landfill	
LOCATION	• SW-4-10-21-W4	
OPERATION PROCEDURES (frequency of cover, burn, etc.)		
PERMIT CONDITIONS	• Liquid restriction (5%) • Contaminated dirt	• Not allowed to burn • Asbestos disposal
OWNERSHIP	• Kedon Waste Services Ltd.	
TYPES OF WASTES ACCEPTED	• Municipal Solid Waste	
LEVEL OF SERVICE (hours of operation)	• 7:30 - 5:30 Monday to Saturday	
ESTIMATED LIFE		
OTHER SERVICES PROGRAMS (separation of wastes)	• scrap metal • white goods	• tires • pesticide containers
EXPANSION PLANS		
"OUTSIDE" WASTES ACCEPTED		
POPULATION SERVED	• City of Lethbridge • Lethbridge Regional Waste Commission • Chief Mountain Waste Authority • Town of Coaldale • Village of Barons • Village of Coalhurst	



GENERAL VIEW



GENERAL VIEW

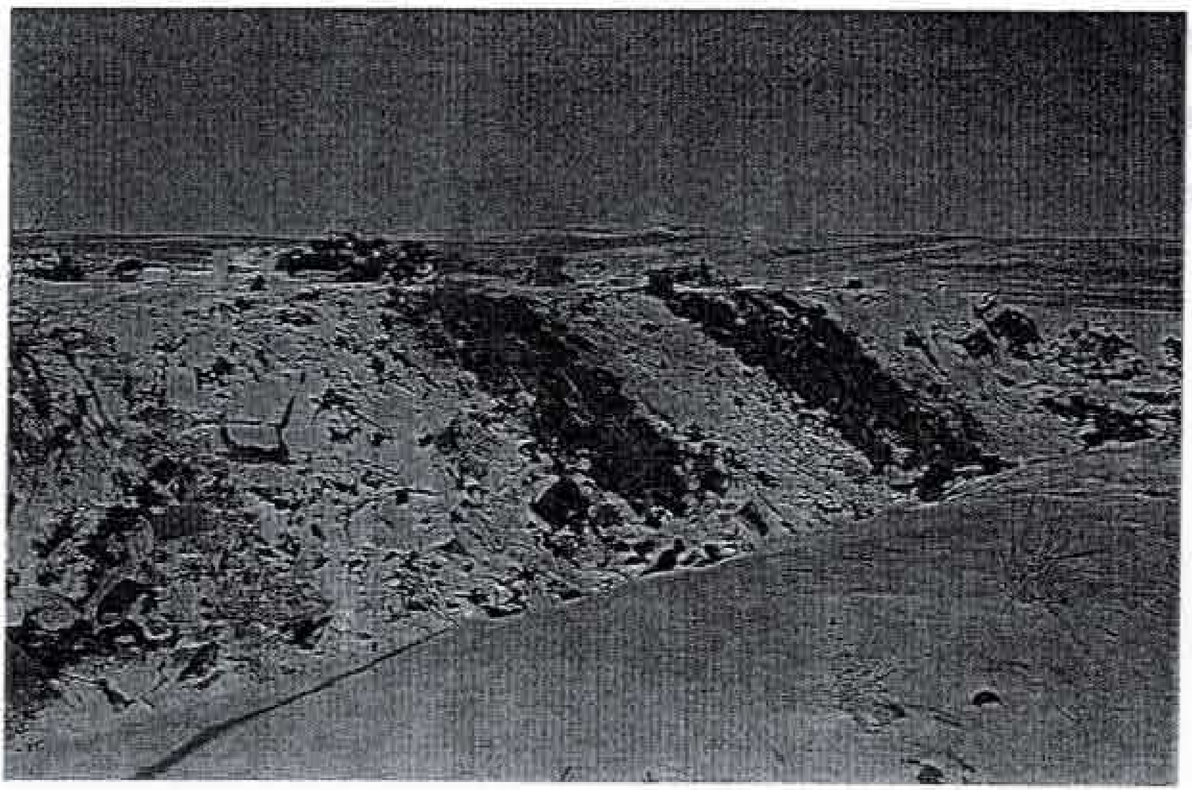
OPERATING COSTS

CONTAINMENT/STORAGE • Pesticide containers

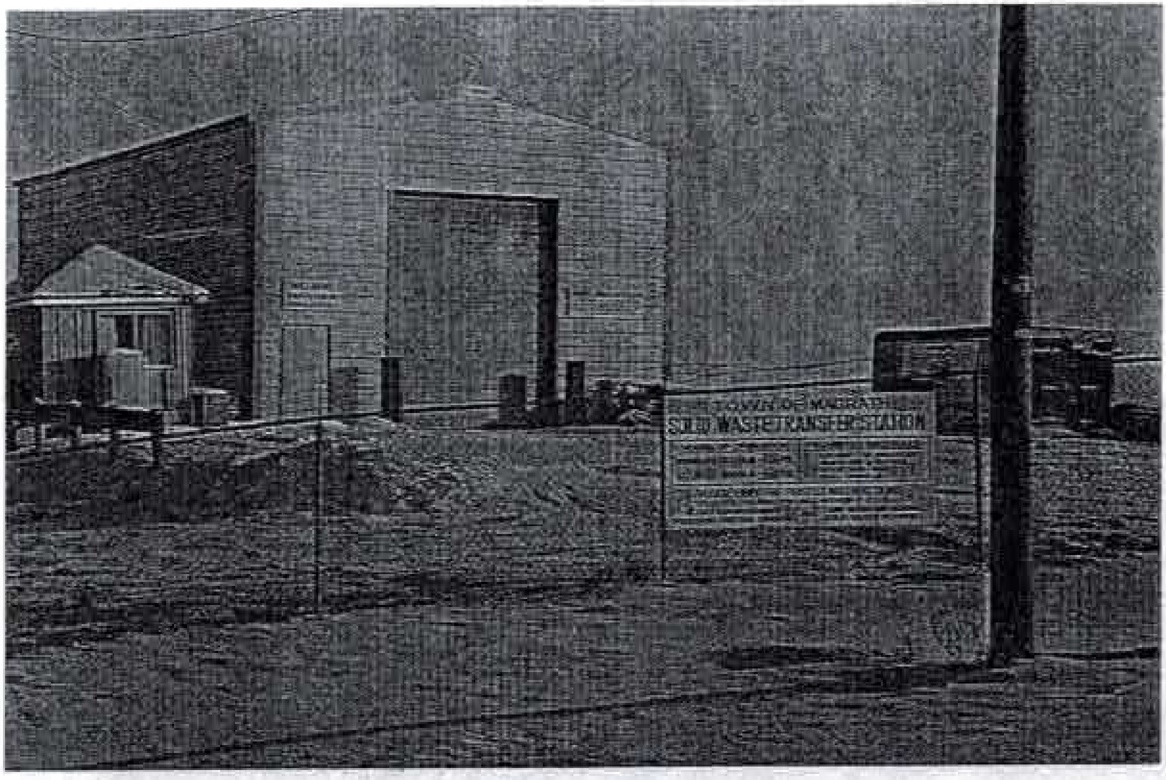
ONSITE PROCESSING

PAST/PRESENT/FUTURE DATA TO ESTABLISH TRENDS

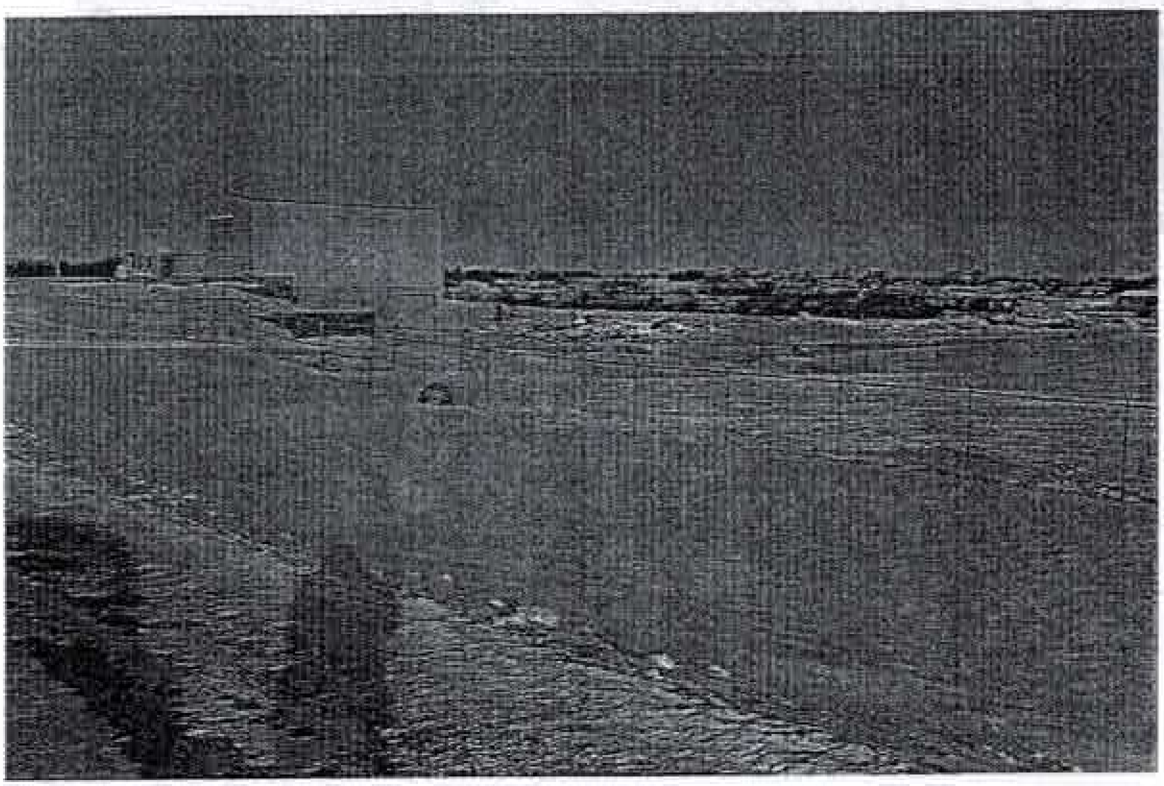
BURNING WASTES IN PIT



BURNING WASTES IN PIT

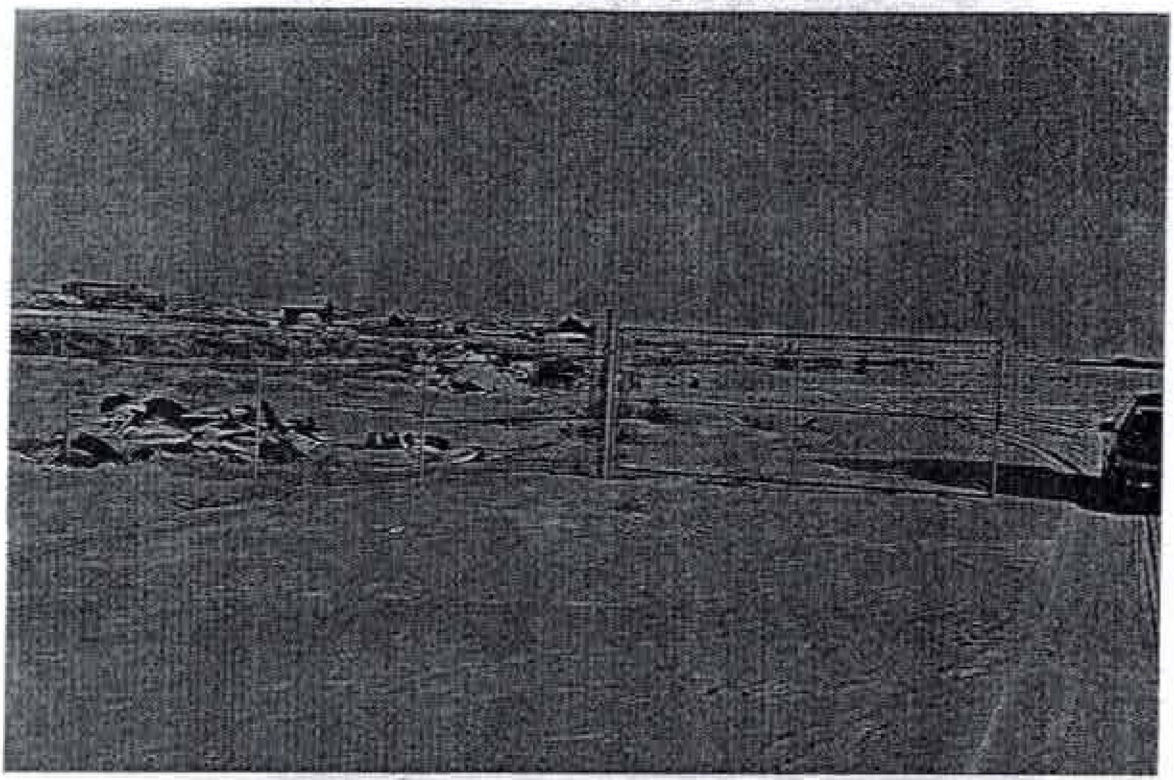


PAPER BIN (Right)

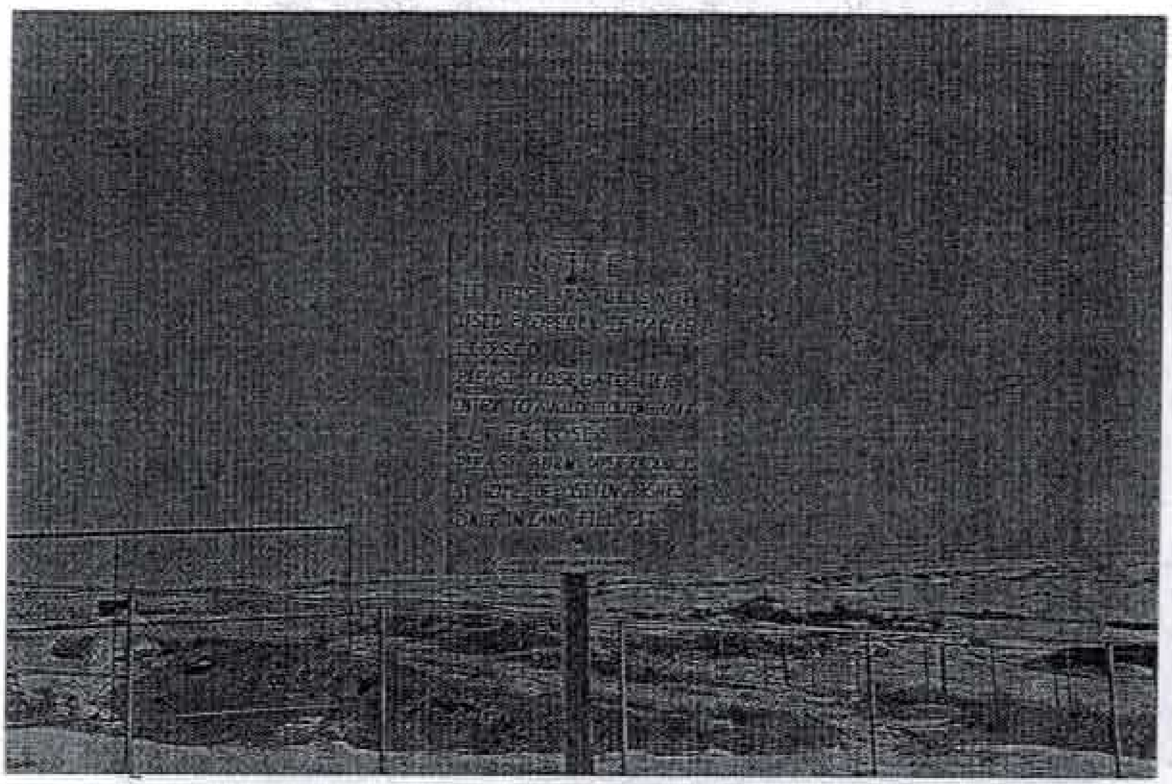


METALS AND WHITE GOODS PILE (Center)

LANDFILLS	Manyberries
QUANTITIES	• No scale
TYPE	• Modified Sanitary Landfill
LOCATION	• SW-24-05-06-W4M
OPERATION PROCEDURES (frequency of cover, burn, etc.)	• No dumping of asphalt or tar roofing
PERMIT CONDITIONS	• No permit
OWNERSHIP	• County of Forty Mile
TYPES OF WASTES ACCEPTED	• Municipal Solid Waste
LEVEL OF SERVICE (hours of operation)	• No supervision, 24 hr access
ESTIMATED LIFE	
OTHER SERVICES PROGRAMS (separation of wastes)	• pesticide containers • concrete/rubble • car bodies • metals
EXPANSION PLANS	
"OUTSIDE" WASTES ACCEPTED	
POPULATION SERVED	• Hamlet of Manyberries & surrounding rural residents
GEOGRAPHIC BOUNDARIES	
CAPITAL COSTS	



ENTRANCE GATE TIRES PILE (Left)



INFORMATION SIGN AT THE ENTRANCE

PERISHABLE WASTES PIT

TRANSFER STATION Welling

LOCATION • NE-20-6-21-W4M

CAPACITY OF STATION

FREQUENCY OF HAUL

DESTINATION OF LANDFILL

TYPE • Push Pit

OWNERSHIP • Authority

LEVEL OF SERVICE (hours of operation) • Saturday 10-4:30, Supervised unlocked

RECYCLING, COMPOSTING, HAZARDOUS (separation of wastes)
• White goods to disposal sites at Cardston, Magrath, Glenwood/Hill Spring

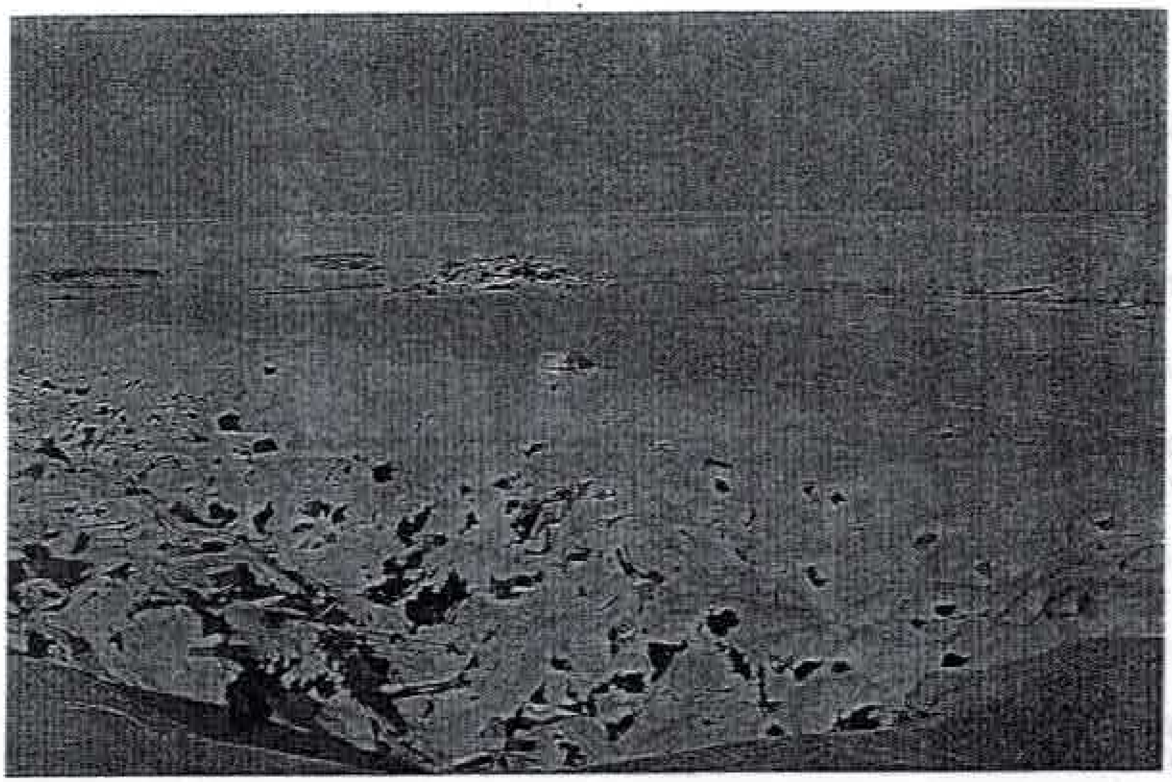
POPULATION SERVED

GEOGRAPHIC BOUNDARIES

CONTAINMENT/STORAGE • Pesticide Containers, Chainlink enclosure

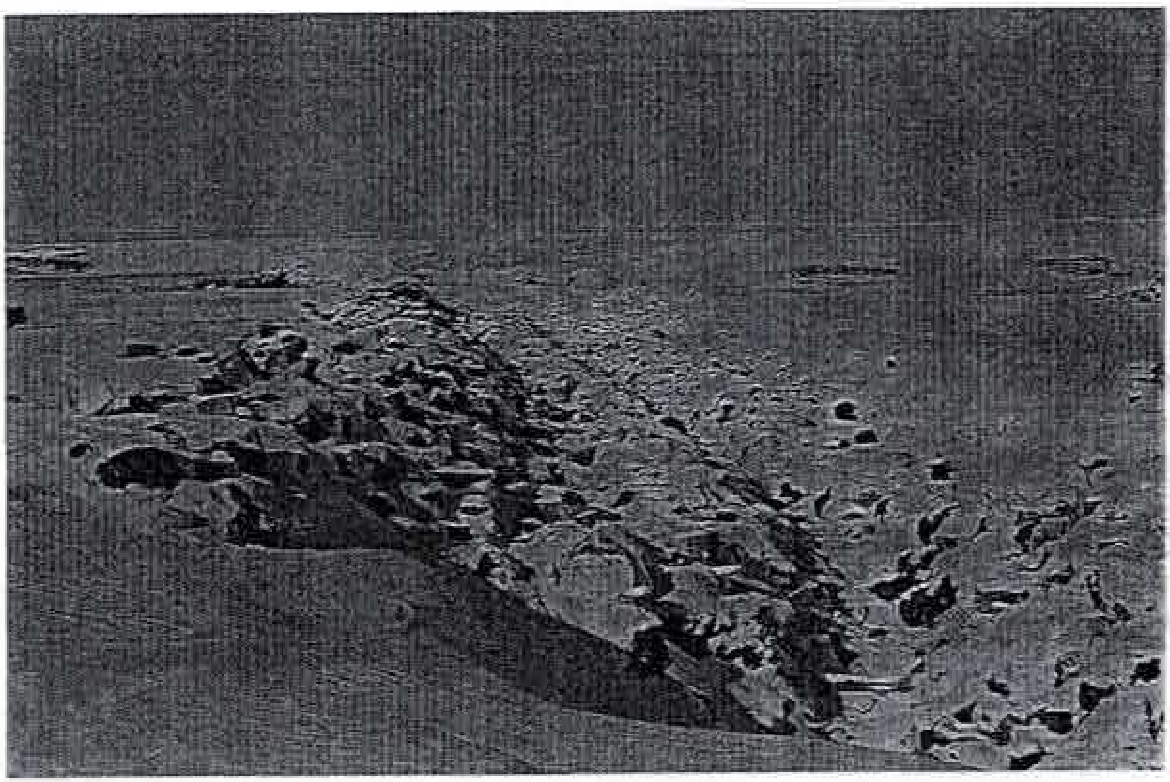
LANDFILLS	Milk River
QUANTITIES	• No scale • Approximately 30 yds/day
TYPE	• Modified Sanitary Landfill
LOCATION	• NW 1/4 22-3-16-W4M
OPERATION PROCEDURES (frequency of cover, burn, etc.)	• Open pit • Burn permits issued
PERMIT CONDITIONS	• Permit No. W0148
OWNERSHIP	• Town of Milk River
TYPES OF WASTES ACCEPTED	• Municipal Solid Waste
LEVEL OF SERVICE (hours of operation)	• Winter - Wednesday 1-3, Saturday 1-3 • Summer - Wednesday 1-4, Saturday 10-12, 1-4
ESTIMATED LIFE	• 2 years
OTHER SERVICES PROGRAMS (separation of wastes)	• Tires, metals
EXPANSION PLANS	• To build a transfer station
"OUTSIDE" WASTES ACCEPTED	
POPULATION SERVED	• Milk River residents only
GEOGRAPHIC BOUNDARIES	• Milk River residents only
CAPITAL COSTS	• Loader & pickup truck

ENTRANCE GATE WITH LANDFILL BUILDING



METALS AND WHITE GOODS PILE (Background)

HOUSEHOLD PIT (Foreground)



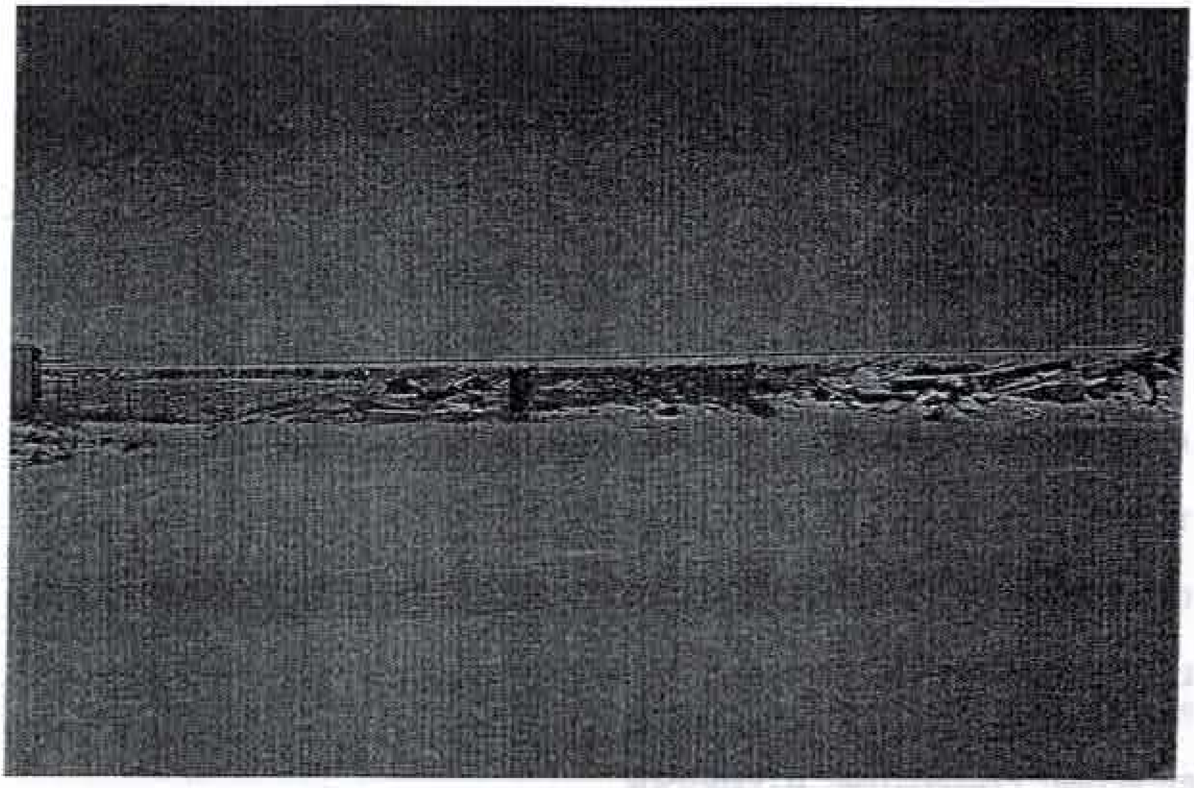
HOUSEHOLD WASTE PIT

OPERATING COSTS

CONTAINMENT/STORAGE • Pesticide containers

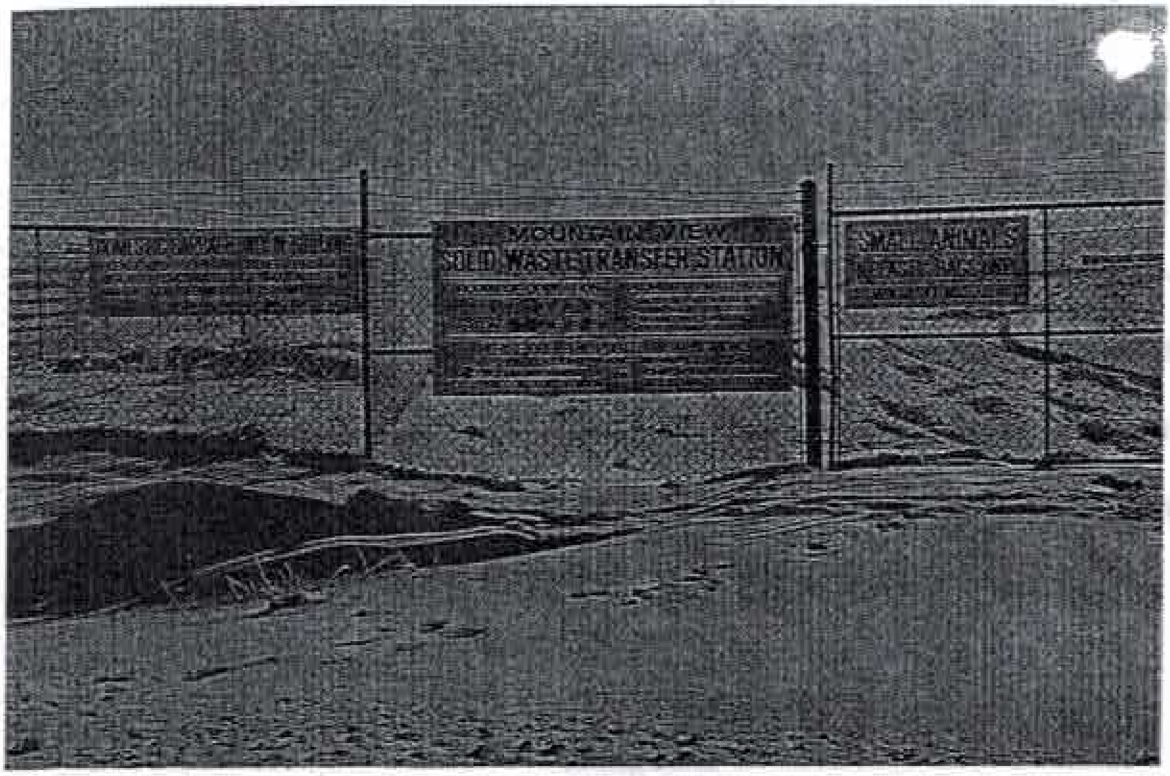
ONSITE PROCESSING

PAST/PRESENT/FUTURE DATA TO ESTABLISH TRENDS

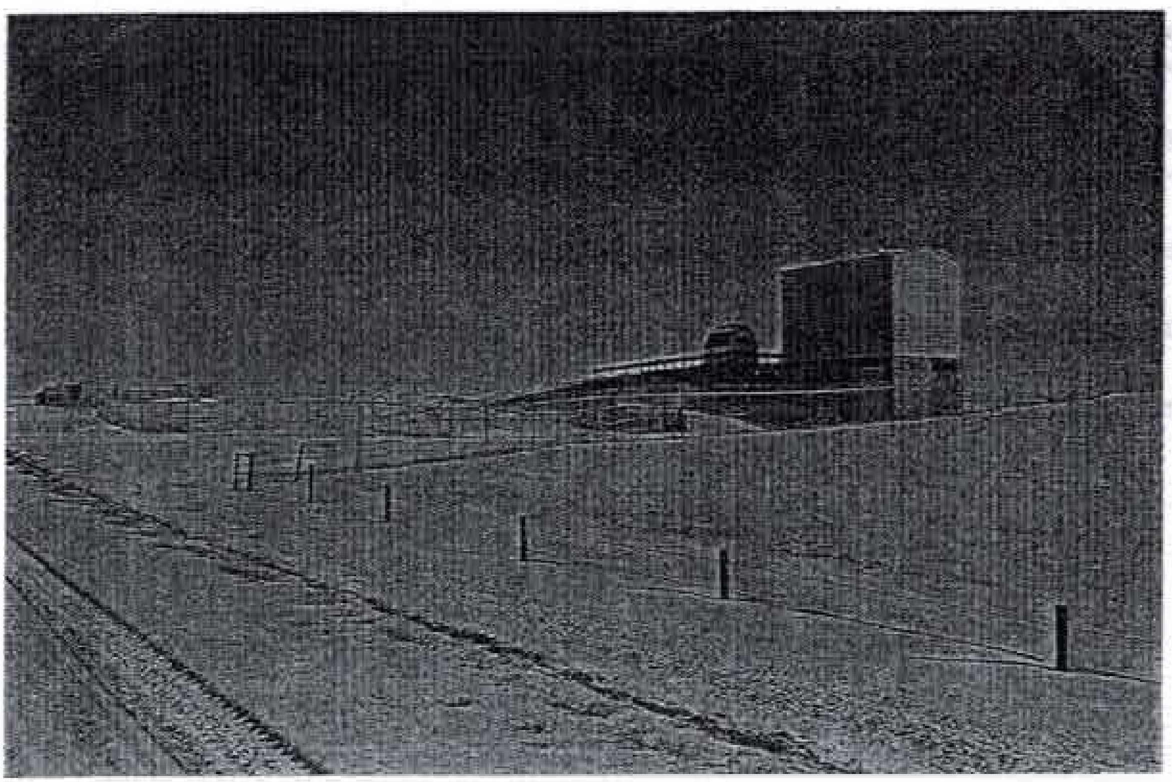


PESTICIDE CONTAINERS STORAGE

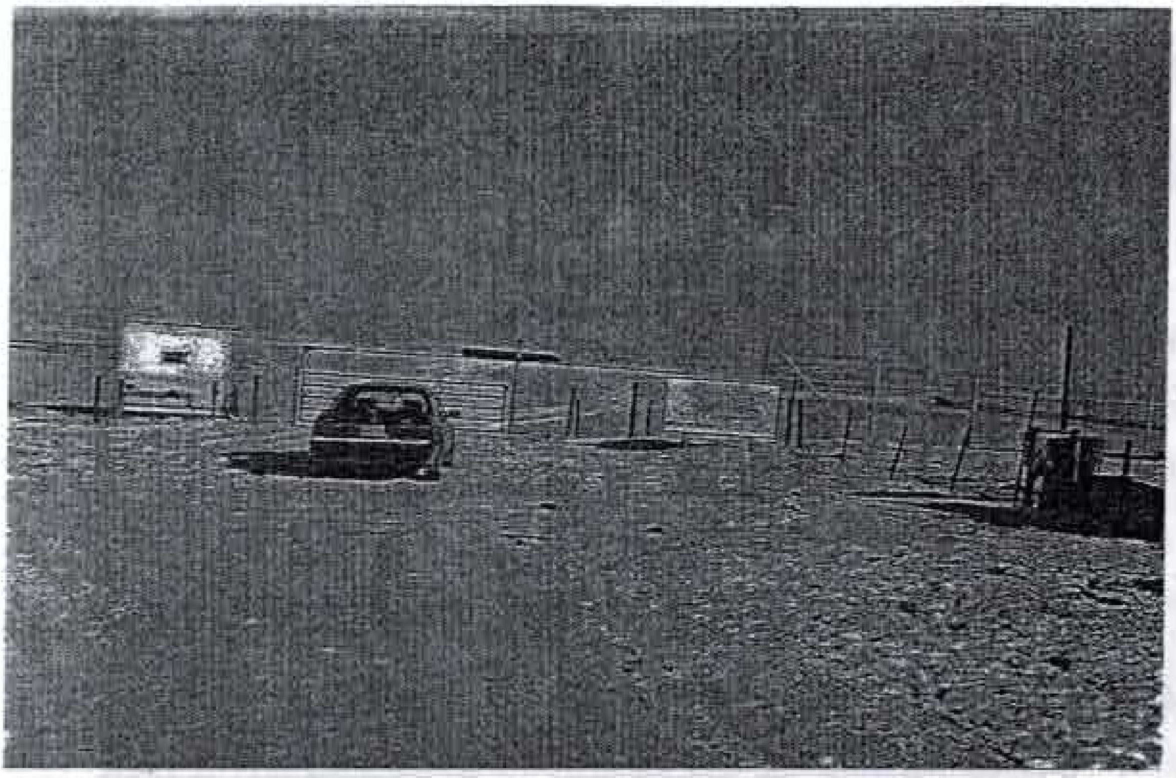
DOMESTIC WASTE PIT



ENTRANCE GATE WITH INFORMATION SIGNS



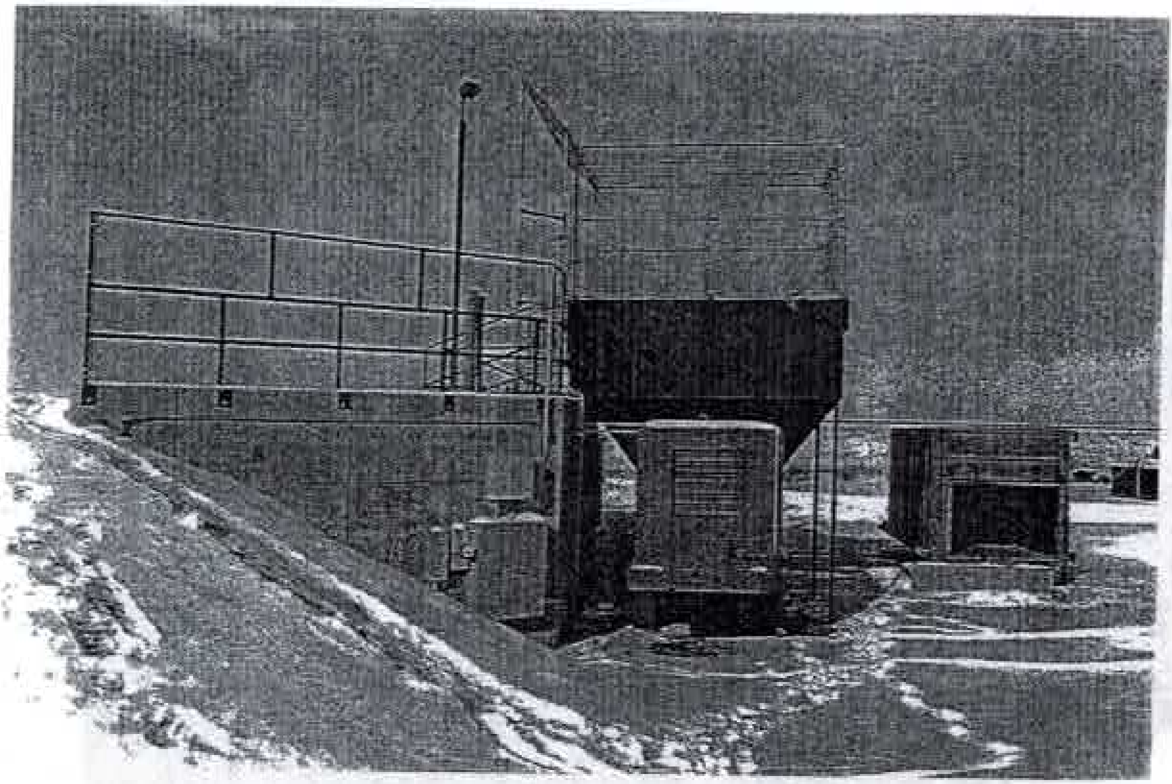
STATION BUILDING AND RAMP (Right)
PESTICIDES AREA (Background Left)



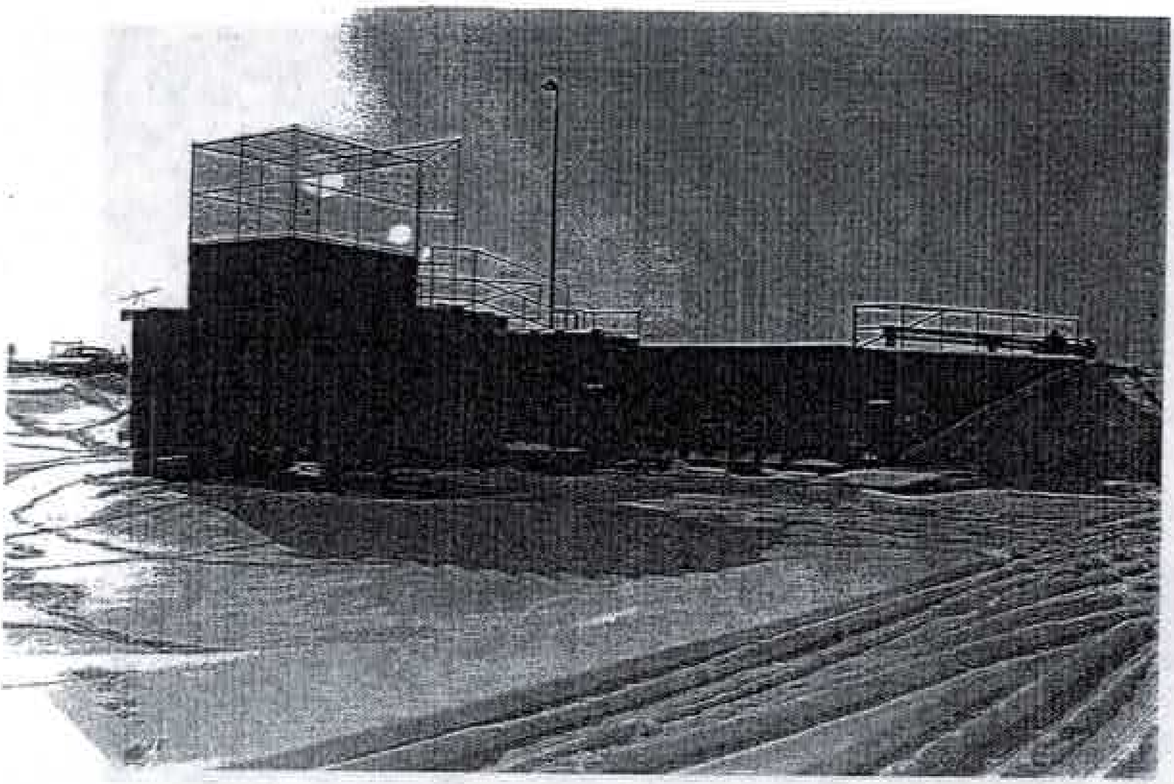
ENTRANCE GATE WITH TRAILER

INFORMATION SIGN AT THE ENTRANCE

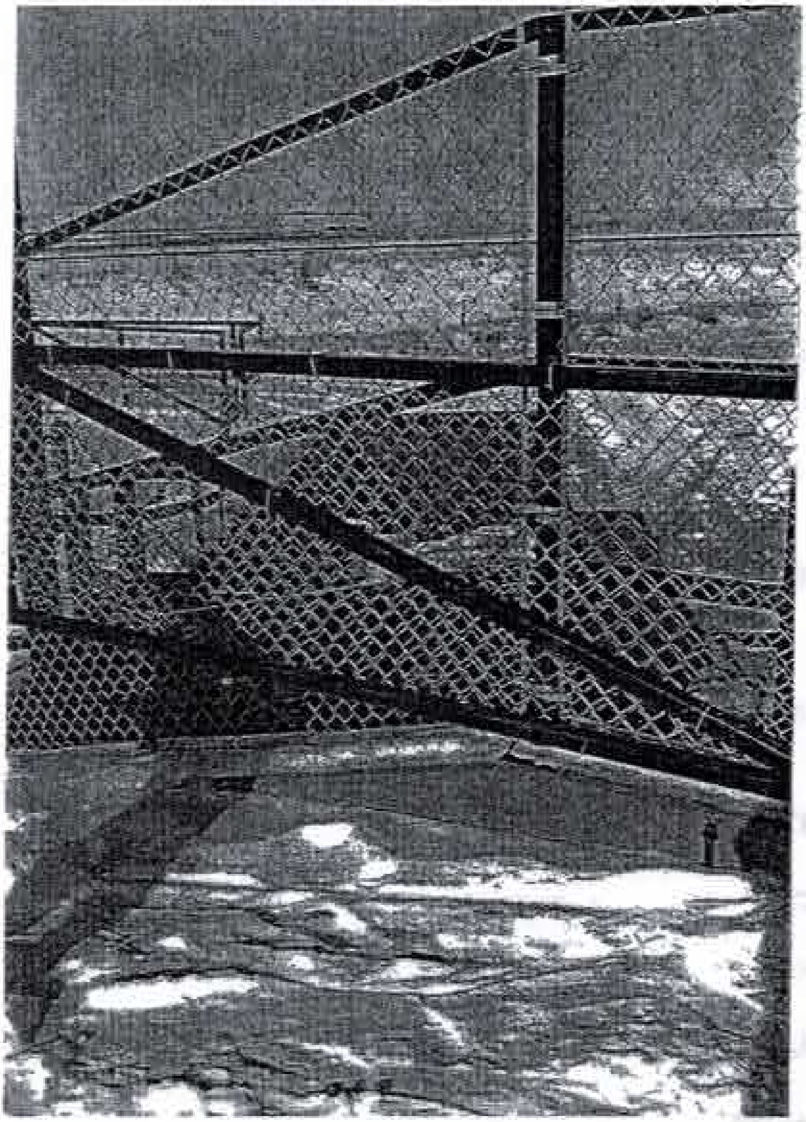
TRANSFER STATION		Nobleford
LOCATION	•	SE-10-11-23-W4
CAPACITY OF STATION		
FREQUENCY OF HAUL		
DESTINATION OF LANDFILL	•	Lethbridge Regional Sanitary Landfill
TYPE	•	Compaction
OWNERSHIP	•	Lethbridge Regional Waste Commission
LEVEL OF SERVICE (hours of operation)	•	Thursday, Friday 10:00-6:00 pm, Supervised Saturday 2:00-6:00 pm, Supervised
RECYCLING, COMPOSTING, HAZARDOUS (separation of wastes)	•	Wood, metals, chemicals, industrial oil, batteries, lawnmowers
POPULATION SERVED	•	Town of Nobleford & surrounding rural area
GEOGRAPHIC BOUNDARIES	•	Town of Nobleford & surrounding area
CONTAINMENT/STORAGE	•	Pesticide containers



CAGED COMPACTION BIN
SPARE BIN (Right)



REAR VIEW OF COMPACTION SYSTEM



WOOD BIN

CAPITAL COSTS

OPERATING COSTS

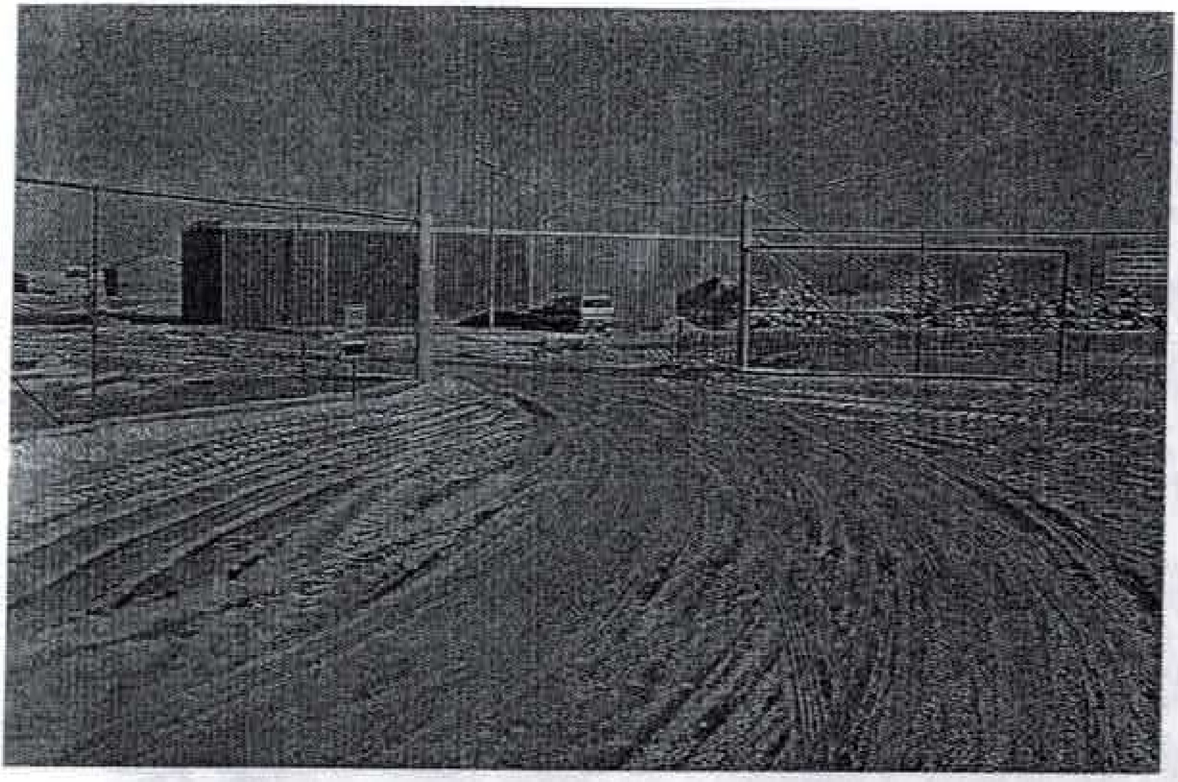
CONTAINMENT/STORAGE

ONSITE PROCESSING • Some

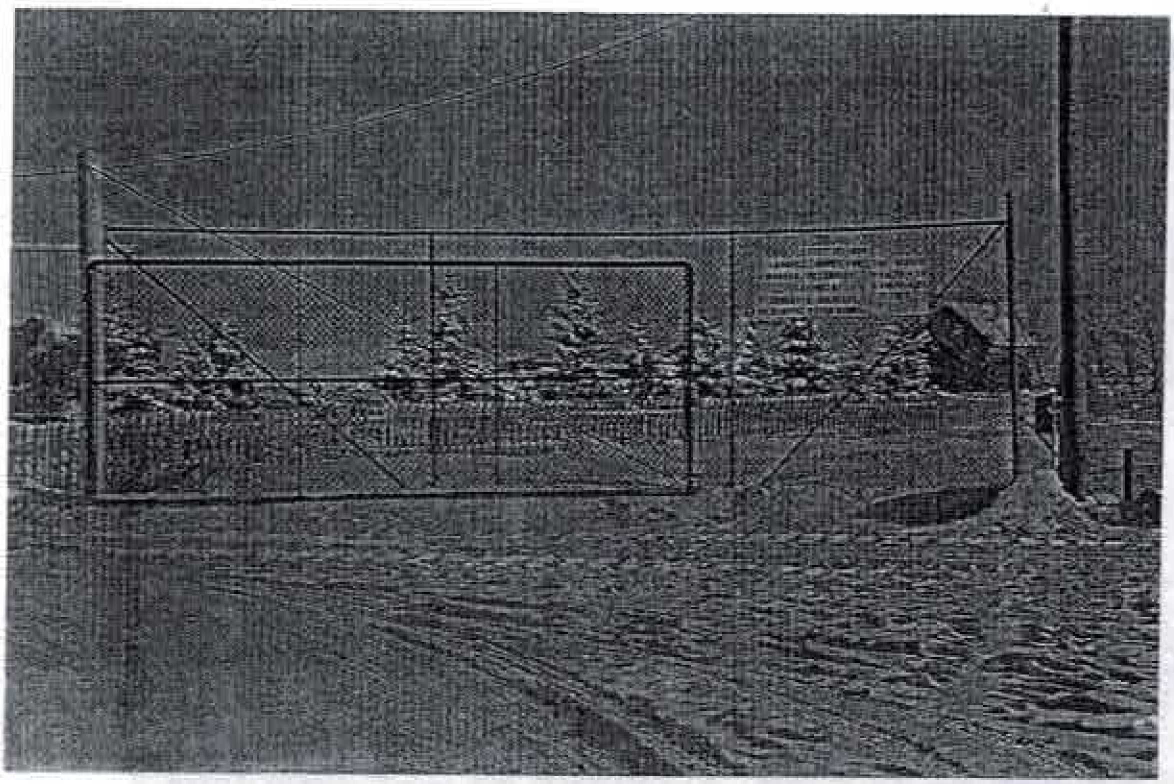
PAST/PRESENT/FUTURE DATA TO ESTABLISH TRENDS

TRANSFER STATION		Picture Butte
LOCATION	•	NW-23-11-21-W4
CAPACITY OF STATION		
FREQUENCY OF HAUL		
DESTINATION OF LANDFILL	•	Lethbridge Regional Sanitary Landfill
TYPE	•	Compaction
OWNERSHIP	•	Lethbridge Regional Waste Commission
LEVEL OF SERVICE (hours of operation)	•	Tuesday, Wednesday 10-6, Saturday 8:30-12:30 pm Supervised locked
RECYCLING, COMPOSTING, HAZARDOUS (separation of wastes)	•	Tires, scrap metal, used oil
POPULATION SERVED	•	Town of Picture Butte & surrounding rural residents
GEOGRAPHIC BOUNDARIES		
CONTAINMENT/STORAGE	•	Pesticide containers

LANDFILLS	Pincher Creek (Cowley Landfill)
QUANTITIES	• 30,158 tonnes (1992 • 12,299 tonnes (1990)
TYPE	• Sanitary Landfill
LOCATION	• W-8-7-1-W5M
OPERATION PROCEDURES (frequency of cover, burn, etc.)	• Pit compacted • Wind fences
PERMIT CONDITIONS	• Allowed to burn wood Permit under Chinook Health Unit
OWNERSHIP	M.D. 9 - Pincher Creek M.D. of Crowsnest Town of Pincher Creek
TYPES OF WASTES ACCEPTED	• Residential commercial non-hazardous (i.e., Hydrocarbon contaminant soil
LEVEL OF SERVICE (hours of operation)	• Winter, Mon-Sat, 9:00-4:30 Summer, Mon-Sun, 9:00-4:30 • Supervised - limited access
ESTIMATED LIFE	• Opened in 1976 - 80 years (1/2 section)
OTHER SERVICES PROGRAMS (separation of wastes)	• Tire, metals, white goods, pesticide containers, used oil tank, wood
EXPANSION PLANS	
"OUTSIDE" WASTES ACCEPTED	• Soon: Ft. MacLeod, Granum, 8 M.D. Willowcreek-possibilities
POPULATION SERVED	
GEOGRAPHIC BOUNDARIES	



ENTRANCE GATE. LANDFILL BUILDING (Background)

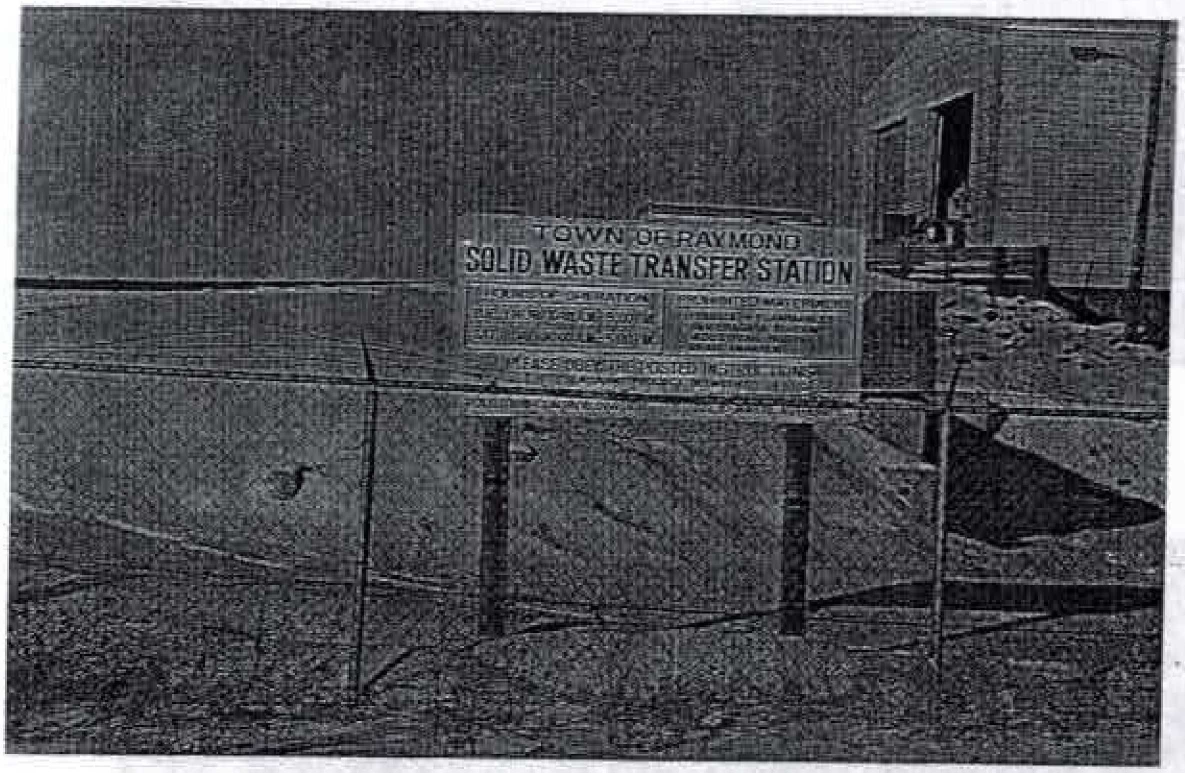


INFORMATION SIGN AT THE GATE

DOMESTIC WASTE PIT

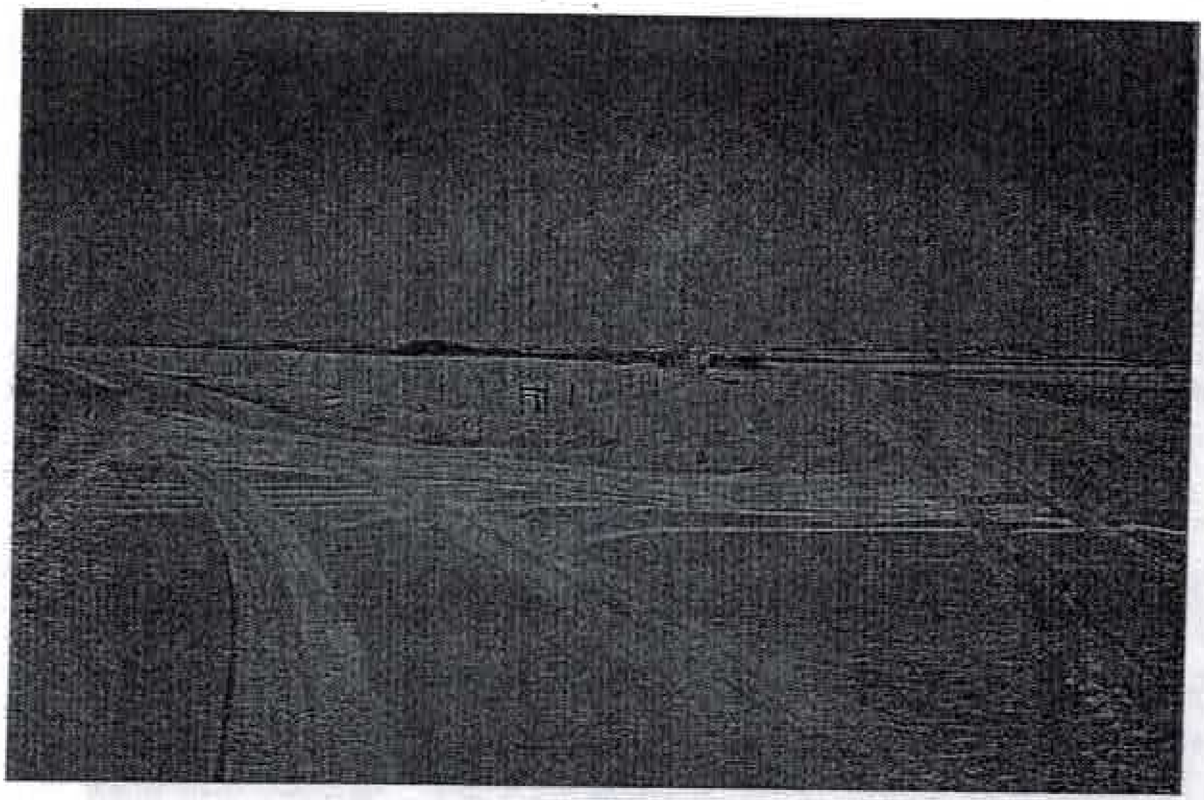
CONSTRUCTION AND METALS AREA

OPERATING COSTS	• Supervision costs
CONTAINMENT/STORAGE	• Pesticide containers
ONSITE PROCESSING	
PAST/PRESENT/FUTURE DATA TO ESTABLISH TRENDS	

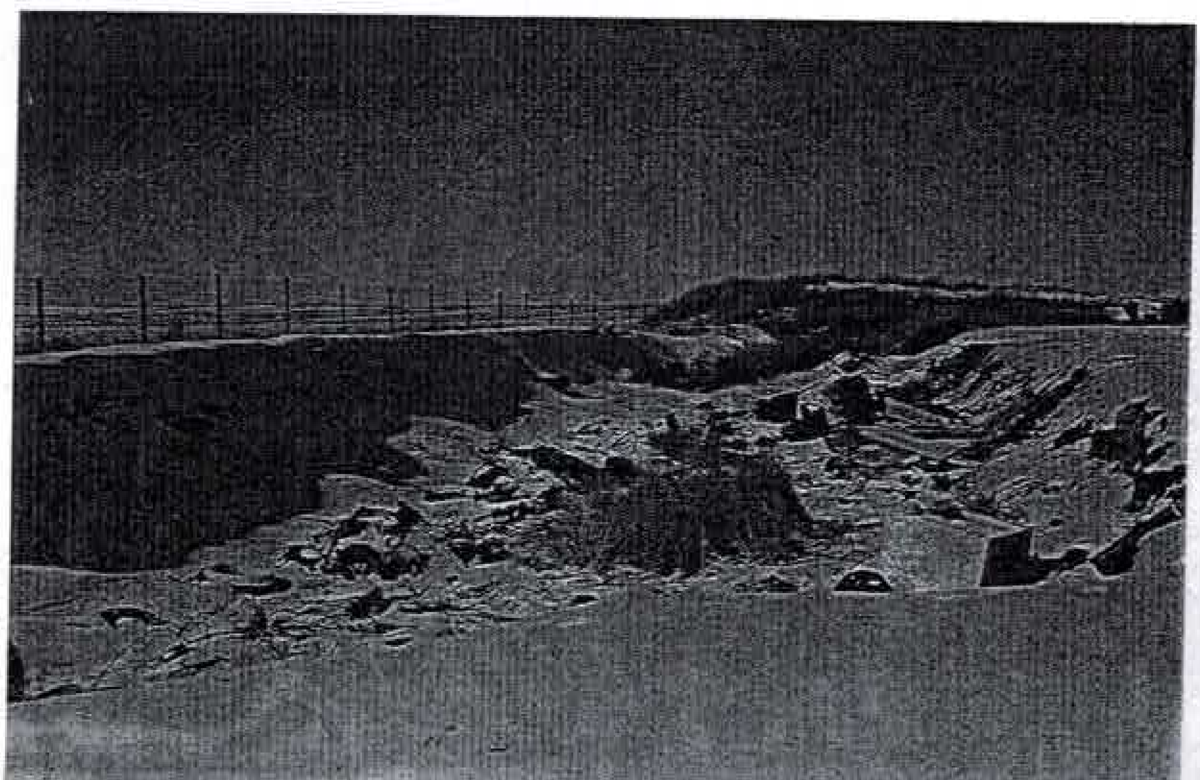


TRASFER STATION INFORMATION SIGN

LANDFILLS	Shouldice Landfill
QUANTITIES	• No scale
TYPE	• Modified Sanitary Landfill
LOCATION	• SE 1/4 22-20-22-W4M
OPERATION PROCEDURES (frequency of cover, burn, etc.)	
PERMIT CONDITIONS	• No known Permit - Approval from Health Unit
OWNERSHIP	• County Regional Waste Authority
TYPES OF WASTES ACCEPTED	• Municipal Solid Waste
LEVEL OF SERVICE (hours of operation)	• Locked gate, Wednesday 1-5, Friday 1-5
ESTIMATED LIFE	• Out of space - to be closed
OTHER SERVICES PROGRAMS (separation of wastes)	• metals
EXPANSION PLANS	
"OUTSIDE" WASTES ACCEPTED	
POPULATION SERVED	• Hamlet of Shouldice & surrounding County residents
GEOGRAPHIC BOUNDARIES	
CAPITAL COSTS	

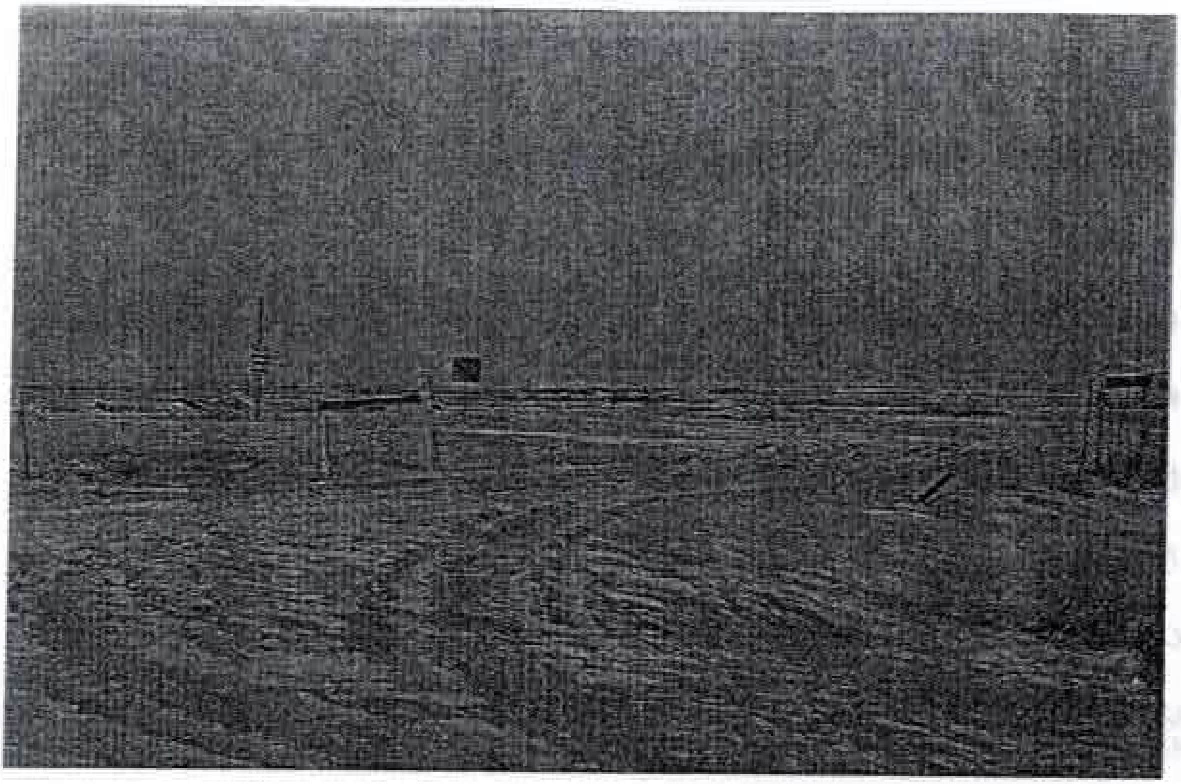


ACCESS ROAD

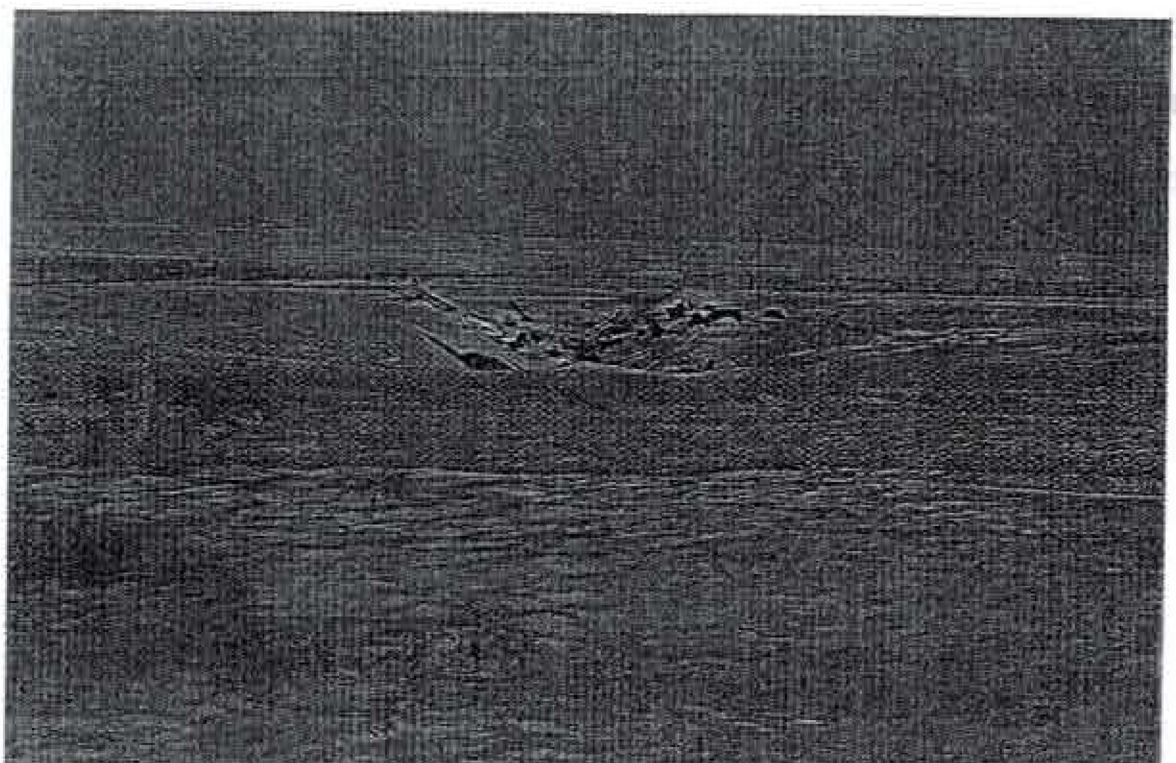


WASTES IN PIT

LANDFILLS	Skiff
QUANTITIES	• No Scale
TYPE	• Modified Sanitary Landfill
LOCATION	• LSD 05 SW-23-06-14-W4
OPERATION PROCEDURES (frequency of cover, burn, etc.)	• Cover when pit full
PERMIT CONDITIONS	• No Permit
OWNERSHIP	• County of Forty Mile
TYPES OF WASTES ACCEPTED	• Municipal Solid Waste
LEVEL OF SERVICE (hours of operation)	• Not Supervised, 24 hour access
ESTIMATED LIFE	
OTHER SERVICES PROGRAMS (separation of wastes)	• None
EXPANSION PLANS	
"OUTSIDE" WASTES ACCEPTED	
POPULATION SERVED	
GEOGRAPHIC BOUNDARIES	• 40 mile radius
CAPITAL COSTS	
OPERATING COSTS	

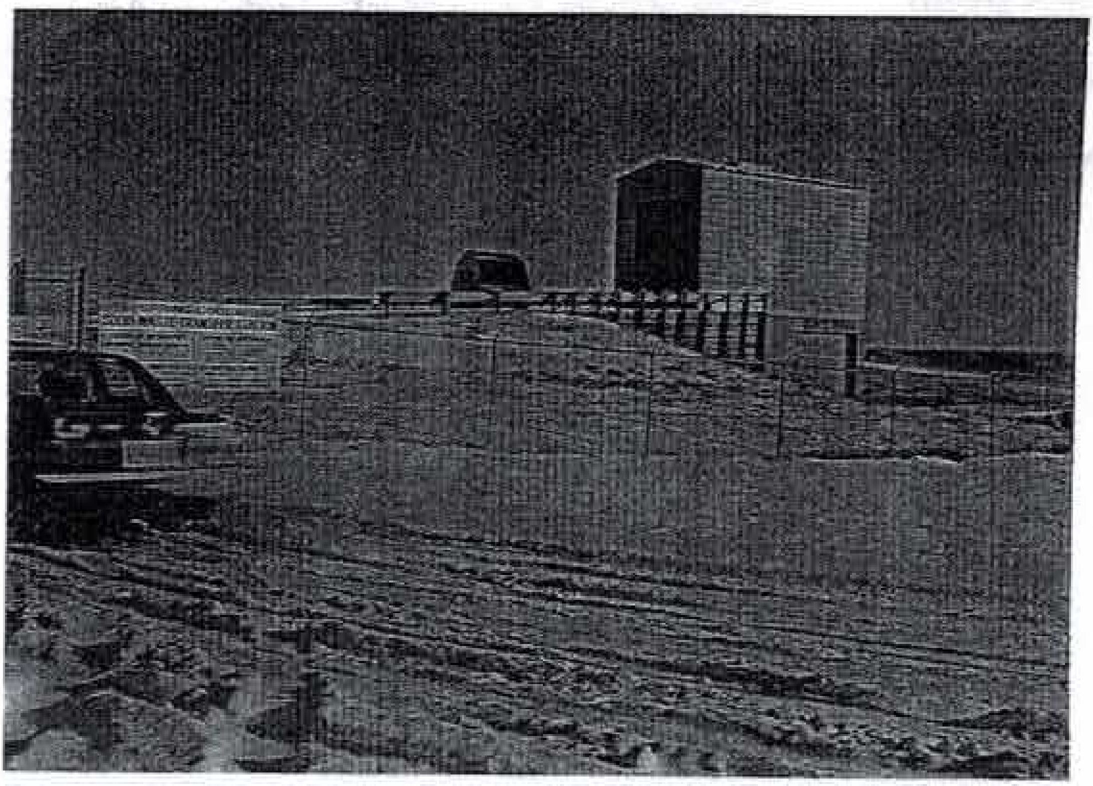


SITE ENTRANCE

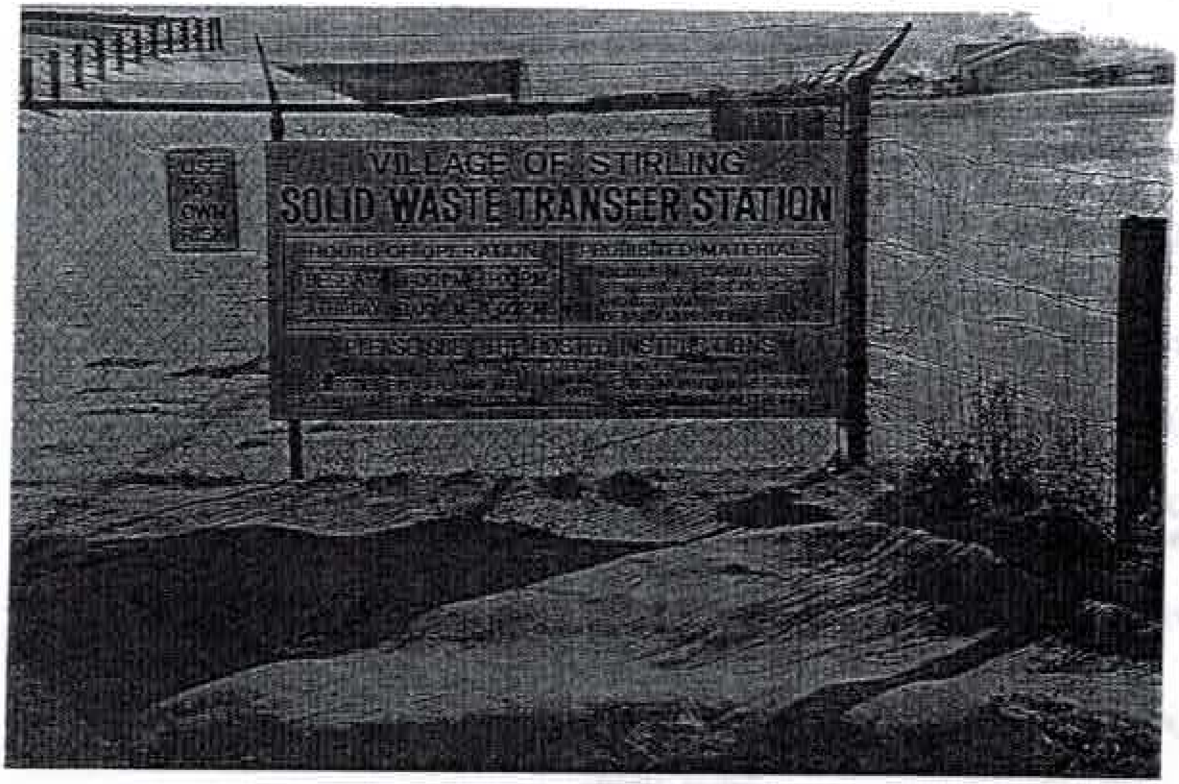


WASTE DISPOSAL PIT

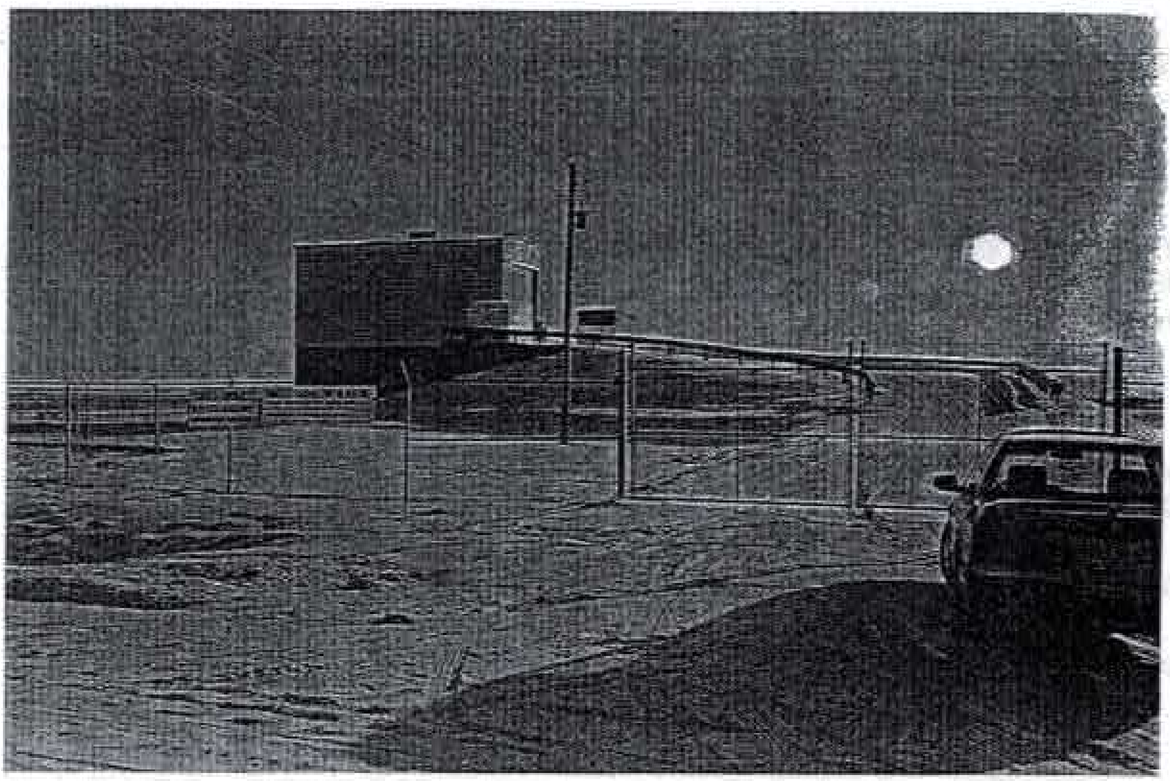
ENTRANCE GATE WITH INFORMATION SIGNS
PESTICIDES AREA (Back)



STATION BUILDING AND RAMP



INFORMATION SIGN AT THE ENTRANCE



GENERAL VIEW AT THE STATION

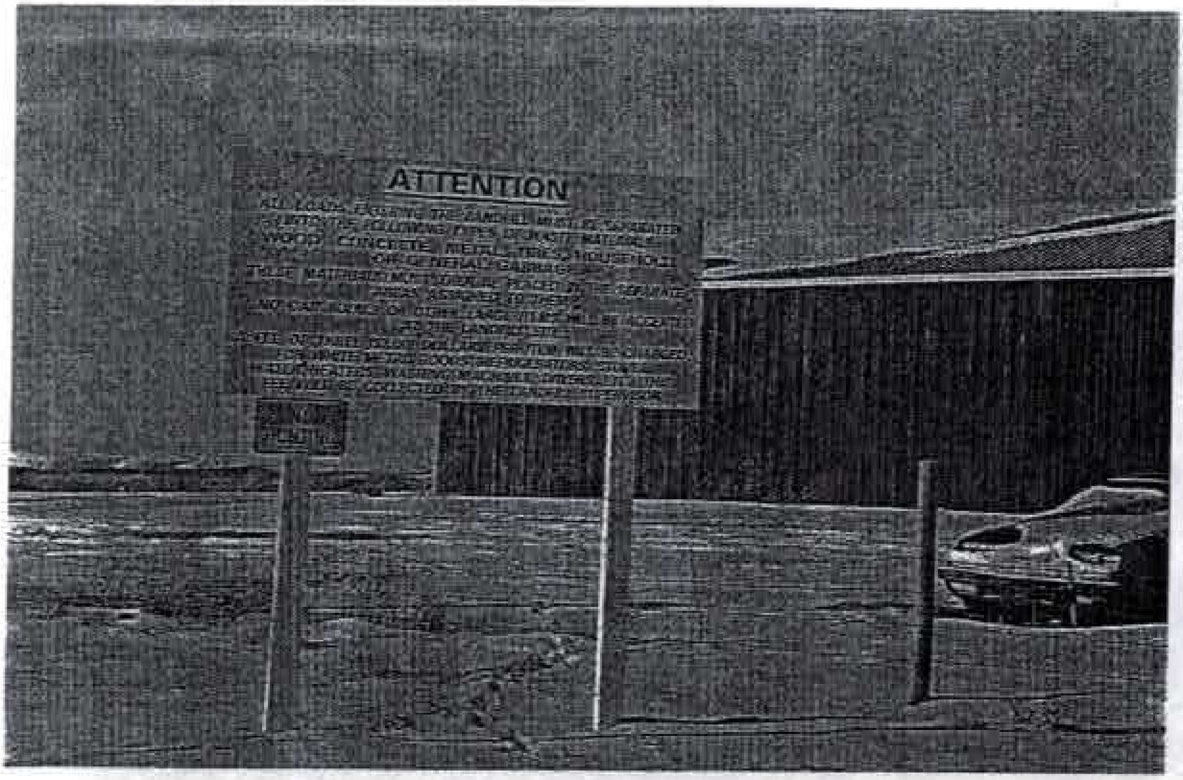
CAPITAL COSTS
- Equipment

OPERATING COSTS
- Labour

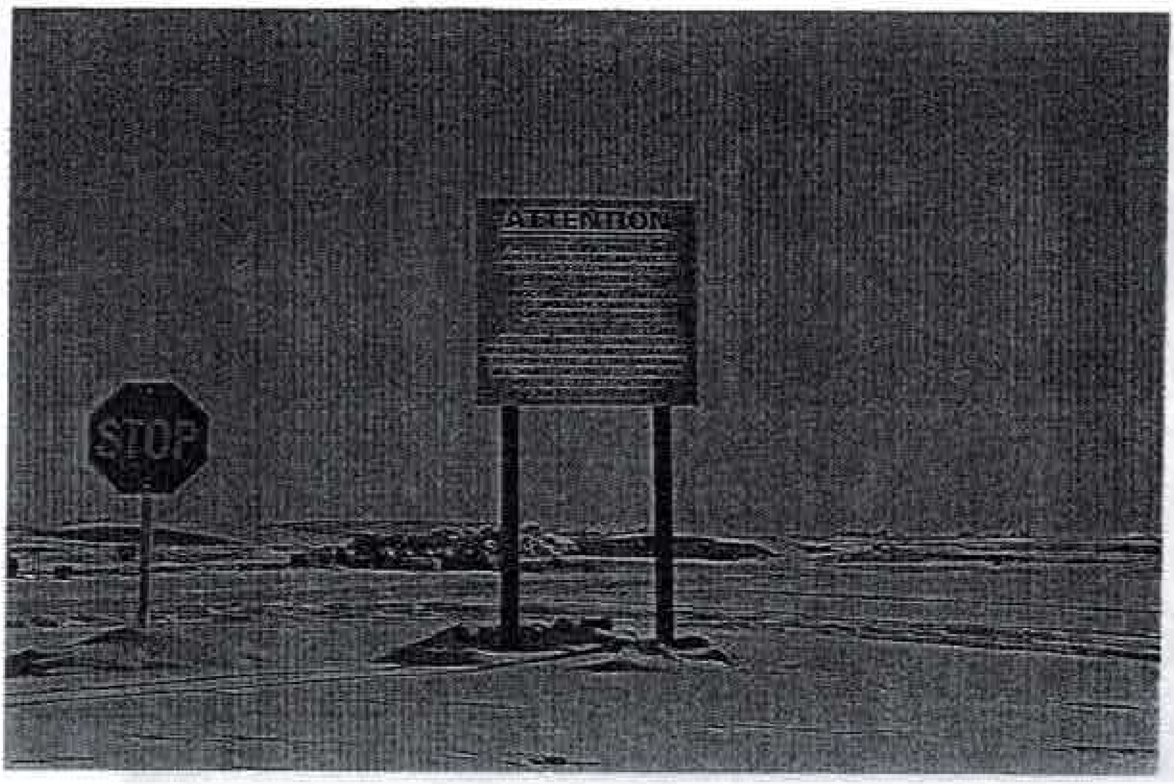
CONTAINMENT/STORAGE

ONSITE PROCESSING

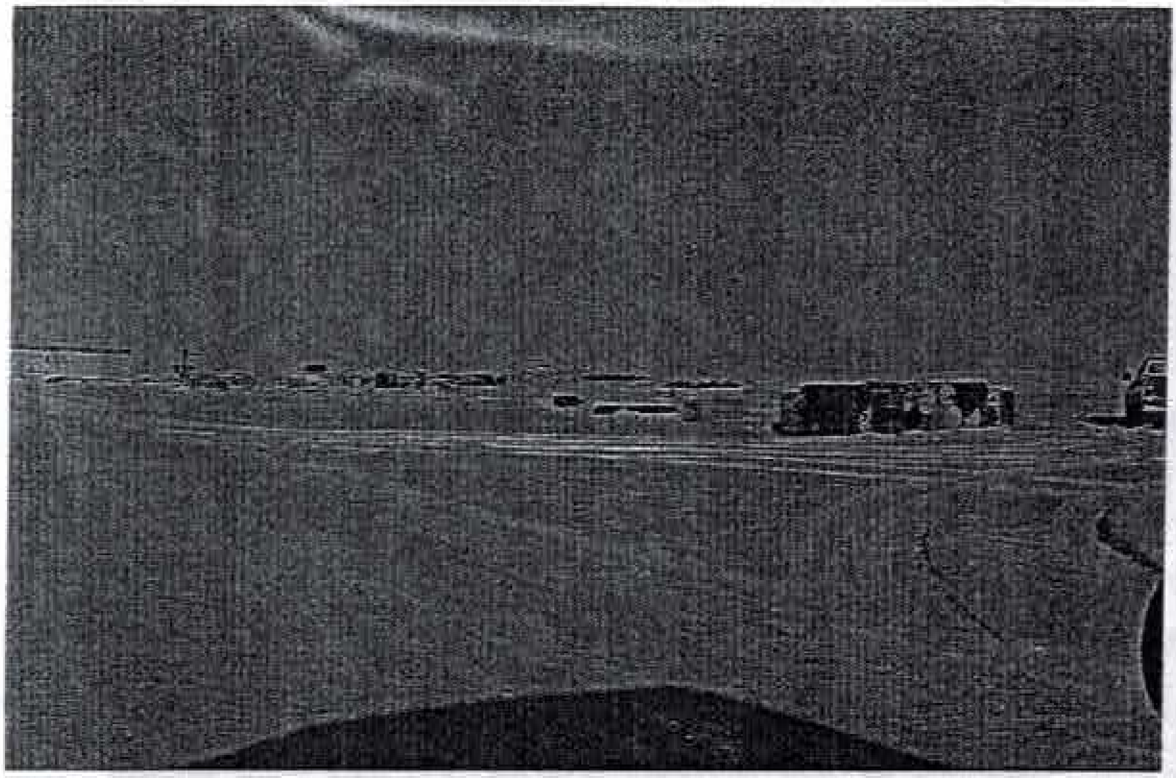
PAST/PRESENT/FUTURE DATA TO ESTABLISH TRENDS



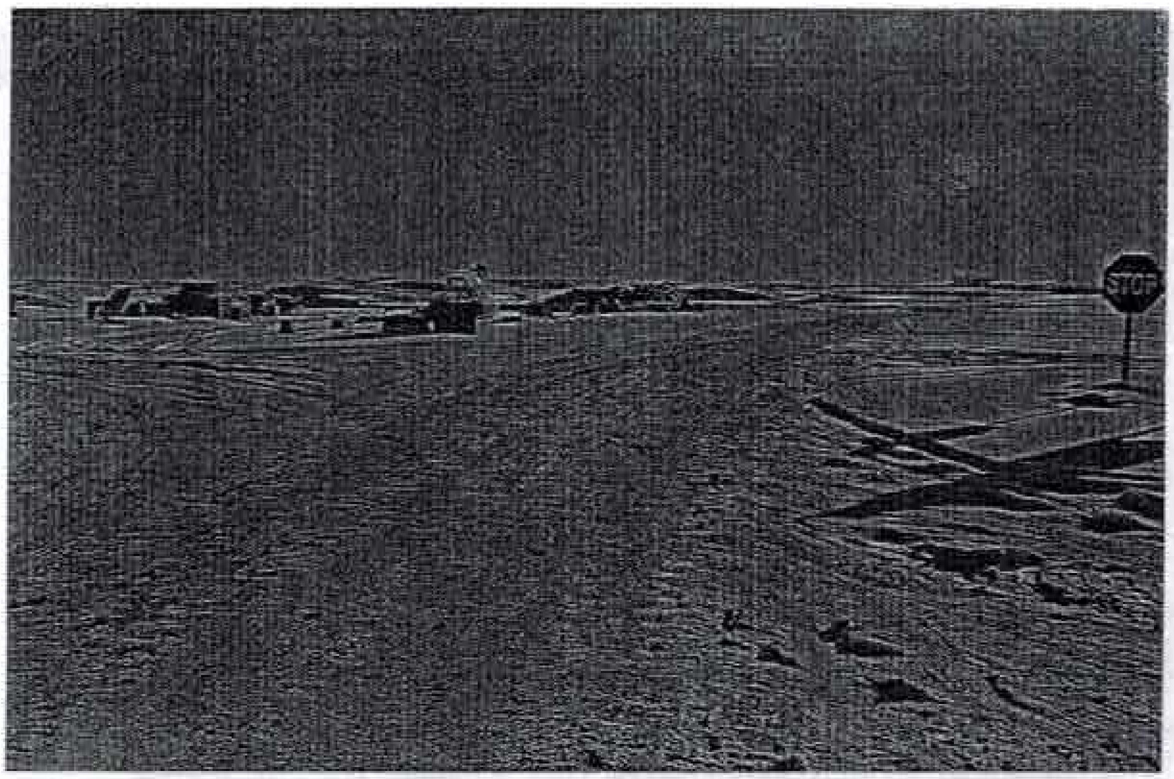
REGULATION SIGN



REGULATION SIGN



CLEARING HOUSE AREA. BARRELS PILE (Right)

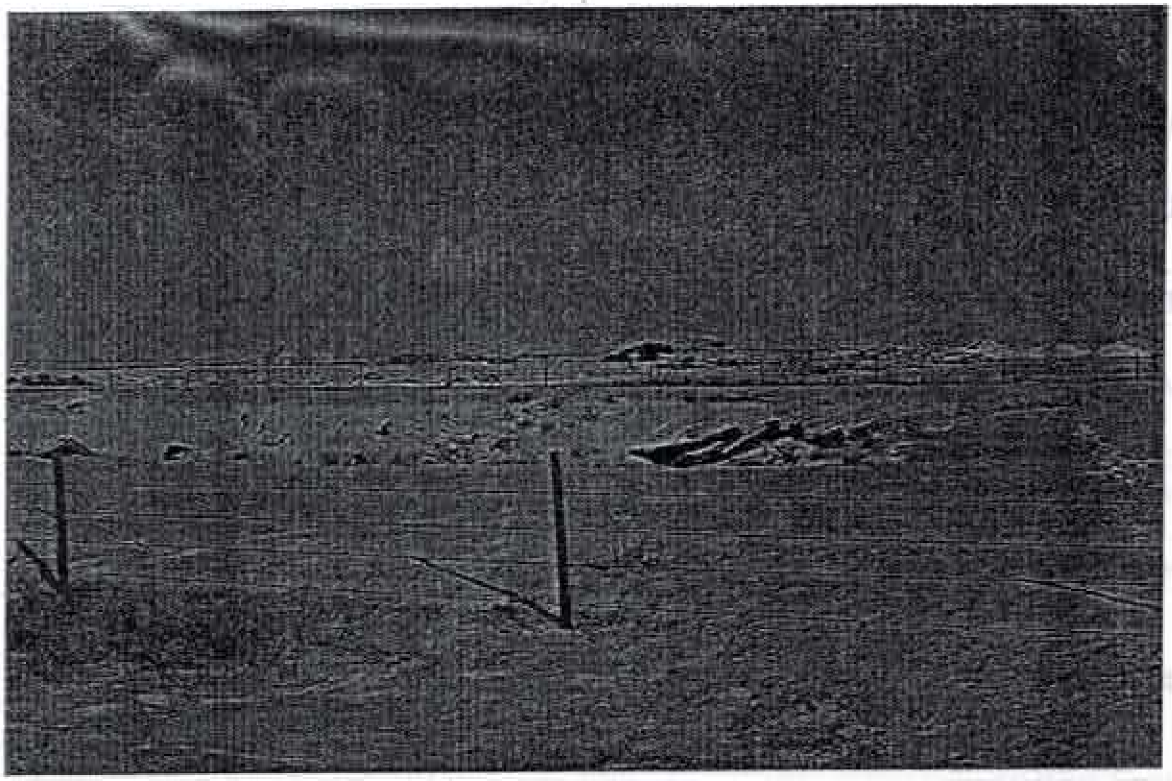


TIRES PILE (Background)

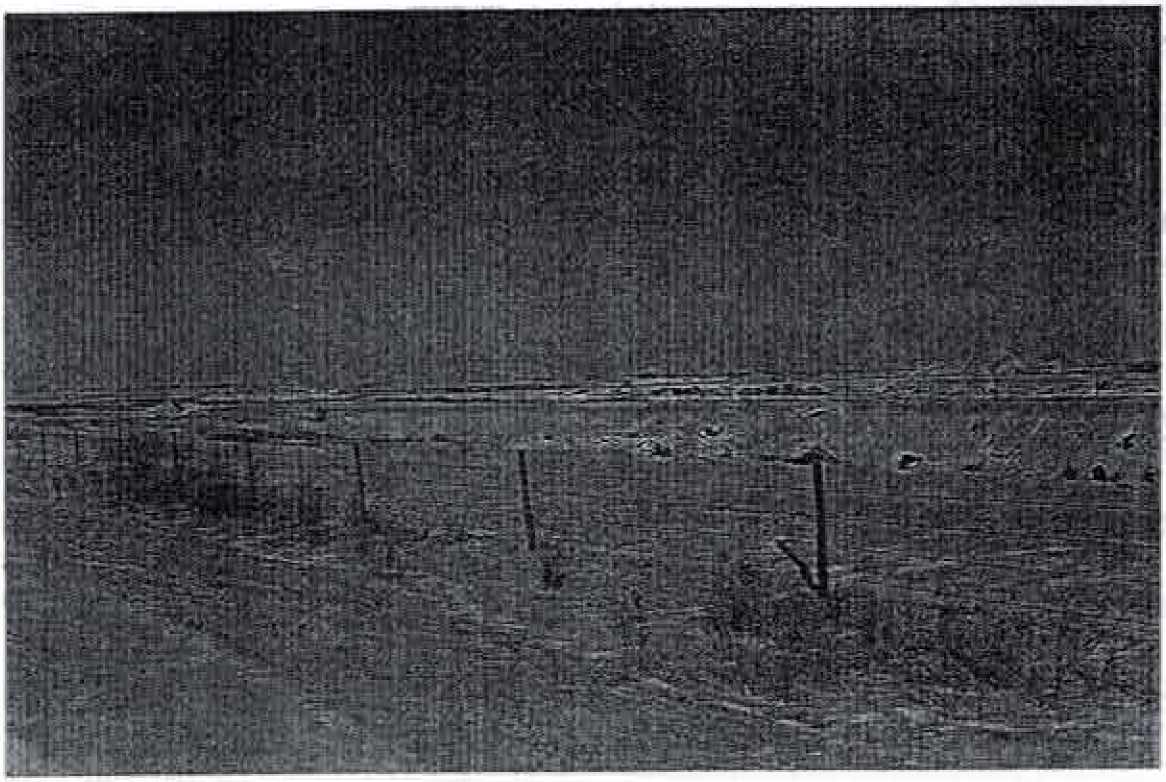
WOOD PIT

WHITE GOODS (Left)

CAPITAL COSTS	• Collection truck & land
OPERATING COSTS	• Labour, contract for landfill operation
CONTAINMENT/STORAGE	• Pesticide containers
ONSITE PROCESSING	
PAST/PRESENT/FUTURE DATA TO ESTABLISH TRENDS	



PESTICIDES, WOOD WASTE
AND TIRES STORAGE AREAS (Background)



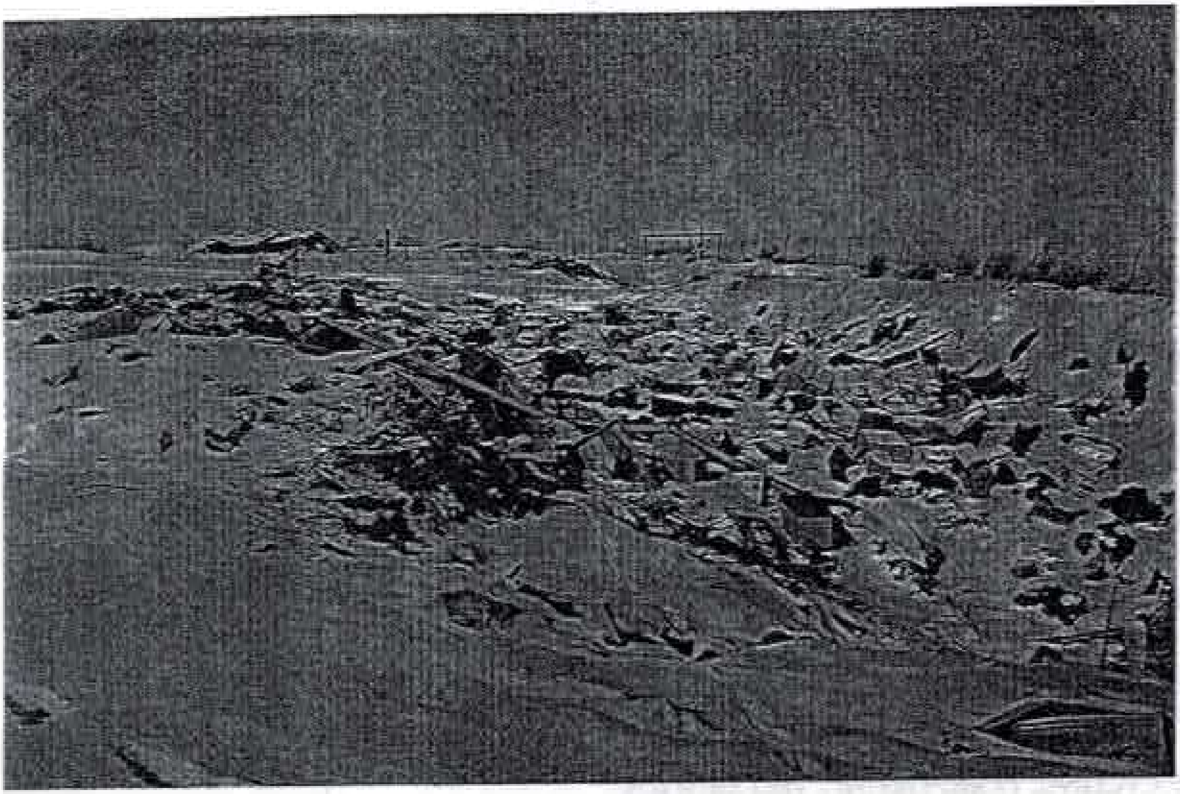
CONSTRUCTION AND DEMOLITION PIT (Foreground)
HOUSEHOLD WASTE PIT (Background)

OPERATING COSTS

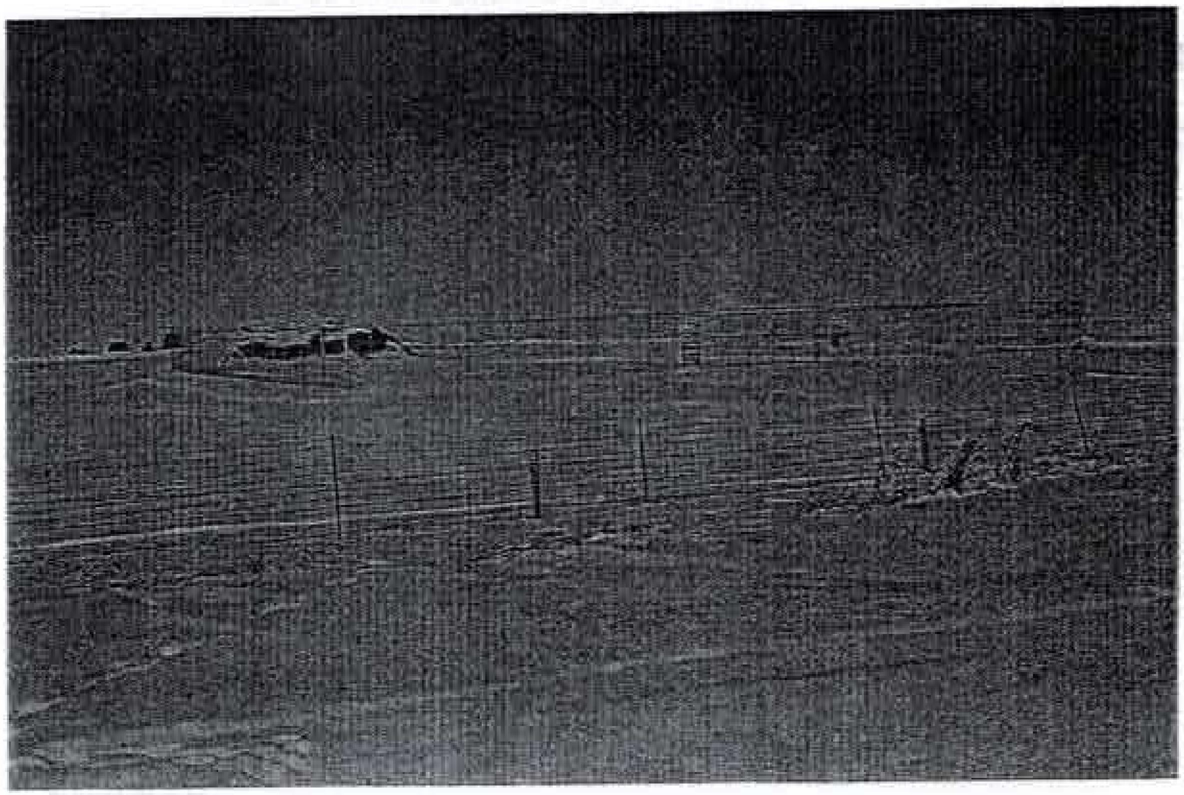
CONTAINMENT/STORAGE • Pesticide containers

ONSITE PROCESSING

PAST/PRESENT/FUTURE DATA TO ESTABLISH TRENDS



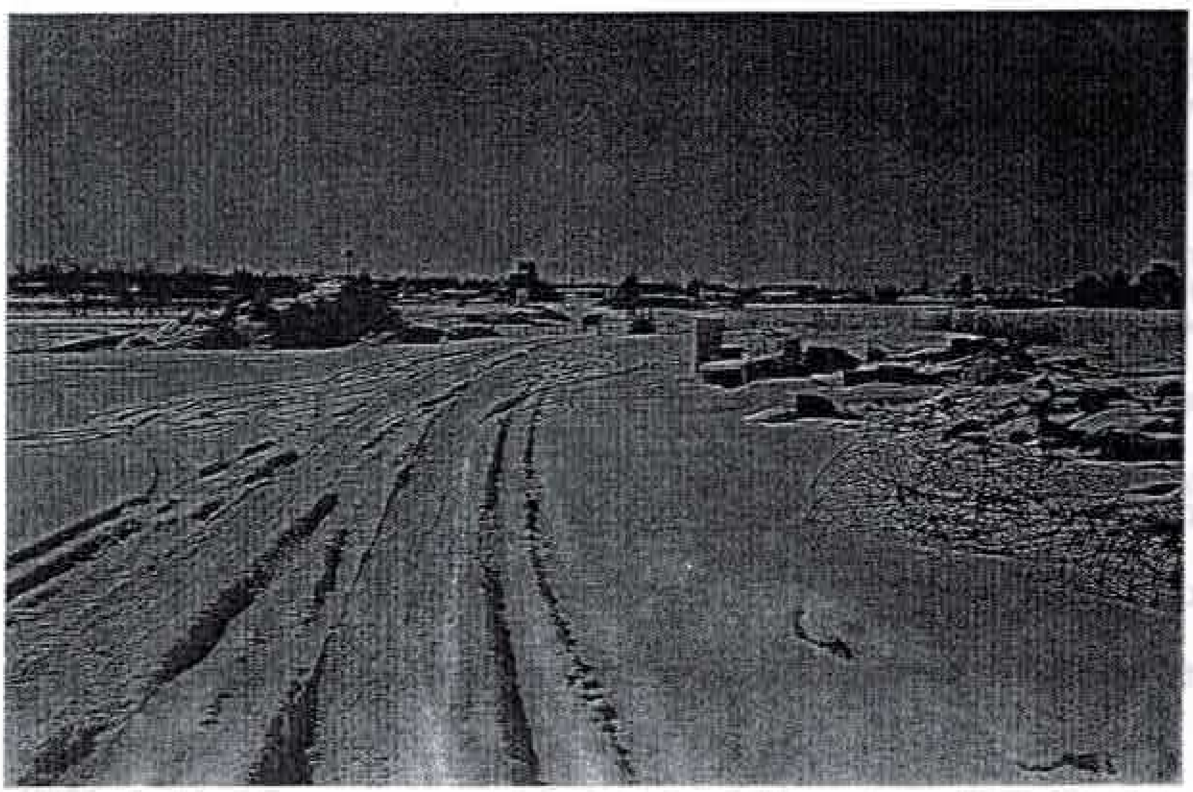
WASTES IN PIT



PESTICIDE CONTAINERS STORAGE

GENERAL VIEW

VULCAN MODIFIED LANDFILL



MISCELLANEOUS METALS (Foreground)
COUNTY TRANSFER STATION (Background)

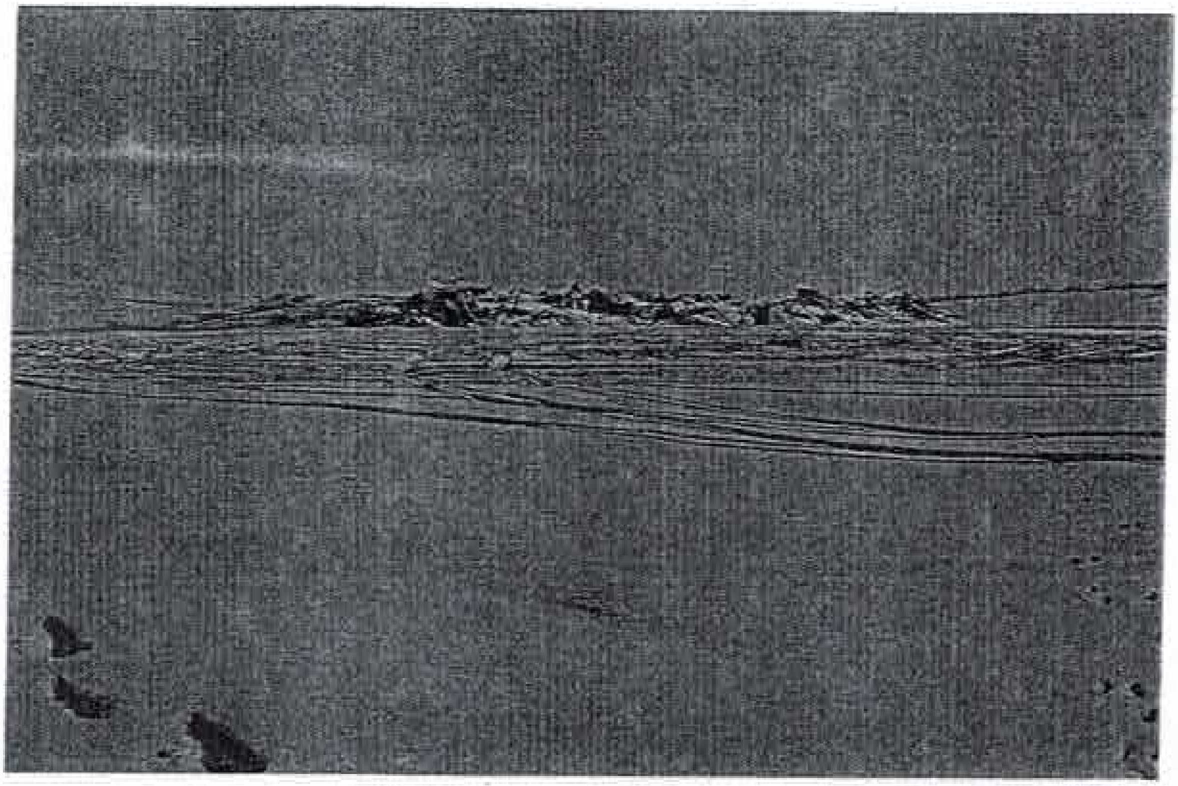
CAPITAL COSTS

OPERATING COSTS · \$2515/month

CONTAINMENT/STORAGE

ONSITE PROCESSING

PAST/PRESENT/FUTURE DATA TO ESTABLISH TRENDS

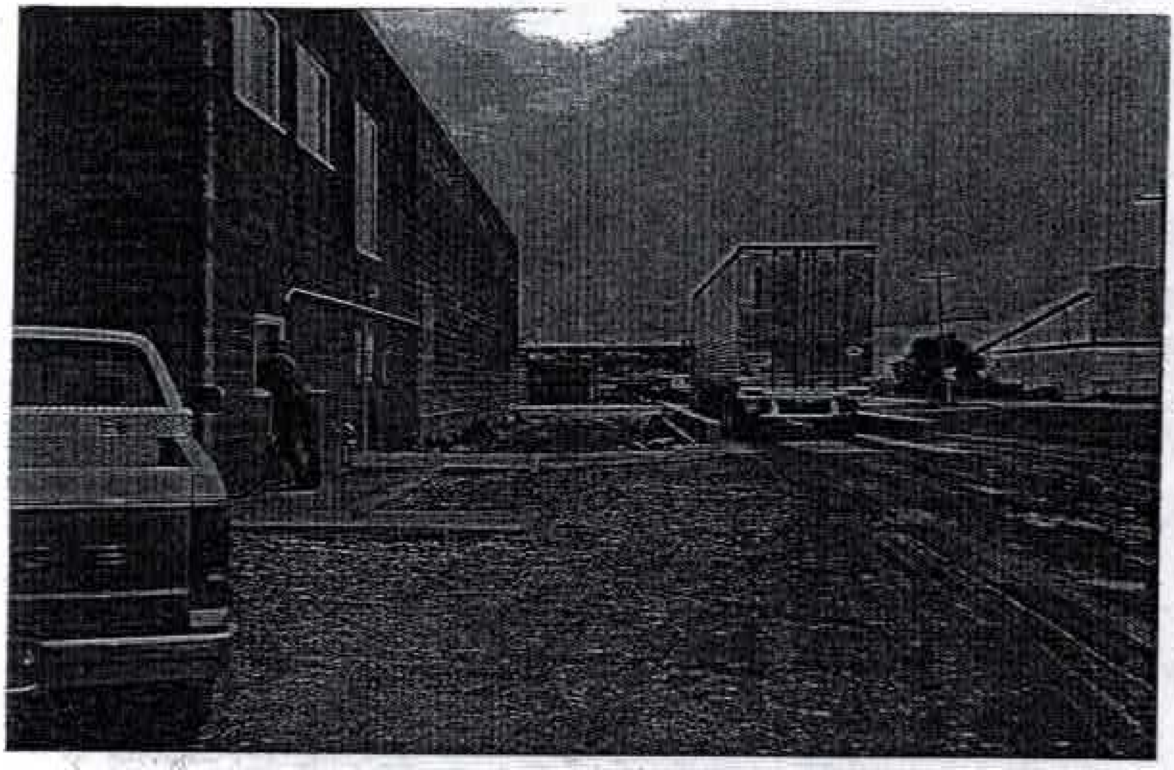


BURNABLE WASTES ONLY (trees etc.)

HOUSEHOLD AND GARDEN WASTE PIT

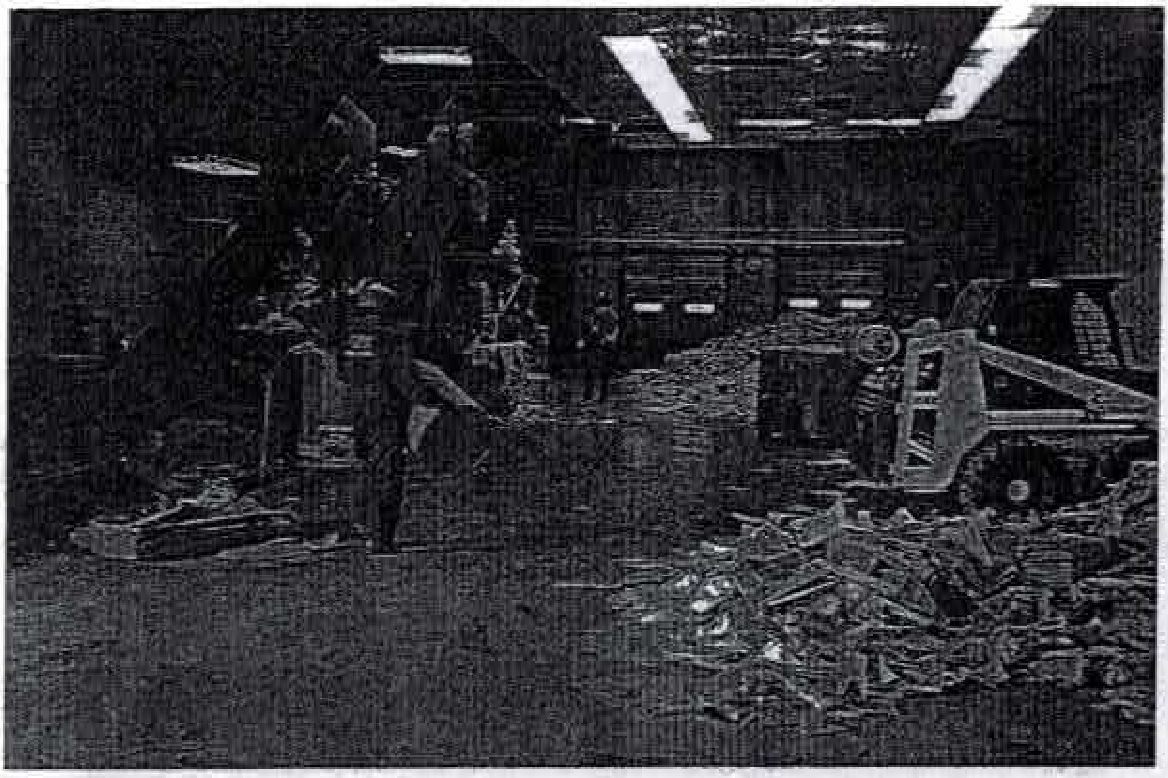
APPENDIX H
PHOTOS OF GPS RECYCLING

GPS RECYCLING
719 - 32 Street
LETHBRIDGE, ALBERTA
Phone : (403) - 329 - 4848

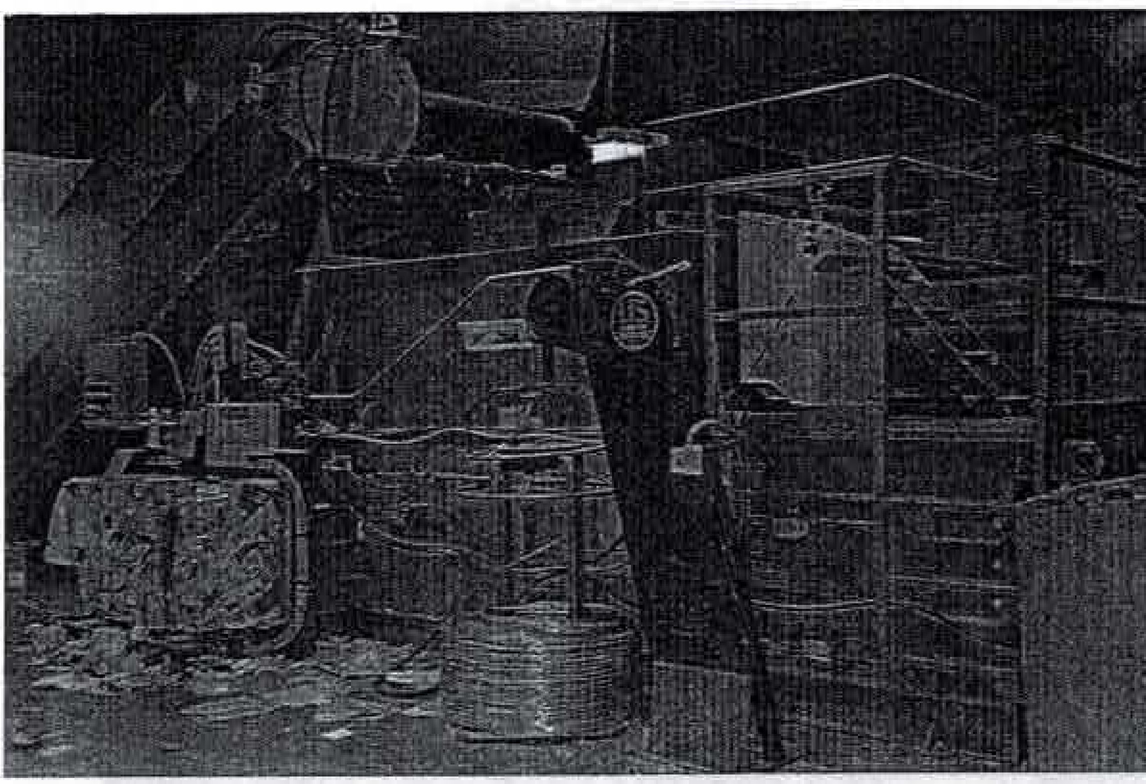


SITE ENTRANCE AND SCALE

Printed on recycled paper

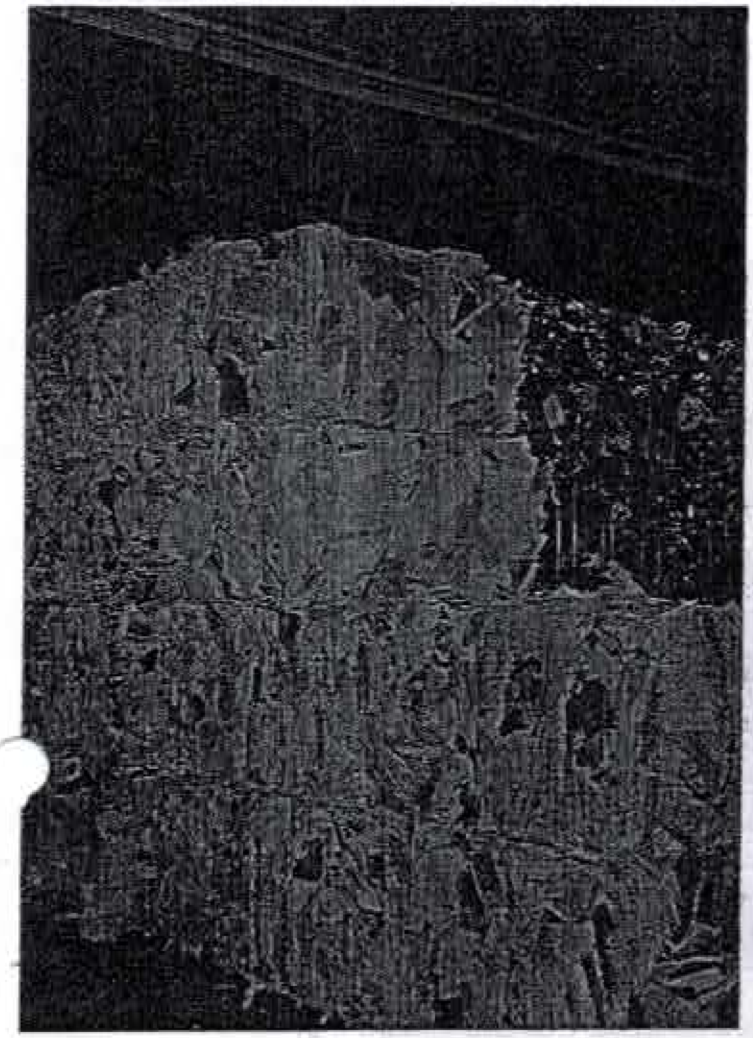


PIT, CONVEYOR AND BALER

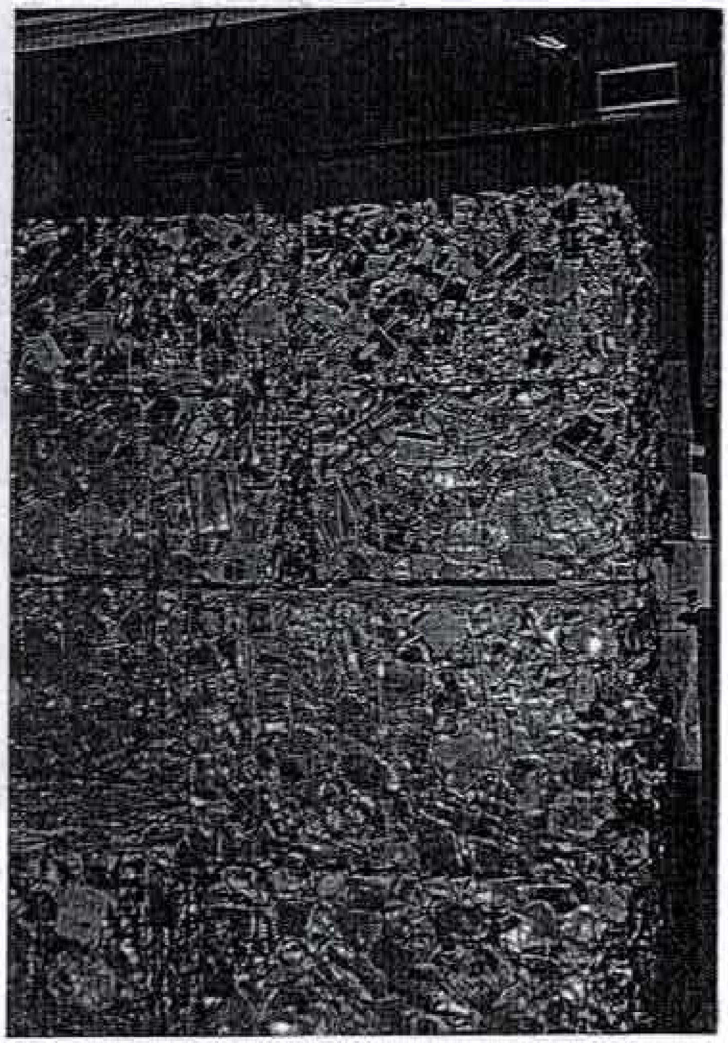


PIT, CONVEYOR AND BALER

Printed on recycled paper

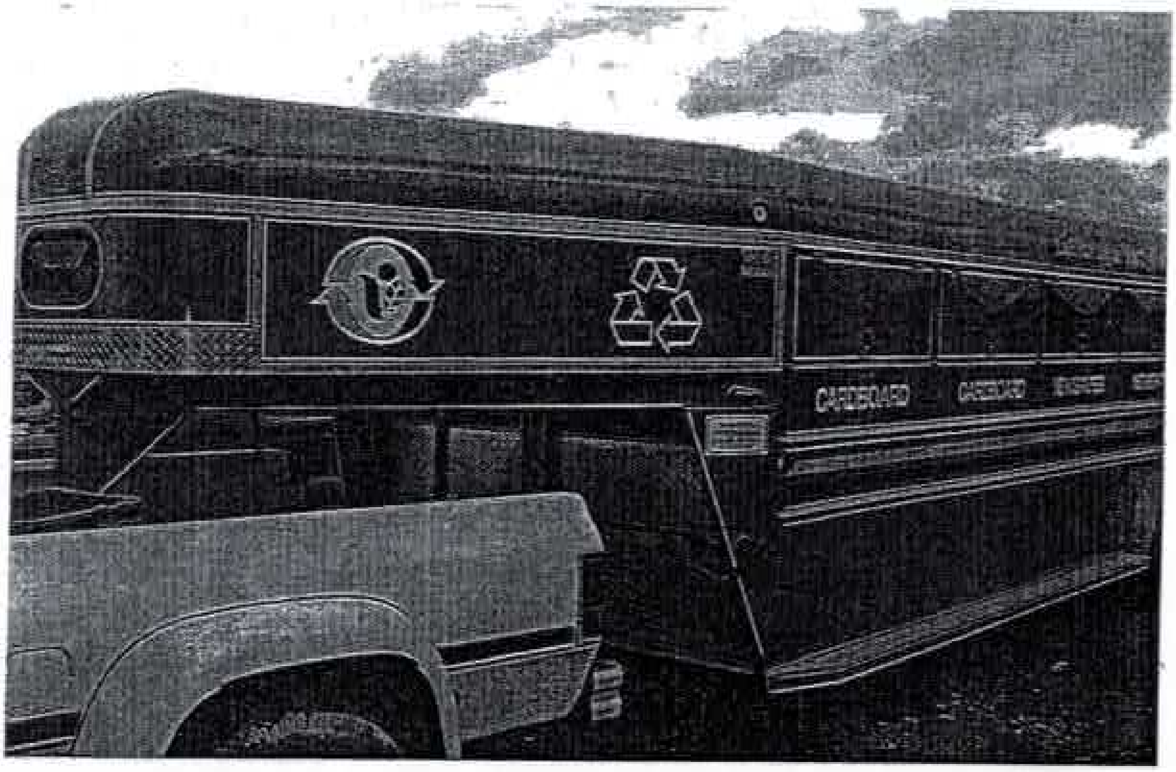


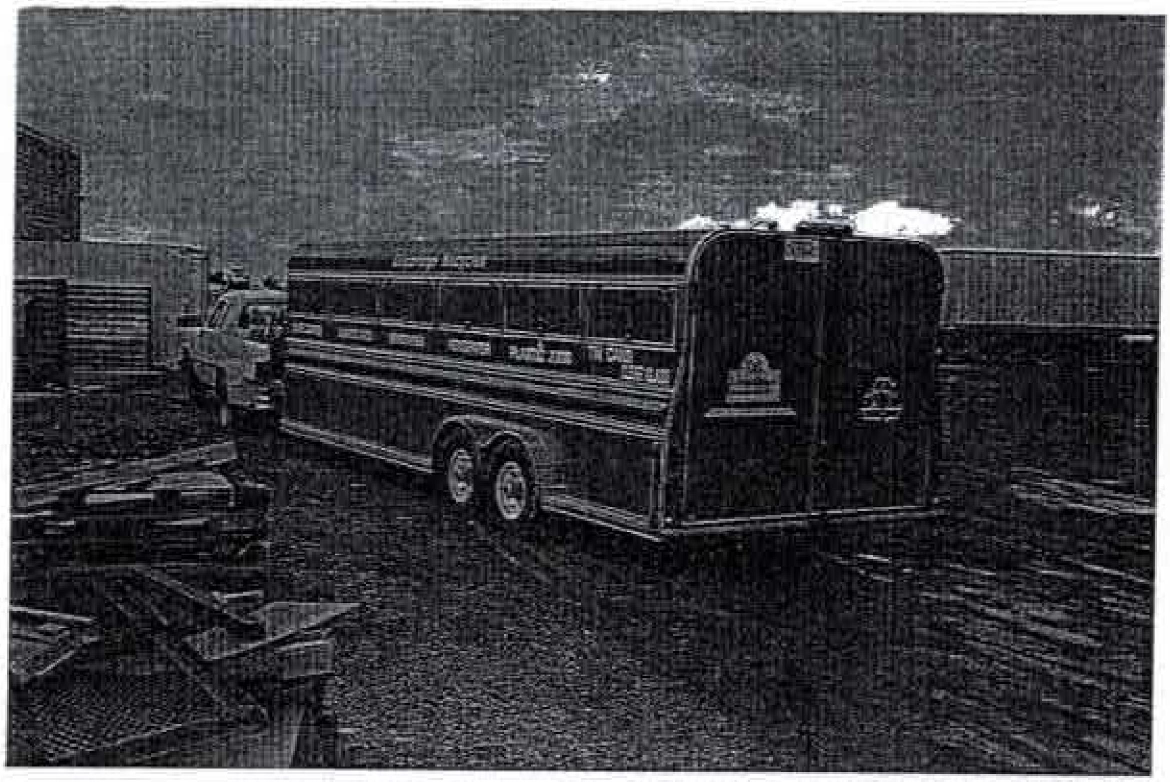
BALED PAPER



BALED TIN CANS

Printed on recycled paper





HORSE TRAILER MODIFIED
FOR COLLECTING RECYCLABLES
IN RURAL AREAS

APPENDIX I
REVIEW OF COMPOSTING TECHNOLOGIES

A REVIEW OF COMPOST TECHNOLOGIES

Composting is defined as the **controlled biological** decomposition of organic materials. Commonly, this definition is further restricted to **aerobic** degradation techniques. However, in this description, **anaerobic** techniques will also be examined.

This description discusses five distinct aerobic composting techniques. These are:

- windrowing;
- aerated static piles;
- mixed in-vessel systems;
- non-mixed in-vessel systems; and
- channel or trough systems.

All of these techniques can be implemented at a scale relevant to small and medium sized communities. Additionally, backyard scale techniques take various forms, and are also addressed.

The state-of-the-art in aerobic, anaerobic, and backyard systems is described in the following subsections.

Windrow Based Systems

Windrow based systems are among the most common, and least expensive, composting systems available. They have a long history of usage for specific materials such as agricultural wastes, yard wastes, and sewage sludges. There are definite economies of scale involved with windrow based systems which manifest themselves in the affordability of equipment (low volume range), and materials handling and site capacity requirements (high volume range).

A typical windrow based composting operation would occur on a well graded, well drained surface upon which long (often in the order of one hundred metres or more) triangular sectioned, or loaf shaped, piles are formed. The windrows are turned on a regular basis (to temperatures cause windrow exteriors to freeze, and using forced aeration systems to supplement the oxygen transferred via mechanical turning of the windrows (see 'In-Vessel systems' for a discussion of hybrid windrow/aerated static pile systems).

Windrow operations can be operated continuously, with fresh material added at one end and mature compost removed from the other, or in a batch mode, with dedicated windrows representing a few days or weeks worth of material. The choice of operating method will depend on factors such as organics receiving frequency, availability of equipment, and availability of labour.

In general, a well operated windrow based composting system will:

- mix the composting mass thoroughly enough that all materials will be exposed to the highest temperatures in the core of the windrow;
- attain temperatures required under relevant legislation for pathogen kill and weed seed destruction, and maintain these temperatures for the stated length of time;
- have good materials handling procedures, inventory control, and a recording system for input materials and product sales/end uses;
- adequately control insects and not attract rodents;
- not generate offensive odours;
- not contaminate surface or groundwaters; and
- produce a mature product that will not decompose appreciably after it leaves the facility or is placed in temporary storage.

Whether or not the finished product meets prescribed standards for heavy metals, synthetic organics, or physical contaminants is primarily a function of the source of the raw organics and any quality control and processing exercised prior to composting operations.

Operating windrow based systems outdoors in northern climates offers a number of challenges. Of critical importance is the windrow size. Unfortunately, this is often dictated by an inappropriate choice of windrow turner; therefore, loader based systems may offer greater flexibility (and cost savings) for those areas subject to severe winters. Another

Aeration is achieved by blowing air through, or drawing air into, the static pile. The choice of which method, or pattern of alternating methods, is a function of the degree of control over odours desired (if high, then drawing is better because the air can be discharged through a biofilter), the desire to cool or heat the pile or ambient air, and moisture control considerations. Irregular aerating patterns and the alternating of blowing and drawing are also often attempts to avoid problems such as channelling of air through the compost pile.

Improvements to the aerated static pile process include the addition of an insulating layer of mature compost, wood chips, or other material to insulate and retain heat and expose all incoming material to the internal conditions of the pile, and the controlling of ambient environmental conditions by enclosing the piles in a building or roofed structure.

In addition, aerated static piles require careful and creative blending and mixing of input materials to achieve the optimum feed for the process. Since materials are not disturbed during the process, initial material preparation is critical. A secondary consideration relates to adequate interparticle spaces which are required for good distribution of air throughout the pile. This porosity is best achieved by:

- the use of a bulking agent;
- the use of a non-uniformly sized source material;
- the avoidance of excessive size reduction, which causes densification; and
- adequate mixing of all materials to achieve a relatively homogeneous blend.

Aerated static piles can be designed to be operated outdoors under northern conditions. Critical design factors specific to winter conditions include pile size and the thickness of the insulating layer of mature compost or other material.

In addition, northern conditions provide opportunities for hybrid turned windrow/aerated static pile systems. These systems would operate as turned windrows during the spring/summer/fall months, but would be converted to static piles for winter operation to better retain process heat. The downside of these hybrid systems is the need to maintain additional equipment which remains idle during certain portions of the year.

system which deposits the material onto a synthetic net lining the floor of the tunnel. A winch attached to the net is used to drag finished compost out of the tunnel.

Oxygen is supplied through perforations in the tunnel floor, and process air is drawn from the head space above the composting mass. Some of this process air is recirculated through the tunnel floor along with makeup air to supplement the oxygen level, while the rest is exhausted either directly outside or outside via an odour control system such as a biofilter. Temperature is often controlled using steam or a heating element, and cool water sprays. Moisture can be modified slightly, but generally the proper moisture content must be achieved prior to placing materials in the tunnel. Similarly, the desired mix of compostables must be achieved before composting in the tunnel.

Tunnel systems have significant potential for use in the composting of the organic portion of the municipal waste stream, as well as a large variety of other materials. Input homogeneity is critical for these systems since there is no crushing or mixing within the composting chamber. Therefore, a heavy emphasis will need to be placed on organics segregation, prewetting, and blending to achieve satisfactory composting results with tunnel systems. The pre-composting processing effort could be greatly curtailed if the organics are source separated and facility operators are knowledgeable and creative about blending materials for optimum degradation. Finished compost structure can then be controlled using good screening equipment.

Mixing Reactors

Mixing reactor systems can either be rotating vessel type systems or stationary vessels with moving internal paddles or other mixing mechanism such as moving floors. Aerobic conditions are maintained by constantly exposing all the organics to air in the reactor. Many systems mechanically supplement oxygen levels by blowing in air. Flanges and blades within the reactors tend to break up clumps of material in these systems, and large inerts such as rocks and bricks tend to pulverize organics and increase the surface areas available to organisms for degradation. These systems are also ideal for adding additional materials, such as bulking agents or water, to enhance process performance during system operation.

Other researchers consider the difference between anaerobic composting and anaerobic digestion to be largely a matter of objective. For instance, if the objective is to produce methane, the preferred descriptive is anaerobic digestion or *biogasification*. If, however, the primary objective is the production of a stable organic material, the preferred term is anaerobic composting. Lastly, a distinguished researcher attempted to clarify the terminology muddle by taking the position that anaerobic digestion occurs when the source material is in a liquid or slurried form, while anaerobic composting takes place when the source material is in a solid form.

For all practical purposes all of these terms describe the same fundamental process. This is the biological breakdown of organic materials by bacteria, in the absence of oxygen (anaerobic), into methane, carbon dioxide, and intermediate compounds.

Anaerobic systems gained widespread use for the stabilization of sewage sludge during the twentieth century. Today, there are hundreds of successfully operating anaerobic digestion systems operating at sewage treatment plants in North America. Their primary function is to reduce the pathogen levels in the settled solids (usually in the range of 5% to 10% solids content) from municipal sewage, to control odours, and to produce a relatively stable end product that can be safely landspread, aerobically composted, landfilled, incinerated, or ocean disposed. Many facilities recover the energy value of the methane on-site, however this practice is not ubiquitous.

During the early to middle periods of this century, these systems competed with aerobic systems in the field of solids decomposition (including MSW) and co-treatment of solids with sludges. Various operational difficulties such as odours, incompletely stabilized end products, process sensitivity, and noxious intermediate substances such as fatty acids, aldehydes, alcohols, and hydrogen sulphide led to the virtual abandonment of these systems for the stabilization of MSW.

The energy crises of recent decades have rekindled interest in anaerobic systems for high solids content wastes due to their ability to produce high quality methane (natural gas). A substantial amount of research is currently being conducted at the present time.

The maturation of the environmental movement during the 1980's, and the realization by many people that the environment is not an issue but rather a place in which they live, caused people to look at what they could do at home to relieve some stress on their piece of the planet. In addition, a growing waste management crisis, manifesting itself in the form of environmental emotion, dwindling landfill space and increasing disposal fees, spurred many governments, environmental organizations, and individuals to encourage home composting on a broad basis in urban locations.

The late 1980's and early 1990's have witnessed a surge in the amount of information available to individuals to build or buy, and operate their own home composting units. Many municipalities, and other organizations, have sponsored demonstration sites which people can visit to see various techniques at work. Also popular are compost hotlines, cost sharing programs for bin purchases, pamphlets and informational guides, videos, presentations to school groups, and the training of volunteer *master compostors* who will, in-turn, train others.

There are a tremendous variety of ways to compost on a very small, or backyard, scale. These can be broken down into a number of broad categories which include:

1. Green manures (or leave it on the ground methods) in which organics such as leaves, grass clippings, and garden wastes are spread on the ground surface and left to decompose, or worked into the surface by tilling. Often these materials provide an additional function such as suppressing weeds and preventing excessive moisture loss from the soil below.

2. Trenching systems in which organic materials, including food wastes and even limited animal products, are placed in a trench and covered with soil. These methods include an English method which rotates trenches, plantings, and garden paths on a three year cycle, and post hole methods where organics are simply dropped into an augured hole and covered with a light layer of soil each time.

6. Non-turned, enclosed systems. These systems are suitable for only small waste quantities such as kitchen wastes. Another system should be used to handle other, bulkier, materials such as yard wastes. One common form of this system which is gaining popularity is the cone digester. These systems work similarly to trenching systems with a number of physical enhancements such as their ability to trap and store solar energy, convenience for addition of organics (no digging or covering with soil required), and their neat, compact, and often aesthetically pleasing appearance. Large volumes of materials are likely to decompose anaerobically in a system of this type which would lead to odours and attraction of pests if not well sealed.

Backyard compostors are not backyard landfills. Some degree of control is required for all of the above systems. For the green manure, trenching, and non-turned enclosed systems, this control is generally limited to selecting the right materials and not overloading the system's ability to deal with the organics.

Other Organics Management Techniques

Other organics management techniques are available. Three of these are:

- landspreading;
- animal feeds; and
- vermicomposting.

Each of these techniques is described below:

APPENDIX J
COMPOST THERMOMETER