MANAGEMENT OF HAZARDOUS WASTES IN YUKON:
AN INVENTORY AND ANALYSIS

by

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ABSTRACT

The purpose of this project was to survey the quantities, geographic distribution and the current practices of hazardous waste generation and disposal in Yukon Territory. In addition, information was requested concerning commercial petroleum storage.

A total of 2,766,312 tonnes of waste is generated in Yukon annually. Of this, 2,765,215 tonnes are mine tailings disposed of into ponds or piles. The remaining 1097 tonnes are miscellaneous hazardous wastes generated for the most part in Whitehorse.

There was approximately 21,000,000 litres of available petroleum storage capacity in Yukon, centered in Whitehorse.

ACKNOWLEDGEMENTS

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I would like to thank the members of my Practicum Committee: Brian Topnik, Civil Engineering, University of Manitoba; Frank Henning, W. L. Wardrop and Associates Limited; and Wishart Robson, Environmental Protection Service, for their advice and criticism.

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CHAPTER I

HAZARDOUS WASTES MANAGEMENT STUDY: INTRODUCTION AND OBJECTIVES

INTRODUCTION

This study attempts to develop a management program for hazardous wastes in Yukon by using inventory and assessment techniques. It is commissioned by the Environmental Protection Service, Whitehorse, and is the first such study which puts into perspective the hazardous waste problem in Yukon. Previous studies in this region have been part of national inventories of specific wastes (such as Polychlorinated Biphenyls and automobile emissions). This survey differs from the above by examining hazardous wastes generally and not focusing on any one specific waste.

DEFINITION OF A HAZARDOUS WASTE

In Canada, a nationally accepted definition of a hazardous waste has not yet been achieved. Authors of various reports on the subject have had to contend with this problem by defining a hazardous waste on an individual report basis. For the purpose of this study, a hazardous waste is defined as any unwanted material in solid, semi-solid, liquid or gaseous form which cannot be disposed of by normal waste management techniques, because it poses a substantial present or potential hazard to public health, safety, and the environment. Hazard characteristics include corrosiveness, ignitability, chemical reactivity and/or toxicity (see Appendix I)

(Environmental Protection Service, 1977). A waste may possess one or all of the above hazard characteristics. For example, ignitable and explosive wastes may be chemically reactive as well; however, for classification purposes, the primary waste characteristics of concern would be ignitability and explosiveness, rather than chemical reactivity.

PROBLEM STATEMENT

Increased industrial development in Canada generally, and in Yukon specifically, has contributed to a rise in the volume of hazardous wastes being generated (Canada Yearbook, 1977). As few records have been kept, it is impossible to estimate the volume of hazardous wastes already dumped into the environment, their fate, or their chemical composition.

Steps have been taken to curtail improper disposal of wastes into air and water by progressive implementation of air and water pollution control programs. As a result, this has made available significant amounts of industrial wastes for disposal. Problems associated with improper disposal of hazardous wastes have not been widely recognized by the public, although damages can be very severe and sometimes impossible to remedy. A series of reports documenting damages from hazardous waste disposal have been prepared by the U.S. Environmental Protection Agency (Battelle Memorial Institute, 1973, and Booz Allen Applied Research Inc., 1973). Damages documented include: groundwater contamination via leachate, surface water contamination via runoff, air pollution via open burning, evaporation, sublimation and wind erosion, poisonings via direct contact and through the food chain, and fires and explosions at land disposal sites.

JUSTIFICATION OF STUDY

This study is the necessary first step in the development of a hazardous waste management program for Yukon. Shortcomings must be identified in the existing situation before action can be taken. An effective management program will minimize damage to the environment. The survey was designed to point out any information deficiencies and give direction to future programs concerning hazardous wastes. Finally, the project will address the following three areas of concern held by the people of Yukon:

1. quality of life;
2. protection of environment; and
3. leisure and recreation.

OBJECTIVES

In order to assist the Environmental Protection Service and Yukon Territorial Government in developing both short- and long-term hazardous waste management programs, this project was aimed at providing data on sources of and disposal methods for hazardous waste materials generated in Yukon.

The specific objectives of this study were:

(1) to determine amounts and types of hazardous wastes currently being generated in Yukon and also to obtain, where possible, future trends in waste production;

(2) to identify and evaluate present methods of handling and disposal of hazardous wastes;

(3) to quantify the amounts of hazardous wastes presently being disposed of directly into the Yukon environment;

(4) to determine if the danger to the environment necessitates any special waste removal procedures being developed;

(5) to make recommendations as to the approach that may be taken to minimize and/or eliminate the hazardous waste problem in Yukon, based on the information gathered during the survey;

(6) to inventory commercial petroleum storage facilities so that an accidential spill contingency plan may be developed.

EXCLUSIONS

The following will not be considered in this study:

1. non-hazardous wastes which are treatable by existing facilities and discharge acceptable effluents to regulatory agencies.

2. accidental spills of hazardous materials;

3. hazardous wastes already surveyed (Polychlorinated Biphenyls and automobile emissions); and

4. radioactive materials.

AUTHORIZATION

This report was commissioned by the Environmental Protection Service, Whitehorse, Yukon, under the Department of Supply and Services, contract number OSB78-00045.

CHAPTER II

INVENTORY APPROACH

To accurately assess the hazardous waste problem in Yukon, accurate data on quantities and types of emissions and effluents from each contributing source was required. The following sections discuss the ways in which these data was collected and the methods employed to meet the objectives of the study.

Information Review

An in-depth survey of existing information relating to management of hazardous wastes was undertaken. This included a literature review and interviews with knowledgeable individuals from the hazardous waste management field.

Persons interviewed included those familiar with the hazardous waste problem in Yukon and other parts of Canada.

Questionnaire Approach

After meetings with Winnipeg-based members of the advisory committee, a questionnaire/personal interview approach was judged the best way to meet the objectives. The study area and the relatively small number of establishments to be contacted lent themselves to this approach.

Questionnaires were designed (see Appendix II) and the format chosen was similar to that used by W. L. Wardrop and Associates in their survey of hazardous wastes in the EPS Northwest region (Alberta, Saskatchesan, Manitoba, Northwestern Ontario and the Northwest Territories). The rationale behind this similarity was:

(a) to provide uniformity between EPS regions; and (b) Wardrop had experienced a high rate of success using this format.

The questionnaire package consisted of:

(1) two cover letters;

(2) an instruction and information sheet;

(3) hazardous waste data sheets; and

(4) commercial petroleum storage data sheets.

The first cover letter was from the Director of the Environmental Protection Service, Yukon Branch. The purpose of this letter was: (i) to introduce the researcher, (ii) state the objectives of the study, and (iii) assure confidentiality and solicit cooperation.

The second letter was from the researcher and it endeavoured to:

(1) provide justification for the study;

(2) define a hazardous waste;

(3) assure confidentiality; and

(4) provide an address and telephone number to which questions could be directed.

The instruction and information sheet was the first page of the questionnaire. This sheet defined a hazardous waste, listed hazard characteristics, provided examples of common hazardous wastes and specified which wastes were to be included or excluded from the survey. The instruction and information sheet also requested the identification of any existing public or private waste storage areas, disposal sites, commercial waste transport, reclamation or disposal services used by the respondent.

Data sheets which requested information on specific waste types were also included. No more than one waste type was to be described on each sheet. Type of waste, physical form of the waste, hazard category, constituents of the waste, frequency and method of disposal, current waste volume, seasonal variation of generation and projected increase in generation over the next two-year period (to summer, 1980) were the data type collected.

The last two sheets requested information on petroleum storage methods and volumes in the Territory. The following information was requested: total fuel storage capacity, method of storage, storage capacity by individual fuel grade, amount of each fuel grade sold in last year, delivery systems, quantities of contaminated fuel and disposal methods, and expansion plans for the facilities.

Hazardous Waste Classification System

The classification system used in this inventory was a modified version of the one developed by the Hazardous Materials Management Division (Appendix I). To be classified as a hazardous waste, the material in question must exhibit one or more of the following characteristics:

1. ignitability;
2. reactivity;
3. corrosiveness; and
4. toxicity.

The material can then be slotted into one of the 14 waste types which form the basis of the classification system.

The 14 waste types are:

Type 1 - Acid Solution	Type 8 - Tank Bottom Sediment
Type 2 - Alkaline Solution	Type 9 - Oil
Type 3 - Pesticides	Type 10 - Drilling Mud
Type 4 - Paint Sludge	Type 11 - Contaminated Soil and Sand
Type 5 - Solvents	Type 12 - Pathological Wastes
Type 6 - Tetraethyl Lead Sludge	Type 13 - Miscellaneous
Type 7 - Chemical Toilet Wastes	Type 14 - Contaminated Fuel

Identification of Establishments and Formation of Inventory Regions

A master list identifying establishments which had the potential to use or produce hazardous materials was developed from three sources:

1. Yukon (1978) telephone directory;
2. 1976 Yukon Territorial Industrial Directory; and
3. Information provided by Statistics Canada (unpublished)

There are 273 establishments identified in 54 categories (Table 1). Categories are based on breakdowns listed in the Yukon Industrial Directory and the Yellow Pages of the territorial telephone directory. Each establishment was then given a code in keeping with the confidentiality of the survey.

Yukon was then divided into five inventory regions based on the nature of the highway system and associated settlement patterns (Fig. 1):

(1) Inventory Region 1 - Whitehorse Proper

(2) Inventory Region 2 - Alaska Highway North

(3) Inventory Region 3 - Klondike Highway - Dempster Highway

(4) Inventory Region 4 - Robert Campbell Highway - Canol Road

(5) Inventory Region 5 - Alaska Highway South.

Table 1. Potential Hazardous Waste Users and/or Generators in Yukon.

Category Number	Category	Number of Establishments
001	Acoustical Contractors	2
002	Air Conditioning and Supplies	3
003	Airline Companies	14
004	Aircraft Maintenance and Service	2
005	Animal Care	2
006	Assayers	3
007	Artists - Commercial	1
008	Auto Body Repair	4
009	Blue Printers	1
010	Building Materials	7
011	Bus Lines	6
012	Chains and Culverts	1
013	Cleaners	4
014	Concrete	8
015	Dental Laboratories	4
016	Drilling Contractors	6
017	Engines	2
018	Explosives	3
019	Fire Protection Service	1
020	Fuel Retail	3
021	Funeral Director	1
022	Government Laboratories	4
023	Government Departments*	6
024	Hospitals	3
025	Insulation Contractors	3
026	Lumber Manufacturers	3
027	Machinery	4
028	Machinery Repairing and Rebuilding	1
029	Mechanical Contractors	2
030	Medicines	3
031	Mining Companies	8
032	Mining Development and Exploration	2
033	Nursing Homes	1
034	Nursing Stations	10
035	Oil Burners - Parts and Supplies	1
036	Oil Fuels and Heating	3
037	Paint Dealers	5
038	Painters	3
039	Photographers	5
040	Physicians and Surgeons	5
041	Printers	2
042	Propane Gas	2
043	Publications	3
044	Refrigeration	2

Table 1. (Cont'd)

Category Number	Category	Number of Establishments
045	Schools	18
046	Septic Tanks	3
047	Service Stations	67
048	Sheet Metal Work	3
049	Signs	2
050	Soft Drinks	2
051	Steel Distributors and Service Centers	2
052	Transportation	9
053	Veterinary Surgeons	1
054	Welding	7
	Total	273

*Includes Crown Corporations.

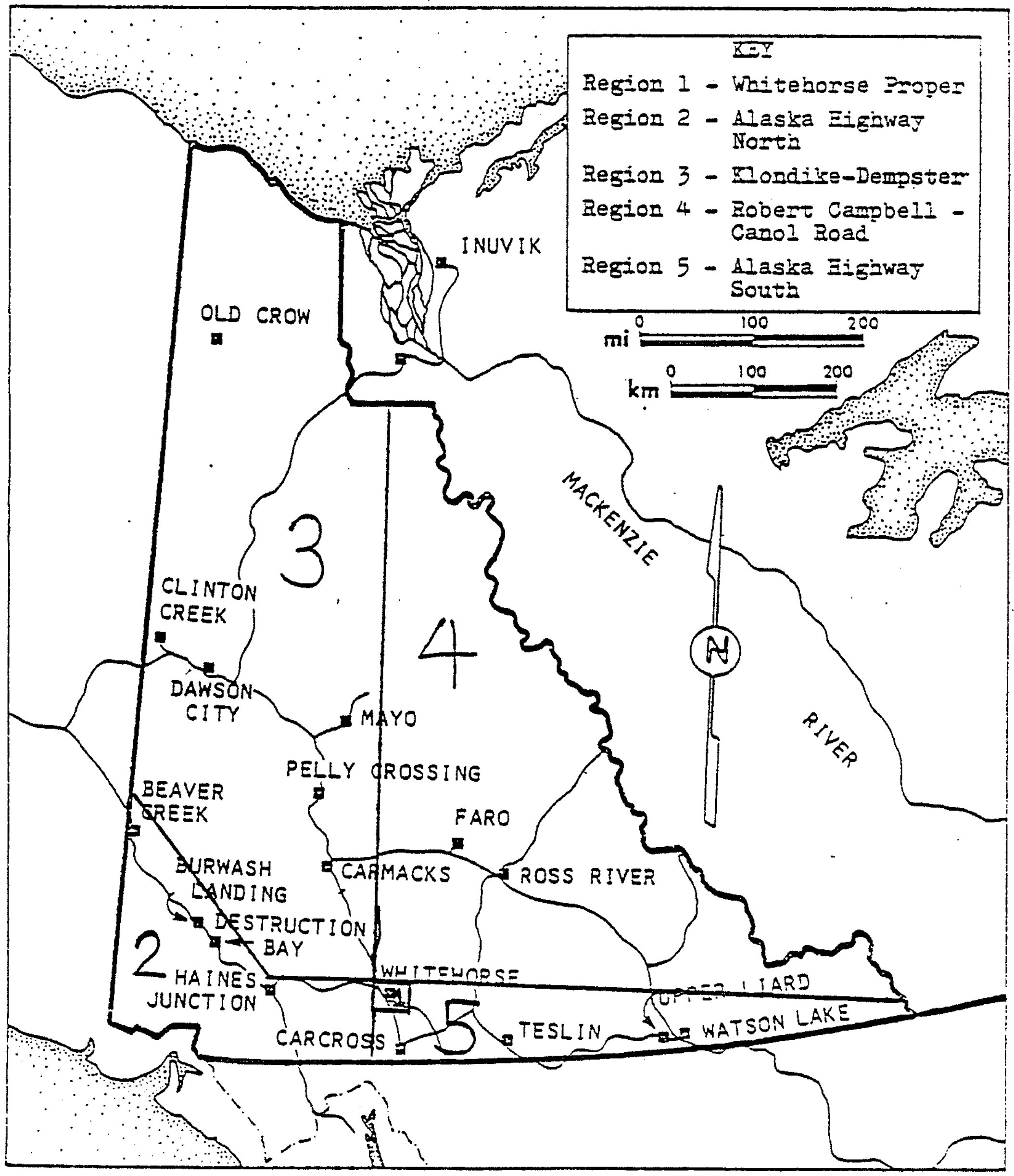


Figure 1. Map of Yukon illustrating major towns and highway systems in each of the five hazardous waste inventory regions.

All establishments were then sent questionnaires, and many were personally interviewed. Special efforts were made to visit non-respondents (no reply for one month) to the questionnaire, so as to increase the percentage return. This would have a bearing on the confidence of the final figures in the report.

Data Collection

Personal interviews with managers of Whitehorse establishments identified as possible users or producers of hazardous waste were conducted during 1978. The purpose of the Whitehorse interviews was to identify questionnaire shortcomings before the inventory was extended to include rural areas.

Questionnaires soliciting information from rural establishments were mailed, and an addressed, stamped return envelope was enclosed. Three weeks was then allowed for response.

A follow-up to the mail returns was carried out, the purpose of which was to interview respondents who had failed to properly complete their questionnaires and also to contact non-repondents. All collected data was then tabulated and analyzed.

CHAPTER III

DESCRIPTION OF STUDY AREA

LOCATION

Yukon Territory is bordered on the west by Alaska at 141° longitude and on the south by British Columbia at latitude 60°. The northern boundary is the Beaufort Sea in the Arctic Ocean and the eastern boundary angles southeast through the Mackenzie Mountains, which separate Yukon from the Northwest Territories (Fig. 1) (Milepost, 1978).

Yukon, because of its location, is subject to conditions imposed by a northern environment. Several of these conditions, primarily temperature, permafrost and precipitation, have important waste management implications. To guarantee the success of a waste program, these factors must be addressed.

TEMPERATURE

In southern Yukon, July temperatures range between 20 - 30°C (Table 2). Occasionally, during winter, cold Arctic air may stagnate over the territory, resulting in a plunge in temperatures. Winter temperatures vary considerably from year to year, but are usually in the range of -15 to -30°C (Table 2). As a result of the wide fluctuations between summer and winter, conditions arise which affect hazardous waste handling safety.

One of the major transportation problems is the development of potholes throughout the Yukon highway system. Potholes may add to

Table 2. Climatic Conditions in the Study Area

	Average Temperature (°C)		Precipitation (mm)		
	January	July	Snowfall	Rainfall	Annual
INVENTORY REGION #1 - WHITEHORSE PROPER					
Whitehorse	-18.9	+14.1	142.2	127.8	260.3
INVENTORY REGION #2 - ALASKA HIGHWAY NORTH - HAINES ROAD					
Haines Junction	-24.4	+12.4	136.7	168.7	269.5
Destruction Bay	-26.5	+12.2	138.4	189.7	328.2
Burwash Landing	-26.5	+12.2	138.4	189.7	328.2
Beaver Creek	-30.8	+13.1	179.3	263.9	443.2
INVENTORY REGION #3 - KLONDIKE HIGHWAY - DEMPSTER HIGHWAY					
Clinton Creek	-28.6	+14.8	167.1	149.9	367.0
Dawson City	-32.4	+15.2	157.7	192.3	328.9
Elsa	-26.2	+13.4	188.5	246.9	435.4
Mayo	-30.9	+14.9	148.6	190.3	326.9
Keno Hill	N.A.	N.A.	N.A.	N.A.	N.A.
Carmacks	-30.6	+14.5	96.0	172.9	268.9
Pelly Crossing	-32.0	+14.6	120.1	181.6	298.5
Old Crow	-34.4	+13.9	96.8	108.7	205.5
INVENTORY REGION #4 - ROBERT CAMPBELL HIGHWAY - CANOL ROAD					
Faro	-26.7	+15.4	140.5	176.0	316.5
Ross River	-30.0	+13.0	N.A.	N.A.	N.A.
INVENTORY REGION #5 - ALASKA HIGHWAY SOUTH - CARCROSS CONNECTION					
Watson Lake	-27.2	+14.7	242.1	256.0	420.6
Teslin	-22.6	+13.2	176.5	167.9	331.5
Carcross	-20.9	+13.3	106.7	103.1	208.8
Upper Liard	N.A.	N.A.	N.A.	N.A.	N.A.

N.A. - Not available

the probability of a vehicle losing control, overturning and accidentally discharging its contents. In the case of a hazardous waste transport truck, resultant environmental damage may occur.

Temperature extremes also have an effect on hazardous wastes which are temperature sensitive (i.e., have critical temperatures within the working range of obtainable daily levels). If exposed to high temperature extremes, certain chemicals may reach their flash points with explosions and fires resulting.

In contrast, prolonged exposure to temperature fluctuations along with other climatic conditions may not affect the waste to any great degree, but could deteriorate the condition of storage containers, thereby making it difficult and often dangerous to transport the waste to a disposal site.

PERMAFROST

Low temperatures in northern Yukon cause the earth surface to be frozen continuously during a large part of the year from a few feet to several hundred feet in depth (Fig. 2). This permanently frozen layer (permafrost) may be composed of mostly ice, ice and soil in varying amounts, frozen gravels, silts, organic material or rock (Associated Engineering Services Ltd., 1973).

Permafrost and extended seasonal frost in cold regions interfere with normal breathing and metabolic processes of the soil and retard assimilation of organic material. Permafrost does not permit proper drainage of soil, and it becomes water-logged when not in a frozen state (Associated Engineering Services Ltd., 1973).

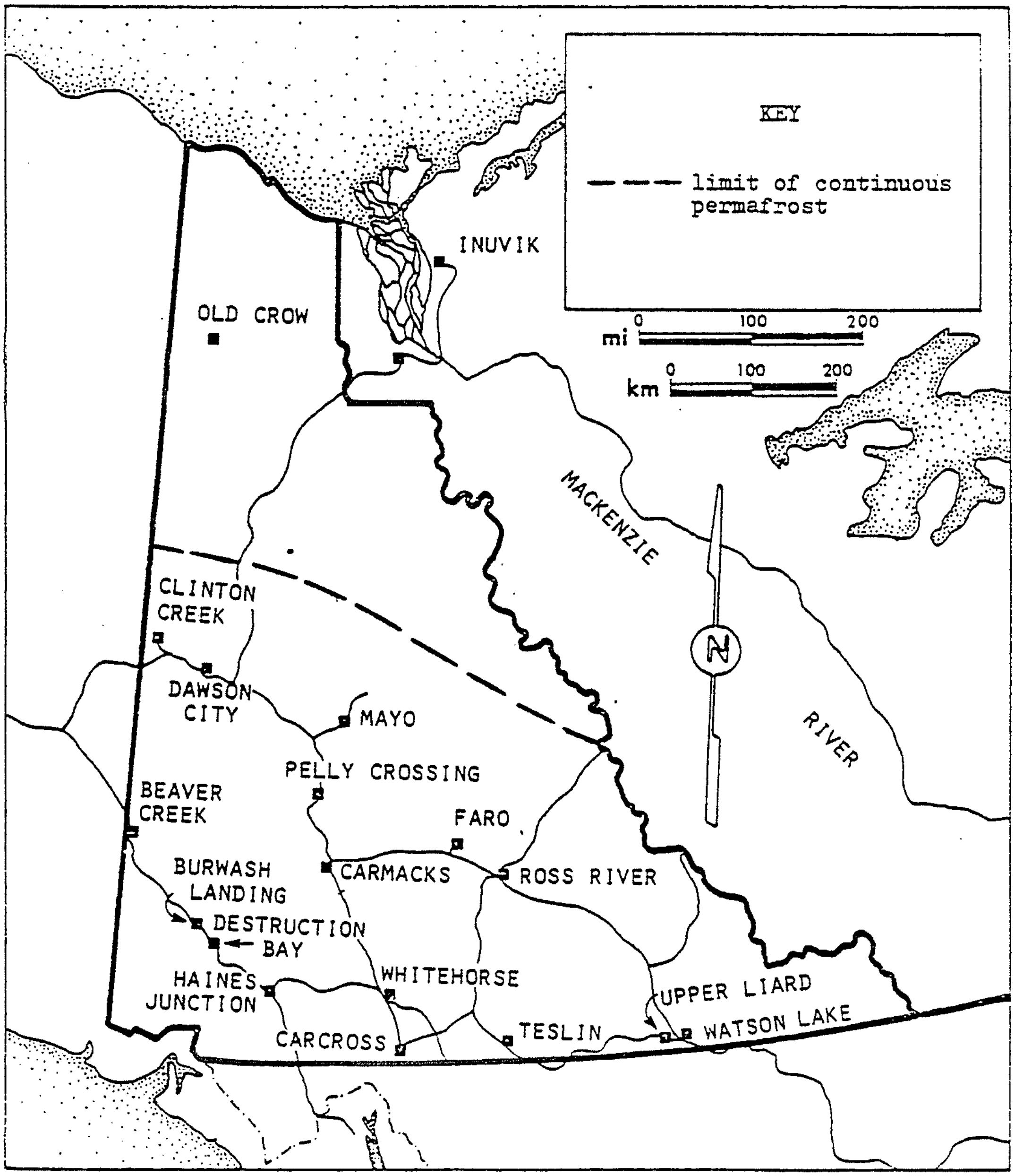


Figure 2. Map of Yukon Showing Limit of Continuous Permafrost.

Due to the above effects, the location and type of landfill site for hazardous wastes are directly influenced by the presence of permafrost and ground ice. The inevitable result of not taking into account permafrost during siting discussions is environmental damage. A classic Yukon example was the siting of mine tailing piles on permafrost. The insulating layer of tailings melted the underlying ice, causing a shifting and slumping of the tailing piles. In this particular case, tailings shifted so as to block the drainage of a valley. This created a lake which flooded many hectares of land and increased the danger of flash-flooding.

If landfill sites are poorly managed in areas of permafrost, exposed ice will melt and cause slumping. The availability of water then raises the probability of hazardous waste leachate polluting nearby water systems.

The problem of slumping is especially acute when dealing with disposal of onshore drilling mud waste onto land. The accepted practice of handling this waste has been to construct a sump near the drilling site for collection and containment. When the drilling site is being abandoned or a sump is filled to capacity, the pit is back-filled. The rationale for this approach is that the fluids and mud waste will freeze and stay frozen because of the climatic conditions and surrounding permafrost. This is an acceptable practice if carried out conscientiously. Unfortunately, this is not always the case and inadequate backfilling results in polluted water pools capable of affecting nearby streams.

PRECIPITATION

The St. Elias Mountains in southwest Yukon play an important role in determining the level of precipitation for the Territory. They provide an effective barrier to warm, moist Pacific air, forcing it to rise and lose most of its moisture on southern slopes of the ranges before it spreads over the territory, displacing cooler, but equally dry Arctic air. When the process is reversed and cool Arctic air displaces warmer Pacific air, temperatures may drop, but will not affect the average annual rainfall. Most of Yukon is a semi-arid zone with an average yearly precipitation of 220-330 mm (Table 2).

Due to the small amount of precipitation, the possibility of contamination by waste materials carried in runoff or by leaching into a high water table is minimal. This is a definite advantage when planning hazardous waste disposal in the southern half of Yukon (areas without continuous permafrost).

DESCRIPTION OF INVENTORY REGIONS

The Yukon population is urbanized and heavily concentrated in the southern portion of the territory. The highway system connects all but one community, Old Crow.

Inventory Region 1 - Whitehorse Proper

Whitehorse was a stopping point on the route to Klondike during the gold rush of the 1890's and a distribution center during the construction of the Alaska Highway (Fig. 1). It was named capital city of Yukon in 1953 and now is the transportation, communications and distribution center of the territory. Whitehorse has 65 percent (1976) of the population of Yukon living within its boundaries and offers the amenities of city life. Within Whitehorse proper, 161 (58 percent of total) potential hazardous waste generation sites were identified (Table 3).

Inventory Region 2 - Alaska Highway North - Haines Road

There are four communities located within this region (Fig. 2): Haines Junction, Destruction Bay, Burwash Landing, and Beaver Creek. The total population of the area is 578 (1976), which represents 2.2 percent of the total Yukon population. In this region 20 (8 percent) potential hazardous waste generation establishments were identified (Table 3).

Haines Junction was built at the junction of the Alaska Highway and the Haines Road, which leads to Haines, Alaska. Haines Junction is a strategic transportation location as well as being the headquarters of Kluane National Park, and as such, is primarily a tourist service center.

Burwash Landing and Destruction Bay are both located on the shores of Kluane Lake. Burwash Landing is a small native village and is one of the oldest settlements in the area, while Destruction Bay is a tourist service center and the location of a territorial highway maintenance camp.

Beaver Creek is just 32 kilometers from the Canada-U.S. border and is the location of the Canada Customs checkpoint. It exists primarily as a tourist service center, being located about midway between Whitehorse and Fairbanks, Alaska.

Table 3. Settlement Data by Hazardous Waste Inventory Region

	Population (1976)	% of Yukon Population	Number of Potential Hazardous Waste Generation Sites in the Region	% of Total Sites in Yukon
Inventory Region #1 - Whitehorse Proper				
Whitehorse	15,305	67.0	161	58
Inventory Region #2 - Alaska Highway North - Haines Road				
Haines Junction	268	1.4		
Destruction Bay	80	.4		
Burwash Landing	60	.4	20	9
Beaver Creek	170	.8		
TOTAL for Region	578	3		
Inventory Region #3 - Klondike Highway - Dempster Highway				
Clinton Creek	564	2.5		
Dawson City	838	3.7		
Elsa	350	1.5		
Mayo	448	2.0	36	13
Keno Hill	70	.2		
Carmacks	420	1.8		
Pelly Crossing	100	.4		
Old Crow	244	.9		
TOTAL for Region	3,034	13		
Inventory Region #4 - Robert Campbell Highway - Canol Road				
Faro	1,544	6.9		
Ross River	350	1.1	17	6
TOTAL for Region	1,894	8.0		
Inventory Region #5 - Alaska Highway South - Carcross Connection				
Watson Lake	1,500	6.5		
Teslin	241	1.0		
Carcross	253	1.0	39	14
Upper Liard	100			
TOTAL for Region	2,094	9.0		
TOTALS	22,886	100	273	100

Inventory Region 3 - Klondike - Dempster Highway

There are eight settlements located within this region with a total population of 3,014 or 12.7 percent of the total Yukon population. Within this area, 36 (13 percent) potential hazardous waste generation establishments were identified (Table 3).

Carmacks has a population of 420 and is situated at the junction of the Klondike and Campbell Highways. It has tourist facilities and is the regional headquarters for Yukon government road maintenance crews.

Pelly Crossing is situated on the Klondike Highway about midway between Whitehorse and Dawson City. It is an Indian community of 100 with a sawmill and facilities for the local people.

Mayo is a distribution and service center for neighboring communities. The area is surrounded by mountains, numerous lakes, rivers and creeks. The hills and mountains are grown over with small timber. Mayo, which has a population of 448, is situated on the floodplain of the Stewart River and is susceptible to flooding during runoff.

Keno Hill is a small community of 70 people and during the 1920's was the main site of extractive operations for United Keno Hill Mines.

Elsa is situated on steep slopes of the McQueston River valley along the main road leading from Mayo to Keno. The community of 350 is a private company town serving the nearby silver-lead-zinc mines. Municipal services are provided by the mining company.

Dawson City has a population of 838 and is the largest community in this inventory region. Tourism is the main industry in

Dawson, as it used to be the gold rush capital of the world. Placer mining for gold is still done on a small scale in the area. Industrial activity in Dawson is limited.

Clinton Creek is a mining community which was closed prior to the end of 1978. At one time an asbestos mine and mill were operated here but ore reserves became depleted and closure resulted.

Old Crow has the distinction of being the only community in Yukon not connected by road. It is a community of 224 and is located at the junction of the Old Crow and Porcupine rivers. The economy of the community is based on hunting, fishing and trapping.

Inventory Region 4 - Robert Campbell Highway - Canol Road

There are two settlements located within this region, (Fig. 1): Faro and Ross River. The population of the area is 1,894, which represents 8.1 percent of the total Yukon population. In this region, 17 (6 percent) potential hazardous waste generation sites were identified (Table 3).

Faro is the larger of the two communities in the area and was established in 1970 to house employees of the nearby lead-zinc mine. This modern town, second largest in Yukon, has the services required by people of the area.

Ross River is a village situated at the junction of the Ross River and Pelly River. Native residents earn their living by hunting, trapping and guiding big game hunting parties, as well as working in mining exploration.

Inventory Region 5 - Alaska Highway

There are four communities located within this region (Fig. 1). They are Watson Lake, Teslin, Upper Liard and Carcross. The population of the area is 2,094 or 8.9 percent of the total Yukon population. Within this region, 39 (14 percent) potential hazardous waste establishments were identified (Table 3). This inventory region is second only to Whitehorse in number of waste establishments.

Watson Lake is a busy growing highway community, sparked by the upsurge of mining activity, logging and lumber production in southern Yukon. It is a key transportation, communications and distribution center for the area.

Upper Liard, an unorganized community, is essentially a village, located just 10 kilometers from Watson Lake.

Teslin is a pioneer village on Teslin Lake. The service industry is the major activity in Teslin.

Carcross is a historic town situated at the north end of Lake Bennett. The settlement's position on the Carcross Road south of Whitehorse, and the imminent opening of the Carcross-Skagway Highway, should continue to ensure its survival as a tourist center.

CHAPTER IV

INVENTORY RESULTS

In Yukon, hazardous wastes are generated from a variety of sources, ranging from large industrial and commercial operations to small laboratories. Table 4 illustrates that most of the potential waste generators (161 of 273) were located in Inventory Region 1 - Whitehorse Proper. The remaining 112 establishments were distributed among the other four inventory regions.

QUESTIONNAIRE RESPONSE

Overall survey response was 75 percent (204 returns of 273 distributed) (Table 4). Of the 204 responses:

(a) 89 were by mail, 72 of which were verified by follow-up personal interviews;

(b) 39 responses were as a result of follow-up personal interviews conducted with non-respondents (no reply after one month) to the mail questionnaire; and

(c) an additional 76 returns were obtained by personal interview (forms were not mailed to these firms, but hand delivered).

QUALITY OF DATA

Due to the nature of the survey and the confidential nature of the information requested, response bias was a distinct possibility. Confidentiality was assured to all respondents, but still some may have

Table 4. Hazardous Waste Survey Response

Inventory Information Solicitation	
Total number of establishments identified in the Yukon which have the potential for generating or coming in contact with hazardous wastes	275
Number of questionnaires mailed to establishments	197
Number of personal interviews conducted	76
Inventory Response	
Personal interview returns	76
Mail returns (72 of the mail returns were verified by personal interviews)	89
Personal interviews conducted with non-respondents	39
Total Returns	204
Survey Response . . . . . 204 ÷ 273 = 75%	

felt threatened to a degree sufficient to bias their figures.

To guard against this problem, data provided by establishments in the same field of endeavour were checked against each other to ensure uniformity of response. Resource people were also consulted to assess responses. If a questionnaire was filled out incorrectly, or figures were suspect, follow-up personal interviews were conducted to enquire as to why the discrepancy between one generator and another had occurred. All 204 questionnaires returned underwent this scrutiny.

Other factors affecting quality of response included:

1. Generators, for the most part, were not aware of their wastes' composition. Only establishments with a scientific staff were able to identify waste components and their overall contribution to a particular waste and the waste stream in general. Because of the large numbers of responses classifying wastes in broad categories, assigning of hazard classifications in terms of severity or strength was not done.

2. There was an absence of recorded information regarding amounts of waste discharged. Most figures were estimates based on whatever factors a particular generator considered important. As indicated earlier, all figures were compared, to try and limit any significant miscalculation on the respondent's part.

3. Because of the large percentage of generators interviewed in person, a uniform level of understanding the questionnaire by the respondents was assumed. This minimized waste omissions and ensured a higher quality response.

The information gathered in this report has been prepared to an accuracy level which will allow an understanding of waste types, amounts, locations, and present disposal practices.

HAZARDOUS WASTE GENERATION

The 204 responses provided data on the 14 waste types described by the modified version of the Hazardous Materials Management Division's identification and classification system (Appendix I). Table 10 summarizes, by individual waste type, amounts disposed and methods of disposal in Yukon over the one-year period summer 1977 to summer 1978. Tables 5 through 9 tabulate the data on waste generation by each individual inventory region. Table 10 was derived by summing information contained in Tables 5 to 9. Figure 3 graphically illustrates the data contained in the tables.

Inventory Region 1 - Whitehorse proper, generated more hazardous wastes than any other inventory region (Table 6). This can be attributed to the large number of potential waste generators in this region (161 establishments of a total 273 in Yukon).

Inventory Region 2 - Alaska Highway North, contributed the least of the five areas to the overall totals found in Table 5.

Inventory Region 3 - Klondike-Dempster Highway, 4 - Robert Campbell - Canol Road and 5 - Alaska Highway South, were fairly equal in their contribution to hazardous waste amounts in Yukon. Regions 3 and 4 have a large amount of waste generated by mineral exploration and development, whereas Region 5 has waste generated by service industries.

Table 5. Inventory Region 1 - Whitehorse Proper. Summary by Individual Waste Type of Amount Disposed, Disposal Methods Practised and Projected Waste Volumes

Waste Type	Amount Disposed Summer 1977 - Summer 1978	Method of Disposal	Projected Waste Volume to Summer 1980 (2-year period)
Type 1 Acid Solution	20,431 ℓ	12% - 2,452 ℓ - on-site treatment (i) neutralization (ii) dilution (iii) incineration 88% - 17,979 ℓ - to sewer system	20% increase
Type 2 Alkaline Solution	8,459 ℓ	10% - 846 ℓ - on-site treatment (i) neutralization (ii) dilution (iii) incineration 90% - 7,613 ℓ - to sewer system	20% increase
Type 3 Pesticides	4,347 ℓ	100% - 4,347 ℓ - to landfill, pit or dump	-
Type 4 Paint Waste	1,811 ℓ	100% = 1,811 ℓ - to landfill, pit or dump	30% increase
Paint Contaminated Solid Waste	645 kg	100% - 645 kg - to landfill, pit or dump	30% increase
Type 5 Solvents	10,328 ℓ	10% - 1031 ℓ - incinerated 40% - 4131 ℓ - to sewer system 50% - 5164 ℓ - to landfill, pit or dump	30% increase

Table 5. (Cont'd)

Type 6 Tetraethyl Lead Sludge	29,440 ℓ	100% - 29,440 ℓ - diluted with fuel (i) sold as fuel (ii) fuel for heating (iii) aircraft disaster simulation	-
Type 7 Chemical Toilet Waste	8,819 ℓ	100% - 8819 ℓ - to landfill, or pit or dump	10% increase
Type 8 Tank Bottom Sediment	-	-	-
Type 9 - Waste Oil Non-contaminated Used Oil	42,053 ℓ	15% - 6,308 ℓ - reused (i) for preservation (ii) fuel for heat (iii) aircraft disaster simulation 32% - 13,456 ℓ to landfill, pit or dump 53% - 22,288 ℓ - surface discharge to land (i) road oiling (ii) race track (iii) indiscriminate dumping	20% increase
Contaminated Used Oil	250,000 ℓ	8% - 20,000 ℓ - on-site treatment (i) burnt (ii) to sewer system 9% - 22,500 ℓ - race track 15% - 37,500 ℓ - landfill sump 28% - 70,000 ℓ - surface discharge to land (i) road oiling 40% - 100,000 ℓ - reused (i) fuel for heating	5% increase

Table 5. (Cont'd)

		(ii) aircraft disaster simulation (iii) for preservation	
Contaminated Solid Waste	87,370 kg	2% - 1,747 kg - burnt 98% - 85,622 kg to landfill, pit or dump	10% increase
Type 10 Drilling Mud	36,800 ℓ	100% - 36,800 ℓ - surface discharge to land	-
Type 11 Contaminated Soil and Sand	Present Unquantifiable	100% surface discharge to land	-
Type 12 Pathological Wastes	9,818 kg	18% - 1,767 kg to landfill, pit or dump 82% - 8051 kg - incinerated	15% increase
Type 13 Miscellaneous			
Drug Waste	245 kg	4% - 9.8 kg - to sewer system 6% - 15 kg - incinerated 90% - 220 kg - returned to supplier	10% increase
Obsolete Explosives	527 kg	10% - 53 kg - construction site disposal 90% - 474 kg - mine site disposal	10% increase
Ink Waste	267 ℓ	100% - 267 ℓ to landfill, pit or dump	40% increase
Ink Contaminated Solid Waste	227 kg	100% - 227 kg to landfill, pit or dump	40% increase
Mile Tailings	511,360,000 kg	100% - 511,360,000 kg - onsite treatment (i) neutralization (ii) dilution (iii) sedimentation and stabilization	-

Table 5. (Cont'd)

Chemical Waste	3,145 kg	1% - 20 kg - to landfill, pit or dump 2% - 63 kg - to sewer system 37% - 1,195 kg - on-site treatment (i) incineration (ii) dilution (iii) discharged to atmosphere 60% - 1,887 kg - interim storage	-
	1,338 ℓ	25% - 336 ℓ - interim storage 75% - 1,002 ℓ - to sewer system	-
Mill Concentrate	230 ℓ	100% - 230 ℓ - interim storage	-
Asbestos Waste	10 kg	100% - 10 kg - landfilled	100% decrease
Type 14 Contaminated Fuels	70,000 ℓ	1000% - 70,000 ℓ - reused (i) heating purposes (ii) for fuel after dilution (iii) aircraft disaster simulation	

Table 6. Inventory Region 2 - Alaska Highway North. Summary by Individual Waste Type of Amount Disposed, Disposal Methods Practised and Projected Waste Volumes.

Waste Type	Amount Disposed Summer 1977 - Summer 1978	Method of Disposal	Projected Waste Volume to Summer 1980 (2-year period)
Type 1 Acid Solution	239 ℓ	10% - 24 ℓ - surface discharge to land 90% - 215 ℓ - to sewer system	100% increase
Type 2 Alkaline Solution	221 ℓ	10% - 22 ℓ - surface discharge to land 90% - 199 ℓ - to sewer system	100% increase
Type 3 Pesticides	-	-	-
Type 4 Paint Waste	46 ℓ	100% - 46 ℓ to landfill pit or dump	10% increase
Paint Contaminated Solid Waste	44 kg	100% - 44 kg to landfill pit or dump	10% increase
Type 5 Solvents	285 ℓ	100% - 285 ℓ - surface discharge to land	40% increase
Type 6 Tetraethyl Lead Sludge	782 ℓ	100% - 782 ℓ - surface discharge to land	-
Type 7 Toilet Waste	2,392 ℓ	100% - 2,392 ℓ - landfill, pit or dump	10% increase

Table 6. (Cont'd)

Type 8 Tank Bottom sediment	-	-	-
Type 9 Waste Oil			
Non-contaminated Used Oil	828 ℓ	6% - 49 ℓ - reused (i) two-cycle engine oil (ii) preservation 34% - 282 ℓ - surface discharge to land (i) road oiling (ii) indiscriminate dumping 60% - 599 ℓ to landfill, pit or dump	20% increase
Contaminated Used Oil	1,771 ℓ	16% - 283 ℓ to landfill, pit or dump 21% - 372 ℓ - reused (i) for preservation 63% - 1,116 ℓ - surface discharge to land (i) road oiling	50% increase
Oil Contaminated Solid Waste	773 kg	100% - 773 kg to landfill, pit or dump	50% increase
Type 10 Drilling Mud	2,300 ℓ	100% - 2,300 ℓ - surface discharge to land	-
Type 11 Contaminated Soil and Sand	Present Unquantifiable	100% - surface discharge to land	-
Type 12 Pathological Wastes	225 kg	100% - 255 kg to landfill, pit or dump (i) burnt	100% increase
Type 13 - Miscel- laneous Drug Waste	9 kg	30% - 3 kg to landfill, pit or dump 70% - 6 kg - returned to supplier	10% increase
Type 14 Contaminated Fuels	-	-	-

Table 7. Inventory Region 3 - Klondike Highway - Dempster Highway. Summary by Individual Waste Type of Amount Disposed, Disposal Methods Practised and Projected Waste Volumes.

Waste Type	Amount Disposed Summer 1977 - Summer 1978	Method of Disposal	Projected Waste Volume to Summer 1980 (2-year period)
Type 1 Acid Solution	5,220 ℓ	3% - 157 ℓ to landfill, pit or dump 32% - 1,671 ℓ - to sewer system 65% - 3,392 ℓ - on-site treatment (i) neutralization (ii) dilution	10% decrease
Type 2 Alkaline Solution	2,518 ℓ	38% - 957 ℓ - to sewer system 62% - 1,561 ℓ on-site treatment (i) neutralization (ii) dilution	10% decrease
Type 3 Pesticides	-	-	-
Type 4 Paint Waste	725 ℓ	100% = 725 ℓ to landfill, pit or dump	45% increase
Paint Contaminated Solid Waste	609 kg	100% - 609 kg to landfill, pit or dump	
Type 5 Solvents	2,343 ℓ	10% - 234 ℓ to sewer system 20% - 468 ℓ - incinerated 30% - 703 ℓ - burnt 40% - 937 ℓ - on-site treatment (i) surface discharge to land (ii) to tailings ponds	25% increase

Table 7. (Cont'd)

Type 6 Tetraethyl Lead Sludge	1,840 ℓ	50% - 920 ℓ - surface discharge to land 50% - 920 ℓ - removed by commercial hauler (i) incinerated	-
Type 7 Chemical Toilet Waste	10,430 ℓ	100% - 10,430 ℓ to landfill, pit or dump	10% increase
Type 8 - Tank Bottom Sediment	-	-	-
Type 9 - Waste Oil			
Non-contaminated Used Oil	1,415 ℓ	10% - 142 ℓ - reused (i) used for preservation (ii) two-cycle engine oil 90% - 1,273 ℓ - surface discharge to land (i) road oiling	10% increase
Contaminated Used Oil	60,260 ℓ	23% - 13,558 ℓ - to landfill, pit or dump 24% - 14,763 ℓ - reused (i) fuel for heat (ii) used for preservation 63% - 31,937ℓ- surface discharge to land (i) road oiling	10% increase
Oil Contaminated Solid Waste	3614 kg	100% - 3,614 kg to landfill, pit or dump	10% increase

Table 7. (Cont'd)

Type 10 Drilling Mud	13,800 ℓ 45,454 kg	100% - 13,800 ℓ - surface discharge to land 100% - 45,454 kg - surface discharge to land	-
Type 11 - Contaminated Soil and Sand	Present Unquantifiable	100% - to land	-
Type 12 - Pathological Wastes	3,170 kg	31% - 983 kg - to landfill, pit or dump	45% increase
Type 13 Miscellaneous Drug Waste	91 kg	8% - 6 kg - incinerated 10% - 9 kg to landfill, pit or dump 10% - 9 kg - to sewer system 72% - 67 kg - returned to supplier	10% increase
Chemical Waste	38 kg	100% - 38 kg on-site treatment (i) neutralization (ii) incineration	-
Obsolete Explosives	360 kg	100% - 360 kg - mine site disposal	-
Mine Tailings	72,855,927 kg	100% - 72,855,927 kg - on-site treatment (i) neutralization (ii) dilution (iii) sedimentation and stabilization (iv) collected into tailing piles	20% decrease
Asbestos Waste	5,000 kg	100% - 5,000 kg - on-site treatment (i) incorporated into final product (ii) deposited onto tailing piles	100% decrease
Type 14 - Contaminated Fuels	5,184 ℓ	100% - 5,184 ℓ - reused (i) heating purposes (ii) burnt	

Table 8. Inventory Region 4 - Robert Campbell Highway - Canol Road. Summary by Individual Waste Type of Amount Disposed, Disposal Methods Practised and Projected Waste Volumes.

Waste Type	Amount Disposed Summer 1977 - Summer 1978	Method of Disposal	Projected Waste Volume to Summer 1980 (2-year period)
Type 1 Acid Solution	5,328 ℓ	15% - 799 ℓ - to sewer system 85% - 4,529 ℓ - on-site treatment (i) dilution (ii) neutralization	20% increase
Type 2 Alkaline Solution	1,476 ℓ	19% - 280 ℓ - to sewer system 81% - 1,196 ℓ - on-site treatment (i) dilution (ii) neutralization	20% increase
Type 3 Pesticides	-	-	-
Type 4 Paint Waste	514 ℓ	100% - 514 ℓ to landfill, pit or dump	10% increase
Paint Contaminated Solid Waste	101 kg	100% - 101 kg to landfill, pit or dump	10% increase
Type 5 Solvents	4,646 ℓ	100% - 4,646 ℓ - surface discharge to land	10% increase
Type 6 Tetraethyl Lead Sludge	-	-	-

Table 8. (Cont'd)

Type 7 - Chemical Toilet Waste	5,635 ℓ	100% - 5,635 ℓ - landfill, pit, or dump	10% increase
Type 8 - Tank Bottom Sediment	3,636 kg	100% - 3,636 kg - on-site treatment (i) neutralization	-
Type 9 Waste Oil			
Non-contaminated Used Oil	3,807 ℓ	10% - 381 ℓ - reused (i) preservation (ii) two-cycle engine oil 40% - 1,523 ℓ to landfill, pit or dump 50% - 1,904 ℓ - surface discharge to land	10% increase
Contaminated Used Oil	11,045 ℓ	2% - 221 ℓ to landfill, pit or dump 48% - 5,301 ℓ - surface discharge to land (i) road oiling 50% - 5,523 ℓ - incinerated (i) used as fuel for heat	15% increase
Oil Contaminated Solid Waste	1,207 kg	100% - 1,206 kg to landfill, pit or dump	15% increase
Type 10 Drilling Mud	9,200 ℓ 40,909 kg	100% - 9,200 ℓ - surface discharge to land 100% - 40,909 kg - surface discharge to land	-
Type 11 - Contaminated Soil and Sand	Present Unquantifiable	100% - surface discharge to land	-

Table 8. (Cont'd)

Type 12 Pathological Wastes	2,686 kg	25% - 672 kg to landfill, pit or dump 75% - 2,014 kg - incinerated	30% increase
Type 13 - Miscellaneous Drug Waste	41 kg	17% - 7 kg - incinerated 83% - 34 kg - returned to supplier	10% increase
Obsolete Explosives	200 kg	100% - 200 kg - mine site disposal	-
Mine Tailings	2,181,000,000	100% - 2,181,000,000 kg on-site treatment (i) neutralization (ii) dilution (iii) sedimentation and stabilization	-
Chemical Waste	150 kg	100% - 150 kg - on-site treatment (i) neutralization (ii) incineration	10% increase
Type 14 Contaminated Fuels	-	-	-

Table 9. Inventory Region 5 - Alaska Highway South. Summary by Individual Waste Type of Amount Disposed, Disposal Methods Practised and Projected Waste Volumes.

Waste Type	Amount Disposed Summer 1977 - Summer 1978	Method of Disposal	Projected Waste Volume to Summer 1980 (2-year period)
Type 1 Acid Solution	1,122 ℓ	38% - 426 ℓ to landfill, pit or dump 62% - 699 ℓ - to sewer system	10% increase
Type 2 Alkaline Solution	1,012 ℓ	32% - 324 ℓ to landfill, pit or dump 68% - 688 ℓ - to sewer system	10% increase
Type 3 Pesticides	-	-	-
Type 4 Paint Waste	570 ℓ	100% - 570 ℓ to landfill, pit or dump	5% increase
Paint-Contaminated Solid Waste	136 kg	100% -136 kg to landfill, pit or dump	5% increase
Type 5 Solvents	2,760 ℓ	10% - 276 ℓ - surface discharge to land 90% - 248 ℓ to landfill, pit or dump	5% increase
Type 6 Tetraethyl Lead Sludge	6,900 ℓ	20% - 1,380 ℓ - surface discharge to land 80% - 5,520 ℓ - disposed of out of territory	-
Type 7 - Chemical Toilet Waste	3,680 ℓ	100% - 3,680 ℓ to landfill, pit or dump	10% increase

Table 9. (Cont'd)

Type 8 - Tank Bottom Sediment	-	-	-
Type 9 - Waste Oil			
Non-contaminated Used Oil	19,844 ℓ	15% - 2,977 ℓ - reused (i) used as fuel for heat (ii) used for preservation (iii) used for two-cycle engine oil 20% - 3,969 ℓ to landfill, pit or dump 65% - 12,899 ℓ - surface discharge to land (i) road oiling	25% increase
Contaminated Used Oil	30,549 ℓ	8% - 2,444 ℓ - reused (i) used as fuel for heat (ii) used for preservation 14% - 4,277 ℓ to landfill, pit or dump 78% - 23,828ℓ - surface discharge to land (i) road oiling	30% increase
Oil Contaminated Solid Waste	1,172 kg	100% - 1,172 kg - to landfill, pit or dump	20% increase
Type 11 Contaminated Soil and Sand	Present Unquantifiable	100% - surface discharge to land	-
Type 12 Pathological Wastes	1,023 kg	100% - 1,023 kg - to landfill, pit or dump (i) burnt	10% increase

Table 9. (Cont'd)

Type 13 Miscellaneous Drug Waste	32 kg	15% - 5 kg to landfill, pit or dump (i) burnt 85% - 27 kg - returned to supplier	5% increase
Obsolete Explosives	Present Unquantifiable	Department of National Defence	100% decrease
Fly Ash - Ash	132,727 kg	unknown % - discharged to atmosphere unknown % - surface discharge to land	-
Type 14 Contaminated Fuels	26,324 ℓ	100% - 26,324 ℓ - disposed outside of territory	-

Table 10. Yukon Summary by Individual Waste Type of Amount Disposed, Disposal Methods Practised and Projected Waste Volumes.

Waste Type	Amount Disposed Summer 1977 - Summer 1978	Method of Disposal	Projected Waste Volume to Summer 1980 (2-year period)
Type 1 Acid Solution	32,340 ℓ	0% - 22 ℓ - Surface discharge to land 2% - 583 ℓ to landfill, pit or dump 32% - 10,375 - on-site treatment (i) neutralization (ii) dilution (iii) incineration 66% - 21,360 ℓ to sewer system	15% increase
Type 2 Alkaline Solution	13,686 ℓ	0% - 22 ℓ - surface discharge to land 3% - 324 ℓ to landfill, pit to dump 26% - 3603 ℓ - on-site treatment (i) neutralization (ii) dilution (iii) incineration 71% - 9667 ℓ - to sewer system	15% increase
Type 3 Pesticides	4,347 ℓ	100% - 4347 ℓ to landfill, pit or dump	-
Type 4 Paint Waste	3,666 ℓ	100% - 3666 ℓ to landfill, pit or dump	27% increase
Paint Contaminated Solid Waste	1,535 kg	100% - 1535 kg to landfill, pit or dump	27% increase

Table 10. (Cont'd)

Type 5 Solvent	20,362 ℓ	3% - 561 ℓ - surface discharge to land 4% - 703 ℓ - burnt 7% - 1562 ℓ - incinerated 21% - 4365 ℓ - to sewer system 27% - 5583 ℓ - on-site treatment (i) to land (ii) to tailings pond 38% - 7648 ℓ to landfill, pit or dump	-
Type 6 Tetraethyl Lead Sludge	38,962 ℓ	2% - 920 ℓ - removed by hauler (i) incinerated 8% - 3082 ℓ - surface discharge to land 14% - 5520 ℓ - disposed of out of territory 76% - 29,440 ℓ - diluted with fuel (i) sold as fuel (ii) used as fuel for heating (iii) used for aircraft disaster simulation	-
Type 7 Chemical Toilet Waste	30,956 ℓ	100% - 30,956 ℓ to landfill, pit or dump	10% increase
Type 8 Tank Bottom Sediment	3,636 kg	100% - 3636 kg - on-site treatment (i) neutralization	-

Table 10. (Cont'd)

Type 9 - Waste Oil

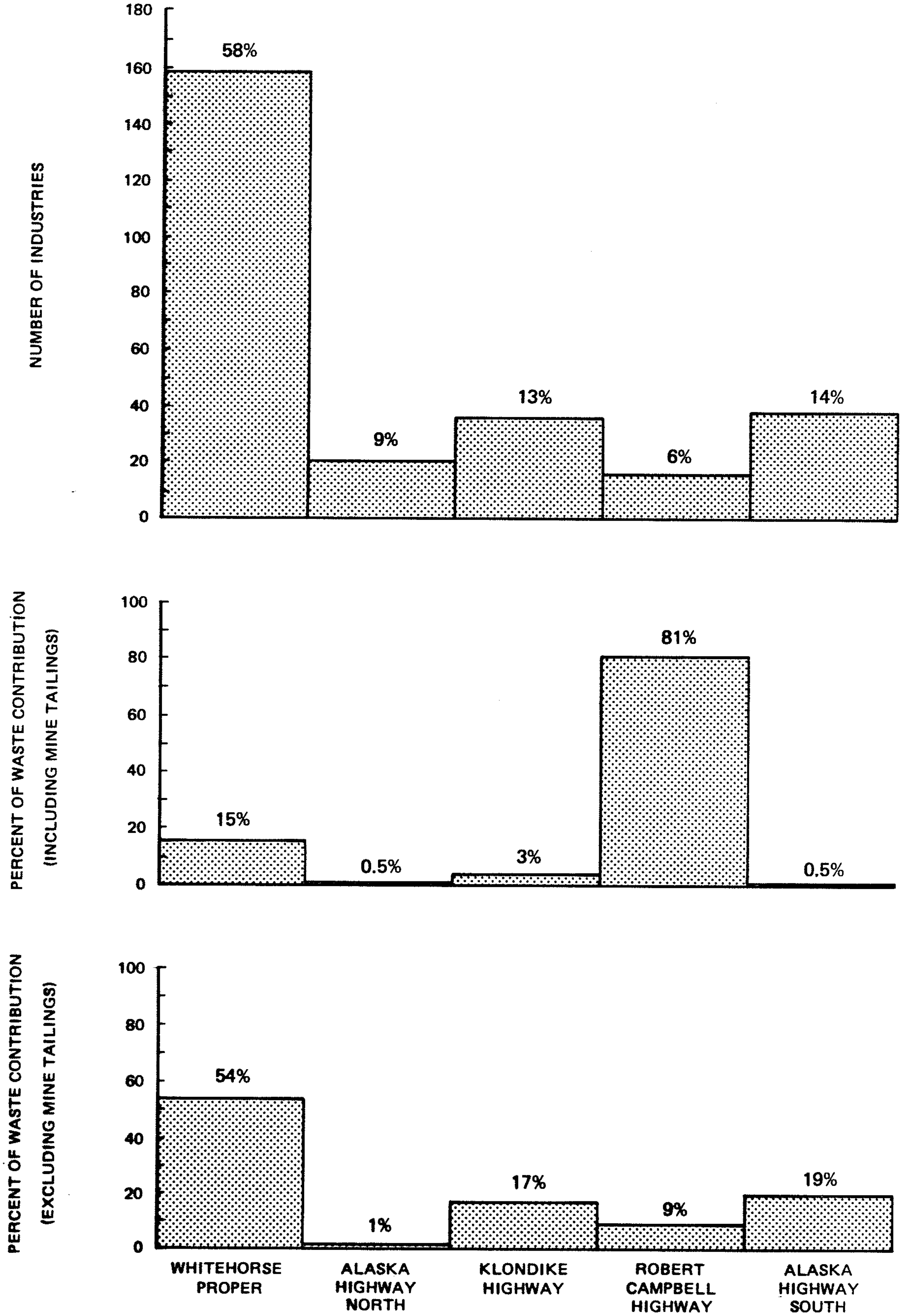
Non-contaminated used oil	67,950 ℓ	15% - 9857 - reused (i) used as fuel for heating (ii) used for aircraft disaster simulation (iii) used in preservation (iv) used as two-cycle engine oil 28% - 19,447 ℓ to landfill, pit or dump 57% - 38,646 ℓ - surface discharge to land (i) road oiling (ii) race track (iii) indiscriminate dumping	20% increase
Contaminated Used Oil	353,623 ℓ	1% - 5000 ℓ - on-site treatment (i) burnt (ii) to sewer system 20% - 70,839 ℓ to landfill, pit or dump 35% - 123,102 ℓ - reused (i) used as fuel for heat (ii) used for aircraft disaster simulation (iii) used in preservation (iv) used as two-cycle engine oil 44% - 154,682 ℓ - surface discharge to land (i) used for road oiling (ii) used on race track (iii) indiscriminate dumping	8% increase
Oil Contaminated Solid Waste	94,136 kg	2% - 1747 kg - on-site treatment (i) burnt 98% - 92,389 kg to landfill, pit or dump	10% increase

Table 10. (Cont'd)

Type 10	64,860 ℓ	100% - surface discharge to land	-
Drilling Mud	109,090 kg	100% - surface discharge to land	-
Type 11 Contaminated Soil and Sand	Present Unquantifiable	100% - surface discharge to land	-
Type 12 Pathological Waste	16,952 kg	28% - 4700 kg to landfill, pit or dump (i) burnt 72% - 12,252 kg - incinerated	23% increase
Type 13 Miscellaneous Drug Waste	419 kg	4% - 19 kg - to sewer system 7% - 28 kg - incinerated 85% - 355 kg - returned to supplier 4% - 17 kg to landfill, pit or dump	10% increase
Obsolute Explosives	1,087 kg	5% - 53 kg - construction site disposal 95% - 1034 kg - mine site disposal Dept. National Defense Disposal Squad	-
Ink Waste	267 ℓ	100% - to landfill, pit or dump	40% increase
Ink Contaminated Solid Waste	227 kg	100% - to landfill, pit or dump	
Mine Tailings	2,765,215,927 kg	100% - on site treatment (i) neutralization (ii) dilution (iii) sedimentation and stabilization (iv) deposited onto tailing piles	-
Chemical Waste	3,333 kg	1% - 20 kg - landfill, pit or dump 2% - 63 kg to sewer system 40% - 1363 kg - on site treatment (i) incineration (ii) dilution (iii) discharge to atmosphere	1% increase

Table 10. (Cont'd)

	1338 ℓ	25% - 336 ℓ - interim storage 75% - 1002 ℓ - to sewer system	1% increase
Mill Concentrate	230 ℓ	100% interim storage	-
Asbestos Waste	5010 kg	0% - 10 kg & landfill, pit or dump 100% - 5,000 kg - on-site treatment (i) incorporation into final product (ii) deposited onto tailings pile	100% decrease
Flyash - ash	132,727 kg	unknown % discharge to atmosphere unknown % discharge to land	-
Type 14 Contaminated Fuels	101,508 ℓ	(i) heating purposes (ii) for fuel after dilution (iii) aircraft disaster simulation 1% - 584 ℓ - burnt 26% - 26,324 ℓ - disposal outside of territory 73% - 74,600 ℓ - reused	-



INVENTORY SUMMARY

FIGURE 3

PROJECTED WASTE VOLUME GENERATION

Percentage figures for projected waste volume generation over the next two-year period (summer 1978 to summer 1980) for the 14 waste types were calculated by information provided by the generators. These projection figures were based on:

(1) plans for expansion of present facilities;

(2) requests for the generator's services or products already received for the two-year period; and

(3) past performance.

The figures are found in Tables 5-24.

INDIVIDUAL WASTES

In this section, data are reviewed by individual waste type. Amounts disposed, methods of disposal, and projected waste volumes to summer 1980 are tabulated and discussed. (Appendix IV lists individual waste streams identified during the study.

For most of the 14 waste types, 100 percent response to the questionnaire by possible generators was not realized. The return rate did, however, average between 75 - 85 percent (Tables 11-24). Because of the relatively high response rate and the nature of the respondents (the larger the generator, the more likely a return) an extrapolation was made to 100 percent response. The extrapolation was achieved by multiplying the amount of waste generated by respondents (W) times the percentage of generators not responding (G). Theoretically this indicated the amount of waste generated by non-respondents (X). Respondent returns (R) and non-respondent generated volumes (X) were then added and the extrapolated figure arrived at (E)*. The extrapolated generation amounts will, if anything, be on the high side, because of the excellent response by the larger generators of each waste type.

This method of extrapolation was used because the seasonal nature of Yukon industries precluded using employee number as an extrapolative factor.

Type 1: Acid Solutions

In Yukon, waste acid solutions were generated primarily by health centers, educational institutions, assay labs., government labs., photo developing units and extractive industries. During summer 1977 to summer 1978, there were 32,342 litres of waste acid solution generated (Tables 10, 11). This figure is based on 40 responses out of a possible 53 (75 percent return) potential waste acid solution generating establishments. After extrapolation for the 13 non-responding potential acid generators, 40,427 litres are likely to be generated in Yukon.

Presently 63 percent of waste acids generated in the territory are in Inventory Region Number 1 - Whitehorse proper. Thirty-three percent are divided equally between the mineral extracting Inventory Regions 3 - Klondike - Dempster Highway and 4 - Campbell Highway - Canol Road.

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*The formulae used to determine the extrapolated amounts of waste generated were:

(1) WXG = X

(2) R+X = E

Table 11. Summary of Type 1 Waste Acid Generation by Inventory Region (40 out of 53 establishments Replying).

Inventory Region	Amount Disposed Summer 1977 - Summer 1978	Method of Disposal	Projected Waste Volume to summer 1980 (2-year period)
Region 1 Whitehorse Proper	20,431 ℓ	12% - 2,452 ℓ on-site treatment (i) neutralization (ii) dilution (iii) incineration 88% - 17,979 ℓ to sewer system	20% increase
Region 2 Alaska Highway North	239 ℓ	10% - 24 ℓ - surface discharge to land 90% - 215 ℓ - to sewer system	100% increase
Region 3 Klondike Highway - Dempster Highway	5,220 ℓ	3% - 157 ℓ to landfill, pit or dump 32% - 1,671 ℓ - to sewer system 65% - 3,394 ℓ - on-site treatment (i) neutralization (ii) dilution	10% decrease
Region 4 - Robert Campbell Highway - Canol Road	5,328 ℓ	15% - 799 ℓ - to sewer system 85% - 4,529 ℓ - on-site treatment (i) dilution (ii) neutralization	20% increase
Region 5 - Alaska Highway South	1,122 ℓ	38% - 426 ℓ to landfill, pit or dump 62% - 696 ℓ - to sewer system	10% increase
TOTAL reported in Yukon	32,340 ℓ		
Extrapolated Value	40,427 ℓ		

Table 12. Summary of Type 2 Waste Alkaline Generation by Inventory Region (40 out of 53 establishments replying - 75%).

Inventory Region	Amount Disposed Summer 1977 - Summer 1978	Method of Disposal	Projected Waste Volume to summer 1980 (2-year period)
Region 1 Whitehorse Proper	8,459 ℓ	10% - 846ℓ- on-site treatment (i) neutralization (ii) dilution (iii) incineration 90% - 7,613 ℓ - to sewer system	20% increase
Region 2 - Alaska Highway North	221 ℓ	10% - 22 ℓ - surface discharge to land 90% - 199 ℓ - to sewer system	100% increase
Region 3 Klondike Highway - Dempster Highway	2,518 ℓ	62% - 1,561 ℓ -on-site treatment (i) neutralization (ii) dilution 38% - 957 ℓ - to sewer system	10% increase
Region 4 Robert Campbell Highway - Canol Road	1,476 ℓ	19% - 280 ℓ - to sewer system 81% - 1,196 ℓ - on-site treatment (i) dilution (ii) neutralization	20% increase
Region 5 - Alaska Highway South	1,012 ℓ	32% - 324 ℓ to landfill, pit or dump 68% - 688 ℓ - to sewer system	10% increase
TOTAL reported in Yukon	13,686 ℓ		
Extrapolated Value	17,107 ℓ		

Table 13. Summary of Type 3 Waste Pesticide Disposal by Inventory Region (2 out of 3 establishments replying - 67% return)

Inventory Region	Amount Disposed Summer 1977 - Summer 1978	Method of Disposal	Projected Waste Volume to Summer 1980 (2-yr. period)
Region 1 Whitehorse Proper	4,347 ℓ	100% - 4347 ℓ to landfill, pit or dump	-
Regions 2 through 5 report no pesticides			
TOTAL Yukon	4,347 ℓ		
Extrapolated Value	5,781 ℓ		

Table 14. Summary of Type 4 Paint Waste Generation by Inventory Region (11 out of 16 establishments replying - 69% return).

Inventory Region	Amount Disposed Summer 1977 - Summer 1978 Paint Waste	Contaminated Solid Waste	Method of Disposal	Projected Waste Volume to summer 1980 (2-year period)
Region 1 Whitehorse Proper	1,811 ℓ*	645 kg	100% to landfill, pit or dump	30% increase
Region 2 - Alaska Highway North	46 ℓ	44 kg	100% to landfill, pit or dump	10% increase
Region 3 Klondike Highway - Dempster Highway	725 ℓ	609 kg	100% to landfill, pit or dump	45% increase
Region 4 - Robert Campbell Highway - Canol Road	514 ℓ	101 kg	100% to landfill, pit or dump	10% increase
Region 5 - Alaska Highway South	570 ℓ	136 kg	100% to landfill, pit or dump	5% increase
TOTAL reported in Yukon	3,666 ℓ	1,535 kg		
Extrapolated Value	4,802 ℓ	2,011 kg		

*Liquid components such as paint and paint stripper were disposed of directly onto land or into sewer systems. The amounts were not quantifiable but were present.

Table 15. Summary of Type 5 Waste Solvent Generation by Inventory Region (26 out of 34 establishments replying - 76% return).

Inventory Region	Amount Disposed Summer 1977 - Summer 1978	Method of Disposal	Projected Waste Volume to summer 1980 (2-year period)
Region 1 Whitehorse Proper	10,328 ℓ	10% - 1,033 ℓ - incinerated 40% - 4,131 ℓ to sewer system 50% - 5,164 ℓ to landfill, pit or dump	30% increase
Region 2 - Alaska Highway North Haines Road	285 ℓ	100% - 285 ℓ - surface discharge to land	40% increase
Region 3 Klondike Highway - Dempster Highway	2,343 ℓ	10% - 234 ℓ to sewer system 20% - 460 ℓ - incinerated 30% - 703 ℓ - burnt 40% - 937 ℓ - on-site treatment (i) surface discharge to land (ii) to tailing ponds	25% increase
Region 4 - Robert Campbell Highway - Canol Road	4,646 ℓ	100% - 4,646 ℓ - on-site treatment (i) to land (ii) to tailings ponds	10% increase
Region 5 - Alaska Highway South	2,760 ℓ	10% - 276 ℓ - surface discharge to land 90% - 2,484 ℓ - to landfill, pit or dump	10% increase
TOTAL REPORTED in Yukon	20,362 ℓ		
Extrapolated Value	25,249 ℓ		

Table 16. Summary of Type 6 Tetraethyl Lead Sludge Generation by Inventory Region (50 out of 72 establishments replying - 69%).

Inventory Region	Amount Disposed Summer 1977 - Summer 1978	Method of Disposal	Projected Waste Volume to Summer 1980 (2-year period)
Region 1 Whitehorse Proper	29,440 ℓ	100% - 29,440 ℓ - diluted with fuel (i) sold as fuel (ii) used as fuel for heating (iii) need for aircraft disaster simulation	-
Region 2 - Alaska Highway North	782 ℓ	100% - 782 ℓ - surface discharge to land	-
Region 3 - Klondike Highway - Dempster Highway	1,840 ℓ	50% - 920 ℓ - surface discharge to land 50% - 920 ℓ - removed by commercial hauler (i) incinerated	-
Region 4 - Robert Campbell Highway - Canol Road	-	-	-
Region 5 - Alaska Highway South	6,900 ℓ	20% - 1,380 ℓ - surface discharge to land 80% - 5520 ℓ - disposed of out of territory	-
TOTAL Reported in Yukon	38,962 ℓ		
Extrapolated Value	51,040 ℓ		

Table 17. Summary of Type 7 Chemical Toilet Waste Generation by Inventory Region (13 out of 18 establishments replying - 72% return).

Inventory Region	Amount Disposed Summer 1977 - Summer 1978	Method of Disposal	Projected Waste Volume to Summer 1980 (2-year period)
Region 1 Whitehorse Proper	8,819 ℓ	100% - 8,819 ℓ to landfill, pit or dump	10% increase
Region 2 Alaska Highway North	2,392 ℓ	100% - 2,392 ℓ to landfill, pit or dump	10% increase
Region 3 Klondike Highway - Dempster Highway	10,430 ℓ	100% - 10,430 ℓ to landfill, pit or dump	10% increase
Region 4 Robert Campbell Highway - Canol Road	5,635 ℓ	100% - 5,635 ℓ to landfill, pit or dump	10% increase
Region 5 - Alaska Highway South	3,680 ℓ	100% - 3,680 ℓ to landfill, pit or dump	10% increase
TOTAL Reported in Yukon	30,956 ℓ		
Extrapolated Value	39,623 ℓ		

Table 18. Summary of Type 8 Tank Bottom Sediment Generation by Inventory Region (3 out of 4 establishments replying - 75%).

Inventory Region	Amount Disposed Summer 1977 - Summer 1978	Method of Disposal	Projected Waste Volume to summer 1980 (2-year period)
Region 4			
Robert Campbell Highway - Canol Road	3,636 kg	100% - 3,636 kg - on-site treatment (i) neutralization	

Regions 1, 2, 3 and 5 reported no tank bottom sediment.

TOTAL reported in Yukon	3,636 kg
Extrapolated Value	4,545 kg

Table 19. Summary of Type 9 Non-Contaminated Used Oil Generation by Inventory Region (80 out of 94 establishments replying - 85%).

Inventory Region	Amount Disposed Summer 1977 - Summer 1978	Method of Disposal	Projected Waste Volume to Summer 1980 (2-year period)
Region 1 Whitehorse Proper	42,053 ℓ	15% - 6,308 ℓ - reused (i) fuel for heat (ii) aircraft disaster simulation (iii) for preservation (iv) two-cycle engine oil 32% - 13,456 ℓ to landfill, pit or dump 53% - 22,288 ℓ - surface discharge to land (i) road oiling (ii) race track (iii) indiscriminate dumping	20% increase
Region 2 - Alaska Highway North	828 ℓ	6% - 49ℓ - reused (i) used as two-cycle oil (ii) used for preservation 34% - 282 ℓ - surface discharge to land (i) road oiling (ii) indiscriminate dumping 60% - 499 ℓ to landfill, pit or dump	20% increase
Region 3 - Klondike Highway - Dempster Highway	1,415 ℓ	10% - 142 ℓ - reused (i) used for preservation (ii) used as two-cycle engine oil 90% - 1,273 ℓ - surface discharge to land (i) road oiling	10% increase

Table 19. (Cont'd)

Region 4 - Robert Campbell Highway - Canol Road	3,807 ℓ	10% - 381 ℓ - reused (i) used for preservation (ii) used as two-cycle engine oil 40% - 1,523 ℓ to landfill, pit or dump 50% - 1,904ℓ - surface discharge to land	10% increase
Region 5 - Alaska Highway South	19,844 ℓ	15% - 2,977 ℓ - reused (i) used as fuel for heat (ii) used as two-cycle engine oil (iii) used for preservation 20% - 3,969 ℓ to landfill, pit or dump 65% - 12,899 ℓ - surface discharge to land (i) road oiling	25% increase
TOTAL Reported in Yukon	67,947 ℓ		
Extrapolated Value	78,139 ℓ		

Table 20. Summary of Type 9 Contaminated Used Oil Generation by Inventory Region (80 out of 94 establishments replying - 85%).

Inventory Region	Amount Disposed Summer 1977 - Summer 1978	Method of Disposal	Projected Waste Volume to Summer 1980 (2-year period)
Region 1 Whitehorse Proper	250,000 ℓ	8% - 20,000 ℓ - on-site treatment (i) burnt (ii) to sewer system 9% - 22,500 ℓ - racetrack 15% - 37,500 ℓ to landfill, pit or dump 28% - 70,000 ℓ - surface discharge to land (i) road oiling 40% - 100,000 ℓ - reused (i) used as fuel for heating (ii) used for aircraft disaster simulation (iii) for preservation	5% increase
Region 2 - Alaska Highway North	1,771 ℓ	16% - 283 ℓ to landfill, pit or dump 21% - 372 ℓ - reused (i) for preservation 63% - 1,116 ℓ surface discharge to land (i) road oiling	50% increase
Region 3 Klondike Highway - Dempster Highway	60,260 ℓ	23% - 13,558 ℓ to landfill, pit or dump 24% - 14,763 ℓ - reused (i) used for fuel for heat (ii) used for preservation 53% - 31,937 ℓ - surface discharge to land (i) road oiling	

Table 20. (Cont'd)

Region 4 - Robert Campbell Highway - Canol Road	11,045 ℓ	2% - 221 ℓ to landfill, pit or dump 48% - 5,301 ℓ - surface discharge to land (i) road oiling 50% - 5,523ℓ - reuse (i) used as fuel for heat	15% increase
Region 5 - Alaska Highway South	30,549 ℓ	8% - 2,444 ℓ - reused (i) used as fuel for heat (ii) used for preservation 14% - 4,277 ℓ to landfill, pit or dump 78% - 23,828 ℓ - surface discharge to land (i) road oiling	30% increase
TOTAL Reported in Yukon	353,625 ℓ		
Extrapolated Value	406,668 ℓ		

Table 21. Summary of Type 9 Oil Contaminated Solid Waste by Inventory Region (80 out of 94 establishments replying - 85%).

Inventory Region	Amount Disposed Summer 1977 - Summer 1978	Method of Disposal	Projected Waste Volume to Summer 1980 (2-year period)
Region 1 Whitehorse Proper	87,370 kg	2% - 1,747 kg - burnt 98% - 85,622 kg to landfill, pit or dump	10% increase
Region 2 - Alaska Highway North	773 kg	100% - 773 kg to landfill, pit or dump	50% increase
Region 3 Klondike Highway - Dempster Highway	3,614 kg	100% - 3,614 kg to landfill, pit or dump	10% increase
Region 4 -Robert Campbell Highway - Canol Road	1,207 kg	100% - 1,207 kg to landfill, pit or dump	15% increase
Region 5 - Alaska Highway South	1,172 kg	100% - 1,172 kg to landfill, pit or dump	20% increase
TOTAL Reported in Yukon	94,136 kg		
Extrapolated Value	108,256 kg		

Table 22. Summary of Type 10 Drilling Mud Generation by Inventory Region (12 out of 16 establishments replying - 75%).

Inventory Region	Amount Disposed Summer 1977 - Summer 1978	Method of Disposal	Projected Waste Volume to Summer 1980 (2-year period)
Region 1 Whitehorse Proper	36,800 ℓ	100% - 36,800 ℓ - surface discharge to land	-
	22,727 kg	100% - 22,727 kg surface discharge to land	
Region 2 - Alaska Highway North	2,300 ℓ	100% - 2,300 ℓ - surface discharge to land	-
Region Klondike Highway - Dempster Highway	13,800 ℓ	100% - 13,000 ℓ - surface discharge to land	-
	45,454 kg	100% - 45,454 kg - surface discharge to land	
Region 4 - Robert Campbell Highway - Canol Road	9,200 ℓ	100% - 9,200 ℓ - surface discharge to land	-
	40,909 kg	100% - 40,909 kg - surface discharge to land	
Region 5 - Alaska Highway South	2,760 ℓ	100% - 2,760 ℓ - surface discharge to land	-
TOTAL Reported in Yukon	64,860 ℓ, 109,090 kg		
Extrapolated Value	81,075 ℓ, 136,362 kg		

Table 23. Summary of Type 11 Contaminated Soil and Sand Generation by Inventory Region (12 out of 16 establishments reporting - 75%).

Inventory Region	Amount Disposed Summer 1977 - Summer 1978	Method of Disposal	Projected Waste Volume to Summer 1980 (2-year period)
Region 1 Whitehorse Proper			
Region 2 Alaska Highway North			
Region 3 Klondike Highway - Dempster Highway			
Region 4 Robert Campbell Highway - Canol Road			
Region 5 Alaska Highway South			

Respondents indicated that contaminated soil and sand was generated in each of the inventory regions; however, they were not able to quantify the amounts. Surface discharge to land was the only method of disposal practised.

Table 24. Summary of Type 12 Pathological Waste Generation by Inventory Region (16 out of 21 establishments replying - 76%)

Inventory Region	Amount Disposed Summer 1977 - Summer 1978	Method of Disposal	Projected Waste Volume to Summer 1980 (2-year period)
Region 1 Whitehorse Proper	9,818 kg	18% - 1,767 kg to landfill, pit or dump 82% - 8,051 kg - incinerated	15% increase
Region 2 - Alaska Highway North	255 kg	100% - 255 kg to landfill, pit or dump (i) burnt	100% increase
Region 3 Klondike Highway - Dempster Highway	3,170 kg	31% - 983 kg to landfill, pit or dump 69% - 2,187 kg - incinerated	45% increase
Region 4 - Robert Campbell Highway - Canol Road	2,686 kg	25% - 672 kg to landfill, pit or dump 75% - 2,014 kg - incinerated	30% increase
Region 5 - Alaska Highway South	1,023 kg	100% - 1,023 kg to landfill, pit or dump (i) burnt	10% increase
TOTAL Reported in Yukon	16,952 kg		
Extrapolated Value	21,020 kg		

Table 25. Summary of Type 13 - Drug Waste Generation by Inventory Region (15 out of 19 establishments replying - 79%).

Inventory Region	Amount Disposed Summer 1977 - Summer 1978	Method of Disposal	Projected Waste Volume to Summer 1980 (2-year period)
Region 1 Whitehorse Proper	245 kg	4% - 10 kg - to sewer system 6% - 15 kg - incinerated 90% - 220 kg - returned to supplier	10% increase
Region 2 - Alaska Highway North	9 kg	30% - 3 kg to landfill, pit or dump 70% - 6 kg - returned to supplier	10% increase
Region 3 Klondike Highway Dempster Highway	91 kg	8% - 6 kg - incinerated 10% - 9 kg to landfill, pit or dump 10% - 9 kg - to sewer system 72% - 67 kg - returned to supplier	10% increase
Region 4 - Robert Campbell Highway - Canol Road	41 kg	17% - 7 kg - incinerated 83% - 34 kg - returned to supplier	10% increase
Region 5 - Alaska Highway South	32 kg	15% - 5 kg to landfill, pit or dump (i) burnt 85% - 27 kg - returned to supplier	5% increase
TOTAL Reported in Yukon	419 kg		
Extrapolated Value	505 kg		

Table 26. Summary of Type 13 - Obsolete Explosives. Amounts by Inventory Region (15 out of 20 establishments replying - 75%).

Inventory Region	Amount Disposed Summer 1977 - Summer 1978	Method of Disposal	Projected Waste Volume to Summer 1980 (2-year period)
Region 1 Whitehorse Proper	527 kg	10% - 53 kg - construction site disposal 90% - 474 kg - mine site disposal	-
Region 2 - Alaska Highway North	-	-	-
Region 3 Klondike Highway - Dempster Highway	360 kg	100% - 360 kg - mine site disposal	-
Region 4 - Robert Campbell Highway - Canol Road	200 kg	100% - 200 kg - mine site disposal	-
Region 5 - Alaska Highway South	Present Unquantifiable	Department of National Defence Disposal Squad	100% decrease
TOTAL Reported in Yukon	1,087 kg		
Extrapolated Value	1,358 kg		

Table 27. Summary of Type 13 - Ink Waste Generation by Inventory Region (6 out of 8 establishments responding - 75%).

Inventory Region	Amount Disposed Summer 1977 - Summer 1978	Method of Disposal	Projected Waste Volume to Summer 1980 (2-year period)
Region 1 Whitehorse Proper	Ink Waste 267 ℓ	100% - 267 ℓ to landfill, pit or dump	40% increase
	Contaminated Solid Waste 227 kg	100% - 227 kg to landfill, pit or dump	40% increase

Regions 2 - 5 reported no ink waste or contaminated solid waste

Table 28. Summary of Type 13 - Mine Tailing Amounts by Inventory Region (4 out of 4 establishments replying - 100%).

Inventory Region	Amount Disposed Summer 1977 - Summer 1978	Method of Disposal	Projected Waste Volume to Summer 1980 (2-year period)
Region 1 Whitehorse Proper	511,360,000 kg	100% - 511,360,000 kg onsite treatment (i) neutralization (ii) dilution (iii) sedimentation and stabilization	-
Region 2 - Alaska Highway North	-	-	-
Region 3 Klondike Highway - Dempster Highway	72,855,927 kg	100% - 72,855,929 kg onsite treatment (i) neutralization (ii) dilution (iii) sedimentation and stabilization (iv) collected into tailing piles	20% decrease
Region 4 - Robert Campbell Highway - Canol Road	2,181,000,000 kg	100% - 2,181,000,000 kg onsite treatment (i) neutralization (ii) dilution (iii) sedimentation and stabilization	-
Region 5 - Alaska Highway South	-	-	-
TOTAL Reported in Yukon	2,765,,215,927		
Extrapolated Value	as above.		

Table 29. Summary of Type 13 - Chemical Waste Amounts by Inventory Region (28 out of 37 establishments replying - 76%).

Inventory Region	Amount Disposed Summer 1977 - Summer 1978	Method of Disposal	Projected Waste Volume to Summer 1980 (2-year period)
Region 1 Whitehorse Proper	3,145 kg	1% - 20 kg to landfill, pit or dump 2% - 63 kg - to sewer system 37% - 1,175 kg - on-site treatment (i) incineration (ii) dilution (iii) discharge to atmosphere 60% - 1,887 kg - interim storage	-
	1,338 ℓ	75% - 1,002 ℓ - to sewer systems 25% - 336 ℓ - interim storage	-
Region 2 - Alaska Highway North	-	-	-
Region 3 - Klondike Highway - Dempster Highway	38 kg	100% - 38 kg on-site treatment (i) neutralization (ii) incineration	-
Region 4 Robert Campbell Highway - Canol Road	150 kg	100% - 150 kg on-site treatment (i) neutralization (ii) incineration	
Region 5 - Alaska Highway South	-	-	-
TOTAL Reported in Yukon	3,333 kg, 1,338		
Extrapolated Value	4,132 kg, 1,659		

Table 30. Summary of Type 13 - Miscellaneous Waste Generation by Inventory Region
Mill Concentrate (5 out of 5 establishments replying - 100%)
Flyask Ash (2 out of 3 establishments replying - 67%)
Asbestos Waste (1 out of 1 establishment replying - 100%)

Inventory Region	Amount Disposed Summer 1977 - Summer 1978	Method of Disposal	Projected Waste Volume to Summer 1980 (2-year period)
Region 1 Whitehorse Proper	mill concentrate 230 ℓ	100% - 230 ℓ - interim storage	
Region 2 - Alaska Highway North	-	-	-
Region 3 Klondike Highway - Dempster Highway	asbestos waste 5,000 kg	100% - 5,000 kg - on-site treatment (i) incorporated into final product (ii) deposited onto tailing pile.	100% decrease
Region 4 - Robert Campbell Highway - Canol Road	-	-	-
Region 5 Alaska Highway South	flyash - ash	Unknown % - discharge to atmosphere Unknown % - surface discharge to land	-
TOTAL Reported in Yukon	As above		
Extrapolated Value	As above		

Table 31. Summary of Type 14 - Contaminated Fuel Amounts (all types) by Inventory Region (80 out of 94 establishments replying - 85%).

Inventory Region	Amount Disposed Summer 1977 - Summer 1978	Method of Disposal	Projected Waste Volume to Summer 1980 (2-year period)
Region 1 Whitehorse Proper	70,000 ℓ*	100% - 70,000 ℓ - reused (i) heating purposes (ii) for fuel after dilution (iii) aircraft disaster simulation	-
Region 2 - Alaska Highway North	-	-	-
Region 3 Klondike Highway Dempster Highway	5,184 ℓ	89% - 4,600 ℓ - reused (i) used as fuel (ii) burnt; 11% - 584 ℓ to landfill, pit or dump	
Region 4 - Robert Campbell Highway - Canol Road	-	-	-
Region 5-Alaska Highway South	26,324 ℓ	100% - 26,324 ℓ - disposed outside of territory	
TOTAL Reported in Yukon	101,508 ℓ		
Extrapolated Value	116,734 ℓ		

*Reported in Whitehorse, not necessarily generated in this inventory region.

A composite of responses revealed that over the next two years (summer 1978 and summer 1980) an increase of 15 percent in the amount of waste acid solutions requiring disposal in Yukon could be realized (Table 10). This projected increase can be attributed to expanded mineral exploration and expansion of existing facilities to handle demand brought about by an increased Yukon population.

The most popular form of waste acid disposal is to discharge solutions into community sewer or drainage systems. Sixty-six percent of all waste acid in the Territory is disposed of in this manner (Table 10).

Neutralization, dilution and incineration were means by which the corrosive and ignitable hazard characteristics of acids are minimized on site. Thirty-two percent of the waste acids generated were treated on site.

The least engaged in disposal practices were depositon into landfills, pits or dumps with two percent and surface discharge to land with a value approaching zero percent.

Type 2: Alkaline Solutions

Waste alkaline solutions were generated by the same activities as type 1 waste acid solutions. There were 13,686 litres of waste alkalis generated in Yukon between summer 1977 and summer 1978. Return from possible generators was 75 percent (40 out of 53 establishments replying). An extrapolated value of 17,107 litres for Yukon is obtained for a 100 percent response situation. Sixty-three percent of the waste alkaline solutions reported in Yukon are generated in Whitehorse.

Over the next two years, to summer 1980, a 15 percent increase in waste alkaline solutions in Yukon is expected. This rise corresponds to the waste acid increase and is a reflection of projected mineral exploration and development as well as potential Yukon population growth.

Seventy-one percent of waste alkaline solutions generated in Yukon are disposed of into community wastewater systems (Table 10).

On site treatment of waste alkaline solutions includes dilution, neutralization and incineration. Twenty-six percent of the generated total are treated in this manner.

Surface discharge to land and disposal into landfill, pit or dumps were the other disposal methods identified in the survey for alkaline solutions. Only three percent are disposed of in this manner.

Type 3: Pesticides

Pesticides are used in Yukon by various government agencies, both federal and territorial, as well as by private operators. Unwanted, surplus, or unused pesticides are disposed of on a request basis by the Environmental Protection Service (EPS). EPS entered into this program to ensure that pesticides are disposed of properly. All respondents to the survey indicated that they utilize this service.

Pesticides are delivered to and subsequently stored in the EPS interim storage facility in Whitehorse until a sufficient amount is accumulated to warrant disposal. During the summer of 1978, 4,347 litres of unwanted, surplus or unused pesticides were taken to the toxic chemicals disposal site at the Whitehorse landfill and disposed of by EPS (Table 13).

Type 4: Paint Waste

The paint waste generated in Yukon is by small scale applicators. Paint waste includes paint slops, paint left after application and paint-contaminated solid waste. Examples of contaminated solid waste include paint-covered rags and tissues as well as paint cans and brushes.

In the time frame covered by the survey, respondents indicated that 3,666 litres of paint waste were generated. Associated with this were 1,535 kg of solid waste contaminated by paint (Tables 10, 14). These figures are based on 11 of 16 establishments replying (69 percent return).

All of the paint waste and contaminated solid material was disposed of into designated landfills, pits or dumps around the Territory.

Table 5 shows a 27 percent projected increase over the next two years in the amount of paint waste and associated contaminated solid material generated. This can be attributed to restoration projects and an expected continued increase in the number of housing developments.

Type 5: Solvents

Solvents are important to a variety of industries in Yukon because of their capability to dissolve and disperse other substances. In Yukon, solvents are connected to extractive industries, dry cleaning industry, automotive service industry, printing industry and painting industry.

Seventy-six percent (26 of 34) of the possible waste solvent generators replied to the questionnaire, and reported 20,632 litres of solvent generated between summer of 1977 and summer of 1978. An extrapolated value of 25,249 litres of solvent disposed in the Territory is extrapolated for the complete response situation.

Disposal practices concerning solvents were varied in nature. Tables 5 and 15 illustrate the methods identified. The most popular method of disposal was into a landfill, pit or dump, (38 percent of the time). Twenty-seven percent was treated on site by dumping onto land or into a tailings pond, while an additional 21 percent was disposed of into community sewer systems. The least popular disposal practices were incineration (11 percent) and surface discharge to land (3 percent).

From survey responses, a 22 percent increase in waste solvent generation was indicated for the next two years.

Type 6: Tetraethyl Lead Sludges

Tetraethyl lead sludges are sediments containing tetraethyl and/or the organic lead found in petroleum bulk plant operations, including fuel storage tanks of service stations. This sludge is highly toxic and settles to the bottom of storage tanks, where it must periodically be flushed.

The respondents, (50 out of a possible 72, or a 69% return), reported 38,962 litres of tetraethyl lead sludge generated from summer 1977 to summer 1978 (Tables 5 and 16). The extrapolated value for the Territory was $1,040 litres.

Of the total reporting, 76 percent or 29,440 litres were from respondents in Whitehorse proper - Inventory Region 1. This represents amounts trucked into Whitehorse for disposal from the inventory regions as well as amounts generated in Whitehorse itself. In many cases the Whitehorse bulk plants service outlying stations; and when a tank is to be flushed, the removed sludge is pumped into the truck and taken to Whitehorse for disposal. Whitehorse data do not include amounts appearing in Table 16 for the other inventory regions. These amounts were disposed of in the inventory region that generated them.

Disposal methods included fuel dilution with subsequent incineration: 62 percent; fuel dilution with subsequent sale as a fuel: 14 percent; surface discharge to land: 8 percent; removal by commercial hauler: 2 percent, and disposal out of Territory: 24 percent (Table 10).

Predictions on future amounts generated were not available for tetraethyl lead sludges as tank flushings were not carried out on any predetermined basis by smaller generators. The bulk plants did flush annually but amount of sludge varied from year to year.

Type 7: Chemical Toilet Waste

The concern with chemical toilet waste is primarily with the various components of treatment chemicals, especially caustic soda and formaldehyde. Primary sources of these wastes in Yukon include territorial and federal campgrounds, air and rail lines and terminals.

From summer 1977 to summer 1978, 30,956 litres of chemical toilet waste were disposed of by 13 establishments. The respondents represented 72% of possible Yukon generators. An extrapolated value for the Territory is 39,623 litres (Tables 10, 17).

All 30,956 litres reported were disposed of into landfills, pits or dumps in the Territory. Projected waste volumes to summer 1980 were not provided by the respondents.

Type 8: Tank Bottom Sediments

This category includes any toxic, ignitable or corrosive material in sludges and/or residue which accumulate in storage tanks (petroleum storage tanks excepted as they are covered under Type 5 - tetraethyl lead sludges and Type 8 - waste oils). In Yukon, 3,636 kg of Type 8 material were generated during the period summer 1977 to summer 1978, all of which were treated on site (Table 10, 18). On-site treatment involved neutralization of the hazardous components in the sediment with subsequent disposal on to land or in a landfill, pit or dump.

The extrapolated amount of tank bottom sediment in Yukon for the study time frame was 4,545 kg, an increase of 909 kg over the 3,636 kg reported by the three out of four possible generators responding to the survey. Projected percentage increases in waste volume were not available.

Type 9: Waste Oil

Three types of oil-associated waste contribute to form the type 9 waste oil category--non-contaminated used oil, contaminated used oil and oil-contaminated solid waste.*

During summer 1977 to summer 1978, 80 of 94 establishments (85% return) reported 67,947 litres non-contaminated used oil and 353,625 litres of contaminated used oil. In conjunction with the above, 94,136 kg of oil-contaminated solid waste were also generated (Tables 10, 19, 20, 21). Extrapolating each figure to account for non-respondents, totals of 78,139 litres for non-contaminated used oil, 406,668 litres for contaminated used oil and 108,256 kg for oil-contaminated solid waste were obtained (Tables 19, 20, 21).

The primary sources of waste oil in Yukon are:

(1) Automotive Service Centers. This classification includes service stations, garages, new car dealers and automotive fleet service areas where used oils are drained from crankcases of automobiles and trucks. Drain oils are generally collected in underground tanks having capacities averaging 2,300 litres, and occasionally above ground in drums or other containers. Drain oils consist primarily of crankcase waste oils, but also include waste transmission fluids, gear lubricants, hydraulic oils and minor amounts of diesel and other solvents used in the service area. Some oil is disposed of to solid waste collection

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*(1) Non-contaminated used oil means used vehicle, motor and machine oils that are not contaminated with foreign substances.

(2) Contaminated used oil refers to oil that is contaminated by waste or other petroleum products such as transmission and hydraulic fluids, diesel, gasoline and a variety of solvents.

(3) Oil-contaminated solid waste refers to used oil filters, oily rags and other spill absorbents such as sawdust.

via oil filters.

(2) Commercial Engine Fleets. Commercial fleets refer to trucking firms and construction equipment which have diesel or gasoline engines. Diesel engine drain oils are similar to those from gasoline engines except that the lead content is negligible. This difference may disappear as the present trend is towards lead-free gasolines.

(3) Railroad Service Center. In Yukon there are minimal service facilities for diesel engines. Railroad lubes, when present, are disposed of off-site.

(4) Aviation Service Centers. The aviation industry is an important user of petroleum-based fuels and lubricants in Yukon. Fueling is performed primarily at airstrips, float bases and remote sites.

Waste oil generation at airports includes the following:

(a) Jet fuel drained from aircraft. This is in very small quantities;

(b) Aircraft sumping, i.e., water removed from sumps. This becomes a minor constituent in the airport waste water system.

(c) Loading facility spills. These occur but are not predictable. Some oil is retrieved, but some is also flushed to sewers.

(d) Draining of engine and transmission lubricants, primarily from ground support equipment. These are stored for transport by a hauler.

(e) Aircraft exterior and ground support equipment washing. Mixtures of dirt, oil, detergent and water are discharged to the sewage system.

(f) De-icing fluids. These are generally able to find their way into the sewage system.

(5) Electric Generation Plants. These consist of turbine and transformer oils.

(6) Drilling Industry. These are mainly lubricating and cutting oils and are included with Type 10 drilling mud figures.

The disposal methods of Type 9 wastes in order of predominance are:

1. surface discharge

(i) road oiling

(ii) race track

(iii) indiscriminate dumping

2. recycling, recovery

(i) fuel for heating purposes

(ii) aircraft disaster simulation

(iii) preservation purposes

(iv) two-cycle engine oil

3. to landfill, pit or dump

4. on-site treatment--disposal

(i) burnt on site

(ii) to drainage system

Projected waste volumes to summer 1980 from summer 1978 for the three waste categories included under Type 0 waste oil are: 20 percent increase for non-contaminated waste oil, 8 percent increase for contaminated used oil, and a 10 percent increase for oil-contaminated solid waste.

Type 10: Drilling Mud

Included in the definition of drilling mud for this study are: (1) drill cuttings; (2) waste lubricating oils; and (3) the mud itself.

Over the one-year period covered by the survey, 64,860 litres and 109,090 kg of drilling mud waste were generated (Tables 10, 22). All of the waste was disposed of into a sump constructed near the drilling site. The above figures are based on 12 establishments out of a possible 16 (75% return). Extrapolation results in values of 81,075 litres and 136,362 kg drilling mud waste generated in Yukon. Projected waste volumes to summer 1980 were not available for this waste type.

Type 11: Contaminated Soil and Sand

Components of Type 11 contaminated soil and sand include such items as sand and oil, spent blasting sand, lagoon residue mixed with soil and contaminated soil or sand from spills. The nature of the waste type does not lend itself to be quantified with any accuracy, thus the present but unquantifiable amount rating in Tables 10, 23 under this heading.

The amount of contaminated soil and sand in a given year can fluctuate widely. Sand and oil mixture could rise and fall with oil disposal procedures practised; spent blasting sand depends primarily on the level of exploration for and extraction of minerals during a year; lagoon residue remains constant from year to year except when new lagoons are introduced without phasing out of old ones; and finally, the amount of soil and sand contaminated as a result of a spill varies with the number of accidents over a year and the severity of each incident.

Type 12: Pathological Wastes

Pathological wastes which are offensive to the senses or hazardous to public health are usually solid and are generated by hospitals, laboratories, research stations and similar complexes. The principal kinds of wastes which fall under this general heading are:

(a) surgical dressings and similarly soiled material;

(b) disposables used in medical practice, for example, plastic syringes, tongue depressors, and test tubes;

(c) anatomical wastes;

(d) animal carcasses;

(e) miscellaneous wastes--paper towels, sanitary towels, etc.

During summer 1977 to summer 1978, 16,952 kg of pathological wastes were generated in Yukon. This figure was compiled from 16 responses out of a possible 21 establishments identified (76 percent return). Extrapolation to account for non-respondents produced a figure of 21,020 kg for the Territory. Projected waste volume, based on responses received, indicates a 23 percent increase over a two-year period, to summer 1980 (Tables 10, 22).

Most pathological waste (9,818 kg) was found in Region 1 - Whitehorse Proper. This is expected because of the high concentration of medical facilities and scientific laboratories located there.

The bulk of the pathological waste in Yukon (72 percent) is incinerated, while the remainder is buried in landfills, pits or dumps. It is readily apparent in Table 24 that the areas outside of

Inventory Region 1 must depend to a greater degree, and in some cases exclusively, on burying their wastes in landfills. This can be directly attributed to the lack of incineration facilities in the outlying regions of Yukon.

Type 13: Drug Waste

Drug waste is generated by health facilities, pharmacies and government laboratories in Yukon. The term 'drug waste', for the purpose of this inventory, refers specifically to drugs which have outlived their shelf life and must be destroyed. During summer 1977 to summer 1978, 419 kg of drug waste required disposal. Fifteen of 19 potential generators replied to the survey for a return rate of 79 percent. By extrapolating the 419 kg to account for the non-respondents, a figure of 505 kg is obtained. A 10 percent increase in drug waste may be expected in Yukon over a two-year period, to summer 1980 (Tables 10, 25). In Yukon the bulk of the drug waste, 355 kg (85 percent) is returned to the supplier, 28 kg (7 percent) is incinerated, 19 kg (4 percent) enters the sewer system of communities and 17 kg (4 percent) is taken to landfills (Tables 10, 25).

Type 13: Obsolete Explosives

Explosives are used extensively in Yukon by the extractive and construction industries in their everyday operations and it is from these sectors that 1,087 kg of obsolete explosives recorded in Tables 5 and 26 are derived. Twenty establishments were identified as possible generators of obsolete explosives and 15 replied for a 75 percent return. Extrapolated value to account for non-respondents results in a figure of 1,358 kg for Yukon.

Explosives to be destroyed may be fresh material from damaged packages, or material that has deteriorated, either from natural aging or from improper storage, to the point where it is unfit for use. Presently the disposal of obsolete explosives in Yukon is carried out at mining and construction sites where they are included with fresh material and detonated.

There is another component to the obsolete explosives problem in Yukon and that is unexploded military devices. These may be found in Region 5 around Watson Lake. At the time this survey was undertaken, the amounts of these obsolete explosives were not able to be quantified. In September 1978, the Canadian military was proposing to enter the area and begin a clean-up campaign.

Type 13: Ink Wastes

All the ink waste generated in Yukon was in Inventory Region 1 - Whitehorse Proper (Tables 10, 27). There are two activities which contribute to the generation of ink wastes--the printing industry (newspapers, posters, etc.) and the T-shirt business (imprinting of logos).

During summer 1977 to summer 1978, there were 267 litres of waste ink generated, all of which was disposed into the Whitehorse landfill site. Associated with the 267 litres of waste ink were the generation of 227 kg of contaminated solid waste (Tables 10, 27). The contaminated solid waste, which includes items such as ink cans and ink-covered rags, was also disposed of into the Whitehorse landfill site.

From survey responses, there is likely to be a 40 percent increase in the generation amounts of waste ink and contaminated solid waste, over the next two years (till summer 1980), (Table 10). Increased demand for printing services and the introduction of a new Whitehorse daily newspaper in summer 1978 are the main reasons for this projection.

Type 13: Mine Tailings

In Yukon, extraction of ore is the single most important industrial activity and is also the largest generator of what is classified as hazardous mine tailings waste.

From summer 1977 to summer 1978, there were 3,416,215,927 kg (dry weight) of mine tailings generated in Yukon (Tables 10, 28). Of this, 62 percent was generated in Inventory Region 3, Klondike - Dempster. There were no tailings wastes reported in Regions 2 or 5.

Projected waste amounts to summer 1980 were not available because of uncertainty in mineral market conditions. These market conditions control the mining effort for a given mineral. The higher the market price for a mineral, the greater the effort to extract it, therefore the larger the amounts of tailings generated. Due to mineral price fluctuations and their effects, any projected waste amount value would be meaningless.

The nature of tailings ranges from waste rock placed in piles in asbestos operations, to heavy metal-containing effluent in copper, lead and zinc extractive operations. The latter tailing type is highly toxic and is treated on-site in ponds or lagoons. Tailings are discharged into ponds where gravity settling, chemical oxidation or reduction and ultra violet breakdown take place over a set period of months before the decant is allowed to enter the environment.

Type 13: Chemical Waste

In Yukon, chemical waste is generated by mining companies, assay labs, educational institutions, health centers and government laboratories. The nature of wastes includes: (a) those which have outlived their shelf life; (b) spent solids and liquids used in the performance of experiments and health tests; and (c) a wide variety of miscellaneous chemicals, such as mercury from broken thermometers and carbon tetrachloride from fire extinguishers.

Over a one-year period ending in summer 1978, there was 3,333 kg of solid chemical waste and 1,338 litres of liquid chemical waste generated in Yukon (Tables 10, 29). Whitehorse Proper (Region 1) was responsible for most of this amount with 3,145 kg and 1,338 litres reported. Sixty percent of the 3,145 kg solid waste and 25 percent of the 1,338 litres of liquid waste were kept in the EPS interim storage facility in Whitehorse prior to final disposal. The remaining 75 percent of the liquid waste in Region 1 was discharged into the Whitehorse sewer system, while 40 percent of the solid waste was treated on-site (37 percent), discharged into the sewer system (2 percent) and landfilled (1 percent) (Tables 10, 29).

Thirty-eight kg and 150 kg of chemical waste were generated in Regions 3 and 4 respectively, all of which were disposed on-site.

The projected increase in generation of waste chemicals for the territory is expected to be in the order of one percent.

Type 13: Mill Concentrate

These are solutions that contain potentially toxic compounds and are generated during the milling of ore. When the hazardous waste survey figures were being compiled, the only mill concentrates reported were 230 litres in the EPS interim storage facility in Whitehorse awaiting ultimate disposal (Tables 10, 30). Information regarding the projected increase in generation of this particular waste over the next two years was not available.

Type 13: Fly Ash - Ash

Incineration of wood wastes and bark residues from forestry operations is carried out in Yukon in conical or wigwam burners. As a result, smoke and fly ash are emitted into the air, while heavier ash settles to the bottom of the burner. The settled ash is then removed and disposed of onto land.

Two of three possible generators (66 percent return) reported 132,727 kg of fly ash-ash requiring disposal from summer 1977 to summer 1978. No estimates on future generation rates were available.

Type 13: Asbestos Waste

Asbestos waste (5000 kg) from mining operations was reported in Inventory Region 3, Klondike-Dempster (Table 30). Most of the waste was recovered and incorporated into the final fibre product, but the remainder was deposited onto tailing piles.

This waste type will disappear completely when the mine closes down at the end of 1979.

Type 14: Contaminated Fuels

Contaminated fuels were generated at automobile service centers, bulk petroleum plants and aviation centers around the territory. In total, 101,508 litres of contaminated fuels were reported during summer 1977 to summer 1978, by 80 responding establishments (Table 31). Extrapolating to account for 14 non-respondents, increased the total of contaminated fuels to 116,734 litres (Table 24).

Of the reported total, 70,000 litres were generated in Region 1 - Whitehorse, 5,184 litres in Region 3 - Klondike-Dempster and 26,324 litres in Region 5 - Alaska Highway South (Table 31).

Projections on whether the waste generation rate will increase or decrease to the summer of 1980 from the summer of 1978 are not applicable in this case because of the nature of the waste. Contamination of fuels is not a necessary consequence of a certain process. It is a waste type which the petroleum industry is constantly attempting to minimize because excessive costs are incurred by these operations.

Contaminated fuels in the territory arose from three events: (a) water entering storage containers; (b) accidental mixing of fuel types; and (c) utilizing fuel as a solvent.

Disposal of contaminated fuels was by: (1) reuse--this includes (a) dilution with uncontaminated fuels and subsequent sale, (b) used as a fuel in heating systems to extract its calorific value, and (c) burnt in mock aircraft disasters; (2) burning in dump--fuel is used as a primer in some disposal sites where burning is allowed for waste volume reduction; (3) disposed of out of territory - Region 5 - Alaska Highway South, is serviced by northern British Columbia petroleum interests. All of the contaminated fuels generated in this area were trucked to British Columbia.

DISPOSAL METHODS

The method of disposal chosen by a particular generator in Yukon depended primarily on the volume of waste, chemical composition of waste, availability of existing disposal streams, economics of erecting a disposal facility and legislative requirements. The Yukon, because of its geographical isolation and low generation rate of hazardous wastes, does not have as great a choice of disposal methods to employ as do southern Canadian generators.

Table 32 summarizes disposal facilities available in Yukon communities. Disposal methods which predominated were:

(1) Disposal into designated landfills, pits or dumps;

(2) Sewer system disposal;

(3) Surface discharge to land;

(4) On-site treatment;

(5) Incineration;

(6) Reuse;

(7) Discharge to atmosphere;

(8) Disposal outside of territory;

(9) Interim storage.

COMMERCIAL PETROLEUM CAPACITY

Tables 33 through 37 summarize information on the commercial petroleum storage capacities in Yukon by inventory region. There were 10 fuel types for sale in Yukon:

(1) regular

(2) unleaded

(3) extra unleaded

(6) heating oil

(7) propane

(8) 100/130 aviation gas

Table 32. Summary of Disposal Facilities Available in Yukon Communities

	Sewage and Waste Disposal Facilities
Inventory Region #1 - Whitehorse Proper:	
Whitehorse:	Sewage from Porter Creek subdivision is treated in an aerobic lagoon with the effluent being discharged into the Yukon River. Crestview has no identified discharge to date. Lobird trailer court utilizes an anaerobic lagoon for waste treatment. The sewage from the remainder of Whitehorse is discharged into the Yukon River after passing through an anaerobic lagoon. Municipally operated garbage collection service is available. Garbage is disposed in a landfill site.
Inventory Region #2 - Alaska Highway North:	
Haines Junction:	Collection system, anaerobic lagoon, drainage into Dezadeash River; garbage disposal in open trench; no collection system.
Destruction Bay:	Community sewage system, treated by anaerobic one-cell lagoon; garbage disposal in open trench. Volume reduction is achieved by burning.
Burwash Landing:	Septic tanks and sub-surface tile fields; dump for garbage.
Beaver Creek:	Septic tanks with disposal into weeping tile field; garbage disposal into open trench.
Inventory Region #3 - Klondike Highway-Dempster	
Clinton Creek:	Abandoned.
Dawson City:	Sewage discharges directly into Yukon River; the city operates an open trench and fill garbage disposal system and pick-up is by contract.
Elsa:	Sewage and garbage collection system, overland hillside disposal for sewage (ends upon mine tailings pond).
Mayo:	Collection system draining a marshy area into the Stewart River; garbage disposal in open dump, no garbage collection.
Keno Hill:	Septic tanks; garbage disposal in open dump, no garbage collection system.

Table 32. (Cont'd)

Carmacks:	Gravity sewage system conveying sewage to extended aeration lagoon before discharge into Yukon River; garbage in open dump and covered.
Pelly Crossing:	Septic tanks and privies; garbage dump.
Old Crow:	Some septic tanks, and privies, sewage eduction service; local garbage pick-up to open dump and covered.
Inventory Region #4 - Robert Campbell Highway - Canol Road	
Faro:	Sewage lagoons discharge into river; garbage in landfill site.
Ross River:	Septic tanks; garbage disposed in trench and fill dump.
Inventory Region #5 - Alaska Highway South - Carcross	
Watson Lake:	Mostly serviced by a gravity sewer discharging into a lagoon; some septic tanks; garbage disposed in landfill.
Teslin:	Piped sewage distribution system with holding tank pump-out to lagoon; some septic tanks with pump-out available; garbage disposal in landfill site.
Carcross:	Septic tanks pump to lagoon; private garbage truck service once a week.
Upper Liard:	Septic tanks or earth privies; garbage in open dump.

(4) diesel (9) 80/87

(5) furnace oil (10) JP4 - turbo fuel

The largest storage capacity is in Whitehorse as it is the major territorial distribution center. Four bulk plants are located here as well as large storage capacities for certain establishments such as the Whitehorse airport. An attempt was made to determine the amounts of each grade sold over a one-year period and how it was transported to its place of sale. Tables 33 to 37 give an idea of the flow of fuel in Yukon.

Table 33. Summary of Petroleum Storage Capacities in Whitehorse Proper (Inventory Region #1).

Fuel Grade	Total Storage Capacity (ℓ)	Number of Establishments Responding	Average Storage Capacity per Establishments (ℓ)	Amount Sold in Past Year (ℓ) (1977-1978)
Regular	3,422,400	32	106,950	30,521,532 *
Unleaded	450,800	13	34,676	723,300 *
Extra Unleaded	103,600	3	34,533	216,700
Diesel	4,919,364	19	258,913	16,398,130
Furnace Oil	824,320	7	117,760	2,014,782
Heating Oil	354,320	7	50,617	454,150
Propane	213,900	3	71,300	7,134,600
100/130	864,800	3	288,266	2,175,000 *
80/87	436,600	3	145,533	1,076,400 *
JP4	1,173,920	3	391,306	3,631,078 *

*Does not include all estimates, because some were unquantifiable.

Table 34. Summary of Petroleum Storage Capacities in Alaska Highway North - Haines Road Area, Inventory Region #2.

Fuel Grade	Total Storage Capacity (ℓ)	Number of Establishments Responding	Average Storage Capacity per Establishment (ℓ)	Amount Sold in Past Year (ℓ) (1977-1978)
Regular	395,600	12	32,966	1,940,280
Unleaded	115,000	7	16,429	204,700
Diesel	105,800	7	15,114	579,600
Furnace Oil	43,700	4	10,925	Not Known
Heating Oil	29,900	4	7,475	Not Known
Propane	9,200	2	4,600	Not Known
100/130	4,600	1	4,600	Not Known
80/87	4,600	1	4,600	Not Known
JP4	13,800	2	6,900	Not Known

NOTE: Fuel transported from Haines and Whitehorse by truck.

Table 35. Summary of Petroleum Storage Capacities in Klondike-Dempster Area (Inventory Region #3).

Fuel Grade	Total Storage Capacity (ℓ)	Number of Establishments Responding	Average Storage Capacity per Establishment (ℓ)	Amount Sold in Past Year (ℓ) (1977-1978)
Regular	358,800	8	44,850	2,564,095
Unleaded	46,000	3	15,333	Not Known
Diesel	3,392,164	5	678,432	1,857,935
Heating Oil	463,650	5	92,736	Not Known
Furnace Oil	161,000	5	32,200	62,647
Propane	23,000	3	7,666	55,200
100/130	69,000	6	11,500	41,400 *
80/87	27,600	3	9,200	13,800 **
JP4	115,000	4	28,750	92,000 **

* Does not include all estimates given, because some were not quantified.

**Does not include private interests who used their own supply.

Table 36. Summary of Petroleum Storage Capacities in Campbell - Canol Road Area (Inventory Region #4)

Fuel Grade	Total Storage Capacity (ℓ)	Number of Establishments Responding	Average Storage Capacity per Establishment (ℓ)	Amount Sold in Past Year (ℓ) (1977-1978)
Regular	248,400	8	31,050	1,481,200
Unleaded	13,800	1	13,800	Not Known
Diesel	979,800	6	163,300	4,393,000
Furnace Oil	147,200	2	73,600	460,000
Heating Oil	9,200	1	9,200	36,800
Propane	55,200	2	27,600	101,200
100/130	13,800	2	6,900	Not Known
80/87	9,200	2	4,600	Not Known
JP4	27,600	2	13,800	Not Known

NOTE: Fuel transported from Watson Lake and Whitehorse by truck.

Table 37. Summary of Petroleum Storage Capacities in Alaska Highway South Area (Inventory Region #5)

Fuel Grade	Total Storage Capacity (ℓ)	Number of Establishments Responding	Average Storage Capacity per Establishment (ℓ)	Amount Sold in Past Year (ℓ) (1977-1978)
Regular	708,400	16	44,275	9,275,191 *
Unleaded	138,000	10	13,800	418,600
Extra Leaded	18,400	1	18,400	115,000
Diesel	441,600	9	49,066	9,567,595
Furnace Oil	60,262	4	15,065	53,005
Heating Oil	24,380	4	6,095	2,300
Propane	126,500	7	18,071	4,600,000
100/130	345,000	5	69,000	381,800
80/87	340,400	6	56,733	345,000
JP4	910,800	5	182,160	945,451

* Does not include private use by companies, as this was unquantifiable.

NOTE: Fuels transported by truck from Fort Nelson and Whitehorse.

CHAPTER V

REVIEW OF OTHER HAZARDOUS WASTE STUDIES IN CANADA

PROVINCE OF ALBERTA

In January 1972, the Province of Alberta appointed Associated Engineering Services Ltd. as consultant for a study of the problem of disposal of toxic and other difficult to treat industrial and institutional wastes.

From questionnaire and interview responses, it was estimated that 23.4 million litres of oily wastes and sludges were generated in the Province of Alberta. This volume was considered adequate to justify establishment of a regional disposal facility for these wastes. It was concluded that a single facility near Edmonton with a tank farm near Calgary provided the most economical solution. In general, distribution of wastes was found to be approximately 45 percent from the Edmonton area, 35 percent from Calgary and about 20 percent from the remainder of the province (Associated Engineering Services Ltd., 1972).

The study also provided an operational conceptual plan for a multiple waste treatment and disposal facility.

NORTHWEST CANADA

In January 1979, W. L. Wardrop and Associates Ltd. completed a survey to determine sources of hazardous waste production, types of waste produced, quantities discarded or reclaimed, and the disposal practices used in the northwest region of Canada. The study was commissioned by EPS in conjunction with the governments of Alberta, Saskatchewan, Manitoba, Ontario and the Northwest Territories. The information collected was to be used to assess the need for a central disposal facility for hazardous wastes in the survey region (Wardrop, 1979).

A 20 percent questionnaire return rate was realized from the firms in SIC categories suspected of generating hazardous wastes (Wardrop, 1979).

The study concluded that proper disposal of hazardous wastes is a major environmental problem and that current disposal practices were inadequate. As well, no economical, accessible and environmentally acceptable disposal facilities existed for proper disposal of hazardous wastes in the survey region, although the amounts of waste warranted it (Wardrop, 1979).

CITY OF VANCOUVER

The Environmental Protection Service in 1977 inventoried industrial wastes generated by 1661 firms within the city of Vancouver, British Columbia. The survey effort was a joint City/Federal report released in 1979. Data was collected from owners and managers of industry, primarily through interviews (EPS, 1979).

Ninety-six percent of all liquid wastes identified were discharged to sewers in compliance with City of Vancouver by-laws. The remainder was recovered or disposed of at landfills. Sludge recovery comprised 64 percent of total sludge waste identified, while the bulk of the remainder, 29 percent, was deposited in landfills.

Soluble oils were predominantly sent to landfills (87 percent), while the majority of insoluble oils (99 percent) were recovered (EPS, 1979).

It was concluded that wastewaters generated by industries in Vancouver do not have a significant impact on effluent quality.

GREATER VANCOUVER REGIONAL DISTRICT (GVRD)

The data collected by the GVRD describing hazardous, toxic and nuisance wastes was obtained through interview and questionnaire. Findings of the study showed that industrial waste contributions to the sewerage system were low compared to other metropolitan areas (GVRD, 1978).

Disposal of sludges and chemicals was usually by tank truck at unknown locations. Concern was expressed by some firms at the lack of local facilities for disposal of such wastes as polychlorinated biphenols and chlorinated hydrocarbons (GVRD, 1978).

Data on effluent quality at Greater Vancouver Sewerage and Drainage District plants indicated that industrial waste discharge does have an impact on effluent quality. The impact, however, was considered insignificant by the researchers (GVRD, 1978).

ONTARIO

In 1979 the provincial government in association with the Environmental Protection Service commissioned a study to evaluate the existing hazardous waste situation in Ontario. This study by James F. MacLaren Ltd. has as yet not been completed. However, MacLaren (1979) has compiled hazardous waste generation data from Ontario's manifest system. The data showed 136,000 tonnes of waste generated (excluding acids, alkali, dilute aqueous wastes and recoverable and dilute oils) in the Province.

DATA COMPARISON WITH OTHER JURISDICTIONS

Table 38 compares the hazardous waste generation data of this report with experience in other jurisdictions in Canada. While a direct comparison between regions cannot be made because of the factors discussed below, a degree of correspondence between figures would add confidence to the survey results.

Factors affecting the comparison include:

- definition of hazardous waste - there is no universal definition of a hazardous waste; consequently materials classified as such differ between regions.
- survey method - different methodologies have varying degrees of accuracy, and tend to key on certain processes or waste types.
- distribution of industries - industry concentration tends to skew results if the study does not cover a large enough geographical area.
- technology - similar industries do not necessarily utilize the same processes, thus affecting effluent constituents and amounts.

From Table 38 it is apparent that estimates of waste amounts generated in Yukon agree with comparable predictions of waste volumes in other jurisdictions. It can be concluded, from this favourable comparison, that the waste volumes presented in this study are reasonable estimates.

Table 38. Comparison of Northern and Western Canada Inventory Results with Other Jurisdictions*

Data Collection Method	Reference	Jurisdiction	Population	Annual Waste Volume (tonnes)	Hazardous Waste Generated kg/Person/Year
<u>Report Results</u>					
Questionnaire Inventory	This report	Yukon	25,000	510	20
<u>Other Canadian Surveys</u>					
Questionnaire Inventory	Associated Engineering, 1972	Alberta	1,800,000	25,900	14
Questionnaire Inventory	Environment Canada, 1979	City of Vancouver	415,000	5,000	12
Questionnaire Inventory	Greater Vancouver Regional District 1978	Greater Vancouver	1,750,000	N/A	N/A
Manifest Data	MacLaren, 1979	Ontario	8,000,000	136,000	17
Questionnaire Inventory	Wardrop, 1979	Prairie Provinces, NWT, N.W. Ont.	4,000,000	61,200	15

*NOTE: Table excludes acids, alkalies, recoverable and dilute oils, and dilute aqueous wastes to facilitate comparison between jurisdictional areas.

N/A - Not Available.

CHAPTER VI

INVENTORY ANALYSIS

The first part of the chapter will address collection, transportation and waste disposal of hazardous wastes. The rest of the chapter will discuss the individual waste types according to the following criteria:

(1) availability of a particular waste for a disposal facility;

(2) evaluation of the environmental impact of current disposal practices.

COLLECTION AND TRANSPORTATION

Collection and transportation are the first links in the chain of events that lead to the final disposal of a hazardous waste. A successful collection and transportation system does the job in a manner which is acceptable to community and government regulatory agencies, as well as providing a service which is economically efficient.

COLLECTION

Collection is the act of accumulating hazardous waste by the generator for subsequent transport and disposal. There were five methods of collecting and storing wastes identified in the survey:

Underground Tanks

This system is found in service stations and establishments which generate some form of liquid wastes. The objective of this system is to store the waste generated by the everyday operation of the establishment for a short period of time. Capacities vary, but

2,300 litres is common. Tanks are emptied by tank trucks on a regularly scheduled, prearranged basis or when the tanks are full. Once waste is removed from these tanks (or any other container system), the transporting agency generally can do as they see fit with it. This leads to arrangements between transporter and local government districts such as spreading of waste oil for dust control. Agreements between transporter and private or corporate citizen for reuse of a particular waste are known to have been made. This raises questions concerning liability of a waste cleanup if a spill were to occur and the acceptability of the transporter's disposal method.

45-gallon drums: These are quite popular in Yukon and are called on to store any waste imaginable. Currently, the only criteria a waste has to meet to be deposited into a 45-gallon drum for storage is that it fit. Some drums are reused many times in some establishments; in others, however, the drum is disposed of with the wastes. Contents of 45-gallon drums can vary greatly from week to week due to adaptability of storing various wastes.

If a 45-gallon drum was used for many years as a collection receptacle, it should be carefully disposed of. After being used to store oils, pesticides and heavy metal solutions, sides are often seriously contaminated and should be shown special disposal consideration. The present practice of disposal is to discard drums wherever convenient. The drums should be taken to a designated site.

Commercial bins: These are found in the larger centers and are privately owned and operated. A bin can be bought or rented and the accumulated waste is removed regularly by a hauler. Due to the large size of these bins, hazardous materials are easily concealed by non-hazardous wastes, thereby increasing the possibility of inadequate disposal of these materials.

Small container systems: This refers to garbage cans and boxes that may be found throughout an establishment. In most cases, one container is emptied into another until a suitable volume is generated to merit disposal.

Tailing ponds and piles: These collect the largest amount of hazardous wastes generated in the Territory. They are found at mine sites and collect wastes as they are produced for on-site treatment. The treatment in ponds includes: gravity settling, chemical oxidation and/or reduction and ultra violet breakdown.

Frequency of Waste Removal

The frequency of waste removal in Yukon falls into four categories. These are:

(1) Small volume generators who tend to allow waste to accumulate until their holding capacities are full. Implications of this are that, although an establishment may not generate a large amount of waste every day, they dispose of it in bulk, thereby increasing potential for environmental damage.

(2) Generators who dispose of their waste at times of slow business. This is not a preferred practice. Chances are that the waste storage container has accumulated significant amounts of wastes which are generated during peak business periods. Therefore large amounts are disposed into the environment at once.

(3) Waste is disposed of continuously as it is produced--this is characteristic of companies who are high volume waste generators, or

of establishments which generate liquid wastes in larger centers where sewage systems are available.

(4) Disposal of waste on a regular basis by hiring a waste contractor, by utilizing local government services, or by having an employee dispose of waste on a certain predetermined day of the week.

Collection Analysis

The above accumulation patterns do not make Yukon unique. In fact, similar patterns exist in other parts of Canada. To be emphasized, however, is that allowing wastes to accumulate until holding facilities are full is not in the best interests of the environment.

Addressing the question of containers directly, the following observations were made during the course of the survey. Firstly, storage containers have often deteriorated with age and weather exposure, thereby making it difficult and sometimes dangerous to transport wastes to an area of interim storage or ultimate disposal. Generators should be educated by an information program about dangers of storage containers.

Secondly, refuse containers in most instances are not properly marked with labels informing transporters of their contents. Legislation should be introduced requiring hazardous and toxic waste generators to label their containers to inform the hauler as to what he is transporting.

TRANSPORTATION

As the economy grows, so does the quantity and frequency of hazardous waste shipments by road or rail to interim storage facilities or ultimate disposal sites. The movement of these hazardous wastes through transportation channels creates risks which are not fully understood, but which are viewed with apprehension by the Environmental Protection Service, private industry and the public in Yukon.

Conditions under which transportation of hazardous wastes in Yukon are presently operating can at best be termed unfavourable. There are two major conditions:

Long distances to be hauled: Settlement patterns in Yukon are not conducive to short distance disposal. Hazardous wastes such as tetraethyl lead sludges and pesticides which require specialized disposal techniques must be hauled from their point of generation or application to Whitehorse. Also obsolete explosives are being hauled to various mine sites to be destroyed and waste petroleum products are being trucked across the Territory in great quantities. Implications of this are that there is a fair amount of hazardous waste that requires transportation to an off-site disposal area, and as distance increases from generation point, the probability of an accident rises sharply. For this reason, stringent controls should be placed on transportation companies. This would include safety programs for drivers, and regular equipment inspection.

Bad road conditions: The Alaska Highway is well known for taking its toll on vehicles due to its winding nature. This, coupled with pothole development in spring and severe dust in summer, make for treacherous conditions. Since the nature of the road, or pothole development, cannot be controlled by man, a different approach to minimize the accidental discharge of hazardous wastes must be taken. Drivers that haul materials classified as hazardous should be in better than average condition to handle severe tests handed out by the road. To ensure that top physical condition is achieved and maintained, a new class of license could be introduced whereby drivers have to pass yearly medical examinations before they are allowed to transport hazardous wastes.

Waste Hauler Categories

Haulers who are responsible for the collection and transportation of hazaroud wastes in Yukon can be classified into four categories. These are:

(1) large firms which haul their own waste;

(2) commercial contractors;

(3) private haulers of a specific waste;

(4) private haulers of their own waste.

Large firms which haul their own waste: These have necessary generation volumes and manpower to make them an economical undertaking. Haulers in this category are the ones most likely to be involved with long distance hauling. Types of wastes which are transported include tetraethyl lead sludges, waste petroleum products and tank bottom sediments. One drawback is that specialized vehicles are not used for transportation of wastes, rather they are the same as those that are utilized to deliver a company's finished product to market. An example of this is found in the petroleum industry where contaminated fuels are transported in the same tanker truck that will be used to deliver the next day's uncontaminated fuels. This practice is inherently wrong, but in Yukon, existing economic conditions dictate that it continue. The extent of problems which result from this lack of "dedication" was not quantifiable, but steps should be taken to minimize the possibility of even slight contamination of the next load.

Once clear technical standards for hazardous waste management are adopted by governments in western Canada, it will not be necessarily the case that remote areas such as Yukon must compromise adherence to poor practices because of local economic conditions. High costs in remote areas can be equalized if a regional facility is utilized in western Canada. If costs for generators are the same across the management network, then wastes will be directed to a facility from all points. If costs are not equalized (costs increase as distances increase) then there will be a point where it will be uneconomical to transport wastes to a particular facility and mis-management will occur.

Overall, vehicles in this category are in the best mechanical condition as compared to other categories. The reason for their road worthiness can be attributed to the mechanical staffs employed by large industrial operators.

This category can expect to be affected by the Transportation of Dangerous Goods Act (see Chapter VII) when it is passed. Presently, labelling of these vehicles is not up to standards proposed by the bill. Labels are either obscured, torn, or altogether missing. Inspection of transporting vehicles for mechanical soundness and labelling should be done every year by an inspector to ensure regulations are being observed.

Commercial contractors: Commercial contractors are located, for the most part, in major population centers of Yukon. In areas where waste generation volumes are not sufficient to make a commercial hauler viable, disposal is carried out by local government districts. Where waste volumes are sufficient, such as in Whitehorse, private enterprise exists almost exclusively.

The types of wastes handled by these operators are classified as non-hazardous. The complication is that, mixed with the non-hazardous wastes, are those which have the potential to affect human health, safety and the environment adversely. Drivers, when disposing of wastes from industrial sites, are unaware of what they are carrying because of non-hazardous cover. This would cause problems at the disposal site if quantities of hazardous waste in Yukon were to reach a higher level of generation in the printing and painting industry. These two industries are noted for their high generation rate of non-hazardous wastes. A mix of non-hazardous waste is an acceptable way of disposal only if the ratio of one to the other is heavily weighted in favor of the non-hazardous component.

Because of the fine line between acceptable and unacceptable mix ratios, there is some merit to initiating a study on the feasibility of segregating wastes at the industrial site into hazardous and non-hazardous groups. Hazardous wastes would then be taken to an area specialized for receiving and disposing of the waste, while the non-hazardous waste would be taken to a landfill. The advantages of this system may include: (1) elimination of future detrimental impacts of mishandling or improper disposal of a hidden waste; and (2) start of an efficient waste utilization system, because types of wastes would be quantified and available for another industry's use.

Transportation equipment utilized by commercial contractors includes open-style dump trucks, specialized container pick-up trucks and tank trucks for liquid wastes. Distances travelled to disposal sites from waste pick-up points are usually minimal due to location of the contractor's operations. Routes are from generation point to disposal site and return.

One disturbing practice which does exist within the commercial contractor category is the subsequent reselling of a waste. On surface, this is commendable because reuse of waste is made, but the potential of a particular waste being utilized in an unacceptable manner is very high. A specific Yukon example is the case of waste oils being collected by a commerical contractor from a generator(s) and subsequently sold to a third part. The third party may utilize the waste oil for dust control on roads. Waste oil contained deleterious substances which were unknown to the contractor or receiving party. As a result, environmental damage to the land was significant. A management program, when it is introduced, should not allow the reselling of a waste until it has been approved by the authorities with respect to the acceptability of the proposed use.

Private hauler of a specific waste: This category refers to one or two vehicle operations which haul Type 9 waste oils and Type 14 contaminated fuels from generation points to disposal sites. Usually long distance transport is involved and petroleum wastes are picked up as a result of a prior arrangement. The fate of these wastes ranges from dust control on a race track to burning for heating purposes. The mechanical condition of the tank trucks in this category is,for the most part, quite good. One reason for this is the economic consequence of having the only vehicle in a transport operation not in operating condition. This group, along with private haulers of their own waste, were the main offenders of inadequate labelling.

Private haulers of own waste: Private haulers of waste are hazardous waste generators who have the capability of transporting their own waste. There are many reasons for generators to transport their own waste in Yukon. The first reason is economics--the generator cannot afford the service charge of a contractor. The second is insufficient volume for a contractor to be engaged. The third is capability of the generator to transport his own waste. Finally, the fourth is that there were no alternative methods of removal available. This group is characterized by short distance disposal, in that the waste removal route is from generation point to disposal area and return. Vehicles used to transport wastes to a disposal site are varied. They range from station wagons to pick-up trucks. These vehicles transport everything from 45-gallon drums to cardboard boxes.

Transportation Analysis

Overall, considering working conditions and type of wastes involved, the transportation system in Yukon is quite good. People involved are concerned and when violations occur, it is usually not through any deliberate action. There are exceptions to this by those operators dictated solely by economics. Violations include leaky valves, burnt out tail lights and inadequate labelling. To alleviate this problem, the Yukon territorial government or Transport Canada could institute a carrier inspection program. Periodic inspections of the truck would go well with the periodic medical examination of drivers to greatly decrease the possibility of an accidental discharge of a hazardous waste into the Yukon environment.

The cost of transportation in Yukon is considerably higher than in the rest of the country. This can be attributed to higher fuel costs and the high cost of obtaining suitable equipment in the North. The consequences of this situation are that disposal of some hazardous wastes is being carried out in an unsuitable manner. Disposal of waste oils, lead sludges and paint is such that they are deposited on land with no regard for the consequences.

Generators utilizing more expensive methods of ultimate disposal such as incineration, neutralization and lagooning, are either government institutions which must conform to federal or territorial standards or are large private companies in the extractive industry which must conform to stringent regulations.

WASTE DISPOSAL ANALYSIS

FACTORS AFFECTING WASTE DISPOSAL

There are many factors affecting waste disposal which are unique to Yukon and north of 60° in general. In much of the Territory, there has been very little soil development. Where soils have formed, changes are that they contain large quantities of ice for several meters beneath the surface or are located in mountainous regions in southwest Yukon. Much of the land around Old Crow and further north is covered with muskeg or organic terrain that acts as an insulating blanket maintaining uniformly low soil temperatures. Thus soil, that in southern Canada is the final recipient of so much of man's waste, in Yukon is often almost non-existent (Hemstock, 1973).

The climate aggravates the effects of the cold soil; Yukon has very little rainfall and low mean annual temperatures with long winter periods of little sunlight. Very little energy is contributed to the system to reduce waste materials.

The water of Yukon is cool to cold. Lakes and rivers are covered with ice for six to 11 months of the year and, in many cases, oxygen content is exceedingly low. Processes of degradation that are normal in the south, either do not exist or proceed exceedingly slowly in Yukon waters.

Vegetation and wildlife in Yukon consist of relatively few species, and wildlife may be subject to fluctuations in population. Vegetation, due to low soil temperatures, grows slowly. The impact of poor waste disposal practice may be very serious to habitat, or directly to fish or wildlife populations (Hemstock, 1973).

DISPOSAL: EXISTING PRACTICES

Following is a review and evaluation of present practices and problems of waste disposal in Yukon, as identified by the study.

Disposal into Designated Landfills, Pits and Dumps

The most popular disposal method of haxardous wastes in Yukon is deposition into landfills, pits or dumps. Most waste types identified in the inventory (Table 5) were ultimately disposed of in this way. These disposal areas are where any individual, industrial or community wastes may be dumped at any time, with little or no control. Table 32 summarizes the availability of these disposal facilities by community in the five hazardous waste inventory regions.

The Whitehorse landfill site, largest in the territory, is the only location where segregation of waste is practised to any degree. The landfill site has an experimental toxic chemical disposal area which periodically accepts wastes under supervision of EPS. In addition, there is a waste oil sump and a municipal refuse area supervised by the City of Whitehorse landfill manager.

Open burning for waste volume reduction is not permitted in the Whitehorse landfill site. Other designated disposal areas utilize open burning for volume reduction and make use of Type 9 waste oils and Type 14 contaminated fuels to keep the fires burning.

Utilization of landfills, pits or dumps as ultimate disposal sites for hazardous wastes without prior treatment is widely practised in all of Canada, not only Yukon. The result is an unsightly area that attracts animals and flies and is a source of smoke and odor which contribute to air, surface and groundwater pollution.

Pollution may occur because long term containment of wastes which have not been detoxified or neutralized cannot be guaranteed. There are many examples in the literature of leachate problems from landfills caused by untreated wastes (Moell, 1977, 1978).

Yukon has two alternatives to protect itself from problems which may arise in the future, from inadequate disposal of hazardous wastes in landfills, pits or dumps.

The most economical, as well as environmentally acceptable alternative would be to construct a secure landfill in close proximity to Whitehorse. A liner could be placed in the bottom of the site and a leachate gathering system installed. A monitoring system would also be part of this secure system. Special consideration would have to be given to permafrost and its effect on the overall process.

The proposed site would accept wastes from all over the territory. This site development, if backed by regulations requiring generators of hazardous waste to dispose in the designated area, would eliminate the possibility of environmental damage around the existing disposal sites in the future. At present, consequences of each landfill, pit or dump accepting wastes cannot be determined, but a real possibility of damage exists. A central site would eliminate potential environmental damage and provide for easier regulation.

The second alternative, although much more attractive environmentally, may not be as economically feasible as the first. This would involve complete detoxification and neutralization of hazardous wastes before disposal. Facilities to undertake such a task would only be found in a regional complex, such as the one proposed by Kinetic Contaminants (1979) in the northwest region of Canada. The way by which this method could be utilized most effectively would probably be by storing most toxic and hazardous wastes and shipping them to the regional facility in the south for treatment when amounts warrant.

If these recommendations are accepted, larger amounts of less toxic materials would be disposed of in Yukon in a secure landfill, whereas smaller amounts of highly toxic waste would be treated in the regional facility (see also Chapter VII).

Surface Discharge to Land

This category concerns waste which is deposited off-site by generators. Establishments who dispose of wastes on their own property are categorized under on-site treatment.

Reasons for surface discharge to land are many:

(1) economics

(2) convenience

(3) ignorance of legislation

(4) no alternative disposal area or technique available

Surface discharge to land is the most inexpensive and environmentally damaging of the disposal techniques practised in Yukon. Toxicity of wastes deposited on land results in vegetation kill with resultant scars.

Acid and alkaline solutions, solvents, tetraethyl lead sludges, waste oil and drilling muds are principal waste types disposed of onto land. Total amounts disposed are 261,275 litres of liquid and 109,090 kg of solid material. Most wastes discharged to land could and should be directed to existing incinerators, landfills, pits and dumps at the very least and to a secure landfill, storage transfer station complex at the most (as discussed under landfills, pits and dumps). Problems encountered by surface discharge to land are covered by individual waste types in this chapter.

Sewer System Disposal

Table 32 provides information on sewer systems and treatment of wastewater for each community in Yukon. Most, if not all sewer systems, discharge into nearby water courses, usually with limited treatment in lagoons. Some communities have septic tank systems to collect their waste.

Essentially, any waste which is disposed of into a community's drainage system has a high probability of entering a water course untreated except for the dilution factor of the wastewaters. Whitehorse was especially guilty of this until January 1979, when a sewage treatment facility was put on line. The Whitehorse facility does not treat the wastewaters completely in that its capability allows for 50 - 60 percent wastewater constituent neutralization.

Acids, alkalis, solvents and chemical waste are being disposed of to sewer systems in varying quantities (Table 10). If required, these wastes could be made available for a disposal facility.

On-Site Treatment

A variety of on-site treatment techniques were identified by the inventory. These included:

(a) acid solutions--neutralization, dilution, incineration;

(b) alkaline solutions--neutralization, dilution, incineration;

(c) solvents--burning;

(d) tetraethyl lead sludge--dilution;

(e) tank bottom sediment--neutralization of toxic compounds with subsequent burial;

(f) waste oils--surface discharge to land, burning;

(g) pathological waste--incineration;

(h) chemical waste--burning, neutralization;

(i) asbestos waste--recovery for inclusion into final product;

(j) mine tailings-- to specialized ponds.

Compatible acid and alkali solutions were neutralized by adding one to the other with a salt precipitated. Tank bottom sediments were also neutralized and buried on site.

Dilution of acid and alkaline solutions refers to large quantities of water flushed with wastes into sewer system of communities. Tetraethyl lead sludge, on the other hand, is diluted by large quantities of fuel and subsequently sold as a fuel.

Incineration and burning result in volume reduction of the waste. The difference is that incineration takes place in an incinerator or furnace while burning takes place in 45-gallon drums, dumps or pits.

Recovery for inclusion into final product is done for asbestos waste by generators so as to reap the benefits of its subsequent sale. This method requires a gathering of fibres which have dropped during the milling process.

On-site treatment of mine tailings by disposing into specialized ponds results in gravity settling, chemical oxidation or reduction and ultraviolet breakdown. Evaluation of disposal techniques is found under individual waste types.

Incineration

Incineration is a controlled process that uses combustion to convert a waste to a less bulky, less toxic or less noxious material. Although incineration is included in this discussion of ultimate disposal techniques, it is not truly so; it merely reduces the total volume of wastes. The residue requires final land or water disposal. The principal products of incineration from a volume standpoint are carbon dioxide, water and ash, while products of primary concern due to their environmental effects are compounds containing sulfur, nitrogen and halogens (Powers, 1976).

Liquid waste incinerated includes waste oils, contaminated waste oils, contaminated fuels and solvents. Most liquid waste incinerated is done so that benefits are realized. A fair percentage of waste and contaminated oil and fuel is burnt for heating purposes. Waste oils and fuels are also burnt by Whitehorse airport firefighters during similation drills of aircraft disasters.

Solid wastes incinerated include pathological and drug waste. Pathological waste incineration results in a residue. This residue is then buried at a landfill site or is dumped on the ground.

Incineration is an acceptable method of disposal for the waste types discussed. Further details are available under individual waste types.

Reuse

Reuse is not a common method of dealing with hazardous wastes because the generated amounts are not of sufficient magnitude. The only waste types to be reused in Yukon are Type 9 waste oils and Type 14 contaminated fuels.

Type 9, non-contaminated and contaminated oils, are used as:

(1) a fuel for heating purposes;

(2) preservatives on telephone poles and fence posts; and

(3) oil in two-cycle engines such as chain saws and outboard motors.

Type 14--contaminated fuels, may be diluted with other fuel and sold or, as above, used for heating purposes.

Both types of waste are also used at the Whitehorse airport during simulation of air disasters. Firefighters ignite, then extinguish, oils and contaminated fuels which have been poured over a simulated aircraft frame.

Discharge to Atmosphere

The sources of atmospheric discharges include furnaces, incinerators, dry cleaning establishments, and wigwam burners disposing of forestry wastes. No problem exists with those sources.

Disposed Outside Yukon Territory

This method refers to contaminated fuels and tetraethyl lead sludges which are taken out of Inventory Region 5--Alaska Highway South, and disposed of in northern British Columbia by the petroleum interests which supply the area.

Interim Storage

Since the fall of 1977, EPS has been accepting hazardous wastes on a request basis. EPS has not advertised this service but will accept hazardous materials for interim storage at the request of other government departments or the general public.

At present, the interim storage facility is located in a large cement bunker. This facility does not meet the standards laid out in the "Code of Good Practice for Management of Hazardous and Toxic Wastes at Federal Establishments" but was the only one available. The building provides secure storage, i.e., a locked building inside a locked compound, and is reasonably dry with some ventilation. However, there is no heat, no light, no provision for segregated storage, i.e., separation of non-compatible materials and the storage area is not properly protected in the event of an explosion.

There is every indication that the annual volume of wastes that will be referred to this facility over the next few years will not decrease (see Table 5 for expected increase of hazardous wastes in the Yukon for a two-year period). To date, about four tonnes of waste has been accepted into this facility. A portion of this total has since been disposed of in a safe and environmentally acceptable manner.

Due to possible increases in waste generation, an upgrading of the facility as discussed under landfills and in Chapter VII is required.

TYPE 1 ACID SOLUTIONS

There were 32,342 litres of waste acid generated in Yukon during the inventory period, all of which would be physically available to a disposal facility if one were built. The economics of transporting small amounts to a central collection point in Yukon, however, would effectively eliminate the acid wastes generated in inventory regions 2 through 5 from such a scheme.

Acid solution disposal techniques identified during the survey are, for the most part, acceptable to regulatory agencies. Present methods of disposal include 22 litres which are discharged to land and 583 litres which are taken to landfill, pit or dump. These are the most environmentally unacceptable means of disposal as the potential for damage is high without prior treatment to inhibit the corrosive and ignitable properties of the solutions. The impact on the environment of wastes disposed of in the above manner is negligible.

Another form of waste acid disposal is on-site treatment. On-site treatment accounts for the disposal of 10,375 litres in the territory. Shortcomings of neutralization and/or dilution, which are two forms of on-site treatment, are that any deleterious substances such as heavy metals are not destroyed, merely dispersed. This is not a significant factor in Yukon due to small amounts of this type of waste. The third form of on-site treatment is incineration, which is very expensive and utilized only at establishments having an incinerator in place (medical facilities).

The remainder of the acid wastes generated, 21,360 litres, are discharged to sewer systems. This presents no environmental hazard as the disposed amounts are small when compared to dilution capabilities of receiving wastewaters.

TYPE 2 ALKALINE SOLUTIONS

The fate and availability of alkaline solutions are identical to acid solutions. The 13,686 litres of waste alkaline solutions generated would be physically available to a disposal facility, but economically restricted in regions 2 through 5.

Alkaline solutions were generated at the same establishments as acid solutions, according to the survey response. Only a small percentage of the total was highly corrosive or ignitable as most were utilized in a dilute form.

Methods of disposing alkaline wastes were identical to those for waste acid solutions.

TYPE 3 PESTICIDES

During the inventory period, 4,347 litres of waste pesticide were disposed of. Pesticides are only utilized to any degree by government departments, and whenever any requires disposal, the Environmental Protection Service is called upon to do it. Extreme caution is exercised by EPS during disposal to eliminate any possibility of environmental damage.

Availability for a disposal facility would vary from year to year depending on amounts left over after the application season. These amounts are usually insignificant.

TYPE 4 PAINT WASTE

All paint waste (3,666 litres) and paint-contaminated solid waste (1,535 kg) generated in Yukon is presently being disposed of into landfills, pits or dumps. This is the only method of disposal practised and is not environmentally damaging if the mix ratio of paint waste to non-hazardous waste is in favor of the latter.

All of this waste would be available for a disposal facility in physical terms, but the number of generators and the percentage of the total each generates would require full cooperation and a lot of money for a successful collection system.

Paint waste is unique among hazardous wastes generated in Yukon in that the generated amount recorded during the survey could conceivably be quite low because only commercial operations were canvassed. Private generation of this waste type could come close to, or even exceed, the commercial amounts generated because of the high percentage of people in Yukon building their own homes. The private sector would have to be included in any program dealing with paint wastes for this reason.

TYPE 5 SOLVENTS

During summer 1977 to summer 1978, 20,362 litres of solvents were generated in Yukon from a variety of sources. The many sectors that solvents are utilized in and the lack of large generators of waste solvent in any of them, would make the economical collection of these wastes for a disposal facility possible only if costs are equalized across western Canada. Yukon is unique in that for any of the 14 waste types, there are no large generators of waste, thereby making collection of a waste uneconomical unless an equalization approach is taken.

Disposal is accomplished in a variety of ways. Surface discharge to land (561 litres) and disposal into landfill, pit or dump (7,648 litres) are disposal methods with the greatest capability for causing environmental concern. Destruction by means of incineration, and dilution by wastewaters in sewage systems dispose of the 2,205 litres and 4,365 litres respectively, treated in these ways.

On-site treatment is responsible for 5,583 litres and is the method of disposal employed by larger industries, such as mining. Observation of the various on-site treatment techniques utilized verifies the acceptability of these methods for disposal.

TYPE 6 TETRAETHYL LEAD SLUDGE

All tetraethyl lead sludge generated in Yukon would be available for a central disposal facility. Sources of lead sludge are generally on accessible roads and highways. The amounts generated in a given year would vary with the number of petroleum tank flushings.

At present, petroleum establishments do not flush their tanks on a regular basis. In fact, service stations which change proprietorship frequently may have never been flushed.

Once flushed, the problem of sludge disposal is faced. Last year, 920 litres were incinerated, 3,082 litres were discharged to land, 5,520 litres were diluted with fuel and sold as automobile fuel, 5,520 litres were disposed out of territory and 24,141 litres were diluted with fuel and used as a fuel for heating or in aircraft disaster simulation exercises.

Incineration is an environmentally acceptable form of disposal and should be practised when available. Out of territory, disposal moves the waste out of the jurisdictional area; thus the method of disposal is unknown. Discharge to land is a completely unacceptable means of disposing of lead sludges. Disposal in this manner was practised at many locations and the environmental damage was quite noticeable. Large patches of vegetation were killed. Evidence of sludge entering water bodies was also present. Legislation should be enforced requiring the lead sludge to be transported to Whitehorse where it could be disposed of in an environmentally acceptable manner.

Dilution of tetraethyl lead sludges with large quantities of fuel with subsequent resale as heating fuel or automobile fuel was noted during the survey. This rids the generator of the disposal problem but the integrity of the practice must be questioned.

TYPE 7 CHEMICAL TOILET WASTE

Over a one-year period, 30,956 litres of chemical toilet waste required disposal. The main generators of this waste were government departments, who dispose the waste in a manner acceptable under legislation to landfills, pits or dumps.

All of this waste type would be available to a disposal facility.

TYPE 8 TANK BOTTOM SEDIMENT

In Yukon there are a small number of tanks in which sediment can collect. Only 3,636 kg were generated in a one-year period and all of it was neutralized with subsequent burial on-site. The waste is available for a disposal facility, but insufficient amounts make it uneconomical. The present disposal method is efficient and acceptable under the current waste legislation.

TYPE 9 WASTE OIL

The inventory of hazardous wastes in Yukon identified 67,947 litres of non-contaminated used oil, 353,625 litres of contaminated used oil and 94,136 kg of oil-contaminated solid waste. Two factors which have a bearing on the above figures are:
(1) interviews with service station owners indicated only 65 percent of the population utilized their facilities for oil changes--therefore the private sector must be taken into account in any plan proposed; and
(2) R. Phoenix (personal communication) has indicated that only 40 percent of waste oil is identified during a survey.

There are large amounts of waste oil generated in Yukon, most of which would be available to a disposal facility. Road oiling is being curtailed in Yukon by the territorial government and this means that over 100,000 litres would become available for disposal in such a facility.

There is a reuse program in place, with fuel for heat, preservation purposes, two-cycle engine oil and aircraft disaster simulation being the main uses. This oil would be unavailable to a disposal facility.

Waste oil sumps are found in some landfills around the territory and are adequately handling the amounts discarded in this way.

TYPE 10 DRILLING MUD

During the inventory, 64,860 litres and 109,090 kg of drilling mud were generated by mineral exploration and extractive industries. Characteristics generally exhibited by drilling mud wastes include:

(1) acute toxicity to fish;

(2) high immediate dissolved oxygen demand;

(3) high concentrations of organic carbon, total nitrogen, phosphorus, solids, chemical oxygen demand and chromium (Bryant et al., 1974).

Present legislation allows sumping with subsequent backfilling of the mud adjacent to the drilling site. This is acceptable if carried out conscientiously. What is required for drilling mud management is a list of acceptable additives a drilling company may use in its operations. EPS should make a list available to drillers.

The amount of drilling mud recorded would not be available to a disposal facility primarily because of location and nature of the terrain. These two factors would make collection and transportation next to impossible.

TYPE 11 CONTAMINATED SOIL AND SAND

Contaminated soil and sand is a waste, whose availability for a disposal facility cannot be quantified. These wastes are associated with drilling mud and with accidental discharges of a hazardous material. The amount of drilling mud depends on the mineral activity during a given year and accidental discharges are avoided at all costs by industry.

To manage this waste type effectively, two steps should be taken: (1) stricter enforcement by Indian and Northern Affairs of existing land use regulations, and (2) designation of a hazardous waste disposal site in the Whitehorse region. These measures would curtail abuses now occurring and also provide a destination for cleaned up accidental spill material.

TYPE 12 PATHOLOGICAL WASTES

Table 5 shows 16,952 kg of pathological wastes generated in Yukon Territory from summer 1977 to summer 1978. Most of the waste generated is in Region number 1 (Whitehorse Proper) because medical facilities and scientific laboratories are located there.

Problems associated with disposal of pathological wastes are unique. There is a high accident risk involved in disposal of needles, syringes, glass and surgical items, as well as personal and/or environmental contamination associated with handling and disposal of such wastes. The increasing part played by disposables in the biological research fields, for reasons of infection control and economy, has created problems disposing of the resultant large volume of wastes generated.

Most pathological waste is incinerated (72 percent), while the remainder is removed to landfills, pits or dumps. Incineration is the preferred method of disposing of pathological wastes and is used wherever possible in Yukon. Pretreatment for incineration may include compacting and in some instances, sterilization. It is readily apparent in Table 22 that areas outside Inventory Region 1 must depend to a greater degree, and in some instances exclusively, on burning their wastes in landfills. This method is inferior to incineration and should be minimized wherever possible.

Focusing on Whitehorse, the facilities are in place and the capacity for incinerating the generated amounts exists, but still some (18 percent) is being taken to the Whitehorse landfill site. Wastes that are presently being ultimately disposed in Whitehorse landfill could be more effectively treated if they were redirected to the Whitehorse Hospital incinerator.

TYPE 13 DRUG WASTE

During the inventory period, 419 kg of drug waste were identified requiring disposal. Of this total, 19 kg went to municipal sewer systems, 28 kg were incinerated, 355 kg were returned to supplier and 17 kg were taken to a landfill, pit or dump.

Some drugs (especially tetracyclene based) have the ability to become concentrated over time, making them poisonous if ingested. The disposal methods discharge to sewer, incineration and returning to a pharmaceutical supply house are all efficient methods of disposing drug waste as they remove the danger to human health and safety.

Disposal to a landfill, pit or dump does not destroy the hazard characteristic of the drug and the possibility of accidental ingestion by man and animal exists. Ideally, all drug waste should be dealt with by incineration, or returned.

A disposal facility or secure landfill could receive all the drug waste from the existing generators if one was built, but amounts are insufficient to warrant disposal procedures other than those presently practised.

TYPE 13 OBSOLETE EXPLOSIVES

There were 1,087 kg of obsolete explosives reported by survey respondents. All reported obsolete explosives were detonated with fresh material at either a construction site or a mine site. They are handled by experts, and are disposed of in an efficient and environmentally acceptable manner.

Although in physical terms these wastes would be available to a disposal facility, they would not be taken there due to the advantage of having them included in detonation procedures. Their presence means less fresh explosives required to achieve the same blast as only the amount necessary to act as a primer for the obsolete material would be needed.

Obsolete explosives cannot be counted on for a constant rate of generation. The amounts change from year to year, depending on construction, mineral exploration and mining activity.

TYPE 13 INK WASTE

Over the one-year period covered by this inventory, 267 litres of ink waste and 227 kg of ink-contaminated solid waste were disposed of in Yukon landfills. The amounts generated are insignificant and are easily handled by the landfill disposal method.

All ink wastes are generated in Whitehorse, thus making collection of them convenient for a disposal facility. Shortcomings include small amounts, and present disposal practices are inadequate.

TYPE 13 MINE TAILINGS

This is the largest waste type generated in Yukon. The 2,765,927 kg (dry weight) generated during 1977-1978 were treated on-site by neutralization, dilution, sedimentation and stabilization and collected into tailing piles or ponds.

The major shortcoming of the existing situation is the regular failure of containment structures. This should be minimized by requiring all mines operating in Yukon to have on staff an environmental specialist who would be responsible for disposal of wastes. Although one employee may be bestowed the title of environmental manager, usually they are concerned with other aspects of the mine and only devote minimum time to their environmental tasks. Under the present system, there is too much government required supervision regarding procedures; the industry should be self-regulating.

The amount of waste generated conceivably makes the transport of selected portions of the tailings economically feasible. The only question is that of safety. A better alternative at this point in time is to put pressure on industry to self-supervise regarding its on-site practices.

TYPE 13 CHEMICAL WASTE

There are hundreds of chemicals represented under this general heading. During the inventory period, 3,333 kg of solid chemicals, and

1,338 litres of liquid chemical waste required disposal. Chemical waste has the whole spectrum of hazard characteristics exhibited by its members and they are generated for the most part, in small amounts.

Insufficient quantities and incompatability of numerous waste types would make transport and disposal difficult. These are two problems which would have to be overcome if these wastes were to be made available to a disposal facility. Safe and environmentally acceptable disposal procedures are presently being practised in Yukon and, as yet, there is no reason for a change in strategy.

TYPE 13 MILL CONCENTRATE

The mill concentrate reported during the inventory is being stored at the EPS interim storage facility. There were insufficient quantities generated to warrant any form of disposal. A disposal facility, if accepting mill concentrates, would have to be prepared for fluctuations in amounts of available waste, because generation is dependent upon mineral output in a given year.

TYPE 13 ASBESTOS WASTE

Asbestos waste in Yukon will no longer be generated because of the closure of the Clinton Creek mine at the end of 1978.

TYPE 13 FLY ASH-ASH

Fly ash is scattered by forestry operations. In the year 1977-78, 727 kg were generated, of which an unknown percentage was disposed of on land and the rest discharged to the atmosphere. It is a low-level hazardous waste which, if regulated at the point of generation, would not pose a serious problem. Beehive burners should be inspected from time to time so as to insure efficient operation.

TYPE 14 CONTAMINATED FUEL

The amount of contaminated fuels generated in Yukon from summer 1977 to summer 1978 was 101,508 litres. This waste is constantly minimized by the petroleum industry because of the loss of income. Due to the minimization strategy, only small amounts of contaminated fuels would be available for a disposal facility. Present disposal practices--reuse and disposal outside of Yukon--are effective in eliminating any danger to human health, safety or the environment in the study area. Burning of fuels in landfills is the only questionable practice. If only the amount required to be used as a fire primer in landfills is disposed of in this manner, then the practice could continue with limited impact. The rest of these wastes could be diverted to the secure landfill proposed, to be dealt with by the regulatory agencies.

CHAPTER VII

HAZARDOUS WASTE MANAGEMENT IN YUKON: POLITICAL BACKGROUND AND POLICY ALTERNATIVES

Hazardous waste management refers to the complete interlinked system of storage, collection, transportation, treatment and disposal. The need for such a program in Yukon is imperative. Large scale hazardous waste generating development schemes are proposed for the territory and, if built and managed under the current policy, the potential for affecting the Yukon environment and the quality of life is enormous. Possible future development projects include the Alaska Highway Natural Gas Pipeline, Alaska Highway Oil Pipeline, an aluminum smelter and a lead-zinc smelter.

Any hazardous waste management program introduced in Yukon must consider various factors affecting development and implementation. The parties who have been, and would be, involved in developing a hazardous waste management program for Yukon include the federal government, the territorial government and private industry.

PRESENT ROLE OF THE FEDERAL GOVERNMENT

Until the years following World War II, government involvement in development of the north was minimal. In the post-war years, federal government interest in northern resource exploitation was spurred by a perceived need to establish a Canadian presence in the North (Gibson, 1978). This chapter in the history of Yukon began with the articulation of John Diefenbaker's "Northern Vision" and its emergence as actual policy in the late 1950's and early 1960's (Rees, 1978).

Government policy focus was clearly in harmony with interests of the private sector. In fact, government-industry relationship was openly referred to as a partnership. To fulfill the requirements of partnership, the federal government introduced incentives designed to stimulate resource exploitation activities, especially mining projects. These incentives included subsidies, tax exemptions, exploration assistance programs and infrastructure grants (Gibson, 1978).

As interest in the North increased and the partnership strengthened, the pace of development accelerated. Canadians had every reason to expect the situation to be administratively taken care of. An Advisory Committee on Northern Development (ACND) had been established in 1948, consisting of Deputy Ministers of all relevant departments, and had the full potential to serve an integrating function. Also, in 1953 the Department of Northern Affairs and Natural Resources was established to develop policy and ensure orderly development. In spite of these arrangements, however, administration of the North was characterized by chaos brought about by 60 federal departments and agencies operating alongside each other without central direction and often at cross-purposes (Dosman, in Rees, 1978).

As a result of concessions to industry and the governmental administrative chaos, ecological research was reduced to a trickle and virtually nothing was done to develop legislation to protect the environment. By 1969, it became evident that the federal government was completely unprepared to meet needs of environmental protection

(Pimlott, 1974). Threatened and actual damage to the sensitive Yukon environment was not only due to inadequate waste disposal but an overall lack of regulations, of which waste disposal is the last and frequently most obvious symptom. This was one of the major reasons for the pollution control legislation in the early 1970's.

In specific response to environmental problems, both the Northern Inland Waters Act and the Arctic Waters Pollution Prevention Act were enacted in 1970 (though not proclaimed until 1972). The Yukon Act and Territorial Lands Act were all amended in 1970 and proclaimed in 1971. Of particular interest were the long-awaited Territorial Land Use Regulations that came into effect in November 1971. These measures together were seen by the Department of Indian Affairs and Northern Development (DIAND) as a framework for providing the legislative and administrative tools for managing and controlling the resource industry in the North.

Other legislation introduced included the Canada Water Act and the Clean Air Act in 1969 and 1970 respectively. In 1972, the Fisheries Act was the main federal environmental protection statute, at least from an enforcement standpoint. Today, the Northern Inland Waters Act and the Territorial Lands Act with pursuant regulations specific to north of 60° may be considered the main pieces of enforcement legislation.

From 1972 to present, legislative developments relevant to environmental protection have been largely a process of refining and tailoring existing statutes and regulations. The most important examples are revisions to the Territorial Land Use Regulations in 1977, development of regulations under the Arctic Water Pollution

Prevention Act and amendments to the Fisheries Act. Appendix III summarizes and highlights the key sections of the environmental legislation related to hazardous wastes.

Federal government departments which administer environmental legislation or affect hazardous waste management in Yukon today include:

Department of Indian and Northern Affairs. The Department of Indian and Northern Affairs (DINA) administers all lands in the territory except those in block transfers given over to the territorial jurisdictions and the urban areas such as Whitehorse which have their own councils. The block transfers are buffers (approximately 100 miles wide) around major urban concentrations. DINA administers hazardous wastes with the aid of the following acts:

Territorial Lands Act; Northern Inland Waters Act.

Under the Territorial Lands Act, DINA has the power to locate landfills, pits or dumps and establish waste disposal procedures to be followed by extractive industries. Because DINA lacks the expertise to establish or enforce such procedures, EPS advises on particular activities such as the design of containment structures and the acceptability of proposed disposal techniques. The Territorial Lands Act is superceded by the Yukon Placer and Yukon Quartz Mining Act in certain instances. In these cases, only if water is involved is there any control.

Environmental Protection Service. The Environmental Protection Service (EPS), a division of Environment Canada, has the primary responsibility for hazardous wastes in the territory on a working level. The acts which EPS enforce include the Fisheries Act, the Ocean Dumping Control Act and the Environmental Contaminants Act.

The Environmental Protection Service coordinates contingency plans dealing with oil and hazardous chemical spills in the territory. They also accept and store hazardous wastes in an interim storage facility on a by-request basis. Wastes are then disposed of when amounts warrant it. However, EPS does not advertise the fact that it has an interim storage facility; thus its use is restricted.

The Environmental Protection Service is waiting for the results of the current study before it decides how it will dispose of the highly toxic material collected to date.

Other Federal Departments. Several other federal departments administer acts which impact to some extent the disposal of hazardous wastes. The Canadian Wildlife Service enforces the Migratory Birds Convention Act and the Department of Transport will administer the Transportation of Dangerous Goods Act currently under consideration in Parliament.

The Department of Health and Welfare runs the health facilities in the Territories and deals with pathological wastes, sewage treatment, air pollution and pesticides. Federal health legislation fails to deal directly with particular hazards such as hazardous consumer products. However, public health legislation which is similar to provincial health legislation is included in the Public Health Ordinances of the Yukon Territory.

Quasi-judicial Bodies

The Yukon Territory Water Board is autonomous from DINA, but utilizes DINA's water rights people as staff to carry out inspections.

The Boards are responsible for granting water licenses--for example, licenses to mine operations regarding disposal of wastes to water bodies.

The Yukon Territory Water Board consists of nine members. Six of these members are appointed on recommendation of the Commissioner in Council of the Yukon Government.

The Arctic Waters Advisory Committee administers the Arctic Waters Pollution Prevention Act.

PRESENT ROLE OF YUKON TERRITORIAL GOVERNMENT

The Yukon territorial government derives all of its power by delegation from the federal government under the Yukon Act. This act precisely delineates the powers of the territorial government. This differs from the 10 provinces in Canada, which derive their powers from the British North America Act and are thus independent within their spheres of power.

If a power is not provided for under the Yukon Act, then it is outside the jurisdiction of the territorial government, and the only way to obtain such power would be to persuade the federal government to amend the Act. Moreover, the federal government has the power to rescind the Yukon Act and thus abolish the territorial government.

Section 16 of the Yukon Act reveals that the wholly elected territorial council has nearly all the legislative authority of a provincial assembly. The only exception is that, unlike a provincial assembly, the commissioner in council has no authority over mineral rights and only limited authority over certain restricted areas of land (called commissioner's lands). Authority in these areas is reserved to the federal government, while elsewhere in Canada it is the exclusive domain of the provinces.

The effect of this restriction on the powers of the territorial council is very significant. The territorial council is denied control over development of resources and the use of land, and thus their input into the making of land and resource decisions is severely reduced.

Clearly the impetus for all resource development decisions rests with the federal government at this time. However, there is action for a transfer of these powers to the territorial government; powers not provided under the Yukon Act may be assumed by the Yukon Territorial Government as the federal government has shown a great deal of latitude in their approach to the territorial government. What the territorial government should focus on is the management of the wastes generated by establishments directly concerned with resource development and their associated service industries.

Presently, territorial involvement in hazardous waste management is limited to the passing of public health ordinances and gas handling ordinances and regulations and responsibilities thereunder. The Yukon territorial government has been content to leave all other hazardous waste responsibility to the federal departments which have traditionally administered them.

Civic jurisdiction over hazardous wastes is limited to supervision of landfills, pits or dumps, which are often provided by the territorial government. The City of Whitehorse does have its own collection and transportation system for refuse which may contain hazardous materials. Most other local governments do not have as elaborate a system.

PRESENT ROLE OF PRIVATE ENTERPRISE

Private enterprise is involved with hazardous wastes in four ways: as generators, collectors, transporters and disposers. As generators, private operations discharge more hazardous waste than do government institutions. Collection and transportation of waste is a viable private industry based in Whitehorse, serving all sectors of society. Privately owned disposal sites are located throughout the territory, primarily at mine sites.

MANAGEMENT RESPONSIBILITY

Responsibility for hazardous waste management in Yukon has traditionally been with various federal government departments. It was a responsibility assumed as a result of the historical development of Yukon. To this point in time, development projects undertaken, amounts of waste generated and disposal practices utilized have been regulated by the federal departments. Any of the four major development projects (Alaska Highway Natural Gas Pipeline and/or Oil Pipeline, aluminum smelter and lead-zinc smelter) proposed for Yukon has the potential to significantly increase the amount of hazardous wastes to be generated in the future. This increase, coupled with Yukon's desire to become a province with the associated powers, suggests that the territorial government should assume responsibility for hazardous waste management.

The Government of the Northwest Territories, with a similar political framework to Yukon, has taken a first step towards waste control and environmental management by passing an Environmental Protection Ordinance. Although one ordinance does not constitute a waste management program, it does indicate that the Northwest Territorial Government is willing to take steps to protect the environment.

A system similar to that found in southern Canada would be appropriate for Yukon. Under this system, the federal government departments set national guidelines and act in an advisory capacity to provincial representatives. This should be the extent of federal involvement in Yukon.

Under the plan, the territorial government would be the central agency, by whom all information regarding hazardous wastes would be collected. The information would be analyzed and new regulations or directives regarding hazardous waste management specific to Yukon would be formulated.

Private enterprise should, wherever possible, be included in the operation of any program. Private entrepreneurs could handle collection, transportation and disposal under legislative regulations set by territorial council.

HAZARDOUS WASTE MANAGEMENT OPTIONS IN YUKON

In developing a hazardous waste management program for Yukon, one must keep in mind certain factors such as:

(1) remoteness

(2) climate

(3) settlement patterns

(4) low waste generation rates

(5) manpower restrictions

(6) high costs.

Acknowledging the uniqueness of the area and the fact that the territorial government should assume responsibility for a management program, the following options are open:

(1) maintain the status quo;

(2) dispose of hazardous wastes outside of territorial boundaries;

(3) dispose of hazardous wastes in Yukon;

(4) combination of the above.

Status Quo

Maintaining the status quo would mean that the federal government would retain all hazardous waste management responsibility in Yukon. This situation does not mean that mismanagement would occur, only that local and regional objectives may be ignored by the general federal legislation in place.

If this option is selected, the following amendments to federal legislation would be required so as to ensure effective waste management:

(1) Territorial Land Use Regulations--The regulations presently contain no provisions for dealing with direct impacts on wildlife. To some extent, this may be achieved through requirements and permit conditions that protect wildlife habitat. Regulation of activities that may interfere with wildlife reproduction or migration does not appear to be contemplated by the regulations. Hazardous wastes have the capability to inhibit reproduction and migration.

Similarly, regulations do not contemplate regulation to alleviate social concerns caused by proposed land use activities. This factor would become particularly important during siting of hazardous waste disposal areas.

A clause should be included in the land use regulations which would prohibit discharge of contaminants into the natural environment that adversely affect the health, safety or comfort of persons. At present, this is totally ignored by the legislation.

(2) Arctic Waters Pollution Prevention Act--The regulations under this Act authorize deposition of domestic waste under conditions sanctioned by the relevant public health ordinance. Also the deposition of industrial waste of a type and in a quantity as authorized under the Oil and Gas Production and Conservation Act, the Territorial Lands Act and the Public Lands Grants Act is allowed. Where there are many acts of similar legislation, confusion over priority often arises. Some steps should be taken to eliminate confusion and allow recognition of the various pieces of pertinent waste legislation.

Disposal of Hazardous Wastes Outside of Territory

Presently there are studies being carried out to determine a site for a centrally located hazardous waste disposal facility in western Canada (Reid Crowther, 1980, Kinetic Contaminants, 1979). Once built, Yukon will have an opportunity to use the facility for disposal of its wastes. Conceivably, a territorial policy could be adopted to transport as much waste as is politically and economically feasible to the disposal facility.

Before such a policy can be adopted,however, three problem areas need to be addressed. Firstly, the transportation network is inadequate. Unlike paved highways of the south, Yukon roads are generally gravel and extremely treacherous to drive. As waste-carrying traffic increases, these characteristics would serve to increase the probability of accidental discharges.

Secondly, at present there is no transport fleet available which is capable of transporting the wastes to the disposal facility. Possibly the disposal facility operators will have their own fleet of transport vehicles, or Yukon haulers may be coerced into upgrading their present vehicles through legislation.

Thirdly, there are insufficient volumes of hazardous waste generated to warrant full-scale transportation. Point source release of hazardous waste is the major problem at the present time. If proposed development projects proceed, then possibly the waste volume may approach transportable amounts.

Presently, the only waste of significant quantity available to the disposal facility would be waste oils. However, available amounts are reduced significantly by reuse of the oil by different interests. All other wastes would have to be stored until the amounts collected would warrant economic disposal. This storage requirement would mean an upgrading of the old storage facility in Whitehorse or construction of a new one.

Disposal of Hazardous Wastes in the Territory

Disposing of the small amounts of hazardous wastes generated in Yukon at various sites around the territory is another disposal option. To occur in an environmentally acceptable manner, while at the same time meeting local and regional objectives, a strong management plan must be developed.

Focusing on the individual components of an overall program--collection and transportation, storage and disposal, the following should be introduced:

(1) Collection and Transportation

(i) Reduction of unacceptable collection (accumulation) practices by introducing an educational program on how to handle and dispose of major hazardous waste types in Yukon.

(ii) Disposal of contaminated collection containers, such as the popular 45-gallon drum, should only be allowed in designated sites.

(2) Transportation

(i) Hazardous material-transporting vehicles should be inspected four times per year by the territorial government department of highways to insure they are roadworthy.

(ii) Labels should be placed on all transporting trucks and containers indicating the waste and its hazard characteristics.

(iii) Introduction of a new class of drivers' license by the Yukon Government to drivers who would be involved with transporting hazardous wastes. Every year the driver must pass a medical examination and attend a course on what to do in case of accidental discharge.

(iv) Cost equalization over differing transportation distances.

(3) Storage

(i) A new storage facility should be built and a public notice advertising the service started.

(4) Disposal

(i) Subsidies should be given to those who dispose of wastes in an environmentally acceptable manner.

(ii) Required registration of waste if it is sold to a third party by a transporter so that the acceptability of the proposed waste use can be determined.

Combination of the Above

An integration of the above three points to form a distinct policy is the best option of all the ones available.

Maintaining the status quo would, under this system, have the federal government close the loopholes in its legislation and act in an advisory capacity.

Disposing of wastes out of territory would be reserved for those that are extremely toxic and are able to be transported economically. All other wastes would be disposed inside the territory.

Disposal of wastes inside the territory would require that territorial legislative regulations be introduced and a leadership role shown by the territorial government. At the core of the whole plan would be an educational program for generators, transporters, disposers and the general public on how to dispose and handle the major types of hazardous wastes in Yukon.

CHAPTER VIII

CONCLUSIONS AND RECOMMENDATIONS

To improve hazardous waste management in Yukon, action is required at the federal and territorial government levels. This chapter capsulizes the existing situation, makes recommendations for improvements, and assigns government responsibility.

FEDERAL GOVERNMENT RESPONSIBILITY

Public Relations and Educational Programs

Conclusion. The survey of the waste management system in Yukon presents a picture of ill-informed plant managers, plant engineers, transporters, disposers, and the general public. Regulations are not known and improper handling procedures routinely practised. The list of environmentally risky practices includes: mixing of waste types in transport containers, disposal in unsuitable areas, poor equipment maintenance, and lack of training and safety programs.

Recommendation. That a compaign be embarked upon to publicize regulations, define hazardous wastes and illustrate proper handling/treatment and disposal methods. This could be accomplished through newspaper articles and industrial and public seminars.

Justification. Costs of such a program can be considered low if taken over the long term. If environmental incidents such as Love Canal may be avoided through proper education of those in the waste management system, then it would be money well spent.

Responsibility. Since the educational program should be started immediately, the federal government should assume responsibility for administration and content. It is the opinion of the author that the federal government should retain responsibility for educational programs even if the territorial government should take over responsibility for waste management. This would ensure a certain level of understanding of the hazardous waste situation nationally.

Drilling Mud Chemical Additive Approval List

Conclusion. Presently it is thought by many drillers that an approval list for chemical additives to drilling mud exists. This is not the case. As a result, some chemical additives are being utilized when they should not be or others preferred in their use.

Recommendation. To eliminate the use of less desirable additives, a list of acceptable chemicals should be established by the federal authorities (EPS) and circulated to relevant industries.

Justification. The exclusion of certain chemicals as drilling mud additives would prevent them from entering sumps next to the drill site and causing potential environmental damage.

Responsibility. Drilling activity in Yukon is administered solely by federal departments. The Department of Indian and Northern Affairs in consultation with EPS should develop this list.

INITIAL FEDERAL GOVERNMENT RESPONSIBILITY WITH SUBSEQUENT TRANSFER TO THE TERRITORIAL GOVERNMENT

Waste Oil Disposal

Conclusion. Oils are being used as a heating fuel and as a dust suppressant on roads. This results in emissions of lead and other heavy metals when burnt, and environmental contamination with applied to road surfaces.

Recommendation. It is recognized that each of these practices may be acceptable in certain limited locations, but in general, they should be phased out. Only uncontaminated oils should be allowed for burning purposes, and calcium chloride used as a dust suppressant.

Justification. Surface and groundwater pollution due to possible runoff and migration of oil particles will be avoided. Heavy metals will not be released into the environment through burning.

Responsibility. The federal government should assume immediate responsibility for overseeing such a program. The territorial government should continue to use calcium chloride on territorial roads and make available the calcium chloride to towns and private interests. Eventually the territorial government should assume responsibility and costs for such a program. Some costs may be recovered through the sale of calcium chloride.

Tetraethyl Lead Sludge Disposal

Conclusion. Presently tetraethyl lead sludge is being disposed of by (1) dilution and subsequent incorporation into automobile fuels and (2) discharge to land with no prior pretreatment. The first practice may have a long-term impact on the life of cars and the environment in Yukon, while the second is visibly environmentally damaging.

Recommendation. Tetraethyl lead sludge from petroleum bulk plants be stored for future removal to a southern disposal site; lead sludge from service stations be collected and stored with the bulk plant waste.

Justification. Unsightly scars on the environment from the indiscriminate dumping of lead sludge waste would be avoided. Car life and air quality (especially in winter inversions) would possibly be improved through elimination of lead concentrations.

Responsibility. Initial responsibility lies with the federal government, as immediate action should be taken to curtail discharge directly into the environment. A transfer of powers at a future date to the territorial government should be planned for.

Pathological Waste Disposal

Conclusion. A large amount of pathological wastes within Whitehorse, Faro and other communities are being disposed of in landfills. Chances of disease transmission are high under this method of disposal.

Recommendation. That pathological wastes generated in Whitehorse and Faro presently not directed to hospital incinerators be directed there for disposal. Possibility of transporting wastes from smaller communities to the larger ones for disposal should also be looked at.

Justification. Environmental health and safety is preserved in Yukon.

Responsibility. This program should be started immediately. Thus responsibility falls to the federal government. Territorial input should be solicited and a change in administrative responsibility planned for. Time frame for a changeover of responsibility should be agreed upon between the two governments.

Interim Storage Facility Upgrading

Conclusion. Presently the interim storage facility does not meet standards laid out in the "Code of Good Practice" for Management of Toxic Wastes at Federal Facilities. Adequate lighting, waste separation facilities and environmental safeguard systems are absent.

Recommendation. The facility for interim storage of hazardous wastes be upgraded.

Justification. As industrial development of Yukon continues, the amount and diversity of toxic material requiring storage will increase. Also, there is a possibility of this facility becoming a transfer station in a western Canada management system.

Responsibility. Should rest with the federal government initially, then be transferred to the territorial government. A form of cooperation between the two governments could possibly be the best solution.

Registration of Hazardous Waste

Conclusion. Wastes are being utilized by a third party in Yukon for purposes unacceptable for that particular waste type. An example of this is oil from the airport in Whitehorse being used as a dust suppressant on roads in and around the city. The impurities in this oil range from heavy metals to de-icing fluids. The oils are being applied to areas with high risk environmental impact.

Recommendation. To attempt to control third party sales, a central registry of the waste types should be established in an appropriate government office. This would allow an assessment of the proposed use of that particular waste.

Justification. This system of registering wastes would allow authorities to monitor whether or not waste materials passed on to a third party may be utilized in the intended manner. Impacts of waste type unsuitable for certain purposes would be halted.

Responsibility. The Environmental Protection Service should set up the system with its present powers. The territorial government should have input into the set-up of the program, so that later this administrative responsibility may be transferred.

Expansion of Existing Hazardous Waste Retrieval Program

Conclusion. Currently some hazardous wastes are accepted by EPS on a by-request basis. This is not a well publicized program and many wastes which should be directed to EPS are presently being sent to an inadequate disposal site.

Recommendation. Extensions of the present service should be made through advertisement, especially to educational institutions at the academic year end. This could be accomplished through a "waste drive" two to four times a year.

Justification. This retrieval system would insure proper disposal of substantial amounts of waste chemicals utilized in laboratories, shops, health and educational facilities.

Responsibility. The Environmental Protection Service should organize and run the system for the first few years. The territorial government should then become involved and provide the manpower for pick-up and disposal. Some costs may be recovered through a fee schedule depending on the amounts and types of waste requiring disposal.

Transfer of Authority for Hazardous Waste Management to the Territorial Government

Conclusion. The Environmental Protection Service is currently handling hazardous waste management in Yukon. In fact EPS represents the territorial government in a study presently ongoing which is endeavouring to locate a disposal facility in western Canada. Although the territorial government has shown some interest in waste management, they have not become involved to the extent of attempting to run their own program.

Recommendation. A single territorial government waste management section established to centralize hazardous waste management planning and enforcement. Local and regional management objectives may be easily attained through territorial control.

Justification. Waste management in the North in the past has failed because of government departments not being willing to take responsibility, (Associated Engineering, 1973). The establishment of a waste management authority would delegate responsibility and provide a central point through which all waste decisions for the territory would be made.

Responsibility. At present, the responsibility lies with EPS. Over a number of years, power could be transferred to the territorial government. The previous recommendations made should be included in any transfer of authority.

TERRITORIAL GOVERNMENT RESPONSIBILITY

Introduction of Transportation System Regulations

Conclusion. Wastes are currently being mixed and disposed of in unsuitable areas, transportation equipment is poorly maintained, and there is a lack of training and safety programs. It is only a matter of time before one of these shortcomings causes an environmental emergency.

Recommendation. Waste mixing should be discouraged through education,and poor disposal practices should be curtailed through education and legislation. Transportation equipment should be checked two to four times per year to ensure roadworthiness if that vehicle is to carry hazardous wastes. Training and safety programs should be made mandatory, possibly through driver license testing.

Justification. To prevent possible accidents resulting in environmental emergencies, preventative measures such as those listed above should be employed.

Responsibility. This is the responsibility of the territorial government highways and vehicle licensing departments. Costs for such a program could be recovered in part through a fee for a mandatory safety program.

Landfill Modification

Conclusion. Hazardous wastes are currently being deposited in landfills, pits and dumps around the territory. There is inadequate monitoring and the fate of these wastes is unknown. At some future date, waste previously deposited could possibly cause severe environmental damage.

Recommendation. Landfills around the territoty should be investigated as to their potential in becoming a secure landfill site for hazardous wastes. The City of Whitehorse landfill site should be given special consideration as the most wastes are disposed here.

Justification. This strategy would provide at least one site where low level contaminated material would be accepted for disposal in Yukon. This would eliminate confusion as to where a waste should be taken by a hauler as a definite destination is established. Coupled with the interim storage facility for hazardous wastes, a complete management program may be introduced.

Responsibility. The responsibility for landfill, dump or pit modification would be with the territorial government. A disposal fee could be charged to recover the costs of site selection and modification.

BIBLIOGRAPHY

Associated Engineering Services Ltd., 1973. Solid Waste Management in the Canadian North. Environmental Protection Service. Edmonton, Alberta.

Battelle Memorial Institute, Pacific Northwest Laboratories , 1973. "Program for the Management of Hazardous Wastes." Environmental Protection Agency Contract No. 68-01-0762. Richland, Washington.

Booz-Allen Applied Research, Inc., 1973. A Study of Hazardous Waste Materials, Hazardous Effects and Disposal Methods", Environmental Protection Agency, 3 Volumes, NTIS: PB-22-464.

Bryant, W., 1974. Survey of Drilling Operations in the Northwest Territories. Environmental Protection Service, internal report, Environmental Protection Service. Yellowknife, Northwest Territories.

Canada Yearbook, 1977. Supply and Services Canada. Queen's Printer, Ottawa, Ontario.

Dosman, E.J., 1975. The National Interest: The Politics of Northern Development 1968-75. McClelland Stewart. Toronto, Ontario.

Environmental Protection Service, 1977. Terms of Reference for Phase I Waste Management Planning in Northern and Western Canada. Environmental Protection Service. Winnipeg, Manitoba.

Fennelly, P.F., Chillingworth, M.A., Spawn, P.D. and Mark, I., 1976. The Generation and Disposal of Hazardous Wastes in Massachusetts. Prepared for Commonwealth of Massachusetts. Division of Water Pollution Control. Boston, Massachusetts.

Kinetic Contaminants Canada Limited, 1979. Responsible Management of Hazardous Industrial Wastes. Public information document presented to the citizens of Fort Saskatchewan in August, 1979.

Moell, C.E., 1977. Leachate and Gas Migration from the Clover Bar Sanitary Landfill Site - Edmonton. Report Number 1184, Alberta Environment. Edmonton, Alberta.

Moell, C.E., 1978. Leachate and Gas Production in Municipal Solid Waste Test Cells - Edmonton Area. Report Number 1305, Alberta Environment. Edmonton, Alberta.

Phoenix, R., Waste Management Officer. Ontario Department of the Environment. Personal Communication.

Pimlott, D.H., 1974. Delta Gas: Time and Environmental Considerations of Gas from the MacKenzie Delta: Now or Later? Canadian Arctic Resources Committee. Ottawa, Ontario.

Rees, W.E., 1978. Development and Planning North of 60°: Past and Future. Paper presented at Canadian Arctic Resources Committee Conference. Edmonton, Alberta. February 1978.

Reid, Crowther & Partners Limited, 1980. Hazardous Waste Management Feasibility Study in Northern and Western Canada. Environmental Protection Service. Edmonton, Alberta.

APPENDIX I

SYSTEM USED TO IDENTIFY AND CLASSIFY HAZARDOUS WASTE

IDENTIFICATION AND CLASSIFICATION OF HAZARDOUS WASTE

(Environment Canada, 1977)

INTRODUCTION

The Hazardous Materials Management Division of Environment Canada has developed a hazardous wastes identification and classification system. The system is an adaptation of systems outlined in the National Fire Prevention Association (NFPA) guide to hazardous materials and as developed by Battelle Pacific Northwest Laboratories.

DEFINITION OF A HAZARDOUS WASTE

A hazardous waste is any refuse or discarded material or combination of refuse or discarded materials which cannot be safely and adequately handled by existing waste management facilities because they pose a substantial, present or potential hazard to human health or other living organisms or the physical environment because of their chemical, biological or physical properties.

Hazardous wastes can be characterized into four categories:

1. Ignitability
2. Corrosiveness
3. Reactivity
4. Toxicity

Criteria for characterization follow:

<u>Hazardous Waste Characteristics</u>:

1. <u>Ignitable Waste</u>. A waste is an ignitable waste if a representative sample of that waste:

   (a) in a liquid state has a flash point less than 60°C (140°F) or, under conditions incident to the management of the waste, is liable to cause fires through friction, absorption of moisture, spontaneous chemical changes, or retained heat from manufacturing or processing, or when ignited burns so vigorously and persistently as to create a hazard during its management.

   (b) is a compressed flammable gas, or

   (c) is an oxidizer.

2. Corrosive Waste. A waste is a corrosive waste if a representative sample of the waste:

   (a) is aqueous and has a pH less than or equal to 3 and greater than or equal to 12, or

   (b) has a corrosion rate greater than .250 inch/year on steel at a test temperature of 130°F.

3. Reactive Waste. A waste is reactive if it:

   (a) is normally unstable and readily undergoes violent chemical change but does not detonate, reacts violently with water, forms potentially explosive mixtures with water or generates toxic fumes when mixed with H_2O or is a cyanide or sulfide bearing waste which might generate toxic fumes under mildly acidic or basic conditions;

   (b) is capable of detonation or explosive reaction but requires a strong initiating source,or which must be heated under confinement before initiation can take place, or which reacts explosively with H_2O;

   (c) is readily capable of detonation or of explosive decomposition or reaction at normal temperatures;

   (d) is a forbidden explosive.

All such wastes include pyrophoric substances, explosives, auto-polymerizable material and oxidizing agents.

4. Toxic Waste. A waste is a toxic waste if it may release to the environment toxicants in sufficient concentration to pose a potential human health or environmental hazard. Toxicity can manifest itself in many forms. Some of these are:

   (a) genetic activity which encompasses oncogenic, mutagenic and terratogenic activity;

   (b) potential for bioaccumulation in tissue; and

   (c) acute and chronic toxicity to humans, animals and plants.

WASTE TYPES AND COMPONENTS

Following is a check list to assist in determining hazardous waste streams and the hazardous components of these streams. The examples cited are not meant to be all-inclusive but rather to assist in determining the waste type.

WASTE TYPES

Type 1. ACID SOLUTION

Spent etching solution
Spent acid plating solution
Picking liquor
Acid sludge
Battery acid
Acidic chemical cleaners
Electrolyte
Spent acid
Sulfonation tar
Copper bathing solvent

Type 2. ALKALINE SOLUTION

Alkaline caustic
Alkaline chemical cleaner
Alkaline battery fluid
Acetylene sludge
Oakite
Wyandotte cleaner
Caustic wastewater
Lime and water
Lime and wastewater
Lime soda water
Spent caustic
Spent cyanide plating solution

Type 3. PESTICIDES

Unwanted or waste pesticides
Pesticides containing wastes from pesticides production or formulation
Unrinsed pesticides containers
Wash water from the cleaning of pesticides containers or application equipment

Type 4. PAINT SLUDGE

Paint slops
Pigment sludges from paint production
Paint waste from paint produced and application

Type 5. SOLVENT

Cleaning solvents
Data processing fluid
Attrix solvent
Paint remover or stripper
Dry cleaning wastes and other spent cleaning fluids

Type 6. TETRAETHYL LEAD SLUDGE

Wastes from tetraethyl lead production
Sediments containing tetraethyl and other organic lead

Type 7. CHEMICAL TOILET WASTES

Type 8. TANK BOTTOM SEDIMENT

Type 9. OIL

Floc
Oil sludge
Refinery waste
Crude petroleum
Bleacher house waste oil

Type 10. DRILLING MUD

Type 11. CONTAMINATED SOIL AND SAND

Sand and oil
Spent blasting sand
Lagoon residue mixed with soil
Contaminated soil or sand from spills

Type 12. PATHOLOGICAL WASTES

Animal carcasses
Anatomical wastes
Syringes
Gauze
Wads
Laboratory wastes

Type 13. MISCELLANEOUS WASTES

This category may include hazardous or non-hazardous wastes not adequately described by any of the above types or which may require further clarification. Such categories might be described by one of the following generic categories:

Bag house waste
Chemical fertilizer
Grease
Tile glaze waste
Sewage sludge
Septic tank waste
Spent catalyst
Incinerator ash
Mine tailings
Wax and water
Peroxide
Asbestos waste
Magnesium waste
Distillation residue
Lagoon residue
Beryllium waste
Obsolete explosives
Ink waste
Cyanide waste
Epoxy waste
Phenolic water
Wash water
Unwashed pesticide containers
Laboratory chemical wastes
Drug waste
Resin
Rocket propellent

Type 14. CONTAMINATED FUEL

EXAMPLES of specific hazardous chemicals or minerals that may be present in the various waste types are indicated below.

WASTE COMPONENTS

Type 1. ACID SOLUTION

(a) acids: sulfuric, chromic, hydrochloric (muriatic), hydrofluoric, hydrobromic, nitric, phosphoric, fluoboric, acetic, formic, fluorosulfonic, hexafluorophosphoric, hydrofluorosilic, fuming sulfuric (oleum), perchloric, sulfurous, acrylic, fluoroacetic, chlorosulfuric.

(b) metals: iron, chromium, tin, lead, mercury, nickel, copper, beryllium, cadmium, zinc, aluminum, arsenic, barium, cobalt, titanium, vanadium, boron, selenium, antimony, silver, manganese.

(c) organics: (see Solvent, Type 5).

(d) inorganics: persulfate, ammonia, hydrogen sulfide.

Type 2. ALKALINE SOLUTION

(a) alkalis: sodium hydroxide (lye, caustic soda), potassium hydroxide (caustic potash), carbonate, amines, lime ammonia.

(b) organics: phenol, naphthol, organic acid salts (e.g., formate, acetate, oxalate, citrate, picrate, acrylate, fluoroacetate) (also see Solvent, Type 5).

(c) inorganics: cyanide, sulfide, fluoride, nitrate, chlorate, bromate, perchlorate, mercaptans, ferrocyanide, ferricyanide.

Type 3. PESTICIDES

(a) organophosphates: demeton (Systox), disulfoton (Di-syston), mevinphos (Phosdrin), parathion, phorate (Phimet, shradan (OMPA), tetraethylpyrosphosphate (Tepp), thionazin (Zinophos), bidrin, DDVP (Dichlorvos), ethion (Nialate), dioxathoin (Delnov), carbophenothion (Trithion), EPN, methyl-parathion, phosphanidon, (Dimecron).

(b) chlorinated hydrocarbons: aldrin, dieldrin, endrin, BHC, chlordan, endosulfan (Thiodan), heptachlor, lindane, toxaphene, chlorobenzilate, DDT, DDD (TDE), methoxychlor, mirex.

(c) carbamates: zectran, carbaryl (Sevin)

(d) miscellaneous: fluroacetate (compound 1080), Temik, pentachlorophenol, sodium arsenite, lead arsenate, calcium cyanide smda (Vapam), rotenone, 2,4-D, 2,4,5-T.

(e) solvents: (see Solvents, Type 5).

Type 4. PAINT SLUDGE

(a) solvents: (see Solvents, Type 5)

(b) pigment metals: titanium, zinc, chromium, molybdenum, iron, cadmium, barium.

(c) other toxic ingredients: cyanide, mercury, organotin compounds, phenols, selenium.

Type 5. SOLVENT

(a) <u>hydrocarbons</u>: aliphatic, aromatic, kerosene, gasoline.

(b) <u>oxygenated</u>: aldehydes, ketones, esters, alcohols, ethers, glycols, glycol ether-esters.

(c) <u>other</u>: chlorinated and fluorinated products, terpenes.

(d) <u>miscellaneous organics</u>: amines, acids, mercaptans, methyl, sulfate, nitrocresols, nitrophenols, phenols, tetranitromethane, chloropicrin, etc.

Type 6. TETRAETHYL LEAD SLUDGE

tetraethyl lead and other organic lead, lead oxide.

Type 7. CHEMICAL TOILET WASTE

caustic soda, cresylic acid, hypochlorite, formaldehyde, zinc.

Type 8. TANK BOTTOM SEDIMENT

any toxic, flammable, or corrosive materials in the sediment.

Type 9. OIL

any toxic, flammable, or corrosive constituents in the oil.

Type 10. DRILLING MUD

(a) <u>acids</u>: (see Acid Solution, Type 1)

(b) <u>alkalis</u>: (see Alkaline Solution, Type 2)

(c) <u>metals</u>: barium, chromium.

Type 12. PATHOLOGICAL WASTES

Type 14. CONTAMINATED FUEL.

APPENDIX II

HAZARDOUS WASTE SURVEY COVER LETTERS AND QUESTIONNAIRE

Fisheries and Environment Canada
Environmental Protection

Pêches et Environnement Canada
Protection de l'Environnement

Room 225
Federal Building
Whitehorse, Yukon

Your file Votre référence

Our file Notre référence
4400.9-2/1

To Whom It May Concern:

RE: INVENTORY OF HAZARDOUS MATERIALS

The Environmental Protection Service (EPS), a Federal Government agency, is undertaking a study entitled "An Inventory of Hazardous Materials in Yukon." Based on the information collected in the above study, it is anticipated that a practical and environmentally acceptable means of handling and disposal would be developed for Yukon.

The objectives of the study are twofold:

1. To provide an inventory of hazardous materials currently being used or produced in the Yukon Territory, and also to obtain where possible, an indication of future trends in waste production. In conjunction with this part of the study, an inventory of commercial petroleum storage methods and volumes will be undertaken.

2. To document existing methods and facilities that transport, collect, store or dispose the hazardous materials referred to above.

To carry out the inventory phase of the program, EPS has engaged Mr. Witold Siemieniuk, a Masters student at the University of Manitoba.

Since the amounts and types of wastes is important rather than who in particular is generating them, information about individual company operations will not be provided to the Environmental Protection Service. No one but Mr. Siemieniuk will have access to the respective questionnaire responses.

Your cooperation would be very much appreciated as it is vital to ensure the success of the study.

Yours truly,

Colin E. Wykes
Director
EPS Yukon Branch

UM

THE UNIVERSITY OF MANITOBA

ATURAL RESOURCE INSTITUTE

WINNIPEG, MANITOBA R3T 2N2

Dear Sir/Madam:

RE: INVENTORY OF HAZARDOUS MATERIALS

PLEASE RESPOND BY JUNE 30, 1978

I have been commissioned by the Environmental Protection Service to survey establishments in the Yukon Territory in order to determine the volume of hazardous materials currently being utilized and disposed of. This information will be used to develop a strategy concerning the long term management of hazardous materials. To this end, I request that you fill out and return the enclosed questionnaire.

Your establishment has been identified as one of approximately 200 firms, which may use or produce materials which are or will be classified as "hazardous" by Federal Regulatory agencies. A hazardous waste is defined as any unwanted material which cannot be disposed of by routine waste management techniques, because it poses a substantial present or potential hazard to human health or to the environment. Please see attached questionnaire for examples of hazardous materials.

The thrust of the study is to provide a practical and environmentally acceptable means of handling and disposing of wastes which are beyond the capability of conventional waste management facilities.

The information collected in this inventory will be held in strictest confidence with no release of data on individual company operations. In accordance with this principle of confidentiality, questionnaire data will only be identified by coded number. No one but myself will have access to the master list which identifies the individual establishments associated with each number. It will not be released to anyone, including the Environmental Protection Service, during or subsequent to the study. Specific establishments will never be named in reporting information provided in the questionnaire.

....2

I am aware that some recipients of this letter may have provided similar information for previous surveys. The broad scope of this study makes some duplications unavoidable and I apologize for any inconvenience to you. It is of course, essential that the information received during the present inventory be accurate and as current as possible if later decisions are to be rational.

If you have any questions regarding the inventory in general or the enclosed questionnaire please feel free to contact me at:

Mr. Witold Siemieniuk
P.O. Box 4857
Whitehorse, Yukon
Y1A 2B5

or phone 667-6487. Two copies of the waste data sheet are enclosed and additional copies will be supplied upon request. Please do not destroy the questionnaire if your establishment does not generate or handle hazardous materials. Simply return it in the enclosed stamped, self-addressed envelope as a nil reply is just as valuable.

Your cooperation and assistance in this project will be appreciated. I hope to hear from you soon.

Yours truly,

Witold Siemieniuk

Witold Siemieniuk

Encl:2

INVENTORY OF HAZARDOUS WASTES DATA SHEET

YUKON TERRITORY

DO NOT DESTROY

CODE REFERENCE NO. 062

Complete a separate sheet for each waste to be reported

Check all applicable responses

WASTE NAME

PROCESS OPERATION WHICH PRODUCES WASTE

WASTE TYPE

- ☐ Acid Solution
- ☐ Alkaline Solution
- ☐ Chemical Toilet Waste
- ☐ Contaminated Soil & Sand
- ☐ Drilling Mud
- ☐ Oil
- ☐ Paint Sludge
- ☐ Pathological Wastes
- ☐ Pesticides
- ☐ Solvent
- ☐ Tank Bottom Sediment
- ☐ Tetraethyl Lead Sludge
- ☐ Other contaminant(s) in oil or water (Specify) ______

PHYSICAL FORM OF WASTE

- ☐ Gas
- ☐ Light Liquid
- ☐ Heavy Liquid
- ☐ Slurry
- ☐ Thick Sludge
- ☐ Semi Solid
- ☐ Solid
- ☐ Oil Base
- ☐ Water Base

HAZARD CATEGORY

- ☐ Flammable or Explosive
- ☐ Chemically Reactive
- ☐ Human Health
- ☐ Plant or Animal Health
- ☐ Other (Specify) ______

SIGNIFICANT HAZARDOUS CONSTITUENTS IN WASTE

Constituent	Approximate Concentration
	(Specify Units)

CURRENT WASTE DISPOSAL METHOD

- ☐ On-Site Treatment (Specify) ______
- ☐ Discharge to Municipal Sewer
- ☐ Surface Discharge to Land
- ☐ Discharge to Water Course
- ☐ Discharge to Pit or Sanitary Landfill
- ☐ Discharge to Atmosphere
- ☐ Storage on Site (Capacity)
- ☐ Removal by Commercial Haulage or Treatment Service
- ☐ Incineration
- ☐ Other (Specify)

FREQUENCY OF WASTE REMOVAL

- ☐ Continuous as Produced
- ☐ Discrete Loads: ______ Times
- Quantity Per Load ______
- ☐ Daily
- ☐ Weekly
- ☐ Monthly

METHOD OF REMOVAL

- ☐ Drum
- ☐ Bucket
- ☐ Tank Truck
- ☐ Tank Rail Car
- ☐ Other (Specify) ______

CURRENT AVERAGE WASTE VOLUME

- ______ Pounds/Day
- ______ Gallons/Day
- ______ (Specify Units) ______

SEASONAL VARIATION OF WASTE

- ☐ No
- ☐ Yes Min. Month ______
- ______ % of Average Flow
- Max. Month ______
- ______ % of Average Flow

FUTURE WASTE VOLUME (2 YEARS)

- ☐ No Change
- ☐ Increase ______ %
- ☐ Decrease ______ %

COMMENTS

STAR PRINTING, WHITEHORSE

CODE REFERENCE NO.

062

DO NOT DESTROY

IF YOU DO NOT PRODUCE ANY HAZARDOUS WASTES PLEASE RETURN THIS SHEET FOR OUR RECORDS.

INSTRUCTION AND INFORMATION SHEET
INVENTORY OF HAZARDOUS WASTES
YUKON TERRITORY

HAZARDOUS WASTES
are unwanted materials containing substances dangerous to:
- •public health
- •public safety
- •the environment

HAZARDOUS CHARACTERISTICS:
include:
- •expolsiveness
- •flammability
- •chemical reactivity
- •hazard to human, animal or plant health

THIS INVENTORY INCLUDES
HAZARDOUS WASTE SUBSTANCES:
- •in solid, liquid or gaseous form
- •stored on-site
- •removed for storage, treatment, disposal or reclamation off-site
- •which may pass through conventional treatment processes (on-site or off-site)
- •which may interfere with conventional treatment processes
- •in current and anticipated wastes

COMMON EXAMPLES OF HAZARDOUS WASTES:
- •waste oils
- •solvents
- •waste inks
- •photographic chemicals
- •plating waste
- •pickling waste
- •sludges
- •reactive metals
- •pesticides
- •waste cylinders of gas
- •cyanide
- •mercury
- •polymers
- •pathological wastes
- •dead animals
- •dissolved metals
- •phenols
- •pigment metals
- •toxic substances
- •PCB
- •waste chemicals
- •residues
- •resins

THIS INVENTORY EXCLUDES:
- •radioactive materials
- •non-hazardous wastes normally acceptable to regulatory agencies
- •accidental spills

INSTRUCTIONS:
- •Supply the information requested below
- •Complete a Waste Data Sheet for each hazardous waste produced at your establishment
- •Check all applicable responses in each question box on the Waste Data Sheet
- •If no response is appropriate, mark N/A, for "Not Applicable"

Identifying information on this sheet is for exclusive use of the consultant and will not be used in any manner to identify the questionnaire respondant to other parties, including the client agencies.

WASTE LOCATION:

☑ Same as Company address

☐ Different (Specify) ________________

RESPONDANT DATA:

Name of Person Completing
Waste Data Sheet(s): ________________

Title ________________

Phone Number ________________

IN THE SPACE BELOW:
Please identify any existing public or private waste storage areas, disposal sites (including dumping pits or landfill sites) and commercial waste transport, reclamation, or disposal services which you utilize. This information will be used to extend our survey to include existing available means of transporting or disposing of hazardous wastes.

STAR PRINTING, WHITEHORSE

INVENTORY OF COMMERCIAL PETROLEUM STORAGE METHODS AND VOLUMES IN YUKON TERRITORY

1) What is your total fuel storage capacity? ________(gals.)

2) What is your method of storage (check below)?

____ underground tank
____ above ground tank
____ 45 gallon drums
____ other (Specify) ____________

3) What is your storage capacity per fuel grade(fill in below)?

______	regular (gallons)	______	80/87
______	extra	______	100/130
______	unleaded	______	JP4
______	diesel		
______	heating oil	______	other (Specify)
______	furnace oil	____________	

4) In the last year how much of each grade did you sell?

______	regular (gallons)	______	80/87
______	extra	______	100/130
______	unleaded	______	JP4
______	diesel		
______	heating oil	______	other (Specify)
______	furnace oil	____________	

5) Who delivers your fuel? ____________________

________________________ ________________

6) How is your fuel delivered?

________ train
________ truck
________ barge
________ plane
________ other

7) In the last year how many gallons of fuel were contaminated?

__________ ______________ __________

8) How do you dispose of contaminated fuels? ________________

____

____

9) Do you have any plans for expanding or upgrading your storage facilities? If so, in what way? ________________________

____

____

____

____

APPENDIX III

SUMMARY OF LEGISLATION PERTAINING TO HAZARDOUS WASTE MANAGEMENT IN YUKON

Fisheries Act

Section 33.(2) - It is illegal to deposit "a deleterious substance". Maximum fine $50,000 first offence, $100,000 subsequent offences.

Section 33.(6) - Each day is a continuing offence.

Section 33.(7) - Court may order the person to take action to prevent further offences of the same nature.

Section 33.2 - Where regulations exist regarding a deleterious substance, there is a 33.2(4) mandatory reporting requirement. Failure to report $5,000 maximum first offence, $10,000 maximum subsequent offences.

Section 33.2(5) - This subsection obligates persons who cause spills or who own or have custody or control of deleterious substances to take all reasonable measures to counteract or prevent deposits of these substances. Failure to comply $25,000 maximum first offence, $50,000 maximum subsequent offences.

Section 33.2(6) - Inspectors have the power to direct clean up where immediate action is necessary. Failure to comply with these directions could result in a $25,000 maximum fine first offence, $50,000 maximum subsequent offences.

<u>Territorial Lands Act</u>

Section 16. - It is unlawful to use Territorial lands without authority.

<u>Territorial Land Use Regulations</u>

Section 31-1.(g) - The land use permit may include conditions in relation to the use, storage, handling and ultimate disposal of any chemical or toxic material to be used in the land use operation.

<u>Northern Inland Waters Act</u>

Section 6.(1) - It is illegal to deposit a waste of any kind in any waters or any place where it may enter waters without authorization under the Regulations or by license. Maximum fine $5,000.

Section 32.(2) - Each day an offence is committed is considered a separate offence.

Section 34. - The Court may order a person to cease any activity considered to be an offence or which in the opinion of the Court, is likely to result in the committing of an offence.

<u>Arctic Waters Pollution Prevention Act</u>

Section 4.(1) - Except as authorized by regulations it is illegal to deposit waste in arctic waters or in places where it would enter arctic waters. Maximum fine $500.00 for persons, $100,000 for ships.

Section 5.(1)(b) - The accidental deposit of waste shall be reported to a Pollution Prevention Officer.

Section 6.(1) and (2) - The persons who are responsible for the deposition of a waste are responsible for any expenses incurred in remedial actions taken by the Crown and for the cost incurred in mitigating any damage caused by the waste.

Section 18.(2) - Each day is a separate offence.

Section 19.(1)(a) - Failure to report the deposition of a waste is an offence. Maximum fine $25,000.

Section 23.(1) - Where a Pollution Prevention Officer has reasonable grounds to believe that a ship has committed an offence under the Act, he may seize the ship with the consent of the Governor-In-Council.

Migratory Birds Convention Act and Regulations

Section 35.(1) of the Regulations - It is an offence to deposit oil, oil waste or other substances harmful to migratory birds into water inhabited by migratory birds. The penalty for an offence upon summary conviction is a fine of not more than $300.00 and not less than $10.00 - or six months' imprisonment.

Gas Handling Ordinance and Regulations

The Ordinance and Regulations apply to the transportation and storage of petroleum products, and cover in detail all aspects of such operation. They also provide for the reporting of spills of petroleum products within 48 hours of the incident (Section 7.(44)) and for prompt clean up of all spills from storage areas (Section 8.(33)).

Environmental Contaminants Act

Section 8.(1) - It is illegal to permit the release of substances specified in the schedule in excess of limits specified.

Section 8.(2) - No one shall import or manufacture, etc., a substance specified in the schedule.

Section 8.(4) - No one shall import, manufacture or sell products containing substances in excess of the limits set out in the schedule.

Section 8.(5) - Anyone contravening this section is guilty of an offence and liable to a maximum fine of $100,000 or two years imprisonment.

Section 8.(7) - Each day constitutes a separate offence.

Ocean Dumping Control Act

Section 4. - No ocean dumping without a permit.

Section 6. - No disposal on ice without a permit.

Section 13. - Fines range from $50,000 to $100,000.

Section 14.(1) - Each day is an additional offence.

Section 14.(2) - The Court may issue orders to persons to refrain from committing an offence.

Clean Air Act

Section 9.(1) - No one shall operate a facility in a manner that results in an emission into the ambient air in contravention of a national emission standard or specific emission standard. Maximum fine $200,000 for each offence.

Section 9.(2) - No operator of a facility may release into the ambient air a concentration of contaminants that exceeds the maximum tolerable limit allowed him in a particular geographical area. Maximum fine $200,000 for each offence.

Transportation of Dangerous Goods Act

This act currently under consideration in parliament is the first attempt to establish a nationwide code governing the handling and transportation of dangerous goods. The act will require carriers and shippers to ensure:

1. That containers, such as railway tank cars or tanker trucks or packages holding dangerous goods, be labelled as such.
2. That procedures regarding handling and transportation of dangerous goods meet prescribed safety standards.
3. That standards regulating the design and performance of containers or packages be met.

The act will also assess liability and penalities among others, carriers and shippers of dangerous goods, in the event that the commodities escape from their containers during an accident.

Public Health Ordinance of the Yukon Territory:

The Commissioner may make rules, orders and regulations respecting:

Part I, 3(d) The Prevention and removal of unsanitary conditions on public or private property;

3(i) The control of waste disposal grounds for the disposal of excreta and garbage;

3(n) The use of noxious materials including fertilizers, sprays or preservatives dangerous to the public health;

3(q) The prevention of the pollution, defilement, discoloration or fouling of lakes, streams, rivers, ponds, pools, springs and water courses, so as to ensure their sanitary conditions.

3(r) The prevention, control and abatement of air pollution due to any cause;

3(s) The confinement and disposition of diseased or injured animals and the disposal of dead animals.

Part II, 17 Every person who violates any of the provisions of the ordinance is guilty of an offence and liable on summary conviction to a fine not exceeding $500.00 or imprisonment for a term not exceeding six months, or both such fine and imprisonment.

APPENDIX IV

WASTE STREAM DATA

CHARACTERISTICS AND EXAMPLES OF HAZARDOUS WASTES IDENTIFIED IN YUKON

A literature review was undertaken to familiarize the author with wastes generated in Yukon and the hazard characteristics they possess. The summary table (1) is a compilation of the characteristics expressed by Yukon wastes. Table 2 gives a representative list of specific wastes found during the inventory stage.

The wastes identified in Yukon may be classified into high priority wastes (those requiring immediate attention) and low priority wastes (wastes that, although not posing an extreme or immediate hazard, should be included in present or future management plans) (Reid Crowther, 1980). This judgement is based on:

- wastes that present an extreme problem due to a very high hazard in a given category (Booz-Allen, 1973);
- wastes that are produced in large volumes (Booz-Allen, 1973).

Using this methodology, Table 3, listing high priority wastes, and Table 4 listing low priority wastes, are arrived at.

The various wastes in Yukon may be treated/disposed of by a variety of systems. The primary treatment/disposal systems identified in the literature (Reid Crowther, 1980) included:

- recovery systems
- thermal destruction
- physical-chemical treatment
- biological treatment
- secure disposal

Table 1. Summary of Hazard Characteristics Expressed by Yukon Wastes*

Classification Waste Groups	Ignitable	Corrosive	Reactive	Toxic
<u>Type</u> 1. Acid Solution		x	x	x
2. Alkaline Solution		x	x	x
3. Off spec./condemned pesticides and dilute rinsings				x
4. Paint Waste; Paint Contaminated Solid Waste		x		x
5. Solvent	x			x
6. Tetraethyl Lead Sludge				x
7. Chemical Toilet Waste				x
8. Tank Bottom Sediment				x
9. Non-contaminated Used Oil	x			x
Contaminated Used Oil	x			x
Oil-contaminated Solid Waste	x			x
10. Drilling Mud				x
11. Contaminated Soil and Sand				x
12. Pathological Waste			x	x
13. Miscellaneous				
(a) Explosives	x			
(b) Ink				x
(c) Mine Tailing				x
(d) Chemical Waste	x	x	x	x
(e) Mill Concentrate				x
(f) Asbestos Waste				x
(g) Fly Ash				x
14. Contaminated Fuels	x			x

*Taken from Booz-Allen, 1973 and Battelle, 1973, and Reid Crowther and Partners, 1980.

Table 2. Representative List of Specific Waste Types Identified During the Inventory

Acids

Chromate saturated sulphuric acid
Nitric acid
Acetic acid
Hydrochloric acid
Hydrogen sulphide
Muriatic acid
Picric acid
Sulphuric acid
Gallic acid
Acid powdered starch
Hydrofluoric acid

Alkalis

Ammonium hydroxide
Sodium hydroxide
Potassium hydroxide
Sodium peroxide

Solvents

Carbon tetrachloride
Acetone
Methyl iso-butyl ketone
Various petroleum products
Various alcohols

Metals

Mercury
Copper
Lead
Barium
Iron
Selenium
Manganese
Nickel
Arsenic
Cyanide

Chemicals

Hexane
Cyclohexene
Benzene
Toluene
Methanol
Freon
Isopropyl alcohol
Hydrozene A & B
Creosol
Molybdate
Phenolphthalein
Chlorohexidine gluconate
Dimethyl ammonium chloride
Dimethyl benzyl ammonium chloride
5-chloro-2-phenol chloride
Potassium chlorate
Perchlorethylene

Pesticides

Abate
Malathion
Diazinon

Table 3. High Priority Wastes

Type	Waste Name
1	Acid Solutions
2	Alkaline Solutions
5	Solvents
6	Tetraethyl Lead Sludge
9	Waste Oil
10	Drilling Mud
13	Miscellaneous - Mine Tailings - Fly Ash
14	Contaminated Fuels

Table 4. Low Priority Wastes

Type	Waste Name
3	Pesticides
4	Paint
7	Chemical Toilet Waste
8	Tank Bottom Sediment
11	Contaminated Soil and Sand
12	Pathological Waste
13	Miscellaneous - Explosives - Junk - Chemical Waste - Mill Concentrate - Asbestos Waste - Fly Ash

- land treatment
- solidification

Compatibility of Yukon waste types to treatment/disposal systems is shown in Table 5.

Table 5. Compatibility of Hazardous Wastes with Applicable Treatment/Disposal Technologies

Treatment/Disposal Systems	Compatible Waste Types
Recovery System	5, 6, 9, 14
Thermal Destruction	5, 9, 12, 13(d)
Physical-Chemical Treatment	1, 2, 4, 8, 10, 13(b)
Biological Treatment	3
Secure Disposal	6, 7, 10, 11, 12, 13(a), 13(c), 13(d), 13(e), 13(f), 13(g)
Land Treatment	9
Solidification	1, 2, 4