APPENDICES A TO E

ECONOMIC PROFILE OF THE HAZARDOUS WASTE MANAGEMENT SERVICE INDUSTRY SUBSECTOR IN CANADA

ENVIRONMENT CANADA
HULL, QUEBEC

FINAL REPORT

JULY 1988

Fenco Newfoundland Limited
189 Water Street
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A.0 UCD WASTE CLASSIFICATION AND COMMONLY ASSOCIATED TECHNOLOGIES

Table A.1 identifies the 14 category UCD waste classification and corresponding waste streams. Table A.2 identifies for each of the 14 UCD waste classes, waste management categories boasting technologies capable of appropriately managing these wastes. Table A.3 presents the four general waste management categories and commonly associated technologies.

TABLE A.1 CONSOLIDATED UCD WASTE CLASSIFICATION SYSTEM*

UCD Consolidated Waste Type	Description of Waste Streams
Organic Sludges and Still Bottoms (No Oil)	Organic sludges containing metals
	Halogenated still bottoms
	Non-halogenated still bottoms
	Polymeric resins
	Other Polymeric wastes
	Phenolic wastes
	Solid or sludge tannery wastes (organic)
	Explosive wastes
	Waste compressed gases, including cylinders
Solvents and Organic Solutions	Non-halogenated solvents with heavy metals
	Petroleum distillates
	Aromatic solvents and residues
	Halogenated solvents with heavy metals
	Other organic liquids (e.g., organic acids, amines)
Oils and Grease	Waste oil and mixed oil (e.g., waste crankcase oils and lubricants)
Oil/Water Mixtures	Oily water/waste oil from waste transfer/ processing sites
	Oily acidic solids

TABLE A.1 CONSOLIDATED UCD WASTE CLASSIFICATION SYSTEM* (cont')

UCD Consolidated Waste Type	Description of Waste Streams
Organic and Oily Residuals	Oily tank bottoms i.e., waste oils/sludges (petroleum based)
	Emulsified oils
	Light fuels
	Other specific organic sludges, slurries and solids (e.g., tetraethyl lead sludge)
Heavy Metals Solutions and Residuals	Aqueous solutions with anions
	Aqueous solutions with heavy metals (e.g., inorganic wastes from pigment manufacturing, neutralized solutions, sludges and residues containing heavy metals)
	Heavy metal sludges (e.g., primary lead, zinc and copper smelting wastes)
	Aqueous solutions with other metals (e.g., chemical fertilizer wastes)
	Liquid tannery waste sludges
	Photoprocessing/photochemical wastes
	Spent pickle liquor
	Acidic solutions, sludges and residues containing heavy metals
	Acid solutions, sludges and residues containing other metals and non-metals
	Other acidic solutions
	Alkaline solutions, sludges and residues containing heavy metals
	Other alkaline solutions (e.g., alkaline phosphates)

TABLE A.1 CONSOLIDATED UCD WASTE CLASSIFICATION SYSTEM* (cont'd)

UCD Consolidated Waste Type	Description of Waste Streams
Miscellaneous Chemicals and Products	Organic chemicals
	Inorganic chemicals
	Pharmaceuticals
	Brines, chlor-alkali sludges
Paint and Organic Residuals	Latex paint and sludge residuals
	Solvent based paint and sludge
	Waste tar and residues (e.g., heavy fuels)
	Adhesive and glue
Aqueous Solutions with Organics	Aqueous solutions with non-halogenated residues less than 10% (e.g., landfill leachate, non-halogenated rich organics)
Anion Complexes	Cyanide
	Sulfide
	Other complexes
Sludges and Inorganic Residuals	Ash
	Spent catalyst
	Dust collector wastes
	Inert inorganic wastes
	Other specified inorganic sludges, slurries or solids
	Neutralized solutions, sludges and residues containing other metals
	Alum and gypsum sludges (e.g., detergents and soaps)

TABLE A.1 CONSOLIDATED UCD WASTE CLASSIFICATION SYSTEM* (cont'd)

UCD Consolidated Waste Type	Description of Waste Streams
Pesticide and Herbicide Wastes	Halogenated pesticides and herbicides
	Organic non-halogenated pesticide and herbicide wastes
PCB Wastes	High concentration liquids (500 ppm)
	Medium concentration liquids (500 ppm)
	Contaminated soil (50 ppm)
Clean-Up Residuals	Pathological wastes

*Compiled from Proctor and Redfern, et. al., 1984, and OWMC, 1988.

Table A.2 UCD WASTE AND CORRESPONDING WASTE MANAGEMENT CATEGORIES

UCD CONSOLIDATED WASTE TYPE	WASTE MANAGEMENT CATEGORIES			
	Thermal Destruction	Physical/ Chemical Treatment	Disposal	Recycling/ Recovery
1. Organic Sludges and Still Bottoms (no oil)	X	X	X	
2. Solvents and Organic Solutions	X	X	X	X
3. Oils and Grease	X	X		X
4. Oil/Water Mixtures	X	X		X
5. Organic and Oily Residuals	X	X	X	X
6. Heavy Metal Solutions and Residuals	X	X	X	X
7. Miscellaneous Chemicals and Products	X	X	X	X
8. Paint and Organic Residuals	X	X		X
9. Aqueous Solutions with Organics	X	X	X	X
10. Anion Complexes	X	X	X	
11. Sludges and Inorganic Residuals		X	X	X
12. Pesticide and Herbicide Wastes	X	X	X	
13. PCB Wastes	X	X	X	
14. Clean-Up Residuals	X	X	X	

Table A.3 WASTE MANAGEMENT CATEGORIES AND COMMONLY ASSOCIATED TECHNOLOGIES[1]

Thermal Destruction	- Incineration (eg. rotary kiln, infrared furnace, liquid injection, fluidized bed, multiple hearth, cement kiln) - pyrolysis - wet air oxidation
Disposal	- landfilling - deep well injection - solidification/stabilization[2]
Physical/Chemical Treatment	- solidification/stabilization[2] - evaporation - oxidation/reduction - biological treatment - surface impoundment - precipitation - distillation - neutralization - chemical dechlorination(eg., sodium dechlorination) - steam stripping - carbon adsorption - land application - decanting
Recycling/Recovery	- recycling - solvent recovery - fuel blending - waste oil recovery

1 This is not an exhaustive list of technologies corresponding to the waste management categories identified since technologies are continuously undergoing testing or being developed.

2 Solidification/stabilization technologies are applicable to both the disposal and physical/chemical treatment categories because 'insitu' use of these technologies provides containment and wastes also undergo solidification/stabilitation to improve physical handling prior to disposal.

Solidification/Stabilization

Solidification and stabilization technologies are designed to decrease the surface area across which transfer or loss of contained pollutants can occur by production of a monolithic block with high structural integrity. These technologies are also used to improve waste handling or other physical characteristics of the waste, and to limit the solubility or toxicity of hazardous waste consitutents. Solidification/stabilization methods can be categorized as cement solidification, silicate-based processes, sorbent materials, thermoplastic techniques, surface encapsulation, organic polymer processes and vitrification (EPA, 1985).

Activated Carbon Adsorption

The process of adsorption onto activated carbon involves contacting a waste stream with the carbon, usually by flow through a series of packed bed reactors. The activated carbon selectively adsorbs hazardous constitutents by a surface attraction phenomenon in which organic molecules are attracted to the internal pores of the carbon granules. Adsorption depends on the strength of the molecular attraction between adsorbent and adsorbate, molecular weight, type and characteristic of adsorbent, electrokinetic charge, pH, and surface area. Activated carbon can be employed in a granular or powdered state for wastewater treatment. Most hazardous waste treatment applications involve the use of adsorption units which contain granular activated carbon (EPA, 1985).

Distillation

Distillation is a well developed technology that can be used to separate or purify wastewater streams containing liquid organic compounds. Distillation involves heating a mixture of liquids to produce a vapor that is rich in lower boiling point components of the original mixture. The mixed vapors may be condensed and recovered for recycling. Distillation can be carried out in a series of stages which, at the limit, can approach a complete separation of the components. Vacuum distillation may be employed to recover valuable organics, such as lubricating oils (Corpus Information Services, 1986).

Precipitation

Precipitation is a physiochemical process whereby some or all of a substance in solution is transformed (generally through flocculation) into a solid phase. It is based on alteration of the chemical equilibrium relationships affecting the solubility of inorganic species. Removal of metals as hydroxides or sulfides is the most common precipitation application in wastewater treatment (EPA, 1985). Precipitates are frequently separated from liquids by settling or filtration.

Steam Stripping

Steam stripping is a form of fractional distillation of volatile compounds from an aqueous wastewater. It can be used to treat aqueous wastes containing organic compounds of relatively high concentration and/or low volatility. It

can also handle a variable waste stream, including solids. However, steam stripping is energy intensive, and because steam is added to the waste, the volume of wastewater to be treated in later process steps is greater (Corpus Information Services, 1986).

Biological Treatment

Biological treatment methods use microorganisms to degrade organic waste streams. The principal factors which control microbial degradation are moisture levels, organic content, oxygen levels, temperature, pH, and nutrient sources. Biological waste treatment can be accomplished through insitu aerobic degradation, pretreatment (e.g., by photolysis or ozonation) followed by degradation, anaerobic degradation, activated sludge and photosynthetic plant farming. Processes such as activated sludge are standard methods for treating domestic wastewater. Insitu degradation is often utilized for hazardous waste in soil matrices.

Chemical Dechlorination

Chemical dechlorination is used to strip chlorine atoms from chlorinated hydrocarbons, such as PCB's. The dechlorination process typically involves a low temperature, exothermic reaction between a highly reactive alkali compound, such as sodium or potassium, and a liquid containing chlorinated organics, to produce a non-toxic organic compound, an inorganic salt, and the treated liquid. Several commercially available dechlorination processes are used in the treatment and recovery of low PCB content oils (Corpus Information Services, 1986).

Neutralization

Neutralization or pH control is a common process in many industries. It has wide applicability to waste streams of diverse physical and chemical compositions. It can be used on aqueous and non-aqueous liquids, slurries, and sludges. Neutralization is simply a liquid-phase chemical reaction between an acid and a base which produces a neutral solution. The treatment may stimulate solids dissolution, precipitation, or gas evolution (Corpus Information Services, 1986).

Oxidation/Reduction

Oxidation-reduction, or redox reactions, are those in which the oxidation state of at least one reactant is raised while that of another is lowered. Chemical oxidation may be considered for dilute aqueous streams containing hazardous substances or for removal of residual traces of contaminants after treatment. Chemical oxidation should be considered as a first treatment step when the waste contains cyanide, when it contains constituents not amenable to other treatment methods, or as a first step to remove traces of contaminants after another treatment. The oxidizing agent may be in the form of gas, liquid, or a solid (Corpus Information Services, 1986).

Incineration

Incineration is the destruction of solid or liquid wastes by high temperature burning. It is generally used to destroy compounds containing organics. Several types of incinerators are available to handle a variety of waste

forms, the most commom of these include rotary kilns, liquid injection incinerators, fluidized bed incinerators, multiple hearth incinerators, infrared furnace incinerators and cement kilns. These types of incinerators are briefly discussed below:

(i) rotary kiln incineration

The rotary kiln is the most flexible and widely used incineration process for hazardous waste treatment. The waste and any auxiliary fuel is introduced into a horizontal rotating cylinder. Drummed wastes, contaminated soils, other solids and sludges, as well as liquids, can be fed directly into the kiln; liquids can also be injected into the afterburner chamber. Operating temperatures range between 800° and 1,000°C in the primary chamber and 1,000° and 1,300°C in the secondary chamber. Gas residence time in the afterburner ranges between one and three seconds at 1,000°C (Corpus Information Services, 1986). Rotary kilns have been successful in the destruction of PCB's.

(ii) liquid injection incineration

Liquid injection incinerators use various injection systems (internal mix air atomizers, rotary cup nozzles or lances) to introduce an atomized stream of waste material into the refractory-lined chamber (some with an afterburner section). The products of combustion are cooled and the residual particulate and acid components are removed by appropriate pollution control equipment. Various configurations

- horizontal, vertically up, vertically down, etc. - are available. Incineration temperatures and residence times are equivalent to those found in rotary kilns (Corpus Information Services, 1986). Liquid injection incinerators are utilized aboard ship for ocean incineration.

(iii) fluidized bed incineration

Fluidized bed incineration is a low temperature system that incorporates an agitated bed of inert material, catalytic material or limestone, depending on the application. Waste is injection into the bottom of the bed and fluidized air is forced through the bed so that it acts much like a boiling liquid. Combustion is accomplished more quickly and at a lower temperature than in other thermal systems. In addition, the bed material can act as a scrubber, capturing off-gases. However, the process requires a certain uniformity in the waste feed and cannot handle a widely varying waste stream (Corpus Information Services, 1986). There are various fluidized bed configurations available including bubbling bed, dual bed and circulating bed systems.

(iv) multiple hearth incineration

In the multiple hearth incinerator, industrial or municipal solid waste is fed onto a primary hearth and ignited. The partially burned products of combustion pass into a secondary chamber where combustion is completed and the gases are directed to the air pollution control system. Modification

of standard municipal incinerator designs and the addition of efficient emission control equipment has allowed the use of multiple hearth units for hazardous waste destruction. In particular, ignitable wastes have been successfully used as supplementary fuel in the secondary chamber (Corpus Information Services, 1986).

(v) infrared furnace incineration

The infrared furnace incinerator is a recent development for hazardous waste treatment. Contaminants are destroyed through infrared radiation. Drummed wastes, contaminated soils, other solids and liquids can be fed directly to the infrared primary furnace chamber; liquids can also be injected into the propane-fired infrared secondary chamber. Operating temperatures range from 500 to 1,050°C in the primary chamber, and up to 1,260°C in the secondary chamber.

(vi) cement kiln incineration

Cement production involves the calcining of raw materials containing calcium, silicon, aluminum and iron to form cement clinker. Typically, the raw materials are fed into cement kilns concurrently with fuel and subjected to temperatures in excess of 1000°C. Cement kilns have been proven to effectively destroy refractory materials such as PCB's and other chlorinated organic compounds. As well, waste streams with high calorific value are often blended to serve as cement kiln fuel.

In addition to the above incinerators, many other types of incineration or thermal destruction technologies are under development or testing.

Mobile Incineration

In addition to stationary units, mobile or transportable incineration facilities have been developed in recent years. Mobile units have the same destruction abilities of stationary systems with the added advantage that the technology can go to the waste rather than the waste being transported to the technology. Rotary kiln, infrared furnace and fluidized bed incinerators are available as transportable units to handle hazardous wastes.

Pyrolysis

Pyrolysis is the thermal decomposition of an organic compound in an oxygen-free environment. Wastes are subjected to temperatures of about 650° to 900°C depending on the nature of the wastes. Without oxygen, the wastes cannot burn and are broken down into steam, carbon oxides, volatile vapors, and charcoal. Pyrolysis is especially appropriate for viscous and abrasive sludges, high-residue materials, wastes which undergo phase changes during thermal processing, and materials that contain salts and metals that melt and volatize at normal incineration temperatures. Pyrolytic thermal processing provides a means of distilling off the organics, which can be captured or destroyed in an afterburner, and separating the inorganics (Corpus Information Services, 1986). The process has destroyed PCB's and solidified nuclear wastes.

Wet Air Oxidation

Wet air oxidation is a process in which combustible material is oxidized by air or oxygen in the presence of liquid water. Elevated temperatures are required to achieve a useful rate and, therefore, to maintain a liquid phase, elevated pressures are required. The process is operated continuously with liquid and gas streams being introduced to the reactor simultaneously. Wet air oxidation may be used for the oxidation of waste liquors, slurries and sludges where the organic matter is a few percent of the predominantly water stream. The process is most effective on wastes too concentrated for biological or chemical oxidation and too dilute for incineration. Wet air oxidation is capable of processing low concentrations of organics autothermally, while allowing the inorganics in the waste stream to be recovered (Corpus Information Services, 1986).

Land Application

The land application, also known as land treatment or land farming, of hazardous wastes involves the use of surface soils as a treatment medium. Land treatment utilizes the natural biological, chemical and physical processes in the soil for degrading, attenuating, or otherwise rendering innocuous, hazardous wastes. Attenuation of the organic constituents occurs largely as a result of biodegradation. Immobilization of metallic contaminants is a result of the physical/chemical properties of the soil (Corpus Information Services, 1986).

Deep Well Injection

Deep well injection of industrial wastes involves injecting liquid wastes into pores of permeable subsurface strata, such as unconsolidated sands, sandstone, limestone, dolomite and fractured gneiss. Wastes suitable for deep well injection include acids, alcohols, solvents, alkalis, salts, chromates, cyanides, nitrates, phosphates and possibly radioactive materials.

Landfilling

Landfilling has been the traditional method of disposal for both treated and untreated industrial wastes. This method includes secure chemical landfilling, mono-landfilling and co-disposal with municipal refuse; secure chemical landfilling for hazardous wastes. Landfills can handle large volumes of wastes and a variety of waste types cheaply and easily. However, if remediation and cleanup are required due to landfill failure this option becomes very costly. Landfills are most applicable to the disposal of solid or semi-solid wastes.

Surface Impoundment

Liquid wastes are placed in surface impoundments or open ponds which may incorporate some form of chemical or biological treatment. Where the evaporation rate is sufficiently high, substantial volume reduction may be achieved. In some cases, it is more appropriately regarded as a storage technique. Quantities of sludges and/or solids accumulate in these ponds. They utlimately require removal and disposal. Since the pond contents are mainly

liquid, protection of the groundwater below and adjacent to the ponds is of particular significance. It is also important to ensure that the ponds do not overflow and thereby contaminate surface waters.

Recycling

Recycling is a waste minimization technique employed onsite and offsite. Recyclable materials are used or reused as process ingredients or effective substitutes. As well, materials are reclaimed by regeneration or by processing wastes.

Solvent Recovery

Solvent recovery can take place onsite or offsite. Solvents in the form of vapours can be recovered by condensing or by trapping with activated carbon and subsequent stripping by air, steam or another solvent. Mixed liquid solvents are separated by distillation if boiling points are sufficiently different.

Fuel Blending

Waste streams with high calorific value can be blended to produce a usable fuel. The fuel produced may be used directly in manufacturing processes such as cement clinker production. It can also be burned an incinerator that is equipped with a heat exchanger to enable the heat to be captured and put to use.

Waste Oil Recovery

Waste oil recovery involves the re-refining of oil. The degree of processing depends upon the required use of the recovered oil. Some commercial oil recoverers remove only water and major solid contaminants then sell the oil to companies for purposes such as road oiling. Others clean-up contaminated oils using processes such as the classic acid/clay re-refining process, replace additives as required, then return th recovered oils directly to the customer's inventories. Mobile waste oil recovery equipment is used by some commercial oil recoverers to clean up contaminated oils onsite.

Decanting

Decanting is a process by which lighter waste components are separated from heavier components by gravity. Usually, the waste streams comprise two liquid phases together with suspended solids. The lighter liquid phase is drawn from the top of the tank or pond and solid constituents settle to the bottom.

B.0 CANADIAN INITIATIVES AND PROGRAMS

B.1 PROVINCIAL/TERRITORIAL INITIATIVES

Hazardous waste management initiatives in the provinces and territories is briefly discussed below. Table B.1 presents an overview of these initiatives.

B.1.1 Overview of Provincial/Territorial Hazardous Waste Management Activities

B.1.1.1 British Columbia

Development of a waste management plan for British Columbia (B.C.) has been ongoing since 1980 when a Hazardous Waste Advisory Committee was established to study provincial hazardous waste management activities and to recommend to the Minister of the Environment mechanisms for appropriate waste management. Since that time, the ministry has been gradually implementing the recommendations including the development of legislation and regulations governing the generation, transportation, storage, treatment and disposal of hazardous wastes. Regional special waste storage sites have been established in the province. The eighth and final facility, opened in 1985, provides drop-off points for small quantity hazardous waste generators. Hazardous household wastes and discarded laboratory chemicals from schools, hospitals and institutions can be taken to the storage facilities for analyses and repackaging; pathological, biological, explosive or radioactive wastes are not accepted. Small quantities of household or public institutional waste are accepted free of charge. Larger volumes are assessed a pro-rated charge for transport and

TABLE B.1 PROVINCIAL HAZARDOUS WASTE MANAGEMENT ACTIVITIES

PROVINCE	HAZARDOUS WASTE STUDIES (STUDY DATE)	WASTE MANAGEMENT CORPORATIONS	WASTE MANAGEMENT ORGANIZATIONS AND COUNCILS	WASTE MATERIALS EXCHANGES	APPLICABLE PROVINCIAL REGULATIONS	WASTE MANAGEMENT ACTIVITES AND PROGRAMS	COMMENTS
British Columbia	Inventory on Industrial Wastes (1979) Hazardous Wastes in Northern and Western Canada (1979-81) Canadian National Inventory of Hazardous Toxic Wastes (1980-82) Data on Hazardous Wastes, Rubber Wastes and Oil Wastes - 1983 (1984)		Recycling Council of British Columbia	British Columbia Waste Exchange - one year pilot project Canadian Waste Materials Exchange	Special Waste Regulation Waste Management Act Waste Management Regulation Transport of Dangerous Goods Act Transport of Dangerous Goods Regulation	Special Waste Advisory Committee commissioned by British Columbia Ministry of Environment Establishing British Columbia Special Waste Services Inc. to provide appropriate management of special wastes in British Columbia Regional Special Waste Storage Sites	Federal TDG regulations adopted Legislation governing biomedical wastes
Alberta	Hazardous Wastes in Alberta - An Inventory and Review of Practices and Technologies (1979) Hazardous Wastes in Northern and Western Canada (1979-81) Canadian National Inventory of Hazardous and Toxic Wastes (1980-82) Data on Hazardous Wastes, Rubber Wastes and Oil Wastes Draft Policy for Public Review on the Management of Hazardous Wastes and Recyclable Materials (1987)	Alberta Special Waste Management Corporation	Recycling Council of Alberta Alberta Environment Centre	Alberta Waste Materials Exchange Canadian Waste Materials Exchange	Hazardous Waste Regulation Hazardous Chemicals Act Special Waste Management Corporation Act Clean Air Act Clean Water Act Transportation of Dangerous Goods Control Act Transportation of Dangerous Goods Control Regulation Department of Environment Act Agricultural Chemicals Act Energy Resources Conservation Act Oil and Gas Conservation Act Pesticides Sales, Use and Handling Regulations	Alberta Special Waste Treatment Centre-handles most provincial special wastes Help End Landfill Pollution Program Disaster Preparedness and Emergency Response Program Alberta Oil Sands Research Program for Collection of Used Agricultural Containers Oil Drop Program	3-part waste management program: (I) construction of treatment centre; (II) transfer stations located in major cities of province; and (III) small collection stations for consumer drop-off. Inter and intra-provincial waste transport manifested Federal TDG Regulations, Parts I to IX adopted for the handling, offering for transport or transport of dangerous goods in the province

TABLE B.1 PROVINCIAL HAZARDOUS WASTE MANAGEMENT ACTIVITIES (Cont'd)

PROVINCE	HAZARDOUS WASTE STUDIES (STUDY DATE)	WASTE MANAGEMENT CORPORATIONS	WASTE MANAGEMENT ORGANIZATIONS AND COUNCILS	WASTE MATERIALS EXCHANGES	APPLICABLE PROVINCIAL REGULATIONS	WASTE MANAGEMENT ACTIVITES AND PROGRAMS	COMMENTS
Saskatchewan	Chemical Waste Inventory Report (1982) Hazardous Waste in Northern and Western Canada (1979) Canadian National Inventory of Toxic and Hazardous Wastes (1980-82) Data on Hazardous Wastes, Rubber Wastes and Oil Wastes - 1983 (1984) The Development of an Information Data Base and Substructure for a 4-R's Program in Saskatchewan (1986)			Canadian Waste Materials Exchange	Environmental Management and Protection Act Dangerous Goods Transportation Act Dangerous Goods Transportation Regulations Municipal Refuse Management Regulations Mineral Resources Act Mineral Industry Pollution Prevention Regulations Pest Control Products Act Department of Environment Act Environmental Spill Control Regulations Pest Control Product Amendment Regulations Vehicles Act PCB Transportation Regulations	No companies established to transport or dispose of hazardous wastes. First province in Canada to license a low-level PCB waste oil treatment facility. Study to establish framework for waste minimization program Pesticide Container Disposal Program Annual collection of derelict vehicles and delivery to provincial steel mill Provision of emergency response services	Federal TDG regulations adopted up to Part IX
Manitoba	Hazardous Wastes in Northern and Western Canada (1979-81) Canadian National Inventory of Hazardous and Toxic Wastes (1980-82)	Manitoba Hazardous Waste Management Corporation	Biomass Energy Institute Inc. (non-profit organization providing appraisal of renewable sources of energy) Manitoba Environmental Council	Manitoba Waste Exchange Canadian Waste Materials Exchange	Dangerous Goods Handling and Transportation Act Classification Criteria for Products, Substances and Organisms Regulation	Manitoba Clean Environment Commission requested by Manitoba Ministry of Environment to study need for provincial waste management system	Province has a "WasteLine" "Bio-Joule" magazine published six times a year by Biomass Energy Institute Federal TDG regulations are adopted in part or in full.

TABLE B.1. PROVINCIAL HAZARDOUS WASTE MANAGEMENT ACTIVITIES (Cont'd)

PROVINCE	HAZARDOUS WASTE STUDIES (STUDY DATE)	WASTE MANAGEMENT CORPORATIONS	WASTE MANAGEMENT ORGANIZATIONS AND COUNCILS	WASTE MATERIALS EXCHANGES	APPLICABLE PROVINCIAL REGULATIONS	WASTE MANAGEMENT ACTIVITES AND PROGRAMS	COMMENTS
Manitoba (Cont'd)	Data on Hazardous Wastes, Rubber Wastes and Oil Wastes - 1983 (1984) Hazardous Waste Management in Manitoba (1985) Report on Public Hearings of the Clean Environment Commission (1987)		Recycling Council of Manitoba Clean Environment Commission		Regulations Respecting the Handling, Offering for Transport and Transporting of Dangerous Goods The Environment Act Pesticides Regulation Generator Registration and Carrier Licensing Regulation Manifest Regulation Environmental Accident Reporting Regulation	Manitoba Symposium on Hazardous and Special Wastes Household Hazardous Waste Days Public education and involvement program undertaken by Hazardous and Special Waste Management Coordinator Several municipalities have initiated programs to collect chemical pesticide containers 3-Phase Hazardous and Special Waste Management Plan	
Ontario	OMMC Waste Quantities Study (1981) Ontario Industrial Hazardous Waste Survey (1980) Ontario Ministry of the Environment Waplil System (ongoing since 1977) Canadian National Inventory of Hazardous and Toxic Wastes (1980-82) Data on Hazardous Wastes, Rubber Wastes and Oil Wastes - 1983 (1984) The OMMC Undertaking (1988)	Ontario Waste Management Corporation	Recycling Council of Ontario Ontario Research Foundation	Ontario Waste Exchange Canadian Waste Materials Exchange	Environmental Protection Act Waste Management - General Regulation (Regulation 309) Waste Management - PCBs Regulation Mobile PCB Destruction Facilities Regulation Spills Regulation Environmental Assessment Act Dangerous Goods Transportation Act	"Blueprint for Waste Management in the 1980s" Commission on Mobile PCB Destruction Facilities Provincial "Comprehensive Funding Program" "OMMC Exchange" published by OMMC Waste Exchange Bulletin Municipal Recycling Support Program Waste Management Improvement Program Waste Management Master Plan Program	Federal TDG regulations adopted Legislation governing biomedical wastes and used oils

TABLE B.1. PROVINCIAL HAZARDOUS WASTE MANAGEMENT ACTIVITIES (Cont'd)

PROVINCE	HAZARDOUS WASTE STUDIES (STUDY DATE)	WASTE MANAGEMENT CORPORATIONS	WASTE MANAGEMENT ORGANIZATIONS AND COUNCILS	WASTE MATERIALS EXCHANGES	APPLICABLE PROVINCIAL REGULATIONS	WASTE MANAGEMENT ACTIVITES AND PROGRAMS	COMMENTS
Ontario (Cont'd)					Dangerous Goods Transportation - General Regulation Consolidated Hearings Act Municipal Act Planning Act Ontario Water Resources Act Ontario Waste Management Corporation Act Pesticides Act	OMMC Waste Reduction Program Household Hazardous Waste Collection Program Municipal Industrial Strategy for Abatement Program ONSITE Program	
Quebec	Canadian National Inventory of Hazardous and Toxic Wastes (1980-82) Market Study of Dangerous Organic Wastes (1983) Data on Hazardous Wastes, Rubber Wastes and Oil Wastes - 1983 (1984)			Canadian Waste Materials Exchange	Environmental Quality Act Hazardous Waste Regulation Regulation Respecting Solid Waste Quality of the Atmosphere Regulation Regulation Respecting the Transport of Waste Transport of Dangerous Substance Regulation (draft)	Establishment of special task force, GERLED, to assess appropriate waste management in province Fund for hazardous waste management research Provincial environment labs being equipped with specialized environmental analyses equipment	Regulations for pesticide wastes and biomedical wastes currently being developed Portions of Federal TDG regulations adopted Provinces policy that private sector is best able to treat and dispose of hazardous waste Legislation governing used oils.
New Brunswick	Hazardous Wastes Inventory Report for the Atlantic Region (1979)		New Brunswick Environmental Council	Canadian Waste Materials Exchange	Clean Environment Act Air Quality Regulation	Conceptual plan for waste management in the province	Interprovincial waste movement is manifested by the federal TDG regulations

TABLE B.1 PROVINCIAL HAZARDOUS WASTE MANAGEMENT ACTIVITIES (Cont'd)

PROVINCE	HAZARDOUS WASTE STUDIES (STUDY DATE)	WASTE MANAGEMENT CORPORATIONS	WASTE MANAGEMENT ORGANIZATIONS AND COUNCILS	WASTE MATERIALS EXCHANGES	APPLICABLE PROVINCIAL REGULATIONS	WASTE MANAGEMENT ACTIVITES AND PROGRAMS	COMMENTS
New Brunswick (Cont'd)	Canadian National Inventory of Hazardous and Toxic Wastes (1980-82) Hazardous Waste in New Brunswick (1982) Data on Hazardous Wastes, Rubber Wastes and Oil Wastes - 1983 (1986)				Water Quality Regulation Pesticides Control Act Pesticides Control Act-General Regulation		Requirements of federal TDG Act for PCB transport is being enforced intraprovincially Federal TDG regulations not adopted for intraprovincial waste transport
Nova Scotia	Hazardous Wastes Inventory Report for the Atlantic Region (1979) Canadian National Inventory of Hazardous and Toxic Wastes (1980-82) Data on Hazardous Wastes, Rubber Wastes and Oil Wastes - 1983 (1986) Industrial/Institutional Special Waste Management Study (1986) Ministers Task force on Hazard -ous Waste Management (1987)			Canadian Waste Materials Exchange	Environmental Protection Act Dangerous Goods Transportation Act General Regulations Dangerous Goods and Hazardous Waste Management Act	Task Force on Hazardous Waste Management Commissioned by Nova Scotia Department of Environment Waste manifest system implemented	Federal TDG regulations adopted except Parts X, XI and XIII
Prince Edward Island	Hazardous Wastes Inventory Report for the Atlantic Region (1980) Canadian National Inventory of Toxic and Hazardous Wastes (1980-82) Data on Hazardous Wastes, Rubber Wastes and Oil Wastes - 1983 (1984)			Canadian Waste Materials Exchange	Environment Protection Act Dangerous Goods (Transportation) Act Dangerous Goods (Transportation) Regulations Pesticide Control Act Pesticide Control Regulations		Federal TDG regulations adopted for inter and intraprovincial waste manifesting. Federal TDG regulations adopted except Parts X, XI, and XIII Department of Community and Cultural Affairs acts as an information broker No plans to develop a treatment, storage and disposal facility in the province
Newfoundland	Hazardous Waste Inventory Report for Newfoundland and Labrador (1983)			Canadian Waste Materials Exchange	Waste Material (Disposal) Act Department of Environment Act	Several interim storage sites for PCB wastes	Federal TDG regulation adopted

TABLE B.1 PROVINCIAL HAZARDOUS WASTE MANAGEMENT ACTIVITIES (Cont'd)

PROVINCE	HAZARDOUS WASTE STUDIES (STUDY DATE)	WASTE MANAGEMENT CORPORATIONS	WASTE MANAGEMENT ORGANIZATIONS AND COUNCILS	WASTE MATERIALS EXCHANGES	APPLICABLE PROVINCIAL REGULATIONS	WASTE MANAGEMENT ACTIVITES AND PROGRAMS	COMMENTS
Newfoundland (Cont'd)	Canadian National Inventory of Hazardous and Toxic Wastes (1980-82) Data on Hazardous Wastes, Rubber Wastes and Oil Wastes - 1983 (1984) Hazardous Waste Disposal Study - Goose Bay, Labrador (1987)				Dangerous Goods Transportation Act Dangerous Goods Transportation Regulations Pesticides Control Act Pesticide Control Regulations Environmental Assessment Act Storage and Handling of Gasoline and Associated Products Regulations Department of Health Act		
Northwest Territories	Hazardous Wastes in Northern and Western Canada (1979) Canadian National Inventory of Hazardous and Toxic Wastes (1980-82) Data on Hazardous Wastes, Rubber Wastes and Oil Wastes - 1983 (1984)			Canadian Waste Materials Exchange			Territorial government developing environmental legislation and assessing need for a hazardous waste facility Utilize federal legislation for waste management
Yukon Territory	Hazardous Wastes in Northern and Western Canada (1979) Canadian National Inventory of Hazardous and Toxic Wastes (1980-82) Data on Hazardous Wastes, Rubber Wastes and Oil Wastes - 1983 (1984) Waste Management in the North (1986)			Canadian Waste Materials Exchange			Federal Environmental Protection Service till recently providing management of hazardous wastes Territorial government developing environmental legislation and assessing need for a hazardous waste facility Utilize federal legislation for waste management

disposal. A portion of the collected material is recycled, some solvents are incinerated at the University of British Columbia's incinerator, and the remaining wastes are sent out of the province for disposal.

In the summer of 1987, the Recycling Council of British Columbia launched a waste exchange program and have since published their first Waste Exchange Bulletin and Recycling Directory. The B.C. Waste Exchange is a one year pilot project (Ryle, 1988). Additionally, a Committee of Inquiry into the management of special wastes in British Columbia was recently appointed. The mandate of the Special Waste Advisory Committee was to review and assess policy and technical options for initiating an effective and comprehensive waste management system for the province that addresses the appropriate treatment, storage and disposal of special wastes. Opportunities for reducing, reusing, recycling and recovery of special wastes is also addressed. The findings of the Committee have resulted in initial steps for establishment of the B.C. Special Waste Services Inc. a joint venture by four privately owned companies. The B. C. Special Waste Services Facility will provide appropriate management of special wastes in British Columbia. However, no government policy decisions have been made to restrict facility use to British Columbia wastes nor does this facility have a monopoly on the commercial waste management industry in the province (Hicke, 1988). Services to be provided include rotary kiln incineration and physical/chemical processes such as solidification and neutralization, and secure chemical landfilling (Pasko, 1988; Hicke, 1988).

B.1.1.2 Alberta

In the late seventies, the Government of Alberta made special waste management a priority with conduct of a comprehensive survey of waste levels, waste sources and waste disposal practices. The result of this investigation was the creation of the Alberta Special Waste Management System, a cooperative effort between government and industry. The first step in the three-part program was the construction of a treatment plant, the Alberta Special Waste Treatment Centre, located near Swan Hills, Alberta capable of neutralizing most wastes originating in the province. The Swan Hills Central Treatment Facility officially opened September 11, 1987. The Treatment Centre is jointly owned and operated by industry and government and is the exclusive offsite facility for the treatment of special wastes in Alberta until at least 1994. Note, however, that provisions have been made whereby the government can change this policy in June 1989. This Centre is capable of handling many waste types such as solvents, acids/alkalies, bleaches/oxidizers, heavy metals/pesticides/cyanides, and bio-accumulative chemicals that multiply in the food chain. Organic liquids and solids are destroyed by high-temperature incineration, inorganic liquids and solids are treated by physical or chemical methods such as neutralization or oxidation/reduction, and contaminated bulk solids (including contaminated soil) which cannot be treated by other means are stabilized and landfilled. To encourage the use of this facility and discourage illegal or substandard disposal practices special waste transportation rates throughout the province are uniform. This "postage stamp" policy, as it is referred to, ensures that provincial waste generators will not be disproportionately advantaged or disadvantaged by the costs of shipping materials to the central facility.

The Alberta Special Waste Management System's second step is the creation of transfer stations in major cities for special waste identification and sorting. The third stage involves strategic placement of smaller collection stations for consumer drop-off in subsidiary areas. Steps two and three are ongoing. Alberta's Special Waste Management System undertakes the identification, receipt, movement, treatment and safe disposal of most hazardous wastes within Alberta (explosives and radioactive wastes are excluded). Such wastes can be generated by large, medium or small industries, even households.

Alberta has a special waste management corporation, a recycling council, a waste exchange, and provincial waste management initiatives including the "Help End Landfill Pollution Program (HELP)." The Alberta Special Waste Management Corporation (ASWMC) is a crown agency established to oversee and manage the special waste management system in Alberta. As part of the waste management system consideration is given to the 4R's - reduction, reuse, recycling and recovery of wastes. The ASWMC has neither sole nor primary responsibility for the development of waste treatment facilities. The government retains overall authority and is responsible for the policy framework within which the province's waste management system is planned. In addition, regulatory authority rests with the various provincial government agencies which set and enforce standards, approve and license facilities, and monitor operations. The ASWMC's role is to oversee the development and coordination of the waste management system, while Chem-Security Ltd. constructs and operates the Central Treatment Facility and the transportation network (Corpus Information Services, 1986). The ASWMC

provides information and education programs, and publishes a newsletter entitled "Collections". The government has also reaffirmed that its 1979 and 1982 moratoriums on approvals of specific waste treatment facilities will continue. This will ensure that the development of a comprehensive special waste management system in the province proceeds under the direction of the corporation alone.

The Alberta Waste Materials Exchange (AWME) was established in 1984 as a project of the Alberta Research Council with funding from Alberta Environment. It operates in conjunction with the Canadian Waste Materials Exchange (CWME) as an information clearinghouse designed to put potential users of waste material in contact with waste producers. A bi-monthly bulletin is published and distributed, without charge, to industries that may be able to recycle or reuse the available materials.

The Recycling Council of Alberta was established in 1987 to promote increased recycling of all types in the Province through four main activities. These are: (1) organizing and operating a public education program to make people aware of the benefits of recycling; (2) to act as an interface between industries, collectors and consumers involved in recycling by providing activities such as the publication of a newsletter, the operation of information services and/or the organization of conferences; (3) to act as an interface between the recycling industry and government to make recommendations regarding recycling and by providing provincial recycling statistics; and (4) to encourage market development for recycled materials through research and development of new ways to use and new uses for recycled materials.

Several programs on waste management are inherent in the province. The Help End Landfill Pollution or HELP Program is a phased program aimed at identifying and solving the problems created by past landfill practices. Phase One, an inventory of active, closed and abandoned industrial landfill sites in the province, has been completed. The province also maintains a program to reduce the environmental and health hazards associated with used agricultural chemical containers. A province-wide collection program has been underway since 1980 (and has since been duplicated in Saskatchewan and Manitoba) with the establishment of permanent depots for the collection of steel and plastic containers for recovery, cleaning and recycling. Containers currently unable to be recycled are being stockpiled for future recycling opportunitites. A special Alberta Oil Sands Environmental Research Program is also in place to address the disposal of liquid and solid wastes generated by the oil sands processing industry. Alberta has an Oil Drop Program providing consumers with drop-off points to deposit used lubricating oil. The province also provides a Disaster Preparedness and Emergency Response Program that responds to spills and fires involving dangerous goods. Additionally, the Alberta Environment Centre is conducting a research program on the ability to solidify hazardous wastes.

B.1.1.3 Saskatchewan

Saskatchewan was the first province in Canada to license a low-level PCB waste treatment facility, opened in 1985, to decontaminate low-level PCB (500 ppm) contaminated oils from the province. Currently, the Saskatchewan Department of Environment is developing a strategy to handle the

province's hazardous and industrial wastes. One component of this strategy is a program aimed at minimizing the amount of wastes that must be disposed of by the industry and the public. Waste minimization through a provincial waste exchange was deemed as a useful mechanism in attaining this goal. The Saskatchewan Research Council was contracted to establish the framework of the waste minimization program and to assist the Department of Environment in its implementation. The study methodology included detailed interviews with the managers of waste exchanges in North America as well as other organizations involved in waste reduction.

Other waste management programs in the province include: a pesticide container disposal program similar to the programs in Alberta and Manitoba ongoing since 1983; collection each year of derelict vehicles and delivery to a provincial steel mill; and, since 1985, provision of emergency response services in the event of a waste spill.

B.1.1.4 Manitoba

In 1982, a three phased Hazardous and Special Waste Management Plan was initiated by the Province of Manitoba to develop and implement an appropriate management system for the handling, treatment, and ultimate disposal of hazardous wastes generated within the Province. Phase One began with a public symposium held in 1983 on hazardous and special wastes. The Symposium addressed and made several recommendations concerning the following issues: facility siting; transportation access and safety; long-term safety and monitoring; public participation; recycling and reclaiming; public or private ownership; alternate technologies; why hazardous wastes at all?; secure landfilling;

legislation/regulation/enforcement; and, low-level radioactive waste. Following the Symposium, information meetings were held in many communities throughout the province to increase public awareness and to solicit public input. Subsequently, public hearings were held by the Clean Environment Commission on management system needs and criteria. The final report of the commission, together with a report on the 1983 Symposium formed the basis for initial planning of the management system and the development of provincial legislation specific to hazardous waste management. Several recommendations of these reports have been undertaken including a public education and involvement program whereby the Hazardous and Special Waste Management Coordinator toured the province to explain the waste problem, to identify possible solutions and to solicit public views.

Also in 1984 as part of Phase One, the Manitoba Waste Exchange (MWE) was initiated. The MWE is operated by the Biomass Energy Institute, Inc. and until 1987 its operation was sponsored by Manitoba Environment Workplace Safety and Health. The Biomass Energy Institute is a private, non-profit organization operating since 1972 to address energy issues and, in recent years, waste management, recycling, and waste exchange. Six times a year the Biomass Energy Institute publishes "bio-joule", a magazine addressing bioenergy research, technology, trade and development. The MWE is operated as part of an overall waste reduction/ recycling program to reduce the amount of waste for disposal in Manitoba. The Exchange provides a co-ordinating framework to facilitate waste recycling transactions by industry and provides a referral service regarding waste disposal, reduction and recycling. The MWE

publishes the Manitoba Waste Exchange Bulletin three times a year. The Bulletin is distributed free of charge. Additionally, waste listing information presented in the MWE Bulletin is sent to the Canadian Waste Materials Exchange for inclusion in the national, bimonthly waste bulletin. A provincial "WasteLine" is also provided by the MWE for advice on waste management. The Industrial Technology Centre, a division of the Manitoba Research Council, provides assistance in identifying waste materials suitable for listing in the MWE Bulletin. Since 1987, the MWE has been sponsored by the Manitoba Hazardous Waste Management Corporation (MHWMC).

The MHWMC, a crown corporation, was established in 1986 to own and operate waste management facilities in Manitoba. The MHWMC is developing an integrated waste management system for Manitoba that will provide for the collection, storage, treatment, and disposal of hazardous wastes. The Corporation offers a generator assistance program that can provide informal technical advice on waste reduction technologies and services.

Phase Two of the Action Plan utilizes recommendations and criteria from Phase One to determine an appropriate collection, treatment and disposal system for Manitoba as well as the selection of potential sites for facility implementation. Phase Three involves implementation of an appropriate hazardous waste management system for the province, including necessary monitoring and control, based on the results of public consultation in Phases One and Two. Phase Two is currently ongoing.

Another waste management program in the province is the Household Hazardous Waste Days, a major activity of Manitoba's program for Canadian Environment Week. This program has been undertaken since the summer of 1986. The purpose of the three-day event is to collect unwanted toxic household products that may be hazardous to human health or the environment if thrown out with everyday garbage. A collection depot for recyclables such as paper, glass, plastics and metal was operated by the Recycling Council of Manitoba in conjunction with the event. Staff and resources of the Biomass Energy Institute, federal, provincial and municipal governments are involved in organization and operation of the event.

Additionally, several municipalities in the province maintain a chemical pesticide container collection program, similar to that in Alberta and Saskatchewan. These municipalities, with the assistance of federal and provincial governments, have programs to separate pesticide containers from the rest of the wastes being taken to municipal landfills. The cans are crushed and the liquid pesticide residues collected. These residues are shipped out of the province for disposal.

B.1.1.5 Ontario

Ontario is a leader in the hazardous waste management industry largely due to its population, waste quantity generated and industrial base. Several waste management activities, programs and organizations exist in the province.

The Ontario Ministry of the Environment (OMOE) was created in 1971. In mid-1983, the OMOE issued the province's "Blueprint for Waste Management in the 1980s". The document and its detailed appendices set forth policy, legislative and regulatory proposals relating to virtually every phase of waste management. The Blueprint stressed the importance of the "4Rs" - reduction, re-use, recycling and recovery - in the management of industrial, residential and special wastes, and emphasized that government, industry and the public each have a role to play in waste management. Revisions were also proposed to provincial legislation governing waste management. Waste management planning in Ontario continues to be guided by the "Blueprint for Waste Management."

In 1984, a commission was established to address proposed regulations and public opinion on the regulatory control of mobile PCB destruction facilities. The OMOE has a research and development program for internal and external research on air and water pollution, solid and liquid waste, analytical methods, toxicity and environmental health. This research is funded by the Ontario Ministry of Environment or the Provincial Lottery Trust Fund, with asi na support supplied by other interested government departments (usually Environment Canada or the provincial Ministry of Energy).

In June 1987, OMOE initiated a program to reduce industrial waste generation in Ontario. The program provides grants to support industrial waste reduction initiatives on a project specific basis. The Industrial Waste Reduction Program has three staff and has been allocated approximately $1.0 million annually until March 1989, at

which time budget requirements for the program will be reevaluated. Given the commitment to waste reduction programs generally in Ontario, however, it is probable that the program will be expanded at that time.

Major efforts are expected to be expended by the OMOE during the next couple of years on strategy updating and regulatory rescoping/refinement. During this summer, the OMOE intends to generate and circulate discussion papers which will address OMOE strategy during the next decade. Some aspects which will be focussed upon will include; financial assurance, best management practices, enforcement of landfill constraints, and standards for carriers and receivers (Breeze, 1988).

The Ontario Waste Management Corporation (OWMC) is a crown agency established in 1981. The primary responsibility of the OWMC is to design, construct and operate a province-wide system for the treatment and disposal of liquid industrial and hazardous wastes along with the development of a long-term program to encourage and assist in greater waste reduction, reuse, recycling, recovery and exchange. The OWMC in its draft report "OWMC Undertaking" (OWMC, 1988) identified the demand for such a treatment and disposal facility in the province with consideration of the commercial services currently available provincially. The OWMC's philosophy is to fill the gap in the provincial supply - demand scenario for provision of commercial hazardous waste management services. A centralized facility with an initial capacity of 150,000 tonnes per annum and the potential for modular expansion to 300,000 tonnes per annum was identified as being appropriate. The facility is to include commercial services for incineration

physical/chemical treatment and secure chemical landfilling. The OWMC is not a regulatory agency responsible for monitoring the industry; this responsibility lies with the provincial Ministry of the Environment. The OWMC has published several documents on waste management. It also publishes an irregular, informal newsletter, "OWMC Exchange", which up-dates its programs and contains details on general waste management literature, technologies and conferences.

The OWMC has a Waste Reduction Program designed to support and complement other existing efforts of the Ontario Waste Exchange, the OMOE, and private industry for industrial recycling activities. The following major programs are currently underway at the OWMC to assist generators in waste reduction activities:

- promotion and assistance to the Ontario Waste Exchange;
- search for and evaluation of new technology;
- information assistance to industry;
- onsite assessments;
- promotion of sound waste management;
- research and development; and,
- waste characterization.

Three additional waste reduction program components currently under consideration are:

- development of promotional activities such as an Award for Source Reduction Excellence in industry;

- provision of direct financial assistance to industry; and,

- examination of and comment on legislation.

The Ontario Waste Exchange (OWE), a joint program of the OWMC and the Ontario Research Foundation (ORF), was established in 1984 in order to encourage waste reduction. The OWE works in cooperation with the Canadian Waste Materials Exchange (CWME) to try to assist industries in finding practical ways of managing wastes. The OWE is managed by ORF under contract to the OWMC. The ORF also manages the CWME. The OWE is fully funded by the OWMC as part of its commitment to encourage industrial waste reduction by helping Ontario industries minimize waste production and find uses and users for those wastes that are produced. A Waste Exchange Bulletin is published by the OWMC on behalf of the OWE.

Aside from government initiatives in Ontario, there is a private program called "ON-SITE" developed and managed by Energy Pathways Inc. ON-SITE is a project to place unemployed professionals and technicians on the staffs of selected companies for six-month work terms in order to improve or accelerate the firm's waste management activities. Salaries and benefits are paid through Employment and Immigration Canada's Unemployment Insurance, Section 38-Job Creation Program. Training and management support is jointly funded by Section 38 and Tricil Limited. The ON-SITE program is a follow-up to pilot projects run in

Ontario and Nova Scotia which yielded impressive benefits for participating firms and resulted in permanent jobs for the participating engineers: 60% in Ontario and 25% in Nova Scotia. The participating companies achieve real improvements in waste management (Saskatchewan Research Council, 1986).

Other programs include: the Household Hazardous Waste Collection Program, implemented by the OMOE, to encourage municipally run "hazwaste" days by defraying part of the costs; and the recently announced Municipal Industrial Strategy for Abatement (MISA) Program.

B.1.1.6 Quebec

The Quebec Ministry of Environment (QMOE) has taken an active role in addressing the problems of hazardous waste. Primary initiatives include the establishment in 1983 of a special task force, le groupe d'étude et de restauration des lieux d'elimination des déchets dangereux (GERLED), to assess the dangers posed by active and abandoned disposal sites and the development and amendment of provincial regulations to specifically address appropriate hazardous waste management. GERLED is now a division within the provincial government.

The philosophy of the Quebec government is that the private sector is best able to treat and dispose of industrial and hazardous wastes, in compliance with the province's legislative and regulatory requirements. The QMOE also supports research in the area of hazardous waste management through its participation in the administration of a research fund. The fund, established by Stablex Canada Inc., is administered by the company, the Ministry, and the Centre de Recherche Industrielle du Québec. The QMOE

anticipates increased responsibility for environmental research and development and particularly hazardous waste site cleanup. To achieve this goal the QMOE has adopted a policy of equipping its labs for specialized environmental analyses such as the measurement of trace organics.

B.1.1.7 New Brunswick

In 1985, a conceptual plan for waste management in New Brunswick was developed and distributed for public review. In early 1986, public meetings were held to discuss the Department of Municipal Affairs and Environment's waste management plan. These meetings were conducted by the New Brunswick Environmental Council. This Council was established in 1971 to study, investigate and report on any matters dealing with the Clean Environment Act and functions as an advisory group to the Minister. Several mechanisms for waste management in the province were recommended. Currently, the province's hazardous wastes and controlled waste (ie., asbestos wastes and soils contaminated with spilled materials which cannot be landfilled) are treated onsite, stored or shipped to Quebec or Ontario for disposal. At present a limited need for a special treatment, storage and disposal facility in New Brunswick exists. The environment department acts as an information broker for industrial waste generators searching for appropriate disposal facilities and service companies outside New Brunswick. Assistance is also being provided to institutional waste generators (eg. schools, hospitals) to dispose of small quantities of hazardous waste.

B.1.1.8 Nova Scotia

Activities have been ongoing in Nova Scotia since late 1984 to assess the need for a special waste management strategy. In 1985, a Task Force on Hazardous Waste Management was established by the Minister of Environment to examine the hazardous waste management problem in the province and to file an action plan to deal with it. In late 1985, the Task Force submitted a Phase I Report to the Minister recommending that a comprehensive strategy for managing dangerous goods and hazardous wastes in the province be developed and that the public should be consulted to assist in the development of this strategy. These activities were undertaken in early 1986. The findings and recommendations of the Task Force are briefly discussed in Section B.1.4.7. The first step in the development of the province's hazardous waste management strategy was the implementation of a waste manifest system, part of the general manifest program under the province's transportation of dangerous goods legislation. Public information sessions are deemed as an integral part of the hazardous waste program's development.

B.1.1.9 Prince Edward Island

Prince Edward Island's industrial base is small and not indicative of an annual production of a large quantity of hazardous wastes. Nevertheless, the ultimate disposal of smaller quantities of toxic wastes from small businesses, schools, farms and households is being addressed by the provincial government. Currently, specific toxics and wastes are handled and disposed of on a case-by-case basis. There are no plans for initiation of a program to establish

a treatment, storage and disposal facility. The Department of Community and Cultural Affairs acts as an information broker to facilitate exchanges between waste generators and potential users of waste materials, and to provide information and advice on proper disposal technology and offsite treatment facilities.

B.1.1.10 Newfoundland

Newfoundland's hazardous waste management program consists of investigating historical disposal problems, responding to localized problems and regulating the transportation of dangerous goods. Provincial volumes of hazardous wastes generated do not justify the establishment of a provincial hazardous waste treatment and disposal facility. Currently, most industrial generators package and ship small quantities of hazardous wastes to out-of-province treatment, disposal and recycling facilities. To allow larger, more efficient waste shipments to be made, the government has identified that a provincial interim storage and transfer facility would be useful. Government, however, encourages construction and operation of such a facility by the private sector. The province has licensed several interim storage sites for PCB wastes awaiting final disposal and studies are currently ongoing to assess provincial PCB volumes and appropriate technologies for treatment or disposal of these wastes.

B.1.1.11 Yukon Territory and Northwest Territories

Waste management activities in the Territories are fairly limited due to the small industrial base. There is, however, a need for management of stored and annually generated hazardous wastes, particularly institutional

wastes. In general, the Federal Environmental Protection Service has been providing hazardous waste management services in the form of storage, treatment (where possible), and coordination of waste transport to approved facilities for treatment or disposal. In the Yukon Territory, this responsibility has now been directed towards the territorial Department of Indian and Northern Affairs and Northern Development (Wile, 1988). The territorial governments are each considering development of environmental protection legislation and assessing the need for a territorial hazardous waste facility (Wile, 1988; Tilden, 1988).

B.1.2 Provincial Waste Inventories Since 1982

The findings of provincial waste inventory studies up to 1982 were included in a "Data on Hazardous Wastes, Rubber Wastes and Oil Wastes in Canada - 1983" report (Proctor and Redfern et. al., 1984). Some provinces have inventoried provincial hazardous waste since 1982 as presented below.

B.1.2.1 Manitoba

During 1983 and 1984 a Hazardous Waste Information Exchange was implemented throughout Manitoba to solicit information from various Manitoba industries that are potential generators of hazardous waste. Information provided voluntarily by the industries participating in the Information Exchange supplemented by provincial and municipal government agency information resulted in the identification and quantification of hazardous wastes produced in the province, and the different types of industries that generate these wastes. This information was presented in a 1985 report entitled "Hazardous Waste

Management in Manitoba" (Yee et.al., 1985). The identified amount of hazardous waste generated in Manitoba was 20,325 tonnes/year (not including air emissions and recycled wastes), produced by at least 293 companies.

B.1.2.2 Ontario

In February 1988, the Ontario Waste Management Corporation (OWMC) published a draft document entitled "The OWMC Undertaking", and is the first of six volumes of OWMC's Environmental Assessment. Chapter 4 of the document examines the quantity and characteristics of waste currently generated in Ontario. Chapter 6 of the document presents estimates of Ontario's generated waste quantities potentially seeking offsite treatment and disposal in 1992 and 1997. Ontario currently generates over 50 percent of the total volume of hazardous wastes in Canada and as a result influences the magnitude of the industrial and waste management capacity. Therefore, since recent inventory data is available from the OWMC document the current and future waste inventory and factors affecting the waste inventory in Ontario are discussed below.

There are three major sources of information for estimating the quantities of wastes generated in Ontario:

- The Ministry of the Environment's (OMOE) generator registration database, which has been compiled from generator registration records submitted to the Ministry in accordance with Regulation 309.

- The OMOE manifest database which includes records of all of the subject wastes transported in Ontario in compliance with the manifesting provisions of Regulation 309.

- Surveys of waste generation in the province commissioned by the OWMC.

Despite some limitations, the OMOE generator registration database and the manifest database are the most comprehensive sources of waste quantity estimates in the province. The OWMC utilized both databases in its quantities evaluation OWMC, 1988). The generator registration database is the only source of detailed information on waste characteristics and on wastes treated and disposed of onsite.

Of the onsite and offsite reported waste approximately half (45.8%) of the waste falls into the "hazardous industrial" category, with "liquid industrial" (22.5%), "registerable solids" (13.5%) and "corrosive" (11.6%) being the other major contributors. Few wastes were classified as "acutely hazardous" or "hazardous chemical". No "severely toxic" or "PCB wastes" were reported in the database. The industries most prominent in waste generation are metals and machinery, resource-based industries and petroleum and chemicals.

PCB wastes are currently stored at various facilities around the province awaiting treatment. The Ministry maintains a separate database recording the type and location of PCB wastes for every site reporting under this

regulation. Waste generated by decommissioning and site cleanups would be manifested for all subject waste categories if shipped offsite for treatment, disposal or storage. However, a fairly large quantity of PCB-related wastes generated by these activities is not manifested. This waste is currently being stored onsite. On average, aproximately 45,000 tonnes of PCB contaminated soil was generated and stored in 1986 and 1987.

For most waste streams, the estimated waste quantities for 1992 and 1997 were derived by applying the economic growth rates, on a standard industrial classification (SIC) basis, with the projected gross domestic product (GDP) growth rates cut in half. However, growth was estimated for the following waste streams in a different manner (OWMC, 1988):

- PCB's in storage and in use are assumed to remain at their 1986 levels.

- The household waste estimates are based on recovery rates projected for 1992 and 1997, therefore, no growth rate was applied.

- Site cleanup and site decommissioning wastes were estimated independently for 1992 and 1997, no economic growth was applied.

Two basic sets of projections of Ontario-generated waste quantities potentially seeking offsite treatment and disposal in 1992 and 1997 have been developed: one for the current regulatory setting and one for an enhanced regulatory scenario.

The current regulatory scenario assumes that those regulations which are currently in place and committed will be implemented, including MISA. The quantities of waste potentially seeking offsite treatment and disposal in the years 1992 and 1997 range between approximately 800,000 and 1,100,000 for 1992 and from approximately 900,000 to 1,200,000 for 1997.

The enchanced regulatory scenario assumes that Ontario will adopt a landfill ban similar to that in the U.S. 1984 Hazardous and Solid Wastes Amendments to the Resource Conservation and Recovery Act, in addition to the regulations implemented in the current scenario. The quantities range between approximately 1,000,000 and 1,400,000 tonnes per year for the 1990s.

It is important to emphasize that these results are preliminary and that all of the factors which will affect quantities potentially seeking offsite treatment and disposal are not included.

B.1.2.3 New Brunswick

In 1985 a survey of more than 220 waste generating companies and institutions was undertaken to estimate the volume, sources and nature of hazardous wastes generated in New Brunswick. This survey indicated that approximately 1814 tonnes of hazardous material are produced in the province annually. It was also noted that a comprehensive waste inventory should be undertaken including detailed information on the volume of used lubricating oil generated in New Brunswick each year.

B.1.2.4 Nova Scotia

In late 1984 a study entitled "Industrial/Institutional Special Waste Management Study" was undertaken for the Halifax-Dartmouth Metropolitan area. The purpose of the study was to inventory sources and types of special wastes and to provide a basis for the development of a special waste management strategy. Data was collected by a telephone survey of industries and institutions generating significant waste quantities. Waste quantities were projected by the UCD class of the waste and the SIC code of the waste generator. Further analysis was conducted by the traffic zone of the generating industries, by the waste disposal techniques utilized by the industry, and by the acceptability of the methods of disposal. An overview of the findings of the study are briefly presented below (Porter Dillon, 1986):

- Approximately 22,800 tonnes per annum of special wastes are generated in the Metropolitan Area. Of this amount, 4,056 tonnes of wastes are deemed to be inappropriately disposed by existing methods. Of the 4,056 tonnes of waste, approximately 2,975 tonnes could be disposed by improved rinse water handling methods by industry, rather than discharge to sewerage systems. The remaining 1,081 tonnes of special waste would require disposal through a management system. Approximately 18 percent of this quantity is estimated as being generated by small industries.

- The quantity and variety of waste generated in the Metropolitan Area requiring disposal does not warrant a

specialized disposal technology being developed locally. Special waste disposal in the area can be accomplished by transhipment to approved waste handling facilities through a collection trans-shipment facility.

B.1.3 Provincial and Territorial Hazardous Waste Management Legislation

The regulation of appropriate hazardous waste management is the responsibility of the provincial and territorial governments. In instances where provincial regulations do not exist to adequately manage (i.e., store, dispose of, treat or transport) hazardous wastes, federal regulations are, in general, utilized. Provincially, however, the definition of a hazardous (or special) waste, the extent of the regulations and the degree to which these regulations are enforced varies. Provincial and territorial legislation utilized for hazardous waste management is briefly discussed below.

B.1.3.1 British Columbia

Waste Management Act (S.B.C. 1982, c.41, as amended)
- Waste Management Regulation (B.C.Reg.432/82,as amended)
- Special Waste Regulation (B.C.Reg.42/88)

Transport of Dangerous Goods Act (S.B.C. 1985, c.17)
Transport of Dangerous Goods Regulation (B.C.Reg. 203/85)

In 1982 the Waste Management Act was introduced. It outlines the provincial special waste management system and provides a mechanism for waste transportation manifests and storage, treatment and disposal facility authorization.

The Waste Management Regulation sets forth permit application requirements such as duties of applicant, publication in the British Columbia Gazette, application of interest to those who might be affected, final notifications, amendments and classifications and exemptions of wastes and operations.

In February 1988, the Special Waste Regulation was issued under the Waste Management Act and is expected to become effective in April 1988. This regulation addresses the handling and transportation of special wastes, and details the waste transfer manifest system to be used, licensing, packaging and identification requirements, and sets out the criteria and test protocols for determining what constitutes a special waste and what materials and quantities are exempt. Additionally, under this Regulation, British Columbia is one of two provinces in Canada with legislation specific to biomedical waste management; biomedical wastes are listed as special wastes.

In 1985 a provincial Transport of Dangerous Goods Act was proclaimed. The manifesting of dangerous goods, including hazardous wastes, are covered by regulations under this Act. British Columbia adopted the federal Transportation of Dangerous Goods Regulations, including the manifest provisions for intra-provincial transport, in 1985.

B.1.3.2 Alberta

Agricultural Chemicals Act (R.S.A. 1980, c.A-6, as amended)
Clean Air Act (R.S.A. 1980, c.C-12, as amended)
Clean Water Act (R.S.A. 1980, c.C-13, as amended)

Department of Environment Act (R.S.A. 1980,c. D-19, as amended)
Energy Resources Conservation Act (R.S.A. 1980, E-11)
Hazardous Chemicals Act (R.S.A. 1980,c.H-3, as amended)
Hazardous Waste Regulation (Alta. Reg. 505/87)
Oil and Gas Conservation Act (R.S.A. 1980, c.O-5, as amended)
Pesticides Sales, Use and Handling Regulations (Alta. Reg. 213/80, as amended)
Special Waste Management Corporation Act (R.S.A. 1982, c.S-21.5, as amended)
Transportation of Dangerous Goods Control Act (R.S.A. 1982,c.T-6.5)
Transportation of Dangerous Goods Control Regulation (Alta. Reg. 383/85)

The major enabling statute for the formation of a comprehensive legislative framework to control hazardous wastes is the Department of Environment Act. Under this Act regulations may be made prescribing disposal methods for any substances detrimental to the environment.

The Hazardous Chemicals Act of 1980 is designed specifically for the control of hazardous or special wastes. Under this Act, Alberta Environment has the right to draft regulations to; (1) establish a schedule of hazardous chemicals, (2) develop a manifest program to track and control hazardous materials, and (3) govern the storage and disposal of hazardous chemicals (Corpus Information Services, 1986). In 1982, the Special Waste Management Corporation Act was proclaimed authorizing the establishment of the Alberta Special Waste Management Corporation (ASWMC) and defining its responsibilities. In early 1985 a package of amendments, the Environmental Statutes Amendment

Act was proclaimed. This package included amendments to the Special Waste Management Corporation Act and the Hazardous Chemicals Act.

The Hazardous Waste Regulation was filed in 1987 under the Hazardous Chemicals Act and in force April 1988. This Regulation deals with the bonding of offsite hazardous waste management facilities, storage conditions, hazardous waste manifests, and the use of a new dangerous goods classification system. It adopts by reference the extensive list of dangerous substances presented in Schedule II of the federal Transportation of Dangerous Goods (TDG) regulations and expands the definition of hazardous waste (Corpus Information Services, 1986).

The provincial Transportation of Dangerous Goods Control Regulation under the Transportation of Dangerous Goods Control Act, proclaimed in 1986, provides a manifest system to control the movement of both special wastes and dangerous goods. This provincial regulation adopted the Federal TDG regulations, Parts I to IX, for the handling, offering for transport or transport of dangerous goods in Alberta.

Both the Clean Air Act and the Clean Water Act may be used to control the improper treatment or disposal of hazardous wastes.

Alberta utilizes deep well injection frequently for waste disposal. Licensing and approval for deep well injection must be obtained from the Standards and Approvals Division of Alberta Environment. The Alberta Oil and Gas Conservation Act also sets out provisions for deep well

disposal including the requirement that each project be approved by the Energy Resources Conservation Board (Corpus Information Services, 1986).

The Agricultural Chemicals Act and the Pesticides Sales, Use and Handling Regulations identify the procedures for the transportation, handling and disposal of agricultural chemicals.

Alberta legislation requires that commercial waste storage facilites, with the exception of generator storage sites, as well as transportation, treatment and disposal operations be authorized by the ASWMC. This so called "one-window approach" places the ASWMC in the position of overseeing the entire provincial waste handling and transfer network. Oilfield wastes and special wastes that are produced by households and farmers are not subject to this provision (Corpus Information Services, 1986).

B.1.3.3 Saskatchewan

Environmental Management and Protection Act (S.S. 1983-84, c.E-10.2)

Department of the Environment Act (S.S. 1983-84, c.D-14.1)

- Environmental Spill Control Regulations (R.R.S. 1981, c. D-14, Reg. 1, as amended)

Mineral Resources Act

- Mineral Industry Pollution Prevention Regulations (Sask. Reg. 317/69, as amended)

Pest Control Products (Saskatchewan) Act (S.S. 1979-80, c. P-8, as amended)

- Pest Control Products Amendment Regulations (Sask. Reg. 207/76, as amended)

Municipal Refuse Management Regulations (Sask. Reg. 701/86)
Dangerous Goods Transportation Act (S.S. 1984-85, c.D-1.2)
Dangerous Goods Transportation Regulations
Vehicles Act
PCB Transportation Regulations (Sask. Reg. 521/85)

The main legislation in Saskatchewan that governs hazardous waste management is the Environmental Management and Protection Act. This Act, proclaimed in 1984, controls the designation, transportation, storage, processing, destruction/disposal, re-use and recycling of hazardous wastes.

The Pollution Prevention Regulations for the Mineral Industry contain some provisions for waste disposal including disposal by injection and waste disposal basins.

The PCB Transportation Regulations, under the Vehicles Act, were promulgated in 1985 to require that articles containing PCB's be drained prior to shipment or enclosed in a rigid, leak-proof container.

The Municipal Refuse Management Regulations prohibit hazardous wastes going to landfills.

The transportation, use, storage and disposal of pest control products is regulated under the Pest Control Products Act.

The Provincial Dangerous Goods Transportation Act and Regulations were proclaimed in 1985 to regulate highway transport of dangerous goods. Saskatchewan has adopted up to Part IX of the federal Transportation of Dangerous Goods (TDG) Regulation.

B.1.3.4 Manitoba

The Environment Act (C.C.S.M., c. E125)

Pesticides Regulation (Man. Reg. 98/85)

Dangerous Goods Handling and Transportation Act (C.C.S.M., c.D-12)

Classification Criteria for Products, Substances and Organisms Regulation (Man. Reg. 282/87)

Regulations Respecting the Handling, Offering for Transport and Transporting of Dangerous Goods (Man. Reg. 141/87, as amended)

Generator Registration and Carrier Licensing Regulation (Man. Reg. 140/88, as amended)

Manifest Regulation (Man. Reg. 139/88)

Environmental Accident Reporting Regulation (Man. Reg. 439/87)

In 1984 Manitoba's Dangerous Goods Handling and Transportation Act was proclaimed. This Act replaces the province's Transportation of Dangerous Goods Act, incorporating dangerous goods handling and transport and hazardous waste management provisions. An important feature of the legislation is a requirement for hazardous waste generators and handlers to register with the provincial Department of Environment and Workplace Safety and Health. The Dangerous Goods Handling and Transportation Act also provides mechanisms for waste manifests, determination of liability for environmental damage, and the establishment of a

cleanup fund. A set of comprehensive regulations under this Act were adopted in 1985 and revised in 1987. The Classification Criteria for Products, Substances and Organisms Regulation establishes the province's dangerous goods classification criteria and lists approximately 1,600 specified dangerous substances. This regulation was designed to compliment and be consistent with the federal TDG regulations. The extensive list of dangerous chemicals and goods in Schedule II of the federal regulations was reduced in the Manitoba regulation to reflect the fact that many of the substances are not produced in Manitoba. In 1986, Regulations Respecting the Handling, Offering for Transport and Transporting of Dangerous Goods adopted the federal TDG regulation excluding Parts X to XIII.

The Generator Registration and Carrier Licensing Regulation of 1987 requires generator registration and licensing for waste transport. In 1988, this regulation was amended to include the definition of recycling, thereby requiring recyclers and generators to register. In 1988, the Manifest Regulation was proclaimed to address particulars not included in the adopted federal TDG regulation. The Manifest Regulation enables multiple pickup and allows recycled materials to be exempt from manifesting. The Environmental Accident Reporting Regulation of 1987 requires that any accidents or spills involving dangerous goods or hazardous wastes to be reported.

The Environment Act proclaimed in 1988 replaces the Clean Environment Act for regulating the approval and licensing of waste management and disposal projects.

B.1.3.5 Ontario

Environmental Protection Act (R.S.O. 1980, c.141, as amended)

- Waste Management - General Regulation (O.Reg. 309, as amended)
- Waste Management - PCBs Regulation (O.Reg. 11/82, as amended)
- Spills Regulation (O.Reg. 618/85)

Mobile PCB Destruction Facilities Regulation (O.Reg.148/86)

Environmental Assessment Act (R.S.O. 1980, c.140)

Dangerous Goods Transportaton Act, 1981 (S.O. 1981, c.69)

- Dangerous Goods Transportation - General Regulation (O.Reg. 363/85)

Consolidated Hearings Act (S.O. 1981, c.20)

Municipal Act (R.S.O. 1980, c.302)

Planning Act (R.S.O. 1980, c379)

Ontario Water Resources Act (R.S.O. 1980, c.361,as amended)

Ontario Waste Management Corporation Act (S.O. 1981, c.21)

Pesticides Act (R.S.O. 1980, c.376, as amended)

The principal statute governing waste management in Ontario is the Environmental Protection Act, Part V, Waste Management. The Act is administered by the Ministry of Environment. Part V provides definitions, requirements and procedures for acquiring certificates of approval for the operation of existing waste management systems and disposalsites as well as proposed systems, sites, expansions or alterations. The Act also specifies when public hearings must be held with regard to the issuing of certificates of approval, allows the imposition of financial guarantees, and controls land use after closure.

Part IX of the Environmental Protection Act, commonly known as the "Spills Bill," was proclaimed in 1985. The Spills Bill embraces three major principles: (1) owners, handlers and carriers of hazardous materials must take all precautions to prevent spills; (2) once a spill has taken place, those same parties bear full and absolute responsibility for its immediate control and cleanup and for restoration measures to undo any damage to the environment; and, (3) and innocent victims who bear costs or suffer damage from a spill are entitled to prompt reimbursement and compensation (Corpus Information Services, 1986). The Environmental Compensation Corporation and an Environmental Security Fund have been established to compensate victims and deal quickly with spill cleanup costs. The Spills Regulation establishes eligibility requirements and formulas for calculating the amount of payments from the Environmental Compensation Corporation for damage or cleanup costs incurred.

The primary regulation for the control of hazardous wastes under the Environmental Protection Act is the General Regulation - Waste Management, commonly known as Regulation 309. This regulation defines the various forms of waste including hazardous waste, sets out the designation of wastes and requires that waste generators and their waste streams to be registered with the OMOE. It classifies waste management systems and waste disposal sites, and prescribes standards for the location, maintenance and operation of landfill sites, dumps, organic soil conditioning sites, waste management systems and for vehicles to collect wastes. Regulation 309 expands the province's manifest (waybill) system for cradle-to-grave tracking of wastes to include solid hazardous wastes as

well as liquid industrial wastes (Corpus Information Services, 1986). Ontario is one of two provinces in Canada with legislation that specifically mentions biomedical waste. Under Regulation 309 a pathological wastes is defined as a hazardous waste. Additionally, Ontario is one of two provinces in Canada with legislation pertaining to used oils. Used oil handling and disposal is controlled primarily by Regulation 309.

The Waste Management - PCB Regulation under the Environmental Protection Act governs the disposal of PCB's. Guidelines governing the Origin and Management of PCB Waste, was released in 1984. In 1986 regulations were proclaimed for mobile PCB destruction facilities. Other provincial guidelines address the Establishment, Maintenance, Operation and Closure of Waste Management Facilities, Environmental Protection Measures at Chemical Storage Facilities and Biomedical Waste Management.

In conjunction with the Environmental Protection Act is the Environmental Assessment Act. Waste management systems may be subject to hearings and assesesment by the Environmental Assessment Board before final approval. Three other acts also play a part in determining whether a disposal site or waste management system is eligible for approval. These are; the Consolidated Hearings Act, the Planning Act and the Municipal Act (Corpus Information Services, 1986).

The Ontario Water Resources Act has provisions prohibiting the deposit of materials into any Ontario waters and sets out penalties and fines for any such offences.

The Ontario Waste Management Corporation Act establishes a crown corporation to develop a central facility to receive, examine, store, treat and dispose of liquid industrial and hazardous wastes.

Ontario's Dangerous Goods Transportation Act and Regulations were proclaimed in 1985. The provincial regulation adopts the federal TDG regulations.

The Pesticides Act and Regulations provide legislation for the handling, storage, use, disposal and transportation of pesticides.

B.1.3.6 Quebec

Environmental Quality Act (R.S.Q. 1977, c.Q-2, as amended)
- Quality of the Atmosphere Regulation (R.R.Q. 1981, c.Q-2, r.20, as amended)
- Hazardous Waste Regulation (O.C. 1000-85)
- Regulation Respecting Solid Waste (R.R.Q. 1981, c.Q-2, r.14, as amended)
- Regulation Respecting the Transport of Waste (R.R.Q. 1981, c.T-12, r.16)

Highway Safety Code (R.S.Q., c.C-24.1)
- Transport of Dangerous Substance Regulation (draft)

The Quebec Environmental Quality Act provides a broad overview of environmental protection, including the disposal of wastes. In 1985, the Hazardous Waste Regulation, under the Environment Quality Act, was issued. This Regulation controls waste management practices and hazardous material transport. The Regulation addresses waste definitions and criteria, detailed disposal, recycling and storage practices for hazardous wastes, applications for required permits and certificates of

compliance, reporting and record keeping requirements, liability and insurance provisions, shipping manifests, notification and shipping numbers, and penalties and offences. The regulation also contains a schedule of 120 hazardous waste categories organized by industrial process. Additionally, Quebec is one of two provinces with legislation specific to used oils. The Hazardous Waste Regulation lists spent lubricating or cutting oil and spent hydraulic oil as hazardous wastes.

As a result of the Hazardous Waste Regulation and the Environmental Quality Act formal environmental impact assessment must be carried out before any new recycling or disposal facilities are constructed. This legislation has considerably improved hazardous waste management in the province but has also temporarily hindered the construction of new disposal and recycling activities.

The Quality of the Atmosphere Regulation governs the emission of contaminants into the atmosphere and includes emission standards and operating controls for hazardous waste, high temperature incinerators.

The Regulation Respecting the Transport of Waste provides requirements for obtaining permits for the transportation of solid waste or liquid sludge. The provincial draft Transport of Dangerous Substance Regulation, under the Highway Safety Code, is based on the federal TDG regulations. The regulation adopts by reference Parts III,IV, V and VI in their entirety, modifies Part 1, and adopts Part II, VII, VIII and IX largely. The deletions relate mainly to areas of federal responsibility - defence, air transport and marine transport. Regulations are currently being developed to address appropriate management of pesticides and biomedical wastes.

B.1.3.7 New Brunswick

Clean Environment Act (R.S.N.B. 1973, c.C-6, as amended)
- Appeal Regulation (N.B. Reg. 84-179)
- Air Quality Regulation (N.B. Reg. 83-208)
- Water Quality Regulation (N.B. Reg. 82-126)

Pesticides Control Act (R.S.N.B. 1973, c. P-8, as amended)
- Pesticides Control Act General Regulation (N.B. Reg. 83-57)

The province's Clean Environment Act addresses the discharge of wastes or contaminants into the atmosphere and waters through its Air Quality and Water Quality Regulations. It also designates substances as contaminants or any material to be a waste and sets fees for licensing and permits. This Act also provides a legislative framework for environmental impact assessments.

The storage, transportation and disposal of pesticides are governed by the Pesticides Control Act and its regulations.

New Brunswick is one of the few Canadian jurisdictions that have not implemented in some form the federal TDG regulation for intraprovincial waste movement. The federal TDG manifest is, however, being used to track out-of-province waste shipments. The Protective Direction under the federal TDG Act aimed at PCB transport is being enforced for intraprovincial shipments. The need for standards for vehicles and routes, and waste quality and type of hazardous wastes transported within the province is being addressed.

B.1.3.8 Nova Scotia

Environmental Protection Act (S.N.S. 1973, c.6, as amended)
Dangerous Goods and Hazardous Waste Management Act (S.N.S. 1986, C.7)
Dangerous Goods Transportation Act (S.N.S. 1982, c.5)
General Regulations (N.S. Reg. 152/85)

The Environmental Protection Act sets out procedures for obtaining provincial licenses for waste management system and pollution abatement such operations, imposes standards of compliance and details penalties for non-compliance. This Act prevails over all other acts, including municipal bylaws.

In 1982, the Dangerous Goods Transportation Act was proclaimed. In 1985, General Regulations under this Act were promulgated which adopt the federal TDG regulations with the exception of Parts X, XI and XIII and any provisions dealing with radioactive wastes.

The Dangerous Goods and Hazardous Waste Management Act of 1985 is enabling legislation for the development of legislation governing dangerous goods and hazardous wastes.

B.1.3.9 Prince Edward Island

Environmental Protection Act (S.P.E.I. 1975, c.9, as amended)
Dangerous Goods (Transportation) Act (S.P.E.I. 1981, c.10)
Dangerous Goods (Transportation) Regulations (P.E.I. Reg. EC 319/85)

Pesticide Control Act (S.P.E.I. 1984, c.29)
Pesticide Control Regulations (P.E.I. Reg. EC 543/84)

Prince Edward Island has no legislation dealing specifically with hazardous wastes. The province's Environmental Protection Act does, however, set out provisions regarding pollution which could be considered to include hazardous waste.

P.E.I. adopted the Federal TDG regulations excepts Parts X, XI, XIII, under its Dangerous Goods (Transportation) Act. The province's Dangerous Goods (Transportation) Regulations contain provisions addressing these areas.

The use, transportation, storage and disposal of agricultural chemicals and associated containers is regulated by the Pesticides Control Act and Pesticides Control Regulations of 1984.

B.1.3.10 Newfoundland

Waste Materials (Disposal) Act (S.N. 1973, No. 82, as amended)
Dangerous Goods Transportation Act (S.N. 1982, c.45)
Dangerous Goods Transportation Regulations, 1985 (Nfld. Reg. 305/85)
Environmental Assessment Act (S.N. 1980, c.3, as amended)
Department of Health Act (R.S.N. 1970, c.83, as amended)
Department of Environment Act (S.N. 1981, c.10, as amended)
Storage and Handling of Gasoline and Associated Products Regulations (Nfld. Reg. 258/82)
Pesticides Control Act, 1983 (S.N. 1983, c.52)
Pesticide Control Regulations, 1984 (Nfld. Reg. 86/84)

Newfoundland has no legislation dealing specifically with hazardous wastes. The provincial Waste Material (Disposal) Act establishes provisions governing waste management systems and disposal sites, including application for approval, franchises, rates, and appeal procedures. In Newfoundland, such projects must be accompanied by personal sureties to ensure the satisfactory maintenance of such systems or sites (Corpus Information Services, 1986).

Waste management systems and disposal sites, particularly those receiving hazardous materials are also subject to the portions of the Department of the Environment Act pertaining to the control of soil or water pollution.

In 1985, the province proclaimed the Dangerous Goods Transportation Act and Regulations. The Dangerous Goods Transportation Regulations, generally adopt the federal TDG regulations for the highway transport of dangerous goods. Although the province has adopted the manifesting requirements for interprovincial and interprovincial waste transport from the federal TDG, it does not enforce these requirements intraprovincially.

The storage, transportation and disposal of pesticides is governed by the Pesticides Control Act of 1983 and its regulations. All empty containers must be disposed of at a site approved under the Waste Material (Disposal) Act.

The Environmental Assessment Act applies assessment procedures both prior to and subsequent to the commencement of any undertaking that may be potentially damaging to the environment.

B.1.3.11 Yukon Territory and Northwest Territories

No specific territorial legislation exists to govern hazardous waste management. Federal legislation such as the Fisheries Act, the Environmental Contaminants Act, the TDG Act and the Northland Water Act are utilized. The territorial governments are, however, developing environmental legislation and addressing the need for a hazardous waste facilities.

B.1.4 Provincial Marketing and Waste Management Planning Studies

With the increased awareness of the hazardous nature of many chemicals and the need for appropriate waste management, several provinces have initiated task forces and conducted studies to assess the need for, market potential of, and mechanism for development of appropriate waste management strategies for that province. Such programs have been undertaken by the provinces of British Columbia, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick and Nova Scotia. The Ontario Waste Management Corporation (OWMC) has placed considerable focus on the appropriate management of hazardous wastes in the province through conduct of an Environmental Assessment, assessing the viability of the OWMC owning and operating a hazardous waste treatment facility in the province. The OWMC has addressed many issues specific to the Ontario hazardous wastes management industry that are being addressed in general for Canada in this report. Since Ontario has such a large industrial base and generates greater than 50 percent of the total hazardous wastes generated in Canada the findings of the OWMC will receive considerable focus in this section.

B.1.4.1 British Columbia

In 1982 the Government of British Columbia issued a call for proposals for provision of provincial special waste handling and treatment facility. In 1983 Genstar Conservation Systems and IT Corporation, the successful proponent consortium, began planning for the treatment facility. Genstar/IT launched a detailed provincial waste stream inventory and analysis based on direct interviews with generators; previous studies had been based on theoretical models. In mid 1984, on the basis of its study, Genstar/IT Corporation announced that they were withdrawing from the project due to (Corpus Information Services, 1986):

- lower than expected volumes of special waste available for treatment and disposal (Company's inventory indicated that only 15,500 tonnes a year would be available, the most optimistic projections previously indicated 36,200 tonnes of special wastes were produced per year provincially);

- the Minister of Environment had announced a policy of zero net flow for the import and export of special wastes, which restricted the availability of out-of-province wastes for treatment at the facility; and,

- the Company felt that the project treatment standards would result in excessively high capital costs for the treatment and disposal facilities.

Since the withdrawal of Genstar/IT Corporation, the provincial government has assessed its waste management policy. A Special Waste Advisory Committee was commissioned to review waste management in the province. The B.C. Special Waste Services, Inc. has recently been established to develop a waste management system including a treatment and disposal facility in the province.

B.1.4.2 Saskatchewan

In late 1986, a study was undertaken by the Saskatchewan Research Council entitled "The Development of an Information Data Base and Sub-Structure for a 4-R's Program in Saskatchewan." The objective of the study was to establish the framework for development of a waste minimization program for the province including a waste exchange. The study methodology included detailed interviews with the managers of Waste Exchanges in North America as well as other organizations actively involved in waste reduction. Discussions with waste exchange centres cited problems with lack of funding, creating awareness/interest and convincing people to recycle as opposed to dumping. Recommendations of the study indicated that a pro-active waste reduction program should be undertaken. The Program would include a waste exchange and initiatives such as: plant visits by technical people to encourage development of new solutions to waste reduction problems; student intern programs (similar to the Ontario "ONSITE" program); publicity of success stories; an up-to-date and local source of information about waste reduction; and, an active liaison with the industry.

B.1.4.3 Manitoba

In 1987, the Manitoba Clean Environment Commission conducted public hearings on the development of a hazardous waste management system for the province. The Commission made recommendations regarding management system options, technologies and site selection criteria, and public participation. Based on the findings of the Commission, Manitoba is currently developing a comprehensive hazardous waste management system to accommodate all of the hazardous waste generated in the province that incorporates waste reduction, reuse, and recycling in its operation. Five options have been proposed and are being evaluated, these include (Yee et.al,1985; Clean Environment Commission, 1987):

1. use of upgraded existing facilities and technology;
2. out-of-province disposal;
3. development of regional specialized facilities;
4. development of an integrated (centralized) facility at one location; and,
5. a combination of above options, such as:

   (a) an integrated facility with out-of-province incineration;
   (b) an integrated facility utilizing shared mobile incineration;
   (c) mobile incineration with out-of-province disposal of non-incinerable waste; and,
   (d) an integrated facility, including a liquid injection incinerator capable of handling 25 percent of provincially generated incinerable hazardous waste, combined with out-of-province disposal of the remaining 75 percent of incinerable hazardous waste.

With the selection of either of the above systems there are inherent advantages and disadvantages associated with implementation in Manitoba. These factors are currently being assessed by the province. It was also noted that any comprehensive hazardous waste management system must address the general areas of analytical support, collection stations, transportation networks, recycling, and enforcement of the legislation.

Additionally, throughout these hearings, there was widespread support for public education and information on hazardous waste. Public input and involvement in the program also received considerable emphasis. The following information was identified for public availability (Clean Environment Commission, 1987):

- an explanation of hazardous wastes for the lay person and description of appropriate means of disposal;
- current practices of hazardous waste disposal;
- hazardous waste generation and reduction;
- the nature of a hazardous waste facility - to indicate that the facility is a high-tech plant, not a disposal dump;
- the means to evaluate the costs and benefits of recycling vs. disposal of hazardous wastes;
- the quantities of hazardous wastes to be transported within the system and the potential severity of transportation accidents; and,

- the training of waste management industry workers on health and safety matters and on the transportation and handling of hazardous wastes.

The above educational/information program could be provided through public school programs and curricula, news releases, a newsletter from the Crown Corporation, Manitoba Waste Exchange Bulletin, safety committees in industry, radio and TV commercials, community TV programs and documentaries.

Other concerns and recommendations of the public hearings evidenced the following, with regard to awareness and promotion of the hazardous waste management industry (Clean Environment Commission, 1987):

- Institutes of higher learning should promote studies of hazardous waste technologies and recycling;

- Government should undertake an ongoing public information program about hazardous waste management. Industry, business and the consumer, as well as the general public, require education on hazardous waste;

- Industrial workers should be informed on handling and exposure to hazardous wastes;

- Public participation is an essential key in waste management program development, in selecting site criteria, treatment and disposal technology, and actual site selection; and,

- Funding should be available for advocacy and interest group studies.

B.1.4.4 Ontario

Waste management planning in Ontario began with the provincial "Blueprint for Waste Management" and has since progressed to an active approach by the provincial government to establish the Ontario Waste Management Corporation (OWMC) for construction and operation of facilities to address the problem of inadequate capacity for treating and disposing of hazardous wastes and liquid industrial wastes. In keeping with this commitment, the OWMC conducted an environmental assessment to identify the need for waste management in the province and the role that it could play in satisfying these needs. A draft document entitled "The OWMC Undertaking" (OWMC, 1988) addresses these needs as briefly discussed below.

To identify its potential waste management role, the OWMC developed the following service objectives:

- to provide the ability to treat all current and anticipated waste types generated in Ontario;
- to provide access for all waste generators in the province to a waste treatment and disposal facility;
- to provide for expansion in treatment and disposal capacity as demand increases; and,
- to locate in an area close to major waste generators.

"The OWMC Undertaking" identified export, storage, 4Rs, onsite treatment and disposal, and additional offsite treatment and disposal as alternative strategies for

managing future waste. The analysis of alternative methods concluded that the most appropriate immediate solution is to develop additional offsite treatment and disposal facilities, since storage, untreated disposal or export are less desirable. The most suitable offsite technologies identified include; physical/chemical treatment, incineration, solidification and secure chemical landfilling. A centralized facility with initial capacity of 150,000 tonnes per annum and the potential for modular expansion to 300,00 tonnes per annum was also considered appropriate.

In addition to constructing and operating the provincial waste management system, the OWMC identified that it would continue to be committed to facilitating the role of the 4Rs in Ontario's waste management system. This commitment is addressed by OWMC's Waste Reduction Program, the objectives of which are:

- to promote waste reduction within Ontario industry;
- to increase the number of waste exchanges;
- to assist Ontario industries in the management of wastes through various research activities;
- to increase OWMC's service capability; and,
- to heighten OWMC's profile in industrial waste management.

Lack of information has been frequently cited as the major barrier to increasing onsite waste management activity. This is the primary motiviation for OWMC's Waste Reduction Program, which is aimed at educating generators about onsite management opportunities.

Other specific activities that OWMC could implement in order to ensure that all waste generators in Ontario are provided with an adequate of waste management service include (OWMC, 1988):

- Transportation and collection. Two courses of action are available to ensure the quality of services:

  - long term contracts with subsidization of private sector haulers by OWMC to provide equitable services in all regions; and,

  - development of an OWMC owned and operated transportation and collection fleet to service such regions.

- Waste transfer facilities. In the event that the private sector cannot, for some reason, provide adequate levels of service to all parts of the province, the OWMC could establish waste transfer facilities.

- Mobile/transportable treatment facilities. Mobile and transportable waste treatment technologies are recognized by the OWMC as a rapidly developing and promising field of waste management. The OWMC would continue to monitor advancements in the mobile transportable technologies field, and cooperate with the private treatment industry to determine potential roles for these technologies in managing Ontario's hazardous waste.

- Spill clean-up and site decommissioning reclaimation. The OWMC would continue to assess the capabilities currently available in the province for site decommissioning and spill clean-up and to identify whether or not there is any role for it to play in this waste management practice.

The following identifies some of the factors which may affect the future waste quantities and waste management practices in Ontario:

1) Regulatory and Related Factors

- Improving Ontario's waste management performance has been a high priority for the government. The Ministry of the Environment recently stated that as much as 800,000 tonnes of waste generated each year in Ontario require better treatment and disposal. Since Regulation 309 came into effect in September 1985, reported waste quantities have already increased significantly and the reported volumes undergoing treatment and disposal have grown. However, the regulation's full effect has not yet been realized.

- A number of revisions are currently being considered for Regulation 309. These may involve listing and delisting of waste, changes in manifesting requirements and other alterations. Thus further implementation of Regulation 309 is likely to redirect streams from less appropriate to more appropriate destinations, as the generator registration database is more rigorously checked.

- Part V of the Environmental Protection Act is being further revised in terms of the conditions for a waste management system (e.g. hearings are required for a wider range of onsite management installations such as incinerators). This may make certain onsite waste management practices less attractive.

- Revisions to Regulation 308 (dealing with air emissions) under the Environmental Protection Act were proposed by the OMOE in a Green Paper in November 1987. New emissions control requirements, more stringent than the existing ones, are being proposed. With more rigorous standards, the cost of onsite incineration will rise. Some generators who would otherwise decide to install incineration equipment onsite may opt for sending wastes to an offsite incinerator.

- The effect of increased stringency for air emissions may be significant in the health sector, where a number of hospitals are and will be considering the need to replace existing incinerator equipment. This will likely increase the demand for offsite incineration of pathological waste.

- Increasingly severe restrictions will also result in more efficient removal of toxics from air emissions which will in turn increase the quantity of air pollution control treatment residuals requiring disposal.

- Ontario also recognizes that other current air and water pollution regulations are not fully enforced. In 1987, the (OMOE acknowledged the importance of the problem of

non-compliance (e.g. the discharges by industries and sewage treatment plans) and stated that significant steps were being taken to enhance enforcement. This enhanced enforcement of existing standards will increase waste quantities.

- In the past, Ontario regulations have been influenced by U.S. legislation and programs. RCRA and Regulation 309, for example, have features in common. There is a possibility that Ontario will adopt in its enhanced regulatory scenario a landfill ban similar to that in the U.S. Hazardous and Solid Waste Amendments. These Amendments progressively restrict the untreated disposal of wastes on land.

- The details of the announced Municipal Industrial Strategy for Abatement (MISA) program are currently being decided and extensive negotiations with waste dischargers are underway. MISA's primary implication for waste management is that it will encourage increased generation of residuals from on-site treatment processes.

2) Economic Growth and Related Factors

- When economic growth takes place with existing products and processes, increased waste generation will generally occur.

- Industrial process change can result in significantly different waste generation characteristics. Usually new plants generate less waste per unit of output than existing plants.

- Product changes can alter both the type and quantity of wastes generated. The nature and direction of those changes are difficult to anticipate.

3) Government Incentive Programs, Attitude Changes and Other Factors

- Most household hazardous waste currently goes unmanifested to municipal landfills. Recently, however, public, provincial government, and municipal interest in diverting these wastes from municipal landfill to proper hazardous waste treatment has developed. The OMOE has implemented a Household Hazardous Waste Collection Program which actively encourages municipally run "hazwaste" days, by defraying part of costs.

- A growth in site decommissioning is likely to occur because of increased closings of older plants, plant amalgamations, and plant streamlinings. Ratification of the Free Trade Agreement with the U.S. may also accelerate shutdowns.

- "The OWMC Undertaking" study concluded that future site cleanup activity in Ontario could be set at approximately double the current level.

From the OWMC study, it was determined that wastes managed onsite will not place demands on the province's offsite treatment and disposal system. Wastes "potentially seeking offsite treatment and disposal" may place some demands on the system and must, therefore, be taken into account for planning purposes. The following approach and assumptions were adopted in identifying these waste streams (OWMC, 1988):

1) Current patterns of 4Rs activity were assumed to continue. This includes streams currently going to the 4Rs and any economic growth in these streams.

2) It was assumed that streams currently treated and disposed of onsite will continue to be handled in this way, including both current quantities and future growth in these streams, but with two exceptions:

   - Under MISA some of the streams which are currently going to the sanitary sewer will be diverted and a portion will end up as a residual requiring disposal.

   - With enhanced regulations, onsite landfill streams will become part of the category of wastes potentially seeking offsite treatment and disposal.

3) It is assumed that dust suppression will continue under the current regulatory scenario.

4) Streams currently going offsite for treatment and disposal are included as part of the category of wastes potentially seeking offsite treatment and disposal. These include streams going to water pollution control plants, reclaimers, miscellaneous treaters, all types of landfill and incineration.

5) It is assumed that PCB's currently in storage are potentially seeking offsite treatment and disposal.

6) The portion of household wastes estimated to be source separated and collected (500 to 5000 tonnes) is part of the category of wastes potentially seeking off-site treatment and disposal.

7) Decommissioning and site cleanup wastes not currently in the manifest are added to the category of wastes potentially seeking offsite treatment and disposal.

B.1.4.5 Quebec

In 1983 the Quebec Ministry of Environment conducted a Market Study of Dangerous Organic Wastes in the province (Environnement Illimitée Inc., 1983). The market study indicates that there are about 50,000 tonnes of dangerous organic wastes produced in Quebec each year, of which 23% are presently being recycled or treated, and 63% are being incinerated. The remainder is composed of substances being temporarily stored by generators or are being released to the environment (11%), and a small percent (2.3%) for which disposition was not determined. Theoretically, approximately 32,000 tonnes of waste should have been incinerated in 1983, but only 21,659 tonnes in 1982-83 (12 month period) are recorded as being incinerated.

Market projections of the 1983 study indicated that the volume of waste would decrease by 1986. However, any increase in the price of incineration was not taken into account in the study. An increase of $100-$150/tonne would probably have negligible effect, but an increase of $250/tonne would precipitate the application of various onsite measures by the generators thereby enabling reduction of the volume of wastes normally destined for incineration - 38% of the volume could be affected.

B.1.4.6 New Brunswick

New Brunswick has undertaken as one of its top priorities to develop a comprehensive waste management program for the

province including public input through a public consultation program. In 1986, a task force from the New Brunswick Environmental Council conducted public meetings throughout the province to discuss the hazardous waste problem and its appropriate management. A report entitled "Waste Management Planning for New Brunswick - Public Consultation" was generated and provides recommendations for development of a waste management plan for the province. Recommendations related to management of hazardous wastes are briefly summarized below:

- encourage generators to implement onsite treatment to neutralize or remove the material's hazardous quality prior to its disposal;
- encourage recycling or reuse of waste products;
- emphasize waste minimization or reduction mechanisms through changes in the production process employed by the generator; and,
- provide appropriate collection and storage facilities for wastes to be transported out of the province for disposal.

B.1.4.7 Nova Scotia

Two recent studies have been undertaken in Nova Scotia to address hazardous waste management; the Industrial/Institutional Special Waste Management Study of the Halifax - Dartmouth Metropolitan (Metro) Area (Porter Dillon, 1986) and the Ministers Task Force on Hazardous Waste Management in the province (Nova Scotia Department of Environment, 1987). The findings and recommendations of these studies are briefly presented below.

(i) Industrial/Institutional Special Waste Management Study

In late 1984 a study was undertaken to inventory sources, types and methods of handling special wastes in the Halifax-Dartmouth Metropolitan (Metro) area and to provide a basis for the development of a special waste management strategy. The potential for implementing a regional waste exchange and the need for federal and provincial legislative changes were also addressed. Several recommendations for special waste management in the Metro area resulted from this study these include, but are not limited to:

- Due to a lack of response or apparent lack of organization noted for waste haulers, hospitals, the power generating industry, universities, and the special chemical industry in relation to special waste generation and disposal potential, it was recommended that the nature and quantity of waste disposed and the acceptability of methods utilized be investigated for these sectors.

- The pretreatment of industrial waste should be promoted, where possible, to reduce the volume of special wastes being inappropriatedly discharged.

- A public information program for industry, institutions and households should be formulated and implemented.

- The waste management system should accommodate the small generator if it is to be successful in reducing risk in other municipal disposal systems.

- The existing applicable provincial legislation should be revised or rewritten to permit the implementation of a special waste handling facility including definition of a hazardous or special waste, permitting requirements and notification requirements in the event of an accidental spill.

- The quality and variety of special waste generated in the Metropolitan area does not require development of a specialized disposal technology locally. Special waste disposal can be accomplished by transhipment to approved waste handling facilities through a collection transhipment facility.

(ii) Minister's Task Force on Hazardous Waste Management

The Minister's Task Force on Hazardous Waste Management was established in 1985 by the provincial Minister of the Environment to "examine the hazardous wastes management problem in Nova Scotia and to file an action plan to deal with it". In 1985, the Task Force submitted a Phase I Report to the Minister recommending that the Task Force initiate development of a comprehsensive stragegy for managing dangerous goods and hazardous wastes in Nova Soctia that included extensive public consultation in early 1986.

Public consultation with industry representatives, waste disposal companies, emergency response personnel, consultants, academics, environmental groups, government officials and individual Nova Scotians was undertaken. Based on these discussions five principles were formulated to assist in the development of a waste management strategy for the province, as presented below (Nova Scotia Department of Environment, 1987):

- The Province must assume a leadership role in providing for the safe management of dangerous goods and hazardous wastes.

- The public must be provided with extensive opportunities to participate in the formulation of any plans, policies and programs implemented by the strategy.

- The efforts of government, industry, institutions and individuals must be directed toward reducing and re-using dangerous goods and thereby minimize the volume of hazardous wastes generated.

- In general, Nova Scotians must be responsible for managing the hazardous wastes generated in their province.

- Hazardous wastes should not be generated in Nova Scotia unless there are approved disposal methods for these wastes.

On the basis of these five principles, the Task Force generated 51 recommendations for the comprehensive management of dangerous and hazardous wastes in the province. In general, these recommendations address:

- the definition, legislation and strict enforcement of dangerous goods and hazardous wastes;

- the preparation of a comprehensive hazardous waste inventory (including institutional wastes) for the province;

- the development of a hazardous wastes transfer facility (facilities) for the province and restrictions on the time period for waste storage;

- formation of a Working Group and an Emergency Response Team to respond to emergencies involving dangerous goods and hazardous waste (necessary equipment and training should also be provided);

- persons generating, transporting or disposing of hazardous wastes should be licensed;

- a provincial hazardous waste manifest system should be developed;

- education and consultation programs should be provided to the public including industries and institutions;

- waste minimization through reuse, recycling, reduction and recovery should be encouraged; and,

- the use and disposal of waste oil and contaminated waste oil should be regulated.

B.2 FEDERAL INITIATIVES

B.2.1 Federal Legislation

Arctic Waters Pollution Prevention Act (R.S.C. 1970, c.2)

Atomic Energy Control Act (C.R.C. 1978, c.365, as amended)

Transport Packaging of Radioactive Materials Regulations (SOR/83-740)

Canada Shipping Act (R.S.C. 1970, c.S-9, as amended)

Oil Pollution Prevention Regulations (C.R.C. 1978, c.1454, as amended)

Environmental Contaminants Act (S.C. 1974-75-76, c.72, as amended)
Canada Water Act (R.S.C. 1970, C.5)
Clean Air Act (S.C. 1971, C.47)
Department of Environment Act (R.S., C.14) (Second Supplement)
Fisheries Act (R.S.C. 1970, c.F-14, as amended)
Ocean Dumping Control Act (S.C. 1974-75-76, c.55, as amended)
Transportation of Dangerous Goods Act (S.C. 1980-81-82-83, c.36, as amended)
Transportation of Dangerous Goods Regulations (SOR/85-77, as amended)
Canadian Environment Protection Act (in third reading)

At present, federal legislation dealing specifically with hazardous waste management does not exist. Federal guidelines in the new Canadian Environmental Protection Act (CEPA), currently in its third reading, will promote a 'cradle to grave' approach for waste management, thereby requiring approved waste management from the point at which a waste may be generated until its disposal. CEPA will provide regulatory officials with additional authorities for waste management. Highlights of CEPA include, but are not limited to, the following (Environment Canada, 1987):

- Defines "environment" for the first time in federal law. Embodies an ecosystem approach to land, water and air pollution.

- Emphasizes protection of the environment for its own sake, as well as the effect of the interaction of environment and human health. Approach is "protect and prevent", not just "react and cure".

- Controls chemical substances through all stages of their life cycle, from importation or research and development, through commercial manufacture, transportation distribution, use and ultimate disposal.

- New chemicals will be assessed before they can be used in Canada. Also addresses the products of biotechnology and controls nutrients.

- Consolidates the environmental protection powers of the Clean Air Act, the Environmental Contaminants Act, the Canada Water Act, Part III, the Ocean Dumping Control Act, and the Department of the Environment Act, Subsection 6(2).

- Regulatory protections provided by the legislation being consolidated will be continued under CEPA. Revisions and new regulations will be developed through public consultation in accordance with the Citizens' Code of Regulatory Fairness and the Canadian Charter of Rights and Freedoms.

- Recognizes other federal environmental protection legislation such as the Transportation of Dangerous Goods Act (TDGA) and the Pest Control Products Act.

- Maximum penalties under the Act are the stiffest ever in any federal environmental protection legislation.

- Public participation and access is extensive.

- Recognizes the shared jurisdiction nature of environmental protection among federal, provincial and territorial governments.

- Calls for the negotiation of federal-provincial agreements which will identify the roles of each level of government in administering the Act to avoid duplication of cost and effort, and promote efficiency.

- Requires federal consultation with the provinces and territories when regulations are being developed. Allows for federal-provincial advisory committees to the Ministers.

- Comprehensive management of chemicals will be established by:

  - a "Priority Substances List" identifying chemicals requiring urgent assessment and evaluation.

  - "Domestic Substances List" naming all substances governed by the Act that are in commercial use in Canada. Expected to list more than 30,000 substances.

  - "Non-Domestic Substances List" naming all chemicals known to be used outside Canada, but not in Canada. It may contain the names of more than 70,000 substances. Industry will be required to provide information to government to permit an assessment of the need to control.

- Establishes the requirement for the Ministers to develop national environmental quality guidelines and codes of practice.

- Provides authority to develop regulations and guidelines to govern activities and operations for all federal lands and undertakings.

Until CEPA is promulgated, federal legislation governing environmental protection includes; the Clean Air Act, the Environmental Contaminants Act, the Canada Water Act, the Ocean Dumping Control Act and the Department of Environment Act. Additional applicable legislation not consolidated by CEPA includes the Transportation of Dangerous Goods Act and Regulations, the Arctic Waters Pollution Act, the Fisheries Act, the Canada Shipping Act, the Atomic Energy Control Act and the Pesticide Control Products Act.

The Environmental Contaminants Act of 1976 enables the control of toxic substances used in commercial, manufacturing or processing activities entering and contaminating the environment. The Act also requires that use of any designated substances be reported to federal environment authorities and that records be kept of all amounts used. Under this Act, regulations have been established to control the use, sale and disposal of PCB's. Additionally, "Guidelines for the Management of PCB Wastes" (Department of Environment, 1982) have been developed to assist waste disposal companies and regulatory authorities in the management of PCB wastes in accordance with the Environmental Contaminants Act.

In 1980, the Transportation of Dangerous Goods Act was proclaimed to control the international and interprovincial transportation of dangerous goods by air, sea, rail and road. In 1985, the Transportation of Dangerous Goods Regulations were proclaimed. These regulations address such criteria as the classification, documentation, safety markings, safety standards and requirements, permitting and manifesting for the appropriate transport of dangerous goods and hazardous wastes.

The Arctic Waters Pollution Prevention Act and Fisheries Act set out penalties for the discharge of pollutants into water, including provincial waters, and may marginally affect industries which discharge pollutants into water.

The Oil Pollution Prevention Regulations, under the Canada Shipping Act, deal strictly with ships in Canadian waters and with loading and unloading facilities in Canada. The regulations set out provisions for the design and equipping of ships; for cargo, fuel and ballast handling; and for emergency procedures, limitation of cargo sizes, and record keeping requirements (Corpus Information Services, 1986).

The Atomic Energy Control Act and its regulations govern the licensing of nuclear facilities and the disposal of radioactive substances in Canada. The transportation of radioactive substances is addressed under the Transport Packaging of Radioactive Materials Regulations.

The Ocean Dumping Control Act and Regulations establish requirements and procedures for obtaining permits to dump as well as prohibitions governing disposal of substances from ships, aircraft, platforms or other man-made structures at sea.

B.2.2 Federal Initiatives and Programs

The following section briefly presents several federal initiatives and programs in hazardous waste management.

B.2.2.1 Programs to Encourage Recycling and Reduction

The Federal government through Environment Canada has been involved in recycling and reduction activities with

programs such as the Development and Demonstration of Resource and Energy Conservation Technology (DRECT), the Canadian Waste Materials Exchange and the Accelerated Capital Cost Allowance (ACCA) Program. Other funding and technical assistance opportunities such as the Industrial Research Assistance Program (IRAP), the Industrial Regional Development Program (IRDP), the Industry Energy Research and Development (IERD) program, the Unsolicited Proposal (UP) fund and the Technology Inflow Program (TIP) are available. Although few of the above programs are designed specifically for pollution control efforts, these programs can be tapped to assist in minimizing pollution by enhancing processing and energy efficiency. Additionally, in 1984 Environment Canada unveiled a new national recycling symbol. The symbol was adopted to enhance the public visibility of national recycling efforts and may be placed on a product to indicate that it contains recycled material or to identify recycling and recovery projects. The DRECT Program, the ACCA Program, the IRAP Program, the IRDP Program, the IERD Program, the UP Fund, the TIP Program and the Canadian Waste Materials Exchange are briefly discussed below.

- Development and Demonstration of Resource and Energy Conservation Technology Program

  The Development and Demonstration of Resource and Energy Conservation Technology (DRECT) Program is a federal government waste reduction program available to assist industry reduce waste output. For the DRECT Program, the federal government will pay up to 50% of the costs of developing and demonstrating prototype systems, of promising new technology that reduce waste, recover or

recycle wastes, and save energy. Private industries and organizations as well as provincial and municipal authorities working with innovative new methods, procedures, processes or equipment can apply to DRECT for funding. This program is administered by Environment Canada and Energy Mines and Resources Canada. New projects that will reduce pollution and recover energy from municipal and industrial wastes are encouraged. However, the main aim of the proposed technology must be energy saving. DRECT will contribute towards the cost of equipment, buildings, installation, engineering and consulting services of approved projects. Upon completion, the developer keeps all equipment, technical data, designs or patents resulting from the project. In return for federal funds, the proposer must undertake to make any patents and technology developed available to all interested parties in Canada (Manitoba Waste Exchange, 1987).

- Accelerated Capital Cost Allowance Program

The Accelerated Capital Cost Allowance (ACCA) Program, like the DRECT Program, is a federal government waste reduction program available to industry to reduce waste output. The ACCA Program is designed to encourage businesses to control pollution. Under the terms of the program an eligible taxpayer may write off the total cost of equipment or processes installed for the prime purpose of controlling air and water pollution over a three-year period - 25% in the first year, 50% in the second year and 25% in the third year. The expenditures may cover the cost of the prevention, reduction or elimination of pollution. The program also covers solid

wastes and the reduction of motor vehicle emissions (Manitoba Waste Exchange, 1987; Environment Canada, 1988b).

- Industrial Research Assistance Program

The Industrial Research Assistance Program (IRAP) aids industrial research by financing the salary component of approved research and development projects. The IRAP-P program is geared to larger companies with in-house research capacity. For those firms too small to maintain a viable research effort in-house, IRAP-M will pay the salaries of individuals in other research organizations that are subcontracted to the firm to solve specific research and development problems.

- Industrial Regional Development Program

Industrial Regional Development Program (IRDP) grants are designed to stimulate industrial growth in slow-growth areas in Canada. Industries that are located or intend to locate in IRDP "designated regions" may receive grants and loan guarantees for plant modernization and expansion. Although not intended to fund pollution abatement as such, many plant modernization efforts are eligible, which result in a simultaneous reduction in waste generation.

- Industry Energy Research and Development Program

The Industry Energy Research and Development (IERD) Program is designed to improve industry energy efficiency largely through research and development. A

maximum of 50 percent federal funding would be obtained for recycling/recovery or disposal of wastes in a more energy efficient manner.

- Technology Inflow Program

  The Technology Inflow Program (TIP) covers travel costs associated with review of new technology to determine if the technology can be exploited in Canada.

- Unsolicited Proposals Fund

  The Unsolicited Proposals (UP) Fund, is administered by Supply and Services Canada to provide 100 percent government funding for research.

- Canadian Waste Materials Exchange

  The Canadian Waste Materials Exchange (CWME) was established in 1978 to facilitate the re-use and recycling of industrial waste. The exchange receives funding support from federal and provincial governments as well as private industry, and operates a country-wide network of waste exchange opportunities. Hundreds of companies are registered with the Exchange, and it is estimated that about one in five find interested customers (OWMC, 1988). The CWME publishes a bimonthly bulletin, the "Canadian Waste Materials Exchange Bulletin", which contains exchange news and advertises the availability of wastes from specific generators.

B.2.2.2 Hazardous Waste Working Groups

The Federal government has chaired or initiated several working groups to assess hazardous waste management in Canada, including; the Hazardous Waste Definition Task Force, the Federal/Provincial/Territorial Committee on Hazardous Wastes, and the Canadian Council of Resource and Environment Ministers (CCREM). The Task Force was established to develop a satisfactory definition of a hazardous waste. The Federal/Provincial/Territorial Committee was established after completion of the Task Force's work. This committee formed two government/ industry groups - the Hazardous Waste Criteria Working Group and the Manifest Working Group - and through these groups established the framework of the Transportation of Dangerous Goods Regulations. The two working groups have since been merged into the Combined Working Group on the Transportation of Dangerous Goods as a forum for exchanging information and recommendations on the implementation and efficient workings of the federal TDG regulations. The Federal/Provincial/Territorial Committee on Hazardous Waste has also been replaced by a waste committee under CCREM. Recently, a plan to manage hazardous waste in Canada was initiated by CCREM. The Action Plan contains detailed proposals for the harmonization of legislation, policies and programs dealing with hazardous waste and the harmonization of rules and manifest systems for the shipment of wastes across provincial and international borders.

B.2.2.3 Other Federal Activities

Through Environment Canada, the Federal government has become involved with the provinces in several joint studies and programs addressing hazardous waste management, pollution control and cleanup. These activities include, but are not limited to, a Waste Disposal Site Program, waste inventory studies, and pollution control aspects and research of a Canada - Ontario Agreement Respecting Great Lakes Water Quality.

Additionally, Environment Canada issues a variety of publications on waste management. Resilog is an irregular newsletter addressing federal and provincial waste management literature, contract and conference news, and program announcements. Environment Update, a bi-monthly publication is designed to inform the public about the programs and activities of Environment Canada. The Spill Technology Newsletter is an informal newsletter published bi-monthly to provide for an exchange of information on oil spills countermeasures, spill prevention, literature and conference news. EnviroTIPs (Environmental and Technical Information on Problem Spills) Manuals provide comprehensive information on chemicals that are spilled most often in Canada. A series of Technical Reports are also published. In addition to the above activities, the Federal government sponsors an annual National Conference on Solid Waste Management in Canada that presents the latest legislative and technological developments in solid and hazardous waste management.

C.0 UNITED STATES INITIATIVES AND PROGRAMS

The following presents an overview of legislation, some federal and state programs for hazardous waste management in the United States and the findings of a commercial hazardous waste management marketing study.

C.1 APPLICABLE LEGISLATION

Legislation governing hazardous waste management in the U.S. has been developed since 1976 and continues to be developed and amended with the growing awareness of this industry. The primary legislation for appropriate management of hazardous wastes include:

- Resource Conservation and Recovery Act of 1976 (RCRA);
- Toxic Substances Control Act of 1976 (TSCA);
- Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA or "Superfund");
- Hazardous and Solid Waste Amendments of 1984 (HSWA); and,
- Superfund Amendments and Reauthorization Act of 1986 (SARA).

Additional legislation such as the Clean Air Act, the Clean Water Act, the Water Quality Act and the Safe Drinking Water Act also have provisions for appropriate waste management. These regulations are briefly discussed below:

C.1.1 Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA) was promulgated in 1976 by the U.S. Environmental Protection Agency (EPA) to regulate current and future waste manage-

ment and disposal practices. RCRA was the first comprehensive federal legislation to specifically address the management of hazardous (and solid) wastes.

The Act provides a cradle-to-grave approach to the present management of hazardous wastes by imposing management requirements on generators and transporters of hazardous materials and upon owners and operators of treatment, storage, and disposal facilities. RCRA addresses existing and proposed facilities but not the problems associated with abandoned or inactive sites. The hazardous waste section of the Act (Subtitle C) requires EPA to promulgate regulations identifying specific hazardous wastes and the persons required to manage, identify and report their activities relative to such hazardous waste. Specific performance standards are established for minimum technology requirements and groundwater monitoring; also, there is a phased-in ban on disposal of untreated hazardous waste in land disposal facilities. Also, States are authorized to assume responsibility for the RCRA program when the State agrees to enforce a program which is at least equivalent to the federal program (Lorenz et. al, 1987).

Additionally, the EPA published a Final Rule under RCRA, effective December 18, 1987, authorizing the use of a corporate quarantee to satisfy liability coverage requirements for hazardous waste treatment, storage and disposal facilities. This Rule enables a parent corporation that is capable of passing the financial test for liability to guarantee to meet obligations on behalf of the facility owner/operator (HazNews, 1988).

C.1.2 Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) was promulgated in 1976 to provide EPA with the authority to regulate and to require testing of toxic chemicals (e.g., pesticides, hazardous wastes, carcinogenics, teratogenics and mutagenics), both new and old, entering the environment. PCB's are currently regulated under TSCA, however, it is likely that steps will be taken by EPA to regulate these hazardous wastes under RCRA.

C.1.3 Comprehensive Environmental Response, Compensation, and Liability Act

In 1980, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also referred to as Superfund, was enacted to address the remediation of uncontrolled (i.e., abandoned or inactive) hazardous waste sites. CERCLA provides funding and enforcement authority for responding to hazardous substance spills and for the cleanup of past hazardous waste activities.

C.1.4 Hazardous and Solid Waste Amendments

The 1984 Hazardous and Solid Waste Amendments (HSWA) established broad new authorities in the RCRA program to: (1) expand coverage by bringing more toxics under regulation; (2) limit use of land disposal methods (i.e., surface impoundments, landfills, lagoons, deep well injection) to prevent ground water contamination; and, (3) bring underground tanks under regulation. HSWA specified minimum technology requirements for the design of specific hazardous waste facilities, required all interim status

facilities to submit applications to finalize facility permits under RCRA, and instructed the EPA to develop new criteria for hazardous waste identification and regulation.

The 1984 legislation also provides that waste minimization programs must be initiated at all manufacturing plants in the U.S. regardless of the size. Every shipment of hazardous wastes moving from a generator to treatment or disposal facilities must include a certification that a waste minimization program is in effect. The biennial reports required of all generators must include descriptions of the minimization program and data on extent of volume reduction. The EPA is required to evaluate the extent of waste minimization being implemented nationally. The mandate was to evaluate the range of state programs that exist, the barriers that may exist for more comprehensive waste minimization in medium to small manufacturing companies, and give recommendations to Congress about mechanisms that would encourage greater corporate efforts to minimize waste generation (Piragis, 1987).

HSWA established a timetable within which the EPA must develop regulations governing hazardous and solid waste disposal in the U.S., as presented below (Lorenz et. al, 1987):

- November 8, 1984 — No disposal underground (salt beds, mines or caves).
- May 8, 1985 — No bulk liquids in landfills.

- November 8, 1986 — Ban on solvent and dioxin wastes in landfills.
- July 8, 1987 — Ban on California List wastes in landfills (e.g., liquids with cyanides, toxic metals or PCB's, halogenated organics).
- August 8, 1989 — Ban on deep well injection of solvent, dioxin and California List wastes. Recommendations for ban on one-third of all listed wastes.
- June 8, 1989 — Recommendations for ban on two-thirds of all listed wastes.
- May 8, 1990 — Recommendations for ban on all listed wastes.

C.1.5 Superfund Amendments and Reauthorization Act

In 1986, CERCLA was reauthorized under the Superfund Amendments and Reauthorization Act (SARA). SARA provides the EPA with considerably more funding to pay for the cleanup of abandoned and inactive hazardous waste sites. This legislation, however, also requires EPA to move more aggressively in initiating remedial activities on sites in the United States.

SARA sets schedules for accomplishments under CERCLA. By 1991, EPA is required to initiate cleanup activities at a minimum of 375 Superfund sites. Also, EPA must have a total of 1,600 to 2,000 sites on its National Priorites

List by 1988. The revised law calls for EPA to commence 275 remedial investigations and feasibility studies (RI/FS) by October of 1989. These are studies that assess the extent of contamination threat at each site and propose cleanup remedies. If this deadline is missed, another 175 RI/FS studies must commence by October of 1990, and another 200 by October of 1991 (Lorenz et. al., 1987).

C.1.6 Clean Air Act

The Clean Air Act (CAA) provides a mechanism under which the EPA can control toxic air pollutants that pose a high risk of serious adverse health effects. The National Emission Standards to Control Hazardous Air Pollutants (NESHAP) program addresses toxic air pollutants from both new and existing sources.

C.1.7 Clean Water Act

The Clean Water Act (CWA) addresses industrial pollutants, including toxics. The CWA is the statutory basis for the comprehensive national strategy to restore and maintain the physical, biological, and chemical integrity of U.S. waters. The CWA focuses its control on two primary sources of water pollution; publicly owned treatment works (POTWs) and industry (Lorenz et. al., 1987).

C.1.8 Water Quality Act

The Water Quality Act (WQA) enacted in 1987 contains new programs for controlling the release of toxic pollutants into waterways and authorized a new funding mechanism for the construction of POTWs. The bill combines grants with

an innovative revolving loan program. The Act requires EPA to identify toxic pollutants that may be present in sewage sludge in concentrations that may adversely affect public health and develop regulations governing appropriate management practices, including disposal. The Act also requires that States identify all navigable waters that are not expected to meet water quality standards due to toxic pollutants, and set individual control strategies that will enable the segments to meet applicable water quality standards.

C.1.9 Safe Drinking Water Act

In 1986, the Safe Drinking Water Act (SDWA) was amended to require EPA to develop regulatory and enforcement procedures to govern the federal drinking water program including the setting of standards for contaminants in drinking water based upon the level of removal and treatment achieved by best available technology. These amendments enable accelerated regulation of contaminants and mandatory filtration and disinfection provisions.

C.1.10 Occupational Safety and Health Act

The Occupational Safety and Health Act of 1970 (OSHA) was passed to insure safe and healthy working conditions, and to preserve human resources. The Act is characterized by a number of standard setting, variance, reporting and inspection procedures. OSHA is tasked with identifying and controlling toxic air contaminants.

C.2 WASTE MANAGEMENT PROGRAMS

Efforts are ongoing in the United Sates to encourage appropriate waste management. In addition to State and Federal legislation, several programs exist to promote the appropriate management of hazardous wastes such as waste exchanges, wastelines, recycling councils and the SITE Program. Several relevant Federal and State programs are briefly discussed below.

C.2.1 Superfund Innovative Technology Evaluation Program

The Superfund Innovative Technology Evaluation (SITE) Program began in late 1985. The program has been developed by the EPA to encourage the application of new technologies to control and eliminate toxic (hazardous) wastes. The program has been allotted $20 million U.S. dollars a year to identify, test and encourage the use of technologies that handle hazardous wastes without burying them. The Hazardous Waste Engineering Research Laboratory (HWERL) in Cincinnati is reviewing a number of technologies prior to demonstration testing. To date most of the demonstration technologies involve thermal destruction.

C.2.2 Waste Exchanges

Waste exchanges exist in the U.S. to provide a direct service to industry enabling waste generators to contact waste users for the purpose of recycling these materials back into manufacturing processes. One such waste exchange is the Northeast Industrial Waste Exchange (NIWE). The NIWE was established in 1981 as a non profit information clearinghouse for recycling industrial wastes. Services

offered include a computerized waste materials listing service, free of charge, and a quarterly catalog that lists materials available and materials wanted for industrial reuse. U.S. waste exchanges include, but are not limited to, the following:

- Great Lakes Regional Waste Exchange-Grand Rapids, Michigan
- Industrial Material Exchange Service-Springfield, Illinois
- Northeast Industrial Waste Exchange-Syracuse, New York
- Southeast Waste Exchange-Charlotte, North Carolina
- Southern Waste Information Exchange-Tallahassee, Florida
- Western Waste Exchange - Tempe, Arizona
- California Waste Exchange - Sacremento, California
- Indiana Waste Exchange - Indianapolis, Indiana
- Montana Industrial Waste Information Exchange - Newark, New Jersey
- Tennessee Manufacturers and Taxpayers Association - Nashville, Tennessee

C.2.3 Telephone Hotline Service

A telephone hotline service is available nationally and in several states. The toll-free numbers accommodate waste related inquiries including interpretation of hazardous waste regulations, and identification of available literature and information sources on waste management. The RCRA Hotline provides a national service specifically for interpretation of the Resource Conservation and Recovery Act, and its 1984 Hazardous and Solid Waste Amendments, however, other waste management related inquiries are also addressed.

C.2.4 Minnesota Technical Assistance Program

The Minnesota Technical Assistance Program (MNTAP) was created in 1984 to provide confidential assistance, free of charge, to industries with waste management problems. MNTAP is funded 100% by a grant from the Minnesota Waste Management Board to the University of Minnesota. The grant is for a one year term and is subject to renewal each year.

The objective of MNTAP is to reduce hazardous waste generation and identify cost effective alternatives to land disposal by providing small quantity waste generators with technical assistance. MNTAP is not a waste exchange nor is it a regulatory agency (this factor appears to make a difference to industry). Technical assistance is provided through several services including a telephone hotline, onsite consultation, an engineer intern program, a grants program, and information clearing house. Basically, MNTAP assists companies, public agencies and nonprofit institutions in managing hazardous waste properly and cost-effectively and encourages the reduced generation of hazardous wastes, in order to reduce the amount of waste requiring management and treatment or disposal facilities (Saskatchewan Research Council, 1986).

(i) Telephone hotline service - a toll-free number is available for the entire state to accommodate waste related inquires.

(ii) Personal visits to company site - through onsite consultations with plant managers or owners, MNTAP can review the characteristics of waste being generated by a firm and discuss possible ways to

handle the waste, as well as methods to reduce waste generation. MNTAP could also suggest areas in an industrial process that need to be changed or altered, so that company can reduce or minimize its hazardous wastes (Saskatchewan Research Council, 1986).

(iii) Engineering intern students - students in engineering programs work with firms to help solve their in-house hazardous waste problems. The students gain practical experience and knowledge in ways to achieve "pollution prevention" within industrial plants and the firms benefit from the free, yet insightful assistance in reducing the generation of hazardous waste (Saskatchewan Research Council, 1986).

(iv) Information resources - information is provided on process equipment, options for process changes, waste reduction, or waste treatment.

(v) Presentations/seminars - through mailings, special seminars and other communications industry is informed of the options available for waste reduction.

(vi) Research grants - grants are available to colleges or universities for small-scale research on ways of addressing waste management problems. Priority is given to projects that can be applied to industry problems on a broad scale.

C.3 HAZARDOUS WASTE MARKET IN THE UNITED STATES

C.3.1 Overview

Perhaps the most important driving force of the U.S. commercial waste management industry is the public. Public awareness of the health risks from hazardous waste contamination has led to stricter legislation regarding hazardous waste management and abandoned dump sites. New regulations are forcing onsite treatment of waste, or hazardous waste transport to commercial waste management facilities. Currently, the largest commercial waste management market in the U.S. is the remediation of problems existing at old disposal sites as a result of past waste disposal practices. This rapidly growing market is driven by Superfund. Another market focusses on the treatment, storage and disposal of presently generated industrial wastewater and other hazardous wastes. This market, is driven by RCRA, HSWA, and the CWA.

Due to the deadlines of the CWA and as firms shift the focus of waste treatment to source specific and in-plant approaches, the industrial and electrical utility wastewater treatment markets will grow.

Under the renewed Superfund, $9 billion (U.S.) has been authorized to clean up abandoned dump sites, in addition to Superfund's earlier $ 1.6 billion (U.S.) funding. Reauthorized RCRA is creating the restructuring of waste treatment activities. It has been estimated by Lorenz et. al. that the total hazardous waste spending in the U.S. could reach an annual rate of $ 15 billion, or more, in 1995. If industrial wastewater treatment capital

expenditures are included, spending could approach $20 billion (U.S.) in 1995. Adding expense items such as chemicals and services will result in total spending of well over $20 billion (U.S.) in 1995. CERCLA, RCRA and CWA driven markets will be in the billions of dollars annually. The Superfund market, which some consider a short term market, will probably persist at least into the next decade. The RCRA and CWA markets will be growing business areas, well into the future (Lorenz et. al., 1987).

C.3.2 Findings of a U.S. Commercial Hazardous Waste Management Services Marketing Study

A study entitled "Analysis of the Market for Commercial Hazardous Waste Management Services" (Industrial Economics Inc., 1988) has recently been undertaken in the U.S. The purpose of the study was to supplement on-going EPA activities in assessing the market for commercial waste management services in the U.S. and where EPA should concentrate its future analytical efforts in this industry. Information compiled in the study was gathered largely through interviews with eleven hazardous waste generators representing a variety of industry groups and two commercial waste management firms. The findings of the study are briefly presented below:

C.3.2.1 Description of Commercial Waste Management Services

Services provided to hazardous waste generators by the commercial waste management industry include: (1) onsite services such as packing of wastes, manifesting, and in some cases consulting on waste minimization practices that might reduce the quantity of materials sent offsite for

treatment, storage or disposal; (2) waste brokering and transportation services; and, (3) the actual treatment, storage, disposal or recycling of the waste. For the study, only those services that supported ultimate offsite management activities were addressed since interviews suggested that onsite treatment and disposal by commercial firms at the generators' sites is a relatively small but growing portion of the overall market for services.

According to both generators and commercial firms, the offsite management of wastes at the treatment, storage, disposal or recycling facilities accounts for a greater portion of waste management costs than either onsite or transportation services (Industrial Economics Inc., 1988).

C.3.2.2 Demand for Commercial Waste Management Services

- Sources of Demand

The study estimated that large and small quantity generators of hazardous waste annually produce approximately eight million metric tons of waste that is managed at facilities handling only commercial waste. This represents between three and four percent of the total hazardous waste generated each year in the U.S. The remaining 96 percent consists predominantly of wastewater that is treated by the generators onsite and discharged to surface waters via publicly-owned treatment works (POTWs) or under the provisions of the Clean Water Act's National Pollutant Discharge Elimination System (NPDES) (Industrial Economics Inc., 1988). In addition, an unknown quantity of waste was stated as being managed commercially at facilities whose predominant activity is treatment of in-house wastes.

Through discussions with representatives of commercial waste management firms, the study suggested that the chemical manufacturing industry is probably the largest buyer of commercial waste management services. Although only 1.7 percent of these hazardous wastes were identified as being transported offsite for treatment and disposal, the chemical industry produces such a large volume of waste that this small percentage accounts for almost 40 percent of the eight million metric tons of waste managed commercially in the U.S. Commercial waste management firms identified the petrochemicals, automobiles, metal working, computers, steel, utilities, and Government services industries as important customer groups.

- Factors Influencing Demand

  Findings of the study indicated that a generator's decision to treat wastes on-or offsite and the type of technology implemented is based primarily on three factors, these are (Industrial Economics, Inc., 1988):

  - cost of onsite versus offsite waste management, including direct costs and potential future liabilities;

  - effectiveness of on-versus offsite treatment and disposal technologies for reducing the hazard posed by the waste; and,

  - ability to permit an onsite treatment process, with particular consideration of the impact of RCRA corrective action requirements and the potential for delisting of treatment residues.

It was also noted that large profitable firms are particularly concerned about avoiding future liabilities, thus selecting waste management services that provide the greatest degree of destruction or permanent immobilization of the waste and the supplier with the "deepest pockets". Selection of suppliers with the "deepest pockets" is based on the assumption that financially strong commercial waste management firms will be more likely to provide liability protection than financially weaker firms.

C.3.2.3 Magnitude of Commercial Waste Management Service Industry

The study estimated that 550 companies provide hazardous waste transportation services in the U.S. Of these firms, 78 percent offer only transportation services while the remaining 22 percent offer transportation along with treatment, storage, disposal and recycling and/or spill response and clean-up services. Approximately 330 companies with operations at more than 500 locations were identified as offering commercial treatment, storage, disposal or recycling services. In general, the total number of facilities with treatment, storage or recycling operations is large relative to the number providing incineration and land disposal services. Nationwide there are only 19 commercial facilities that incinerate hazardous wastes (excluding cement kilns) and only 13 of these burn solids and sludges. In the market for commercial land disposal, 47 facilities provide the service, and only 29 of these have hazardous waste landfills. However, a 1985 EPA survey of commercial waste management firms indicated that landfilling activities accounted for almost 50 percent of the waste accepted at commercial firms. The landfilled quantity was approximately 10 times the quantity

incinerated (5 percent of all waste). Chemical treatment of waste accounted for most of the remaining volume (25 percent) (Industrial Economics, Inc., 1988).

C.3.2.4 Capacity Availability for Commercial Waste Management Services

The findings of the study suggested four potential "problem" areas with the greatest likelihood that capacity is or will not be expanding rapidly enough, these are:

- inadequate capacity of existing treatment and disposal technologies, specifically, the incineration of solids and sludges and inadequate landfill capacity;

- inadequate supply of "quality" waste management services due to generators imposing conditions such as environmental compliance audits and financial tests in addition to the requirements for full compliance with the RCRA statutes. The study stated that some generators indicated that after screening out facilities failing these tests and taking into account the costs of transporting wastes to more distant facilities, commerical tratment or disposal services were often limited to two or three options;

- regional imbalances in the distribution of commercial hazardous waste management facilities resulted in the need for generators to ship wastes long distances for treatment or disposal, thereby increasing waste management costs; and,

- limited availability of transportation services for less than full truckloads of waste thereby making waste pick-up difficult and associated high waste transportation costs.

C.3.3 The Barriers to Industry Development

C.3.3.1 Perceived Causes of Capacity Problems

The commercial hazardous waste marketing study identified several factors influencing the supply and demand of commercial waste management services in the U.S., as briefly highlighted below (Industrial Economics Inc., 1988):

- Supply - uncertainty about what wastes will be regulated and how stringently the regulations will be enforced;

  - the virtual impossibility of getting approval for waste management facilities at new locations;

  - the difficultly of permitting expansions to capacity or new technologies at existing waste management facilities;

  - the difficulty of obtaining environmental liability insurance for commercial hazardous waste facilities; and,

  - lack of available capacity for less-than-full truckload transportation.

- Demand - decision to encourage waste management at only a small number of commercial facilities and requesting large generators to withdraw RCRA Part B permit applications (for onsite treatment);

  - implementation of the RCRA corrective action program requiring a clean-up plan for all solid waste management units is serving as a disincentive to firms considering applications for onsite treatment thereby increasing the demand for offsite services;

  - hesitancy of generators to apply for onsite treatment due to fear of triggering corrective action requirements (as above) and reopening the review process for facilities and activities already permitted thereby increasing the demand for offsite services; and,

  - almost impossible to have EPA approval for delisting of a waste or treatment residue, thereby forcing generators to transport wastes to commercial treatment and disposal firms.

C.3.3.2 Other Problems

The primary constraint to expansion of commercial waste services has been cited as permitting due to (Industrial Economics Inc., 1988):

- lack of resources and personnel at both the state and federal level for processing permits;

- problems caused by differences and inconsistencies between Federal and State regulatory standards;

- perceived attempts by some States to use the permitting process to discourage siting of waste management facilities; and,

- limited incentives for permit writers to issue permits that can actually be implemented by the applicant (due primarily to the need to defend the permit decision at public hearings).

Additionally, permit writer turnover rate, geographic distribution of the industry and lack of incentives for the development of innovative technologies have also been cited as barriers to growth of the industry. Due to the responsibility of permit writers and potential lack of training in making decisions involving chemicals, waste management and innovative technologies, these individuals frequently change positions thereby causing industry permits near the point of completion to change hands and require permit evaluation from the beginning once again (Piragis, 1988).

Geographically waste management facilities are located in certain areas and because of the permitting process (above) and siting difficulties have not distributed uniformly across the country thereby resulting in high transportation and waste management costs. There is not much incentive for development of innovative technologies because quite often in the Land Disposal restrictions, EPA has identified specific technologies (eg. rotaty kiln incineration) that would be accepted for use, thereby ruling out all other

technologies. The National Solid Waste Management Association (NSWMA) has been encouraging the use of performance standards or concentration levels to be utilized for making this decision, as well as, reference to a process (eg. thermal destruction) rather than a specific technology (Piragis, 1988).

D.0 VIEWS ON THE COMMERCIAL HAZARDOUS WASTE MANAGEMENT INDUSTRY IN CANADA

The views of select generators, commercial waste management firms, industry associations and corporations, government entities and other interest groups were solicited on the points of interest identified in Tables D.1 and D.2.

Of the eleven companies solicited for views on the Canadian hazardous waste management industry, five responded. Seven out of twelve of the waste management organizations contacted responded; waste management organizations include industry associations and corporations, government entities and other interest groups (including consultants). All companies and waste management organizations contacted were supportive of the study and indicated a willingness to participate but due to the time constraints of the study and previous internal commitments and constraints were unable to participate. Of the ten generators solicited for views, four responded. Generators or potential generators of hazardous wastes were more restrictive in their responses due to legal concerns and liabilities. Principal types of commercial waste management services provided by waste management firms are not addressed in this section because only a select number of firms were contacted in the study and may not be all encompassing of the range of services available in Canada.

Table D.1 1988 COMMERCIAL HAZARDOUS WASTE MANAGEMENT INDUSTRY (GENERATORS)

1. What are the principal types of commercial waste management services (eg. disposal, treatment, recycling, transport) that you purchase? Domestic or foreign? Extent of utilization of consultant services?

2. Why has your firm decided not to treat the waste onsite? Are there regulatory constraints for development of this industry?

3. For a particular treatment or disposal technology, have you recently experienced any difficulty in contracting for adequate waste management capacity?

4. Are there any particular wastes for which it is especially difficult to obtain treatment or disposal services?

5. What has been the recent behaviour of prices for commercial waste management services purchased by your firm?

6. How far must you transport your wastes for treatment or disposal? Do you utilize firms specializing in waste transport?

7. When contracting for waste management services, how many suppliers do you typically have to choose from?

8. Are there any wastes or treatments for which you believe technological innovation has been inadequate?

9. Do you participate in waste exchange programs?

10. Are Transportation of Dangerous Goods (TDG) regulations and any other specific federal and provincial regulations satisfactory in adequately identifying hazardous wastes requiring management and mechanisms for appropriate handling and management of these wastes? Are federal and provincial officials readily available to assist in interpreting the regulations?

11. Would training programs be useful in identifying appropriate mechanisms for waste management?

12. Are you aware of the commercial waste management facilities in Canada and the services that they provide?

Table D.2 1988 COMMERCIAL HAZARDOUS WASTE MANAGEMENT INDUSTRY
(COMMERCIAL INDUSTRY)

1. What are the principal types of commercial waste management services (e.g. disposal, treatment, recycling, transport) that you provide? Services provided to both domestic and foreign markets? Extent of consultant services utilized?

2. What is the estimated volume of wastes handled, by technology, in calendar year 1987? Anticipated increase or decrease in 1988?

3. What are the estimated volumes of waste handled, by waste type, in calendar year 1987? Anticipated increase or decrease in 1988? Current waste handling capacity of your facility?

4. What are your plans to acquire or expand existing capacity, and/or to construct new capacity in terms of number of facilities, services and capacity? Reasoning for expansion?

5. What are the price ranges for 1987 by technology - waste type combination (eg. incineration of low BTU liquids)?

6. Identify the ability to obtain operational permits and siting permits in your province? What are specific reasons, if any, for delays in permit processing?

7. What is your assessment of growth markets or markets in decline, if any? What are the factors behind the changes you expect?

8. What are the major barriers to market and industry growth and why? Do you have any suggestions for overcoming these barriers?

9. Is there a lack of adequate technology and waste management capacity in Canada? Identify technologies that could be promoted and/or research and development efforts that could be enhanced. Is innovative technology development encouraged in Canada?

10. Does industry have a clear understanding of the requirements of federal and provincial waste management regulations? Would training courses in regulatory interpretation be useful?

Table D.2 1988 COMMERCIAL HAZARDOUS WASTE MANAGEMENT INDUSTRY (Cont'd)
(COMMERCIAL INDUSTRY)

11. What are your suggestions for improving and promoting the Canadian hazardous waste management service industry? What is the availability of and need for financial assistance?

12. In your view, are the Canadian people, both household and industry generators of hazardous waste, sufficiently informed of the definition of a hazardous waste, how it should be handled and technologies and industry in Canada that could handle these wastes in an environmentally sound manner?

D.1 COMMERCIAL WASTE MANAGEMENT FIRMS

Overview of responses by commercial waste management firms on solicited points of interest are presented below:

1. What are the principal types of commercial waste management services (e.g., disposal, treatment, recycling, transport) that you provide? Services provided to both domestic and foreign markets? Extent of consultant services utilized?

Three of five firms indicated that services are currently being provided to both foreign and domestic markets. One company indicated that they operate 15 transfer centres in Canada (no treatment facilities) and 7 recycling facilities, 2 blending facilities and 2 cement kilns in the U.S. Another company indicated that they operate two treatment, disposal and recycling facilities in Canada. Facility services include secure chemical landfilling, physical/chemical treatment, incineration, and recycling. Two transportation fleets are operated in Canada. This company also operates three inorganic pretreatment facilities, one large onsite treatment facility and recycling/recovery facilities in the U.S. One company operates disposal, onsite biological treatment, and physical/chemical treatment facilities, four mobile water treatment units, solvent extraction and recycling facilities, and 100 to 150 mobile transport units in Canada.

Efforts are ongoing in one of the firms not currently servicing foreign markets to expand into these markets. Of the firms solicited most indicated that consultants are

primarily utilized for specialized services and that quite often studies and engineering design are undertaken in-house. One firm indicated that approximately $ 200,000 was spent in 1987 for consulting services, while an estimated $ 1.5 million had been paid by the firms clients to external consultants for services related to contractual work. Additionally, two firms indicated that well over 70 percent of their business was supported by foreign markets.

2. What is the estimated volume of wastes handled, by technology, in calendar year 1987? Anticipated increase or decrease in 1988?

3. What are the estimated volumes of waste handled, by waste type, in calendar year 1987? Anticipated increase in 1988? Current waste handling capacity of your facility?

Information on these topics was not readily available from most firms due to time constraints for generation of the data in-house and within the completion dates of the study. However, one company indicated increased growth of waste volume handled for over a decade with an anticipated increase in 1988 of 20%. This, company also indicated that of the 40 million gallons of liquid wastes handled worldwide in 1987, only 2.5 million gallons represented Canadian wastes. Another company indicated that they have a permit to handle 100,000 tonnes/yr. of hazardous wastes but currently operate at 75,000 tonnes/yr with 70% of these wastes imported from the United States.

4. What are your plans to acquire or expand existing capacity and/or to construct new capacity in terms of number of facilities, services and capacity? Reasoning for expansion?

Each firm is expanding existing capacity by constructing new facilities or by acquiring other waste management companies in an attempt to meet the technological and capacity needs of the waste management industry. Two firms indicated that they had recently bought out other Canadian hazardous waste management companies. Another firm indicated that a transfer facility had recently been purchased in the U.S.

5. What are the price ranges for 1987 by technology - waste type combination (e.g., incineration of low BTU liquids)?

This information was not readily available. However, one firm indicated that the average price for treatment and disposal or organic wastes is $210/tonne. It was also stated that this price varies according to the waste treated and handling requirements.

6. Identify the ability to obtain operational permits and siting permits in your province? What are specific reasons, if any, for delays in permit processing?

All firms responded with dissatisfaction on the ability to obtain operational and siting permits largely due to time required and costly processes for certificates of approval. Specific issues are presented below:

- Legislation governing the hazardous waste management industry is a moving target thereby making standards and requirements unclear. Additionally, due to differences in interpretation, waste management practices designated acceptable by one regulatory official may not be acceptable to another.

- Public acceptance is a key issue in permit approval largely due to the NIMBY ('not in my backyard') syndrome. Public hearings and information sessions may have to be held before the various levels of government endorse a permit.

- Often too many levels of government are involved in the permitting process, even for routine tasks. It is time consuming and costly to obtain several authorizations. As a result, clients become dissatisfied with time delays and additional costs and often cancel waste management initiatives until a release of contaminants occurs making authorization easier to obtain.

- Discrepancies in federal and provincial policies concerning manifesting of recyclable wastes are apparent. A mechanism for standardizing legislation governing waste management would be beneficial.

7. What is your assessment of growth markets or markets in decline, if any? What are the factors behind the changes you expect?

Industry is geared by economics, technology, and media and public response to environmental problems. Waste manage-

ment companies must respond to the needs of the industry - what needs to be done dictates who operates. Small companies are challenged by upfront economics.

Waste management is a dynamic business. One company suggested that in the next 5 to 10 years industry needs will likely increase creating a short term demand for waste management services. This short term demand will be due to regulation of the industry and an increase in the types of waste requiring treatment. However, due to economics, large facilities may opt for onsite treatment and alter their process rather than acquiring commercial waste management services. Additionally, waste minimization efforts will also affect the quantity of wastes requiring appropriate management.

It was also noted that media coverage of certain aspects of environmental problems (e.g., high profile wastes such as PCB's), together with public response, has been responsible for regulatory development and enforcement, which ultimately directs and drives the hazardous waste management market.

8. What are the major barriers to market and industry growth and why? Do you have any suggestions for overcoming these barriers?

Perhaps the most emphasized view of the commercial waste management industry is a lack of regulatory enforcement in Canada. Legislative needs drive the market. Without regulatory enforcement, the management of hazardous wastes relies largely on corporate conscience in ensuring environmental protection. Additional views on the barriers to market and industry growth are presented below:

- Focus is placed on major commercial waste management firms to provide elaborate environmental controls while small companies often operate with virtually no monitoring. This scenario enables smaller companies to undercut prices very easily and maintain or increase their share of the market. Environmental legislation should be applied uniformly.

- Considerable time (up to 3 years was cited) is required for governments to deliver permits or approvals for applications from major companies while smaller companies conduct the work without obtaining government approvals. Staffing of government agencies should be improved to meet the current industry peak. Training programs and workshops could also be sponsored to provide industry and regulatory officials with a mechanism to become knowledgeable of industry and regulatory representatives, the waste management industry and the companies involved, and the applicable regulations and requirements.

- Environmental protection and associated activities are not areas where large quantities of government monies are directed. Nevertheless the environment and its protection receives considerable focus. There is a lack of federal funding addressing waste management and recycling programs. Industry has specifically indicated the need for financial support for companies that are experiencing difficulties in identifying markets for recycled oil due to the current low prices of virgin (i.e., crude) oil.

- Business is market driven. Therefore, regulations must be in place and enforced to drive the industry, that is, there must be a need before anything is done. However, the government does not have enough political will to set up and enforce the regulations to govern the industry. A "chicken and egg" situation results.

- A thorough assessment of waste volumes should be undertaken nationally.

- One company indicated that industry can handle waste management at a profit, thus there is no need for taxpayers to fund waste management through the Crown.

9. Is there a lack of adequate technology and waste management capacity in Canada? Identify technologies that could be promoted and/or research and development efforts that could be enhanced. Is innovative technology development encouraged in Canada?

Most companies indicated that adequate technology exists if not already in Canada then it can be made available to Canada. Biotechnology was identified as a technology that needs to be developed particularly with respect to insitu biodegradation of contaminants in soils.

All responding companies indicated that there is a lack of adequate waste management capacity in Canada largely because the regulatory framework is not in place. Specific facilities cited as having a lack of capacity were identified as:

- incineration facilities in Eastern Canada, to handle organic wastes including solids;

- dewatering of municipal or industrial ponds and lagoons; and,

- landfill capacity for wastes with low toxicity, unsuitable for domestic solid waste facilities, but not classified as hazardous wastes.

In addressing the enhancement of research and development (R & D), one company felt that the technologies that are worth promoting are the exportable technologies and that the Canadian market by itself is too small for justifying the necessary R & D. Another company stated "why promote R & D if industry is not being promoted".

Some companies indicated that innovative technology is encouraged while others felt that it is not largely because people do not want to take a chance on something unproven. Grants or subsidies are mostly reserved for universities and manufacturing industries, and are close to impossible to obtain for service industries. One company indicated that the cost of R & D in Canada is close to being prohibitive, given the high costs involved in going through political steps with government agencies. The following comparison with European countries (Belgium, Germany) was presented for an investment of $ 1.00:

	Canada	Europe
1) Company investment in R&D	0.25/$1.00	0.40/$1.00
2) Government investment in R & D	0.25/$1.00	0.40/$1.00
3) Expenses for items other than R & D	0.50/$1.00	0.20/$1.00

In Canada, an expense of $ 0.75 by a company (categories 1 + 3) produces $ 0.50 (categories 1 + 2) of R & D. In Europe where there is a more organized cooperation between government and the private sector, $ 0.60 (categories 1 + 3) produce $ 0.80 of R & D. The situation in the United States was identified as being different because the size of the market and the greater incentives towards clean-up efforts create a situation favourable to technology development without the need for government involvement.

10. Does industry have a clear understanding of the requirements of federal and provincial waste management regulations? Would training courses in regulatory interpretation be useful?

All companies indicated that industry, generators and regulatory officials (or some combination thereof) do not have an adequate understanding of the regulations. One company stated that regulatory officials need training on applicable provincial and federal legislation and need to acquire a working knowledge of the industry that they are regulating. Regulations need to be enforced because in general industry's view of waste management is "why worry about appropriate waste management if there is no pressure to do so through regulatory enforcement?"

Another firm indicated that a standardized regulatory body would be useful. CEPA may not be able to completely fill this role due to politics associated with taking over the mandate of some provincial jurisdictions. The CCREM Action Plan was identified as a potentially better method for standardizing the federal and provincial regulations governing hazardous waste management.

Training programs and workshops for industry and regulatory officials are recommended. A similar program to the U.S. RCRA telephone hotline program for providing legislative interpretation was noted as being worthy of consideration for implementation in Canada.

11. What are your suggestions for improving and promoting the Canadian hazardous waste management service industry? What is the availability of and need for financial assistance?

Several suggestions were made for improving and promoting the Canadian hazardous waste management service industry, these include:

- The implementation of mechanisms by which governments would evaluate, approve, and endorse technologies would greatly help industry to offer services to clients in Canada and also out of Canada.

- There is a need in the government itself to render uniform the comprehension of regulations and the manner of their application.

- More incentives for onsite treatment are needed, e.g., reward and punishment. For areas of the country that are not readily accessible, that lack a large industrial base and require treatment, disposal or recycling of small waste volumes, incentives such as tax breaks should be provided to the company for coming to the province or region to handle the wastes.

- Create a national waste management association that will interface with the task force at a federal level. This association will know what industry is and what can be done with industrial waste. The mandate of the association should focus around toxic wastes and the technology for handling these wastes. Provincial waste management associations currently existing do not focus on toxic wastes. Financial assistance would be needed for this task.

- Increased financial assistance should be provided to R & D and recycling activities.

12. In your view, are the Canadian people, both household and industry generators of hazardous waste, sufficiently informed of the definition of a hazardous waste, how it should be handled and technologies and industry in Canada that could handle these wastes in an environmentally sound manner?

All responding companies indicated that the public, industry and to some extent regulatory officials are not sufficiently informed on the above. Specific comments are presented below:

- People in general are misinformed. Lots of wastes are hazardous but not highly toxic. The public is only familiar (not knowledgeable) about high profile wastes, e.g., PCB's. The public needs more information about chemicals and toxicity, and the rights of the public.

- An education program is initially needed for training regulatory officials and establishing a comprehensive provincial and national waste inventory. This training will subsequently result in regulatory enforcement thereby requiring industry training. Financial assistance will be required for development and conduct of this program.

D.2 GENERATORS

1. What are the principal types of commercial waste management services (e.g., disposal, treatment, recycling, transport) that you purchase? Domestic or foreign? Extent of utilization of consultant services?

All of the responding generators purchase commercial disposal and treatment services in the form of landfilling and incineration. Licensed haulers are used for waste transport. Most waste management services are provided domestically. Some facilities have onsite treatment provisions such as neutralization, bulking and recycling. Limited consultant services are utilized. One company stated that acid wastes are shipped to the U.S. for recycling.

2. Why has your firm decided not to treat the waste onsite? Are there regulatory constraints for development of this industry?

Most firms indicated that individual onsite treatment facilities are not economically feasible. Additionally, in general, regulatory approval for onsite facilities is thought to be too time consuming.

3. For a particular treatment or disposal technology, have you recently experienced any difficultly in contracting for adequate waste management capacity?

One company indicated seasonal waste management capacity problem with delays in waste pick-up during the summer months. Additionally, wastes have to be stored for up to four to six weeks before being set offsite for treatment or disposal. Most companies indicate that offsite treatment or disposal is costly.

4. Are there any particular wastes for which it is especially difficult to obtain treatment or disposal services?

Difficultly has been experienced in disposing of sludges with a flash point under 70°C. Rotary kiln incinerators have the ability to dispose of these sludges, however, these incinerators are not readily available in Canada. These wastes can be shipped to the U.S. for handling but usually long delays are encountered due to regulatory constraints. Facilities are lacking in Canada for PCB waste disposal. Additionally, one company stated that a waste management facility does not exist in Canada for the appropriate management of explosive wastes.

5. What has been the recent behaviour of prices for commercial waste management services purchased by your firm?

All responding firms indicated that prices for commercial waste management services are going up at an average rate of 14 percent per year for solid wastes and 7.5 percent

annually for liquid wastes. It was also stated that for some waste types the cost for commercial management has increased 50 percent from last year.

6. How far must you transport your wastes for treatment or disposal? Do you utilize firms specializing in waste transport?

Transport distances to a commercial disposal or treatment facility range from 10 to over 300 km. Wastes being transported to the U.S. for incineration or recycling travel up to 550 km. Licenced haulers are utilized for waste transport.

7. When contracting for waste management services, how many suppliers do you typically have to choose from?

Most companies are only aware of one commercial hazardous waste management service industry in Canada. One company indicated two to three facilities are available in Canada for disposal. One company also indicated that five to ten waste haulers are available. One company indicated that many U.S. waste management firms are interested in its business but regulatory constraints make this impractical.

8. Are there any wastes or treatments for which you believe technological innovation has been adequate?

Technological development was cited as being lacking for PCB wastes, and for sludges with a flash point below 70°C.

9. Do you participate in waste exchange programs?

Fifty percent of the responding companies participate in waste exchange programs. Some wastes generated have been identified as not being reusable.

10. Are Transportation of Dangerous Goods (TDG) regulations and any other specific federal and provincial regulations satisfactory in adequately identifying hazardous wastes requiring management and mechanisms for appropriate handling and management of these wastes? Are federal and provincial officials readily available to assist in interpreting the regulations?

In general, the TDG regulations were considered satisfactory, however, specific comments relating to the regulations included: the TDG system operates extremely slow, the TDG regulations are difficult to interpret, and regulations regarding the handling of some wastes (such as explosive wastes) are not well defined. In general, generators felt that government officials were available to provide assistance. One company, however, indicated that proper government contacts are difficult to identify.

11. Would training programs be useful in identifying appropriate mechanisms for waste management?

Fifty percent of the responding generators were in favour of training programs. One company indicated that training programs should be offered to small companies. Additionally, it was stated that some hazardous material reference information (e.g., toxicity data) is not readily available.

12. Are you aware of the commercial waste management facilities in Canada and the services they provide?

Fifty percent of the responding companies are aware of the commercial waste management facilities in Canada while the remaining 50 percent would be interested in seeing a listing of available services.

D.3 WASTE MANAGEMENT ORGANIZATIONS

The views of industry associations and corporations, government entities, and other interest groups (including consultants) on the hazardous waste management industry in Canada were solicited. For the purposes of this report, the views of these groups will be discussed collectively as 'waste management organizations'. Copies of the points of interest distributed to generators and to the commercial waste management industry were provided to the waste management organizations for review. An overview of the comments, needs and recommendations of the waste management industry as provided by the waste management organizations is presented below:

(i) Growth Markets or Markets in Decline

- There is a need for clean-up capabilities through site remediation and decommissioning.

- The recycling and waste minimization industry is growing, including equipment supply for on-site treatment.

- The need for treatment and disposal facilities may grow due to increased regulation of the industry. However, waste minimization will likely be inherent in company processes in the near future. Some generators are currently incorporating waste minimization and reduction technologies and mechanisms to reduce toxicity at the product development stage.

(ii) Major Barriers to Industry Growth

- The hazardous waste management industry is entirely regulatory driven - leislation must be enforced to promote the industry. There is a need for more stringent regulations and their enforcement. "Industry doesn't do anything except what it has to do from a regulatory perspective."

- The major barriers to industry growth are public acceptance - NIMBY syndrome - and politics. The public should be made aware that it is their problem. Viable alternatives should be presented in a public forum. The industry needs public participation and commitment to waste management. Everybody needs to be brought to a minimum level of understanding. The political will and acceptability of bonafide processes must be developed.

- Another major barrier has been slow regulatory development and enforcement in conjunction with insufficient hazardous waste education. These barriers may be overcome by greater cooperation between juisdications in the development of uniform

policies, regulations and educational programs in accordance with the CCREM Hazardous Waste Action Plan.

- Other barriers include:

  - lack of insurance coverage for damages to the environment;

  - uncertainty and delays in approval processes;

  - uncertainty and changes in the regulations and government policies; and,

  - high capital and operating costs for disposal facilities.

(iii) Lack of Adequate Technology and Waste Management Capacity

- There is a lack of technology available in Canada. Not enough money is available to fund R & D in Canada. The Federal Government should focus funds for R & D specifically towards demonstration testing.

- The SITE Program under CERCLA in the U.S. would be a useful approach in Canada. The Program utilizes some Superfund money and conducts demonstration testing of onsite remedial technologies.

- Research and development should be promoted in the area of onsite waste reduction and treatment and disposal technologies.

(iv) Understanding of Industry, Public and Regulatory Officials of Hazardous Waste Management Industry and Associated Requirements

- Industry lacks a clear understanding of the provincial waste management regulations. There is a need to promote greater understanding of the regulations through educational programs and dissemination of information.

- A greater emphasis should be placed on public education to promote both the need for and a better understanding of the Canadian hazardous waste industry.

- Regulatory officials do not have a clear understanding of the regulations. Additionally, with the new CEPA, waste management regulation is a moving target. Training is only required to the extent that government will enforce the regulations.

(v) Suggestions for Improving and Promoting Industry

- From an economics point of view, incentives must be provided to industry to encourage development. With regulation, loopholes can be found. Additionally, regulations must be standardized provincially and nationally.

- The Federal government should support R & D and the provinces should regulate the industry.

- Funding should be directed towards demonstration testing, waste minimization, potential recycling of wastes or waste application in other areas, and process control in industry (eg. Ontario's MISA Program could be a national model).

- Ontario's industrial 4Rs program provides funding to industry and municipalities for waste minimization. This program could be used as a national model.

- Regional municipalities could be encouraged to promote waste minimization through tax incentives.

- Canada could legislate similar to the U.S. and Europe, that generators undertake waste minimization programs.

- Government officials could be more informed on the 4Rs program.

- Government should re-evaluated in-house purchasing policies because often hazardous products requiring complex treatment or disposal are purchased when non-toxic, biodegradable or recyclable products exist to serve the same purpose.

- Environmental consciences should be promoted on a national scale.

- A data base should be developed to increase the buyer's awareness of different products available and the environmental acceptability of the

products. The "Blue Angel" concept proposed in Germany identifies the most environmentally safe product by stamping a blue angel on the product. Such a concept or program could be used to promote public awareness of environmental issues and marketing.

- Federally funded workshops could be provided to enable information transfer in specific industry sectors.

- Information transfer between industry, government and consultants should be increased . A collective approach to waste management by people in the field could be encouraged. Such a program would address the needs of the industry and could be jointly funded by industry and the Federal government.

(vi) Other Noted Views

- The question of what happens in the event of a major accident must be addressed so that there are safeguards to prevent this occurrence (similar to the nuclear industry).

- In industry there is confusion with the concept of FULL SERVICE as applied to consultants and contractors, this should be clarified. Consultants handle everything through to construction management (e.g., design, contract specifications, etc.) where as contractors implement the remediation program under the supervision of the consultant.

- A big void with consultants is their understanding of the legal liability on Occupational Health and Safety of workers at waste site cleanups.

ENVIRONMENTAL POLICY

The Dow Chemical Company

The Dow Chemical Company is committed to continued excellence, leadership and stewardship in protecting the environment. Environmental protection is a primary management responsibility as well as the responsibility of every Dow employee.

In keeping with this policy, our objective as a company is to reduce waste and achieve minimal adverse impact on the air, water and land through excellence in environmental control.

MARCH 15, 1984

DOW

DOW CHEMICAL CANADA INC.

ENVIRONMENTAL POLICY

Dow Chemical Canada Inc. is committed to excellence in protection of public health, the health of our employees and the health of the environment.

Dow Chemical Canada Inc. will develop, manufacture and market its products in accordance with this commitment, and will provide product safety information for the proper handling, use and disposal of each product.

November, 1987

DOW CHEMICAL CANADA INC.

ENVIRONMENTAL PROTECTION GUIDELINES

GENERAL PRINCIPLES

1. Environmental protection is a line responsibility and an important measure of employee performance. In addition, every Dow employee is as responsible for environmental protection as for safety, quality, cost efficiency and productivity.

2. Every operating location will have programs to assure that operations do not adversely affect human health or the environment. These programs will address the concerns associated with:

   a) emissions to the atmosphere and surface waters,
   b) protection of groundwater from contamination,
   and c) the generation and disposal of solid and hazardous waste.

   Accurate records will be maintained of the nature and amount of all emissions and wastes generated and disposed.

   An emergency response program will be available to minimize the effect of spills both on- and off-site.

   Each site will identify at least one qualified person to coordinate the environmental programs and a regular schedule of environmental assessments by both on-site and off-site Dow personnel will be maintained.

3. Dow will comply with all applicable environmental laws and regulations or with Dow guidelines, whichever are more stringent. Interaction with legislative and regulatory bodies will be conducted in good faith and in an open, pro-active, cooperative and consultative manner with the Dow position based on good science.

4. An environmental impact evaluation will be assured by Business Management Teams for all products before they are approved by management for commercial sale. In accordance with the Product Stewardship Policy, the Company will provide information and assistance for customers, including distributors, relating to the safe handling, use and disposal of all products.

5. An environmental assessment will be required before management approval is obtained for the sale or acquisition of any property used for manufacture or storage of chemicals.

6. Every operating location will define a procedure for effective communication of environmental incidents to employees, regulatory officials, the media and the general public.

PROGRAM GUIDELINES

a) Emissions to the Atmosphere and Surface Waters

i) The goal is to continuously reduce emissions.

ii) Plants will be designed or modified, if necessary, to use the best practical technology to permit compliance with regulatory requirements and achievement of a continuous decrease in emissions.

iii) Accurate records of emissions will be maintained and appropriate techniques employed to permit measurement of continuous improvement.

b) Protection of Groundwater From Contamination

i) All operating locations will develop hydrogeological data for the site and associated landfills to define the potential for groundwater contamination.

ii) Existing facilities, including storage tanks, underground lines and impoundments, will be evaluated and steps taken to prevent or mitigate groundwater contamination.

iii) A monitoring program reflecting identified concerns will be developed.

iv) New installations will be designed, constructed, operated and maintained in a manner that will protect groundwater quality.

c) The Generation and Disposal of Solid and Hazardous Waste

i) Each operating location will have a program to minimize the generation of waste for disposal with reduction at source given first consideration.

ii) Recycle, recovery or re-use of generated waste are preferred options to disposal.

iii) Incineration is the preferred disposal method for combustible hazardous waste.

iv) Whenever practical, other wastes will be rendered non-hazardous before disposal.

v) Landfill disposal as a primary disposal method should be used only for those hazardous materials which cannot be recycled or incinerated. All Dow landfill sites for hazardous materials should be secure and, as a minimum, must meet all government standards for hazardous waste disposal. Use of Dow - owned landfills is preferred. Use of non-Dow landfill sites for disposal of hazardous waste requires the approval of the Vice-President of Manufacturing.

iv) Well disposal is not a satisfactory long term practice for hazardous waste disposal. However, use of deep-well technology for return of like-to-like such as brine and brine-related chemicals is an acceptable practice.

v) All non-Dow waste disposal facilties and waste management contractors used by Dow will be subject to a Dow assessment prior to use and re-assessment on a periodic basis.