

WASTE MANAGEMENT PLAN

FOR THE ASTON BAY PROPERTY
(ALSO KNOWN AS STORM PROPERTY)
NUNAVUT, CANADA

Prepared For:



Prepared By:



Effective June 2020

Table of Contents

1. Introduction	4
1.1 Contact Details.....	4
1.2 Purpose and Scope	4
1.3 Other Plans	4
1.4 Project Description	5
1.5 Applicable Legislation and Guidelines	6
1.5.1 Federal	6
1.5.2 Territorial	7
2. Waste Management	7
2.1 Definition of Wastes.....	7
2.2 Waste Sources	7
2.3 Waste Management Activities	8
2.4 Waste Recovery and Reuse.....	9
3. Waste Classification and Disposal Plan.....	10
3.1 Hazardous Wastes.....	10
3.1.1 Used Oil.....	10
3.1.2 Hydraulic Fluid.....	10
3.1.3 Contaminated or Expired Fuels.....	10
3.1.4 Solvents.....	10
3.1.5 Contaminated Soil, Snow, and Ice.....	11
3.1.6 Used Rags and Sorbents	11
3.1.7 Empty Hazardous Material Containers and Drums	11
3.1.8 Waste Batteries	11
3.1.9 Aerosol Cans	12
3.1.10 Fluorescent Bulbs and Tubes	12
3.2 Inert Non-Combustible Solid Wastes.....	12
3.2.1 Tires and Other Rubber Materials.....	12
3.2.2 Scrap Metal and Glass	12
3.2.3 Electronics	13
3.2.4 Vehicles and Other Mechanical Equipment.....	13
3.3 Inert Combustible Solid Wastes	13
3.3.1 Food Waste and Packaging.....	13
3.3.2 Paper and Cardboard	13
3.3.3 Waste Lumber	14
3.4 Greywater.....	14
3.5 Sewage	14
3.6 Drilling Fluids	14
4. Site Facilities.....	15
4.1 Hazardous Waste Storage Area.....	15
4.2 Incinerator	15
5. Training	15
6. Inspection and Monitoring.....	16

Tables

Table 1. Non-hazardous (inert) wastes.....	8
Table 2. Hazardous wastes and pollutants.	8
Table 3. Waste recovery and reuse opportunities.	9

Appendices

Appendix A: Figures.....	17
Appendix B: Example Daily and/or Weekly Hazardous Waste Containment Inspection Record..	23
Appendix C: Canada-Wide Standards for Dioxins and Furans.....	25
Appendix D: Environmental Guideline for the General Management of Hazardous Waste	39
Appendix E: Technical Document for Batch Waste Incineration	75
Appendix F: Environmental Guideline for the Burning and Incineration of Solid Waste.....	121
Appendix G: Environmental Guideline for Used Oil and Waste Fuel.....	159
Appendix H: Environmental Guideline for Waste Batteries.....	189

1. Introduction

This Waste Management Plan (“WMP”) applies to mineral exploration activities conducted by, or on behalf of, Aston Bay Holdings Ltd. (“Aston Bay”) at the Aston Bay Property (the “Property” or the “Project,” also known as the “Storm Property” or the “Storm Project”), Somerset Island, Nunavut. This WMP will come into effect June 2020, pending approval. Copies and updates to this plan may be obtained via Aston Bay.

1.1 Contact Details

Aston Bay Holdings Ltd.
80 Richmond St. W Suite 303
Toronto, ON M5H 2A4
Tel: (416) 456-3516
www.astonbayholdings.com

1.2 Purpose and Scope

The primary objective of the Aston Bay Property WMP is to provide employees and contractors with operational guidelines to minimize the generation of wastes and facilitate the collection, storage, transportation, and disposal of wastes while minimizing adverse effects on the environment. The WMP includes the following:

- A summary of regulatory requirements;
- Potential waste minimization, recycling, and reuse options;
- Methods for collection, storage, and disposal of hazardous and non-hazardous wastes;
- Ways to minimize environmental impacts;
- Training, inspection, and monitoring efforts.

1.3 Other Plans

The WMP should be considered as a part of the Property wide management system. Other management plans in place at the Aston Bay Property include:

- Abandonment and Restoration Plan (“ARP”)
- Emergency Response Plan (“ERP”)
- Environmental Management Plan (“EMP”)
- Fuel Management Plan (“FMP”)
- Spill Prevention and Response Plan (“SPRP”)

1.4 Project Description

Aston Bay Property is located on northern Somerset Island, in the Qikiqtani Region of Nunavut (Appendix A, Figure 1) within the 1:50,000 scale National Topographic System (“NTS”) map sheets 058B14 and 15, 058C02, 03, 06, 07, 10, 11, 13 and 14 and 058F02, 03 and 04. The nearest community to the Property is Resolute Bay, located 112 km to the north, across Parry Sound on the southern edge of Cornwallis Island. The Property includes the Seal Zinc prospect and multiple copper-silver showings, collectively known as the Storm Copper prospect.

Aston Bay Property comprises one hundred eighteen contiguous mineral claims and twelve prospecting permits. The Property covers a combined area of approximately 391, 483 ha and is bound by latitudes 72°45' N and 73°56' N, and longitudes 93°20' W and 95°20' W (Appendix A, Figure 2 and Figure 3).

From 1964 until 2001, Cominco Ltd. was actively conducting exploration within the Property area. Commander Resources Ltd. (“Commander”) explored on the Property from 2008 to 2011. In November 2011, Aston Bay entered into an option agreement with Commander and by February 2016, acquired 100% of Commander’s interest in the Property. From 2012 to 2015, Aston Bay completed small exploration programs, but no drilling was undertaken. The 10-20 person Aston Camp was established in 2014 located at approximately 73°42' N latitude and 94°43' W longitude. In 2016, the Aston Camp was removed, with the exception of one 14'x16' wooden shack containing survival equipment, and the 40-person Storm Camp and airstrip was established along the Aston River at approximately 73°39'23" N latitude and 94°27'07" W longitude (Appendix A, Figure 4 and Figure 5). Between 2016 and 2018, Aston Bay completed surface sampling, an airborne geophysical survey, and diamond drilling. In 2019, no exploration work was completed.

Aston Bay’s annual exploration program may include 5,000 to 10,000 m of diamond drilling, soil and rock geochemical sampling, geological mapping and ground geophysical surveys. Similar programs are anticipated for 3 to 4 subsequent years. All exploration activities will be helicopter supported and based out of Storm Camp.

A fuel cache of approximately 80,000 L (400 drums) will be established at the current fuel cache, adjacent to camp. The cache will be primarily diesel and jet fuel, with small quantities of gasoline and propane. All fuel and any other hazardous materials will be stored within secondary containment. Off-season fuel storage may include up to 60 drums of jet fuel and diesel, and up to 20 cylinders of propane. Small, temporary fuel caches of less than 4,000L may also be required to support the drilling and exploration programs. Within 30 days of establishing any temporary

fuel cache, Crown-Indigenous Relations and Northern Affairs Canada (“CIRNAC”) will be notified of the details of the cache including: location, fuel type, container sizes, method of storage and date of removal.

Aston Bay is currently applying for a Nunavut Water Board (“NWB”) Type B Water Licence Renewal and Amendment as the current water licence 2BE-STO1520 will expire on June 1, 2020. Additionally, as the CIRNAC Land Use Permit (“LUP”) N2015C0014 will expire April 21, 2021, Aston Bay is also applying for a new Class A LUP. The NWB amendment is requesting an increase in the water allowance, from 82 m³/day (2 m³/day for camp and 80 m³/day for drilling) to 299 m³/day (10 m³/day for camp and 289 m³/day for drilling). In addition, Aston Bay is applying to increase the drilling area to include the entire currently permitted Project Extent, but will ensure that all ground disturbance activities, water use and waste disposal will only occur over lands that have an active mineral tenure held by Aston Bay. No exploration activities, drilling, water use, or waste disposal will be undertaken on Inuit Owned Lands (“IOL”), without a licence granted by the Qikiqtani Inuit Association (“QIA”).

1.5 Applicable Legislation and Guidelines

Applicable acts, regulations, and legislation that relate to waste management in Nunavut are listed below:

1.5.1 Federal

- Canadian Centre for Occupational Health and Safety Act
- Hazardous Products Act
- Canadian Environmental Protection Act
- Fisheries Act
- Nunavut Waters and Nunavut Surface Rights Tribunal Act
- Transportation of Dangerous Goods Act
- National Fire Code of Canada
- Northern Land Use Guidelines
- Workplace Hazardous Materials Information System (“WHMIS”)
- CCME Environmental Codes of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products
- Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations
- Guidelines for Spill Contingency Planning (CIRNAC)

1.5.2 Territorial

- Fire Prevention Act
- Environmental Protection Act
- Mine Health and Safety Act and Regulations
- Public Health Act
- Safety Act
- Nunavut Occupational Health and Safety Regulations
- Environmental Guideline for the General Management of Hazardous Waste
- Environmental Guideline for Used Oil and Waste Fuel
- Environmental Guideline for Waste Batteries
- Environmental Guideline for the Burning and Incineration of Solid Waste

2. Waste Management

2.1 Definition of Wastes

Waste at the Aston Bay Property is considered to be any material or substance that can no longer be used for its intended purpose, and is destined for recycling, disposal, or storage. Hazardous wastes are broadly defined in the *Environmental Guideline for the General Management of Hazardous Waste* by the Government of Nunavut Department of Environment (Appendix D) as being “any unwanted material or products that can cause illness or death to people, plants and animals”. Hazardous wastes may include waste petroleum products, solvents, paints, waste chemicals, batteries, and any combination of hazardous and non-hazardous materials (i.e. mixed waste).

The responsibility for proper waste management rests with the waste generator and should be budgeted for accordingly, as a cost of doing business.

2.2 Waste Sources

Tables 1 and 2 provide a summary of the potential types of hazardous and non-hazardous (inert) wastes generated at the Aston Bay Property.

Table 1. Non-hazardous (inert) wastes.

Waste Type	Examples
Organic	Food wastes
Scrap metal	Discarded tent frames, empty drums, rebar, wire, metal furniture, vehicle parts, nails/screws
Wood	Plywood and lumber from camp structures, broken core boxes, timbers used for drill pad construction
Glass	Bottles, jars, windows, mirrors
Rubber products	ATV tires, floor mats
Plastics	Bottles, plastic packaging, plastic bags
Equipment	Non-hydrocarbon contaminated equipment: electric motors, fans, electric heaters, pumps, screens, auto parts, etc.
Incinerator ash	Ash from the incinerator
Sewage	Sewage
Grey water	Water from kitchen, washing machine, sinks.

Table 2. Hazardous wastes and pollutants.

Waste Type	Examples
Petrochemicals	Diesel, jet fuel, gasoline, various oils
Solvents	Varsol, cleaning products
Contaminated soil	Contaminated soil/snow/water
Electronics	Computer parts, circuit boards, transformers
Fluorescent tubes	Regular and compact fluorescent tubes
Batteries	Dry cell batteries, button batteries, lead-acid based batteries

2.3 Waste Management Activities

Waste management operations at the Aston Bay Property comprise a number of activities with the common goal of reducing the amount of waste generated on site and to ensure that any wastes created are reused, recycled, or disposed of in a responsible and appropriate manner. Wastes will be separated at the source into a number of categories including organics (food wastes), materials for incineration, inert recyclables, inert non-combustible materials, and various hazardous materials.

Combustible waste will be burned in a batch feed dual-chamber controlled air incinerator, in accordance with the *Canada-Wide Standards ("CWS") for Dioxins and Furans* by the Canadian Council of Ministers of the Environment (Appendix A), the *Technical Document for Batch Waste*
Effective June 2020

Incineration by Environment Canada (Appendix E) and the *Environmental Guideline for the Burning and Incineration of Solid Waste* by the Nunavut Department of Environment (Appendix F). Aston Bay will ensure that the incinerator is a model that is specifically designed to be capable of incinerating inert combustible wastes produce at the Property, including sewage. The current incinerator model is: i8-20s Incinerator by Inciner8.

All attempts will be made to reduce the moisture content of waste to be incinerated, which will decrease the amount of smoke produced and increase the completeness of combustion. All waste will be covered and stored inside sheds or other secure buildings to keep rain and snow out of the waste and reduce the attraction for wildlife. If wet waste must be burned, such as organic (food) waste, the wet waste will be mixed with dry waste to reduce the overall moisture content of the batch.

Materials that cannot be incinerated or burned will be stored in appropriate containers until they can be removed from site for treatment and/or disposal at an accredited facility. Pending permission from the Hamlet, residual non-combustible wastes will be disposed of in Resolute Bay. If permission is not granted, the wastes in question will be backhauled to Yellowknife for disposal.

2.4 Waste Recovery and Reuse

Recovery and reuse options at the Aston Bay Property are limited due to the site's remote location and are restricted largely by the technology and equipment available on the Property. However, any available opportunity for waste recovery and reuse will be taken. Table 3 lists several potential waste recovery and reuse opportunities for the Aston Bay Property.

Table 3. Waste recovery and reuse opportunities.

Waste Type	Process
Hydraulic oils	Filtered and cleaned for reuse
Waste fuel	Filtered and used in tent stoves
Metal	Suitable pieces repurposed
Wood	Suitable pieces repurposed

3. Waste Classification and Disposal Plan

3.1 Hazardous Wastes

All opportunities will be taken to reuse or recycle hazardous waste materials. All hazardous wastes will be placed in sealed containers, labeled and stored within “Arctic Insta-Berms”, or similar, for secondary containment until they can be reused or backhauled for recycling or disposal. A hazardous waste storage area will be established adjacent to the main fuel cache. Upon seasonal shutdown all hazardous wastes will be backhauled and disposed of properly.

3.1.1 Used Oil

Waste lubricating oils, from vehicles, generators, pumps, or other equipment will be collected and stored in labeled 205 L steel drums. Used oil will be backhauled to a registered hazardous waste receiver and properly disposed of. See Appendix G for *Environmental Guideline for Used Oil and Waste Fuel* by Government of Nunavut Department of Environment.

3.1.2 Hydraulic Fluid

Whenever possible, hydraulic fluids will be filtered and reprocessed for reuse. Waste hydraulic fluid will be sealed in labeled 205 L steel drums and stored in the hazardous waste storage area until the product can be backhauled to a registered hazardous waste receiver.

3.1.3 Contaminated or Expired Fuels

Contaminated or expired fuels, such as Jet B aviation fuel, should remain clearly labeled and tightly sealed in their original containers within the fuel storage area. The fuels may be combusted in tent stoves or moved to the hazardous waste storage area for backhaul to a registered hazardous waste receiver.

3.1.4 Solvents

Whenever possible, non-toxic alternatives will be used in place of petroleum-based solvents. Excess or waste solvents will be packaged in clearly labeled, original, tightly sealed containers, or manufactured containers designed for solvent transport. Waste solvents will be stored in the hazardous waste storage area until backhauled to a registered hazardous waste receiver.

3.1.5 Contaminated Soil, Snow, and Ice

Any contaminated soil, snow, or ice will be cleaned up immediately in accordance with the Aston Bay Property “Spill Prevention and Response Plan.” All contaminated soil, snow, and ice will be sealed in 205 L steel drums and stored in the hazardous waste storage area to await backhaul to a registered hazardous waste receiver.

3.1.6 Used Rags and Sorbents

Used rags and sorbents will be placed in clearly labeled, tightly sealed containers, such as 205 L steel drums, and stored in the hazardous waste storage area until disposal or backhaul is possible. Rags and sorbent pads will be incinerated on site. Granular sorbent will be stored in drums and backhauled to a registered hazardous waste receiver.

3.1.7 Empty Hazardous Material Containers and Drums

Empty containers will be stored in a designated area and returned to the supplier. Drums may alternatively be drained, air dried, backhauled to a recycling facility. Any residual fuels drained will be burned in tent stoves or consolidated into drums and backhauled to a registered hazardous waste receiver.

3.1.8 Waste Batteries

Generation of waste batteries will be reduced by properly maintaining batteries to prolong life and by replacing non-rechargeable batteries with rechargeable alternatives whenever possible. Even with proper maintenance, all batteries will eventually deteriorate and reach the end of their useful life. Waste batteries must be properly handled to avoid spillage of corrosive materials and the release of metals into the environment. See Appendix H for the *Environmental Guideline for Waste Batteries* by the Government of Nunavut Department of Environment.

Dry cell batteries are used in equipment such as hand-held radios and GPS units, flashlights, and cameras. Some of these types of devices utilize rechargeable battery packs, but others use general dry cell battery types such as AAA to D cells, 6- or 9-volt consumer batteries, and button batteries. Specific containers will be set up in the office, common spaces, and drill sites to collect dry cell batteries. The batteries will be placed in appropriate shipping containers and backhauled to an off-site recycling facility.

Waste lead acid batteries and rechargeable batteries will be temporarily stored in a 205 L plastic drum, within the hazardous waste storage area. These types of batteries can only be stored in this manner in quantities of 1000 kg or less and for periods of less than 180 days. All waste lead acid and rechargeable batteries will be backhauled from site for disposal as necessary to conform to regulations.

3.1.9 Aerosol Cans

Use of aerosol cans at the Aston Bay Property will be limited. Whenever possible, alternatives, such as spray bottles, will be used in place of aerosol cans. Any waste aerosol cans will be collected in specific containers around camp and at drill sites. The cans will be stored in the hazardous waste storage area until backhauled for disposal.

3.1.10 Fluorescent Bulbs and Tubes

Waste fluorescent bulbs and tubes will be packaged in their original (or equivalent) containers and stored in a watertight enclosure in the hazardous waste storage area until backhauled to a hazardous waste recycling or disposal company. Fluorescent bulbs and tubes are considered hazardous waste if broken and should be handled accordingly.

3.2 Inert Non-Combustible Solid Wastes

Labeled bins will be provided at various locations around camp and at drill sites for each type of waste listed below. Effort will be taken to reuse or repurpose any materials before disposal is considered. Non-combustible wastes are backhauled on an ongoing basis throughout the program and upon seasonal shutdown.

3.2.1 Tires and Other Rubber Materials

Waste tires, hoses, and other rubber materials that cannot be repaired or repurposed will be backhauled for recycling or disposal.

3.2.2 Scrap Metal and Glass

Scrap metal and glass will be repurposed for alternative uses whenever possible. Any residual metal or glass that cannot be reused will be placed in 205 L steel drums and backhauled for recycling.

3.2.3 Electronics

Electronics and electrical equipment will be collected and stored in sealed containers within the hazardous waste storage area and removed from site for recycling or disposal.

3.2.4 Vehicles and Other Mechanical Equipment

Vehicles and other mechanical equipment, such as generators, that are no longer usable, will be removed from site for refurbishment or recycling/disposal. Vehicles and equipment awaiting backhaul will be stored in a specially designated, bermed area.

3.3 Inert Combustible Solid Wastes

The Aston Bay Property will use a batch feed dual-chamber controlled air incinerator to dispose of combustible solid wastes. All combustible wastes will be burned in accordance with applicable federal and territorial regulations and the Nunavut Department of Environment *Guideline for the Burning and Incineration of Solid Waste*. Combustible wastes will be incinerated on a regular schedule and upon seasonal shutdown.

3.3.1 Food Waste and Packaging

Dedicated steel bins, lined with plastic garbage bags, will be provided for the collection of food waste and packaging at a number of locations throughout camp and at drill sites. The bins will be secured in place and use locking lids to avoid interference by wildlife. Food waste and packaging will be incinerated daily to minimize the attraction of wildlife. Waste oil and grease collected from the kitchen will be stored in sealed plastic pails and remain in the kitchen until transferred to the incinerator for immediate disposal.

3.3.2 Paper and Cardboard

Use of electronic methods for communication will be encouraged at the Aston Bay Property to minimize the amount of paper used. Effort will be taken to restrict the amount of corrugated cardboard coming to site, and waste cardboard will be reused as needed, possibly as packaging for backhauled materials. Specific containers, located throughout camp, will be used to collect paper and cardboard. Waste paper and cardboard will be incinerated.

3.3.3 Waste Lumber

Whenever possible, lumber will be reused at the Aston Bay Property. Excess waste lumber will be stored in appropriate areas and either backhauled or burned in a burned when the camp is completely removed.

3.4 Greywater

Camp greywater will be stored and treated in an excavated sump, which will allow for slow infiltration into the soil and will be located at least 31 m away from the ordinary high-water mark of a water body. The greywater sumps at Storm Camp are approximately 2'x2' in dimension and approximately 3' deep. They are constructed with plywood walls and filled with loose cobbles to aid in filtration, to support the walls and to prevent slumping. Filters and grease traps will be installed on kitchen drains to ensure solid food wastes do not enter the sumps attract wildlife. The sump and pipe will be inspected at regular intervals for leaks or overflow. Full sumps will be covered with enough material for future ground settlement. Upon seasonal shutdown, if the sumps are not full, they are covered with plywood to be used in the future.

3.5 Sewage

Pacto toilets will be used at Storm Camp. All Pacto bags will be incinerated on site in a batch feed dual-chamber controlled air incinerator. Aston Bay will ensure that the incinerator is a model that is specifically designed to be capable of incinerating this type of waste. Incineration of sewage will occur on a regular schedule. Upon seasonal shutdown, all sewage will be incinerated, and the Pacto structure winterized.

3.6 Drilling Fluids

Recirculation and filtration equipment will be used to minimize the amount of water used and additives released into the environment. Secondary containment for additives will be placed around the hole. Any residual drill fluids will be contained in sumps or an equivalent natural depression, preventing the drill fluids from entering water bodies directly and allow for slow infiltration into the soil. Sumps will be positioned a minimum of 31 metres from the normal high-water mark of any water body. Sumps will be positioned down slope from the drill collar in such a manner that runoff flows into the sump. Full sumps will be covered with enough material for future ground settlement. Biodegradable drill additives will be used whenever possible. See Appendix B of Aston Bay's "Spill Prevention and Response Plan" for the MSDS of possible drill additives used.

4. Site Facilities

4.1 Hazardous Waste Storage Area

The hazardous waste storage area will be located adjacent to the main fuel cache, away from any structures and a minimum of 31 metres from the normal high-water mark of any water body. It will be used for storage of any hazardous wastes until they can be backhauled for recycling or disposal. All hazardous wastes will be sealed in appropriate, clearly labeled, watertight containers, such as 205 L steel or plastic drums.

All containers housing hazardous waste will be stored within “Arctic Insta-Berms”, or similar, for secondary containment. These types of berms utilize chemical and fire-resistant fabric (generally polyurethane coated nylon or vinyl coated polyester material) designed for extreme arctic temperatures and puncture resistance. “RainDrain” or similar hydrocarbon filtration systems will be used to safely remove any water collected inside the berms, and as a safeguard against any potential overflows of contaminated water.

All waste storage areas will be clearly marked and labeled with appropriate signage. Within the storage area, wastes will be segregated by type, and labeled to ensure safety for handlers and appropriate disposal.

4.2 Incinerator

The Aston Bay Property will utilize a batch feed dual-chamber controlled air incinerator to dispose of combustible solid wastes. If sewage will be incinerated, Aston Bay will ensure that the incinerator is a model that is specifically designed to be capable of incinerating this type of waste. These types of incinerators typically produce the highest quality burn, with the least amount of ash and airborne particles. Residual ash backhauled and disposed of appropriately.

All combustible wastes will be incinerated in accordance with applicable federal and territorial regulations and the Nunavut Department of Environment *Guideline for the Burning and Incineration of Solid Waste*.

5. Training

All on site management and any personnel required to handle hazardous wastes must have valid First Aid, WHMIS, and Transportation of Dangerous Goods (“TDG”) training. Site and job-

specific training will be provided to all personnel who are required to handle waste materials. All employees and contractors will receive training in emergency response and spill response, as outlined in the Aston Bay Property “Emergency Response Plan” and “Spill Prevention and Response Plan”, respectively. Personnel responsible for operating or maintaining the incinerator will receive hands on training to ensure the equipment is operated safely and efficiently.

6. Inspection and Monitoring

Inspections of the hazardous waste storage area and other waste storage facilities will be conducted daily. Daily inspections will include an assessment of the condition of waste receptacles and storage containers, checking for any damaged or leaking containers or berms, and ensuring that waste is collected and stored in the correct containers and storage areas. More detailed weekly inspections will be conducted to ensure the hazardous waste inventory is up to date, secondary containment is in place and in good condition, and spill kits are fully stocked and available. These inspections will be completed in conjunction with those outlined in the Aston Bay Property “Fuel Management Plan.” An example of a daily/weekly Inert and Hazardous Waste Containment Inspection form is attached in Appendix B. Any leaks or spills will be treated as outlined in the “Spill Prevention and Response Plan.” The Project Supervisor is responsible for supervising the monitoring and inspection program and keeping a detailed inventory of all hazardous wastes on site.

Appendix A: Figures

Figure 1 Aston Bay Property location.



Figure 2. Aston Bay Project Extent and drilling areas.

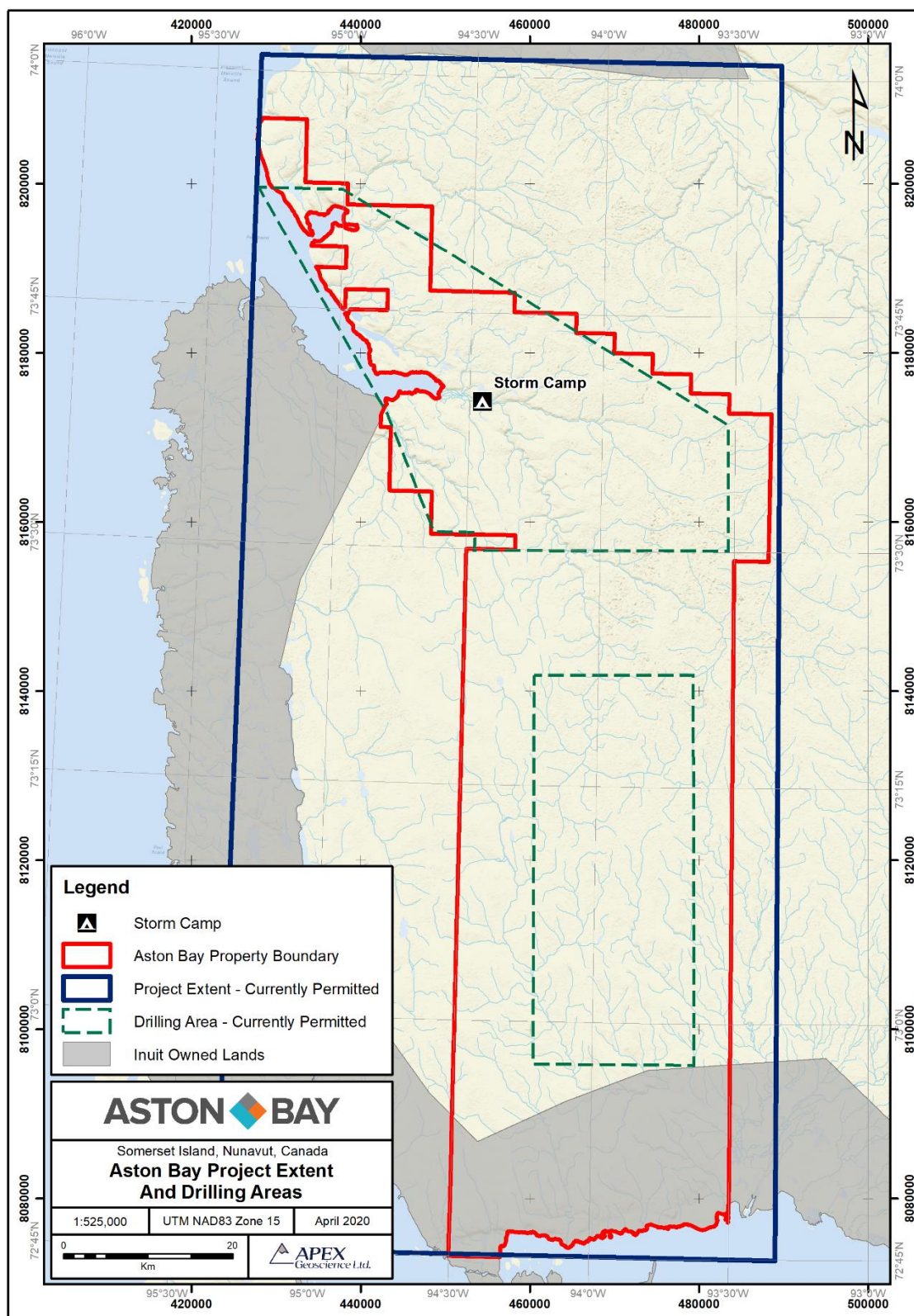


Figure 3. Aston Bay Property mineral tenures.

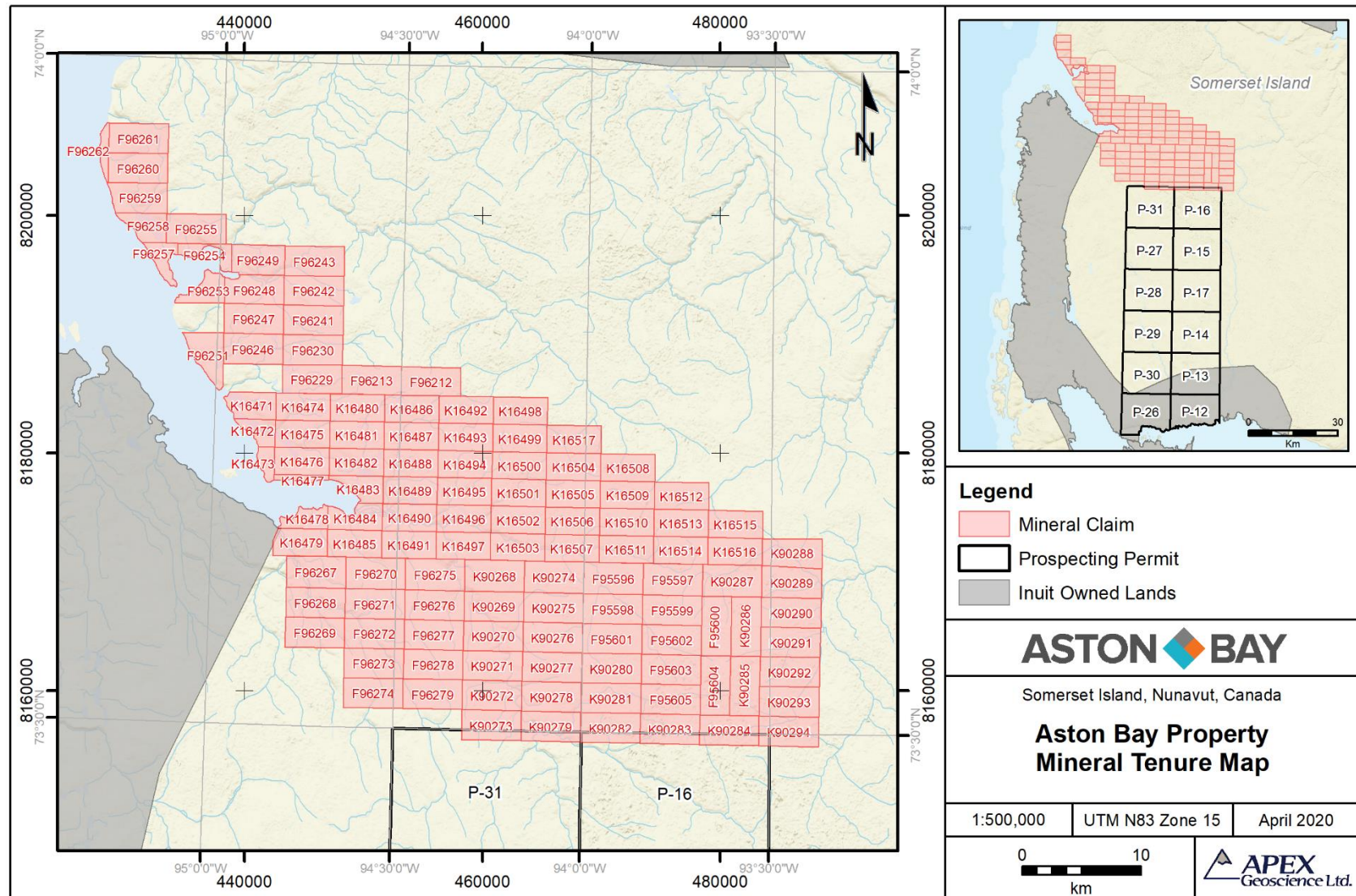


Figure 4. Storm Camp and airstrip locations.

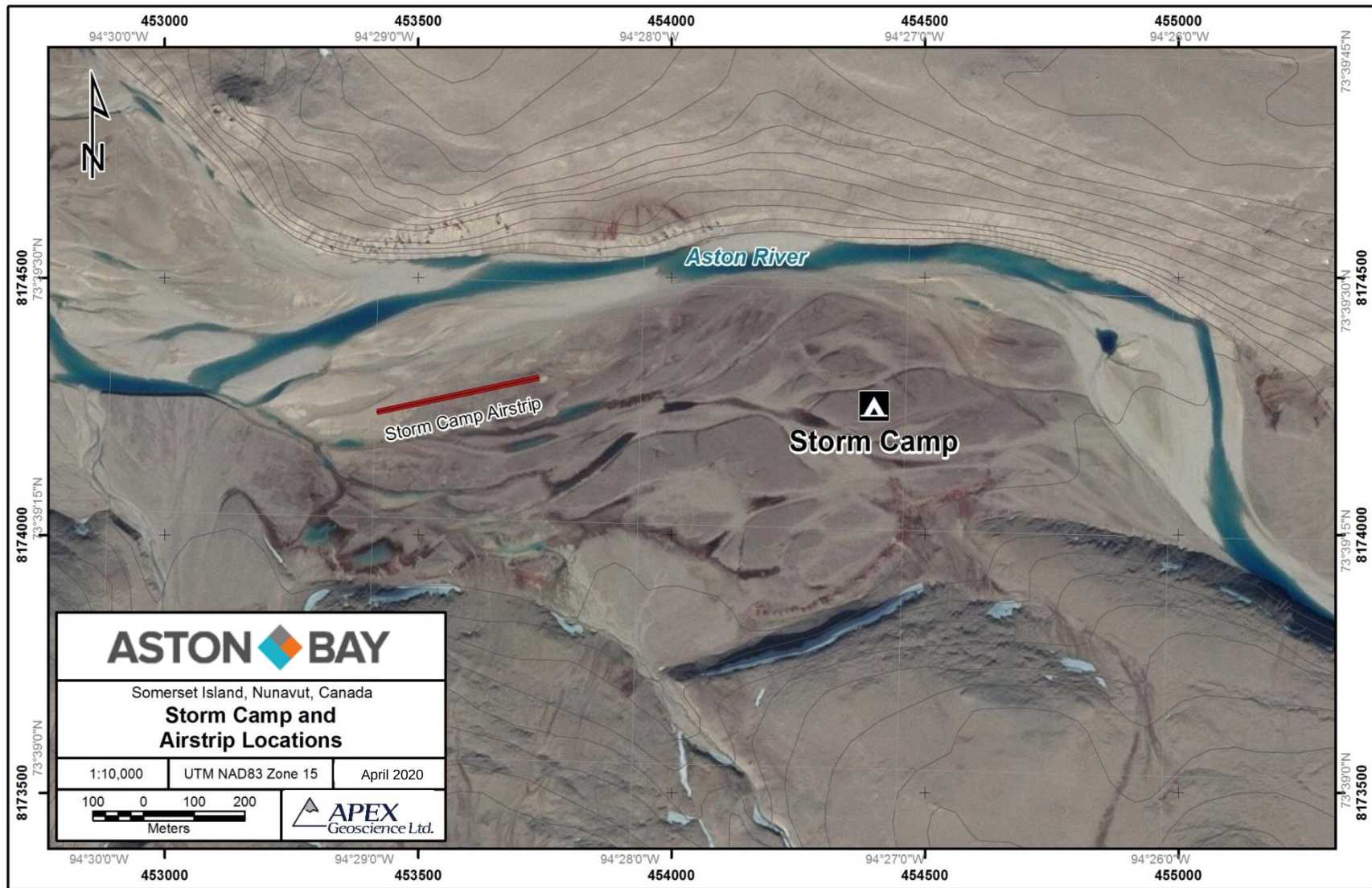


Figure 5. Storm Camp during operations (2018).



Appendix B: Example Daily and/or Weekly Hazardous Waste Containment Inspection Record

Inert and Hazardous Waste Container Storage Inspection Checklist

Each Day/week, place a “Yes” next to all inspection items that meet the Aston Bay Property WMP rules. Place a “No” next to all inspection items that do not meet the rules. Please provide specific comments on all “No-marked”items. When inspection is completed, inspector must initial at the bottom of the table.
Report all No-marked items to appropriate supervisor immediately.

Inert Wastes

Name and Location of Waste Storage Area:

Inspection Item	Mon	Tue	Wed	Thur	Fri	Sat	Sun	Inspector	Comments on Inspected Item
Wastes Segregated by Type (ie. food, recyclable, combustible, etc)									
Number of Containers in Unit									
Containers Marked/Labeled Properly									
Containers Dated Properly									
Containers Observed with Closed Tops or Bungs									
Containers Observed to be free of leaks/staining									
Containers Observed to be free of Dents or Corrosion									
Area Clean and Safe									
Emergency equipment available									
Emergency equipment in good condition									

General Comments:

Hazardous Wastes

Name and Location of Waste Storage Area:

Inspection Item	Mon	Tue	Wed	Thur	Fri	Sat	Sun	Inspector	Comments on Inspected Item
Number of Containers in Unit									
Containers Marked/Labeled Properly									
Containers Dated Properly									
Containers Observed with Closed Tops or Bungs									
Containers Observed to be free of leaks/staining									
Containers Observed to be free of Dents or Corrosion									
Containers in Secondary Containment System									
Secondary Containment System free of Water or Other Liquids									
Secondary Containment System free of Leaks/Holes/Tears									
Area Clean and Safe									
Emergency equipment available									
Emergency equipment in good condition									

General Comments:

Appendix C: Canada-Wide Standards for Dioxins and Furans

Canadian Council of Ministers of the Environment

CANADA-WIDE STANDARDS

for

DIOXINS AND FURANS

Endorsed by CCME Council of Ministers, April 30-May 1, 2001, Winnipeg

1 of 12

CANADA-WIDE STANDARDS for Dioxins and Furans

PREAMBLE

Dioxins and Furans

Polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs), commonly known as dioxins and furans, are toxic, persistent, bioaccumulative, and result predominantly from human activity. Due to their extraordinary environmental persistence and capacity to accumulate in biological tissues, dioxins and furans are slated for virtual elimination under the *Canadian Environmental Protection Act (CEPA)*, the federal *Toxic Substances Management Policy (TSMP)* and the CCME *Policy for the Management of Toxic Substances*.

The presence of dioxins and furans in the Canadian environment can be attributed to three principle sources: point source discharges (to water, air and soil), contamination from *in situ* dioxins and furans, and loadings from the long-range transportation of air pollutants (LRTAP).

LRTAP is the focus of multilateral conventions and bilateral accords at the international level.

Dioxin and furan contamination found in soil, water, sediments, and tissues (*in situ* contamination), is the subject of national guidelines for dioxins and furans. These guidelines outline ambient or “alert levels” which may be used by jurisdictions as benchmarks for the management and monitoring of dioxins and furans already present in the environment.

Point source discharges to water have been the target of aggressive federal and provincial regulation, as well as industry innovation and change. Discharges of dioxins & furans to the aquatic environment reached non-measurable levels in 1995.

Development of the Canada-wide Standard

The Canada-wide Standards process has focussed on anthropogenic sources that are releasing dioxins and furans to the atmosphere and soil in a continuous process.

In January 1999, the Federal/Provincial Task Force on Dioxins and Furans released the *Dioxins and Furans and Hexachlorobenzene Inventory of Releases* which documented the current understanding of anthropogenic sources in Canada releasing dioxins and furans. The *Inventory of Releases* lists emissions from over 20 sectors by province and territory, and provides national summaries for each sector.

Initial efforts have focused on atmospheric releases, the most complete component of the Inventory. Six priority sectors, varying from regional to national in scope, accounting for about 80% of national emissions have been identified as priorities for early action. These are waste incineration (municipal solid waste, hazardous waste, sewage sludge and medical waste); burning salt laden wood in coastal pulp and paper boilers in British Columbia; residential wood combustion; iron sintering; electric arc furnace steel manufacturing; and conical municipal waste combustion in Newfoundland.

To date, CWSs have been developed for the coastal pulp and paper boiler and the incineration sectors. CWSs for the remaining priority sectors will be completed in 2001. Additional source sectors, many of which contribute very small amounts of dioxins and furans emissions, will also be addressed in 2001 as will releases to soil.

Development of CWSs for dioxins and furans has taken into consideration environmental benefits, available technologies, socio-economic impacts, opportunities for pollution prevention and collateral benefits from reductions in other pollutants.

In recognition of the ultimate goal of virtual elimination, pollution prevention is being encouraged as the preferred method for avoiding the creation of dioxins or reducing releases to the environment.

Wherever possible, work on the dioxins and furans CWSs has been coordinated with other ongoing processes (e.g. Mercury CWS and the Strategic Options Process). A multi-pollutant approach will be carried forward to the remaining sectors while ensuring that dioxins and furans issues are addressed and that the ultimate goal of virtual elimination is kept clearly in mind. Opportunities for a multi-pollutant approach will also be pursued as part of the implementation of the Dioxins and Furans Canada-wide Standard.

During development of the inventory, it was realized that the data on dioxins and furans is limited. The information in the dioxins and furans inventory will be refined and updated on a regular basis through a variety of sources including the National Pollutants Release Inventory (NPRI) as a means of tracking progress and as a means of identifying any future sources of releases that must be addressed.

PART 1:

Pulp and Paper Boilers Burning Salt Laden Wood

Rationale for standard

Unique to British Columbia, the burning of salt laden wood results in an annual release of 8.6 gTEQ/year to the atmosphere or 4.3 percent of the national total of dioxin and furans emissions documented in the inventory of releases prepared under the Canadian Environmental Protection Act.

As a result of mill closures and voluntary industry initiatives that have reduced atmospheric releases, the current total represents a 25% reduction from 1990 releases.

Dioxins and furans emitted from coastal pulp and paper mills are created through the burning of salt contaminated hogged fuel. Logs transported and stored in salt water take up chlorine into the bark. The bark is stripped from the logs and ground up to produce hogged fuel.

This material is then used as boiler fuel to produce heat and electrical energy for the pulp and paper process. Over 1.4 million oven dried tonnes of hogged fuel were used by the coastal pulp and paper industry in B.C. in 1998.

Nature and application:

The CWS for this sector consists of two components. The first component sets out numeric targets and timeframes for reducing emissions from new and existing boilers. This standard applies to boilers burning more than 10,000 oven dry metric tonnes per year of hogged fuel generated from wood transported or stored in salt water. All boilers currently reliant on hogged fuel generated from wood transported or stored in salt water currently consume in excess of 50,000 oven dry metric tonnes annually. As part of the implementation of this standard, procedures will be put in place to report on the salt content of the hogged fuel to ensure compliance with the standard.

The second component sets out a process for further examining pollution prevention opportunities to prevent the creation of dioxins and furans.

Numeric Target and Timeframe for Achieving Target

Dioxin and furan emissions will be less than 100 pg/m³ TEQ for new boilers constructed after the effective date of this standard.

Dioxin and furan emissions will be less than 500 pg/m³ TEQ for all existing boilers by 2006. "New" means a total replacement including firebox, heat transfer surfaces and air emission control equipment.

The standard for existing boilers is set pending the acquisition of further test data and controlled studies of boiler operation. Recognizing the ultimate objective of virtual elimination as set out in the Canadian Environmental Protection Act, the mill operators will voluntarily pursue further reductions in emissions during the period of the standard. In doing so the operators will conduct additional studies to identify the reasons for higher dioxin and furan emissions at some locations and explore and, as practicable, implement measures to achieve virtual elimination at all locations. Measures to be explored include physical and process modifications to prevent or reduce dioxin and furan formation as well as emission control upgrades and/or other pollution prevention measures.

Every boiler covered by this standard will be tested twice per year to determine the level of dioxin and furan air emissions for the years prior to 2003 and annually for the years 2003 and thereafter. Testing and reporting will be performed using methods and procedures acceptable to the responsible provincial ministry.

The standard for existing boilers will be reviewed in 2003 based on the results of the additional testing, the additional studies on dioxin and furan creation and opportunities to achieve virtual elimination and the examination of other pollution prevention opportunities.

Pollution Prevention Strategy

In addition to the continuing efforts of pulp and paper mill operators to capture emissions of dioxin and furans, emphasis will be placed on identifying and implementing opportunities to prevent the creation of dioxins and furans. A strategy identifying opportunities to eliminate the formation of dioxins and furans by the coastal pulp and paper industry will be developed through a multi-stakeholder process by December 31, 2001 to provide a framework for continual progress towards the elimination of dioxin and furans.

Recognizing that most opportunities for avoiding the creation of dioxins and furans fall beyond the exclusive influence of the coastal pulp and paper mill operators, preparation of this strategy must engage a wide range of stakeholders.

The range of issues to be addressed in developing the strategy could include:

- maximum allowable salt content for hogged fuel
- removal of chloride from logs
- hogged fuel washing and pressing
- options for blending hogged fuel of different salt levels
- alternatives to log handling, transportation and storage practices that rely on salt water
- impacts of the length of time entailed in transportation and storage on the salt content of hogged fuel
- inclusion of transportation modes and effects in eco-certification criteria
- in-plant opportunities to avoid creation of dioxins and furans
- alternative fuel opportunities and costs
- providing greater opportunities for market intervention by improving the understanding of the costs being imposed on the pulp and paper mills by current log handling and storage practices

Waste Incineration

Rationale for standard

Waste incineration has historically been responsible for a significant portion of the dioxins and furans emitted in Canada. The total release of dioxins and furans from this sector amounts to 44.9 g/ TEQ/y or 22.5% of the total releases to the atmosphere.

Improved exhaust gas controls to reduce emissions of acid gases and fine particulates or activated carbon injection systems have decreased emissions of both mercury and dioxins and furans from the municipal solid waste (MSW) sector. Dioxins and furans emissions from this sector are estimated to be approximately 8.4 g/yr. Many medical waste incinerators have closed for economic or environmental reasons. However, a range of medium-to small-sized facilities remain. Individually these are small sources, but as a sector they are significant, emitting an estimated 28.8 g/yr. Two additional incineration sectors, hazardous waste (7.6 g/yr) and sewage sludge (0.1 g/yr), are also addressed by the CWS.

A Canada-wide Standard for incineration of MSW in conical waste combusters in Newfoundland will be brought forward in 2001. Newfoundland has committed to reviewing the use of these facilities and to considering a phase-out strategy that will reduce emissions of dioxins and furans as well as mercury. These actions are also identified in the Mercury Canada-wide Standard accepted by the Council of Ministers in November 1999.

Actions to reduce national emissions require that any new facilities meet stringent limits, and that the bulk of the emissions from existing facilities be controlled through retrofits with control technology that is efficient at destroying dioxins and furans. Diverting waste from incinerators would result in less incineration overall and thus avoid creation of dioxins and furans. All facilities, and particularly smaller ones, may find that pollution prevention, waste segregation and diversion are options for either achieving the limit, or reducing "end-of-stack" expenditures, and during implementation all facilities should be encouraged to place a priority on reduced inputs rather than controlled releases.

Definitions:

Waste incinerator: a device, mechanism or structure constructed primarily to thermally treat (e.g., combust or pyrolyze) a waste for the purpose of reducing its volume, destroying a hazardous chemical present in the waste, or destroying pathogens present in the waste. This includes facilities where waste heat is recovered as a byproduct from the exhaust gases from an incinerator, but does not include industrial processes where fuel derived from waste is fired as an energy source as a matter incidental to the manufacture of the primary product. For the purpose of the Dioxins and Furans CWS, conical waste combusters are considered separately from other incineration sectors.

Municipal solid waste: any waste which might normally be disposed of in a non-secure landfill site if not incinerated (i.e., including non-hazardous solid wastes regardless of origin), but is not intended to include “clean” wood waste. Clean wood waste means waste from woodworking or forest product operations where the wood waste has not been treated with preservative chemicals (e.g., pentachlorophenol) or decorative coatings.

Medical waste: any waste which includes as a component any Biomedical Waste as defined in the February 1992 CCME Guidelines for the Management of Biomedical Waste in Canada, with the exception that animal wastes derived from animal health care or veterinary research and teaching establishments are excluded.

Determined efforts: Determined efforts include the ongoing review of opportunities for reductions and implementation of in-plant changes and/or emissions control upgrades that are technically and economically feasible and which confer on-going reductions in emissions. Where possible, dioxin and furan emission reductions will be determined by way of a one-time stack test conducted after implementation of the measures. Where testing is not possible or will not provide reliable results, an audit of the dioxin and furan emission reductions associated with waste diversion or other measures is an acceptable alternative. Opportunities for regional consolidation and/or phase-out of smaller facilities may also be considered.

Nature and application:

Emission limits are expressed as a concentration in the exhaust gas exiting the stack of the facility. New or expanding facilities will be expected to comply immediately with the standard, and it will be up to individual jurisdictions to determine what constitutes a significant expansion to trigger the standard. The limits for existing facilities are capable of being met using generally available technology or waste diversion. Larger facilities will be subject to stack testing as described in Annex 1 to verify compliance with the limit. Smaller medical and municipal facilities will have the option of reporting on an audit of the dioxin and furan emission reductions associated with waste diversion or other measures or conducting a one-time stack test, to illustrate progress towards the standard.

Numeric targets:

The following standards are a step towards achieving virtual elimination for dioxins and furans.

For new or expanding facilities of any size, application of best available pollution prevention and control techniques, such as a waste diversion program, to achieve a maximum concentration¹ in the exhaust gases from the facility as follows:

Municipal waste incineration	80pg I-TEQ/m ³
Medical waste incineration	80pg I-TEQ/m ³
Hazardous waste incineration ²	80pg I-TEQ/m ³
Sewage sludge incineration	80pg I-TEQ/m ³

¹ Stack concentrations of dioxins and furans will be corrected to 11% oxygen content for reporting purposes.

² Hazardous waste incinerators include all facilities that burn hazardous waste including low level radioactive waste; however they do not include facilities that use waste derived fuel or used oil.

For existing facilities application of best available pollution prevention and control techniques, to achieve a maximum concentration¹ in the exhaust gases from the facility as follows:

Municipal waste incineration	
> 26 Tonnes/year ³	80pg I-TEQ/m ³
< 26 Tonnes/year ⁴	80pg I-TEQ/m ³
Medical waste incineration	
> 26 Tonnes/year ³	80pg I-TEQ/m ³
< 26 Tonnes/year ⁴	80pg I-TEQ/m ³
Hazardous waste incineration ²	80 pg I-TEQ/m ³
Sewage sludge incineration	100 pg I-TEQ/m ³

Timeframe for achieving the targets:

Any new or expanding facility will be required to design for and achieve compliance immediately upon attaining normal full scale operation, compliance to be confirmed by annual stack testing.

Based on determined efforts in working towards virtual elimination, existing facilities will be required to meet the standards on the following schedule:

Municipal waste incineration	2006
Medical waste incineration	2006
Hazardous waste incineration	2006
Sewage sludge incineration	2005

Pollution Prevention Strategy:

In addition to the continuing efforts of waste incinerator operators to destroy or capture emissions of dioxin and furans, emphasis will be placed on identifying and implementing opportunities to prevent the creation of dioxins and furans as well as emissions of air pollutants and ash quality generally. As an initial action with shared responsibility by all jurisdictions, strategies identifying opportunities to minimize waste incineration emissions of air pollutants including dioxins and furans will be developed through a multi-stakeholder process by December 31, 2001 to provide a framework for continual progress towards the elimination of dioxin and furans.

Recognizing that many opportunities for minimizing air pollutant and ash emissions and specifically avoiding the creation of dioxins and furans fall beyond the exclusive influence of the operators of waste incinerators, preparation of this strategy must engage a wide range of stakeholders.

³ Larger facilities must achieve this stack concentration as confirmed by annual testing.

⁴ Smaller facilities must make determined efforts to achieve this stack concentration.

The range of issues to be addressed in developing the strategy could include:

- waste diversion initiatives to minimize the generation of wastes destined for disposal (waste reduction, material reuse options)
- waste segregation initiatives aimed at materials with greater potential to generate emissions of dioxins and furans or other air pollutants of concern (e.g., mercury, other heavy metals) and aimed at diverting those wastes to recycling or other non-incineration disposal options
- combustion control strategies to optimize performance of existing combustors at destroying pollutants of concern
- use of alternative disposal or treatment technologies (e.g., anaerobic digestion of wastes with material recovery and combustion of biogas)

PART 2:

Reporting on Progress:

Ministers will receive reports on progress in achieving the CWS by jurisdictions in Spring 2004 and Spring 2008. Ministers will ensure that a single public report is prepared and posted on the CCME web site for public access. The report in 2004 will reflect interim progress on achieving the CWSs. Progress on both implementation of the numeric targets and the activities applied as part of the determined efforts provisions for smaller medical waste and municipal solid waste facilities will be documented. The 2008 report will evaluate whether targets have been met and the effectiveness of the determined efforts with respect to smaller facilities. More details on reporting are available in Annex 1.

Each jurisdiction will detail the means of ensuring achievement of the CWS in a manner consistent with the typical or desired programs for the affected facility/sector, so as not to impose an unnecessary level of reporting duplication.

With a view to continuous improvement towards the goal of virtual elimination, an evaluation of the Dioxin and Furan Canada-wide Standards will be presented to Ministers in Spring 2006. The evaluation will consider new scientific, technical and economic information and provide an assessment of the need to develop the next set of CWS targets and timelines to continue progress toward virtual elimination.

ADMINISTRATION:

Jurisdictions will review and renew Part 2 and Annex 1 five years from coming into effect.

Any party may withdraw from these Canada-Wide Standards upon three month's notice.

These Canada-Wide Standards comes into effect on May 1, 2001.

Annex 1

Dioxins and Furans CWS Reporting Framework

Introduction

Under the Harmonization Accord and its Canada-wide Environmental Standards Sub-Agreement, all jurisdictions are to report to the public and to Ministers on their progress towards achieving the CWSs for dioxins and furans.

This reporting framework is intended to provide a transparent and consistent mechanism for reporting by jurisdictions in a fashion which minimizes resource requirements for government and industry alike, while maximizing the availability of information on achievement of these standards.

The framework addresses:

- 1) frequency, timing and scope of reporting
- 2) guidance as to the means of determining compliance/achievement of the CWS
- 3) common measurement parameters for reporting purposes
- 4) data management and public reporting

Frequency, timing and scope of reporting

The reporting schedule will be tied into assessing the performance of the governments in meeting the benchmarks and timelines relevant to the standards. A report in 2004 will provide a means for tracking interim progress and report on additional technical studies (e.g. technology feasibility and pollution prevention options for the coastal pulp & paper sector). The 2008 report will indicate compliance with the standards for the coastal pulp and paper boiler and incineration sectors.

Jurisdictions will submit sectoral data for inclusion in the progress reports in a timely manner. To report on achievement of the CWS, a data report along with an assessment of progress will be compiled into a single report for Ministers and a public version will be posted on the CCME web site for public access.

Reports will be limited to information on those facilities which are subject to achievement and/or compliance with the Canada-wide Standards as endorsed by the Ministers of the Environment May 1, 2001 and as implemented variously by the responsible jurisdictions or industries. This information is intended to show compliance rates and performance characteristics in a manner which documents sectoral performance as well as jurisdictional performance. It is not intended to provide a facility-by-facility record of performance.

Means of determining compliance/achievement of the CWS

The Canada-wide Standards for dioxins and furans lend themselves to achievement through voluntary action, or through compliance with regulated or legally enforceable limits. As such, it is necessary to provide some means to ensure that a level playing field exists so that the numeric value provided in the CWS is applied equally or similarly in each jurisdiction. One means to do this is to require identical compliance procedures, but this may require that some jurisdictions apply compliance procedures for dioxins and furans CWSs that are different than those used for locally determined or regulated parameters such as SO₂, PM, ammonia, etc. An example is where the dioxins and furans CWS is expressed as the average of 3 stack tests, whereas a jurisdiction may normally utilize the median value of 3 tests to determine compliance.

In an effort to streamline implementation, each jurisdiction will determine the exact means of ensuring compliance/achievement in a manner consistent with the typical or desired programs for the affected facility/sector. It is anticipated that minor variations in jurisdictional requirements will result in minimal variation across the country which is insignificant with respect to the overall reduction activities which range from 50-99% for various facilities.

Common measurement parameters for reporting purposes

Each facility report will include specific measures corrected so as to be compatible and consistent for the purposes of public reporting. Dioxin and furan emissions must be corrected for the O₂ content of gases, to ensure compliance with the standards.

Each jurisdiction will determine the sector within which each subject facility will be reported. For example, a jurisdiction may determine that a small mixed waste incinerator (for example, burning both medical and municipal waste) may be subject to either standard, based upon the preponderance of waste (>50% as one type) or based upon the provincial designation of facility type. Sectoral assignments will be updated to reflect the most recent characteristics of the facility under consideration prior to reporting.

While little confusion is likely to exist over the implementation of dioxins and furans CWSs for “greenfield” facilities, it is possible that significantly expanded or modified facilities can/should be considered as new for the purposes of achievement/compliance with the dioxins and furans CWS. It will be the responsibility of the jurisdictions to determine at which point a facility no longer qualifies as an “existing” facility and must conform to the standard for “new or expanded” facilities as a result of significant modifications/alterations to the facility operations or physical plant.

Jurisdictions must report measurements that are below the detection limit in a consistent manner. These measurements should be reported as the limit of detection.

Large facilities will generally be required to perform stack tests at an annual frequency in order to demonstrate compliance. However, jurisdictions may vary the stack testing requirements for these facilities in cases where performance has been consistently demonstrated to be below the Level of Quantification (LoQ) as defined by Environment Canada. Where five years' data has been accumulated with all results reported below the LoQ, the stack testing frequency may be revised to a biennial schedule so long as all subsequent test results remain below the LoQ. For the purpose of reporting emissions, the most recent stack test results available should be used. Jurisdictions have the responsibility of deciding whether to implement this variance for all, some or none of the source types subject to these standards.

Data management and public reporting

Reports on achieving the CWSs will include a data report and a report on achievement of the standards. Sectoral and jurisdictional specific data will be supplied in a spreadsheet format to facilitate reporting. A consolidated report will be made available to all jurisdictions and to the Ministers, along with the draft public report, prior to formal release of the public report. The public report will be released upon approval by the Council of Ministers.

Jurisdictions will provide a report in spreadsheet format so that the data report and report on achievement can be prepared along with the public report for review and approval. Reports will be prepared and distributed to all jurisdictions prior to review by Ministers. Along with the report on achievement, a draft public report will be provided for review and consideration prior to the Ministers' meeting at which public release is anticipated. That public report will be posted to the CCME web site upon approval by the Ministers. Jurisdictions are encouraged to provide reference to the CCME web site and/or pointers in their own web sites in order to ensure a single location for dioxins and furans CWSs reporting should errors/miscalculations have to be corrected at some time.

In addition to the consolidated public reporting on dioxins and furans CWSs, jurisdictions must provide a contact for facility-specific information in the event that the public wishes to access compliance or achievement information. Such data will be supplied in a manner consistent with the normal data-reporting/compliance reporting procedures of the jurisdiction in question - the consolidated spreadsheet will not be made publicly available in that it may include proprietary (business) information.

**Canada-wide Standards for Dioxins and Furans
Emissions from Waste Incinerators and
Coastal Pulp and Paper Boilers**

Signed by:

British Columbia	Honourable Ian Waddell
Alberta	Honourable Lorne Taylor
Saskatchewan	Honourable Buckley Belanger
Manitoba	Honourable Oscar Lathlin
Ontario	Honourable Elizabeth Witmer
Environment Canada	Honourable David Anderson
New Brunswick	Honourable Kim Jardine
Nova Scotia	Honourable David Morse
Prince Edward Island	Honourable Chester Gillan
Newfoundland and Labrador	Honourable Ralph Wiseman Honourable Tom Lush
Yukon	Honourable Dale Eftoda
Northwest Territories	Honourable Joseph Handley
Nunavut	Honourable Olayuk Akesuk

Note: Québec has not endorsed the Canada-wide Accord on Environmental Harmonization or the Canada-wide Environmental Standards Sub-agreement.

Endorsed by CCME Council of Ministers - April 30-May 1, 2001, Winnipeg

Appendix D: Environmental Guideline for the General Management of Hazardous Waste

Environmental Guideline for the General Management of Hazardous Waste



Department of Environment
Government of Nunavut

GUIDELINE: GENERAL MANAGEMENT OF HAZARDOUS WASTE

Original: April 1999
Revised: January 2002
April 2010
October 2010

This Guideline has been prepared by the Department of Environment's Environmental Protection Division and approved by the Minister of Environment under the authority of Section 2.2 of the *Environmental Protection Act*.

This Guideline is not an official statement of the law and is provided for guidance only. Its intent is to increase the awareness and understanding of the risks and hazards associated with hazardous waste and to assist in its proper management. This Guideline does not replace the need for the owner or person in charge, management or control of a hazardous waste to comply with all applicable legislation and to consult with Nunavut's Department of Environment, other regulatory authorities and qualified persons with expertise in the management of hazardous waste.

Copies of this Guideline are available upon request from:

Department of Environment
Government of Nunavut
P.O. Box 1000, Station 1360, Iqaluit, NU, X0A 0H0
Electronic version of the Guideline is available at <http://env.gov.nu.ca/programareas/environmentprotection>

Cover Photos: E. Paquin

Table of Contents

Introduction	1
1.1 Definitions	1
1.2 Roles and Responsibilities	4
1.2.1 Environmental Protection Division	4
1.2.2 Generators of Hazardous Waste	4
1.2.3 Carriers of Hazardous Waste	5
1.2.4 Receivers of Hazardous Waste	6
1.2.5 Other Regulatory Agencies	6
Management of Hazardous Waste	9
2.1 What is Hazardous Waste?	9
2.2 Waste Management	9
2.2.1 Reduce and Minimize – the first option	10
2.2.2 Reuse and Recycle	10
2.2.3 Treatment and Disposal in Nunavut	10
2.2.4 Treatment and Disposal Outside Nunavut	11
General Requirements	13
3.1 Storage	13
3.1.1 Containers	13
3.1.2 Facilities	14
3.2 Registration	14
3.2.1 Hazardous Waste Generators, Carriers and Receivers	14
3.2.2 Hazardous Waste Management Facilities	15
3.3 Transportation	15
Conclusion	17
References	18

Appendices

Appendix 1	Environmental Protection Act
Appendix 2	Dangerous Goods Classifications
Appendix 3	Determining Regulatory Agency Contacts
Appendix 4	Registration Form – Hazardous Waste Generator
Appendix 5	Registration Form – Hazardous Waste Carrier
Appendix 6	Registration Form – Hazardous Waste Receiver
Appendix 7	Registration Form – Hazardous Waste Management Facility
Appendix 8	Criteria for Registering a Hazardous Waste Management Facility
Appendix 9	Hazardous Waste Manifest
Appendix 10	Waste Exchanges and Associations
Appendix 11	Government Contacts

Introduction

'Waste' is a term used to describe materials that are no longer wanted or are unusable for their original intended purpose. Many different types of waste are generated each day in Nunavut by industry and small business, hospitals and health centers, schools and individuals during the normal course of carrying out daily activities. Some types of waste pose greater risks than others because of their chemical, physical and biological properties. These wastes are generally referred to as being a 'hazardous waste'. Examples of hazardous waste include discarded paint, used solvents, motor and lubricating oil, cleaning compounds, certain building construction and demolition waste and products with an expired shelf life. They will generally exhibit one or more of the following characteristics - ignitable (i.e. flammable), reactive, corrosive or toxic. Hazardous waste often requires that specific management measures be taken to ensure the health and safety of the environment, workers and the general public.

The purpose of the Environmental Guideline for the General Management of Hazardous Waste (the Guideline) is to ensure the safe, effective and efficient management of hazardous waste in Nunavut. It provides information to generators, carriers and receivers of hazardous waste on its hazards, how best to reduce or eliminate the effects it can have on the environment, worker and public safety and guidance on its storage, registration and transportation.

The *Environmental Protection Act* enables the Government of Nunavut to implement measures that preserve, protect and enhance the quality of the environment. Section 2.2 of the *Act* provides the Minister with authority to develop, coordinate, and administer the Guideline.

The Guideline is not an official statement of the law. For further information and guidance, the owner or person in charge, management or control of a hazardous waste is encouraged to review all applicable legislation and consult the Department of Environment, other regulatory agencies or qualified persons with expertise in hazardous waste management.

1.1 Definitions

<i>Carrier</i>	A person who accepts hazardous waste for transportation or transports hazardous waste, whether or not for hire or reward. A carrier is also referred to as a transporter of hazardous waste.
<i>Commercial</i>	Actions undertaken for hire or reward.
<i>Commissioner's Land</i>	Lands that have been transferred by Order-in-Council to the Government of Nunavut. This includes roadways and land subject to block land transfers. Most Commissioner's Land is located within municipalities.
<i>Consignee</i>	A person to whom hazardous waste is being or is intended to be transported. A consignee is also referred to as a receiver of hazardous waste.

Guideline for the General Management of Hazardous Waste

<i>Consignor</i>	A person who has possession of hazardous waste immediately before it is transported. A consignor may also be a generator of hazardous waste.
<i>Contaminant</i>	Any noise, heat, vibration or substance and includes such other substance as the Minister may prescribe that, where discharged into the environment, (a) endangers the health, safety or welfare of persons, (b) interferes or is likely to interfere with normal enjoyment of life or property, (c) endangers the health of animal life, or (d) causes or is likely to cause damage to plant life or to property.
<i>Dangerous Good</i>	Any product, substance or organism included by its nature or by the <i>Transportation of Dangerous Goods Regulations</i> in any of the classes listed in the Schedule provided in the <i>Transportation of Dangerous Goods Act</i> (Canada).
<i>Empty Container</i>	A container that previously held a hazardous waste and has been emptied to the greatest extent practical or triple rinsed with an appropriate cleaning agent. This does not include containers that previously contained mercury or Class 2.3, 5.1 or 6.1 materials.
<i>Environment</i>	Means the components of the Earth and includes (a) air, land and water, (b) all layers of the atmosphere, (c) all organic and inorganic matter and living organisms, and (d) the interacting natural systems that include components referred to in paragraphs (a) to (c) above.
<i>Generator</i>	The owner or person in charge, management or control of a hazardous waste at the time it is generated or a facility that generates a hazardous waste. A generator may also be a consignor of hazardous waste.
<i>Hazardous Waste</i>	A contaminant that is a dangerous good and is no longer wanted or is unusable for its original intended purpose and is intended for storage, recycling, treatment or disposal. A hazardous waste does not include a contaminant that is (a) household in origin; (b) exempted as a small quantity; (c) returned directly to a manufacturer or supplier of the product, substance or organism for reprocessing, repackaging or resale for any reason; (d) an empty container; or (e) intended for disposal in a landfill or a sewage treatment facility and meets the applicable standards set out in the Environmental Guideline for Industrial Waste Discharges.

Guideline for the General Management of Hazardous Waste

<i>Hazardous Waste Management Facility</i>	A commercial facility used for the collection, storage, transfer, treatment, recycling or disposal of a hazardous waste. For clarity, a hazardous waste management facility does not include a municipal landfill or sewage lagoon.
<i>Incompatible Hazardous Waste</i>	A hazardous waste that, when in contact with another substance or hazardous waste under normal circumstances, reacts to produce heat, gas, fire, explosion or a corrosive or toxic substance.
<i>Landfilling</i>	The intentional depositing or placement of waste in or on land for the purposes of disposal.
<i>Long-term Storage</i>	The storage of hazardous waste for a period of 180 days or more.
<i>Manifest</i>	The manifest as set out in Schedule IX to the <i>Export and Import of Hazardous Waste and Hazardous Recyclables Regulations</i> under the <i>Canadian Environmental Protection Act</i> (Canada).
<i>Minister</i>	The Minister of Environment of the Government of Nunavut.
<i>Qualified Person</i>	A person who has an appropriate level of knowledge and experience in all relevant aspects of hazardous waste management.
<i>Receiver</i>	A person to whom hazardous waste is being or is intended to be transported. A receiver is also referred to as a consignee of hazardous waste.
<i>Responsible Party</i>	The owner or person in charge, management or control of the hazardous waste.
<i>Small Quantity</i>	Hazardous waste that is generated in an amount that is less than five kilograms per month if a solid or less than five litres per month if a liquid, and where the total quantity accumulated at any one time does not exceed five kilograms or five litres. This does not include hazardous waste that is mercury or Class 2.3, 5.1 or 6.1 materials. These wastes must be generated in an amount that is less than one kilogram per month if a solid or less than one litre per month if a liquid, and where the total quantity accumulated at any one time does not exceed one kilogram or one litre.
<i>Transport Authority</i>	The statute and regulations controlling the management of hazardous waste under that mode of transport. These include (a) Road and Rail - <i>Transportation of Dangerous Goods Act</i> (Canada) and <i>Regulations</i> ; <i>Interprovincial Movement of Hazardous Waste Regulations</i> (CEPA) and <i>Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations</i> (CEPA). (b) Air – <i>International Air Transport Association (IATA) Dangerous Goods Regulations</i> and <i>International Civil Aviation Organization (ICAO) Technical Instructions</i> ; and

(c) Marine – *International Maritime Dangerous Goods Code* (IMDG).

<i>Transfer</i>	The temporary storage of hazardous waste for a period of 179 days or less for the purpose of changing from one vehicle or means of transportation to another.
<i>Transporter</i>	A person who accepts hazardous waste for transportation or transports hazardous waste, whether or not for hire or reward. A transporter is also referred to as a carrier of hazardous waste.
<i>Waste Audit</i>	An inventory or study of the amount and type of waste that is produced at a location.

1.2 Roles and Responsibilities

1.2.1 Environmental Protection Division

The Environmental Protection Division of the Department of Environment is the key environmental agency responsible for ensuring the proper management of hazardous waste and other contaminants on Commissioner's Land. Authority is derived from the *Environmental Protection Act*, which prohibits the discharge of contaminants to the environment and enables the Minister to undertake actions to ensure appropriate management measures are in place. Although programs and services are applied primarily to activities taking place on Commissioner's and municipal lands and to Government of Nunavut undertakings, the *Environmental Protection Act* may be applied to the whole of the territory where other controlling legislation, standards and guidelines do not exist. A complete listing of relevant legislation and guidelines can be obtained by contacting the Department of Environment or by visiting the web site at <http://env.gov.nu.ca/programareas/environmentprotection>.

The Department of Environment will provide advice and guidance on the proper management of hazardous waste. However, it remains the responsibility of the owner or person in charge, management or control of the hazardous waste to ensure compliance with all applicable statutes, regulations, standards, guidelines and local by-laws.

1.2.2 Generators of Hazardous Waste

The generator is the owner or person in charge, management or control of the hazardous waste at the time it is produced or of the facility that produces the hazardous waste. The generator is responsible for any and all hazardous waste produced and must ensure the hazardous waste is properly and safely managed from the time it is generated to its final disposal. This is referred to as managing the waste from cradle-to-grave.

Contractors may manage hazardous waste on behalf of the generator. However, the generator remains responsible for determining whether the waste is hazardous and ensuring the method of management complies with all applicable statutes, regulations, standards, guidelines and local by-laws. If the contractor does not comply with the requirements of the *Environmental Protection Act* and is charged with a violation while managing the waste, the generator may also be held liable.

The basic responsibilities of a hazardous waste generator in Nunavut are:

- Registering with the Department of Environment as a generator of hazardous waste.
- Registering the facility with the Department of Environment as a hazardous waste management facility where the facility is used for commercial purposes and is intended for the storage of hazardous waste for a period of 180 days or more, where stored quantities exceed the criteria set out in Appendix 8 or where hazardous waste is recycled, treated or disposed of in quantities in any single month that exceed a 'small quantity'.
- Classifying and labeling hazardous waste in accordance with the Transport Authority.
- Managing the hazardous waste in accordance with the Guideline, *Environmental Protection Act*, *Fire Prevention Act*, *Safety Act*, *Public Health Act* and all other applicable statutes, regulations, standards, guidelines and local by-laws.
- Reusing, recycling, treating or disposing of the hazardous waste in a proper and safe manner.
- Where the hazardous waste is transported off-site, completing Part A of the waste manifest form and retaining a copy for two years, using a registered hazardous waste carrier to transport the waste and sending the waste to a registered receiver or hazardous waste management facility.
- Ensuring staff are trained and qualified to safely handle the hazardous waste.
- Filing a spill contingency plan with the Minister where stored quantities of hazardous waste exceed the criteria set out in Schedule A of the *Spill Contingency Planning and Reporting Regulations*.
- Reporting any spill immediately to the NWT/Nunavut Spill Report Line at (867) 920-8130.

Further information and application forms for registering as a generator or a hazardous waste management facility are available from the Department of Environment. Refer to sections 3.2.1 and 3.2.2 and Appendices 4 and 7 for further information.

1.2.3 Carriers of Hazardous Waste

Hazardous waste must be transported in accordance with the appropriate Transport Authority: Road and Rail - *Transportation of Dangerous Goods Act* (Canada) and *Regulations, Interprovincial Movement of Hazardous Waste Regulations* (CEPA) and *Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations* (CEPA); Air – *International Air Transport Association (IATA) Dangerous Goods Regulations* and *International Civil Aviation Organization (ICAO) Technical Instructions*; and Marine – *International Maritime Dangerous Goods Code (IMDG)*.

Carriers operating in Nunavut must be registered with the Department of Environment before transporting hazardous waste. Other basic responsibilities of hazardous waste carriers are:

- Placarding and labeling all transport vehicles and containers in accordance with the appropriate Transport Authority.
- Completing Part B of the waste manifest form and retaining a copy for two years.
- Accepting hazardous waste only from registered generators and safely transporting hazardous waste only to a registered receiver or hazardous waste management facility.
- Ensuring staff are trained and qualified to safely transport hazardous waste.
- Reporting any spill immediately to the NWT/Nunavut Spill Report Line at (867) 920-8130.

Further information and application forms for registering as a hazardous waste carrier are available from the Department of Environment. Refer to section 3.2.1 and Appendix 5 for further information.

1.2.4 Receivers of Hazardous Waste

Any person receiving or accepting hazardous waste in Nunavut for the purpose of storage, transfer, reuse, recycling, treatment or disposal must be registered with the Department of Environment as a hazardous waste receiver. The facility must also be registered as a hazardous waste management facility where it is used for commercial purposes and is used to store hazardous waste for a period of 180 days or more, store quantities that exceed the criteria set out in Appendix 8 or hazardous waste is recycled, treated or disposed of in quantities in any single month that exceed a 'small quantity'. Other basic responsibilities of hazardous waste receivers in Nunavut are:

- Handling and storing the hazardous waste in accordance with the Guideline, *Environmental Protection Act*, *Fire Prevention Act*, *Safety Act*, *Public Health Act* and all other applicable statutes, regulations, standards, guidelines and local by-laws.
- Reusing, recycling, treating or disposing of the hazardous waste in a proper and safe manner.
- Completing Part C of the waste manifest form and retaining a copy for two years.
- Accepting hazardous waste only from registered generators and carriers.
- Ensuring staff are trained and qualified to safely handle hazardous waste.
- Filing a spill contingency plan with the Minister where stored quantities of hazardous waste exceed the criteria set out in Schedule A of the *Spill Contingency Planning and Reporting Regulations*.
- Reporting any spill immediately to the NWT/Nunavut Spill Report Line at (867) 920-8130.

Further information and application forms for registering as a receiver or hazardous waste management facility are available from the Department of Environment. Refer to sections 3.2.1 and 3.2.2 and Appendices 6 and 7 for further information.

1.2.5 Other Regulatory Agencies

Other regulatory agencies may have to be consulted regarding the management of hazardous waste as there may be other environmental or public and worker health and safety issues to consider. Some of the other agencies include:

Department of Economic Development and Transportation

The Motor Vehicles Division is responsible for ensuring the safe transport of hazardous waste and other dangerous goods by road through administration of the *Transportation of Dangerous Goods Act*. The Department is also responsible under the *Motor Vehicles Act* for driver licensing and various other vehicle and load safety matters.

Workers' Safety and Compensation Commission

The Workers' Safety and Compensation Commission is responsible for promoting and regulating worker and workplace health and safety in Nunavut. The Commission derives its authority from the *Workers' Compensation Act* and *Safety Act* which require an employer to maintain a safe workplace and ensure the safety and well being of workers. The Workplace Hazardous Materials Information System, or WHMIS, requires information be provided to workers on the safe use of any hazardous material used in the workplace. All hazardous waste generators, carriers and receivers should consult the Prevention Services Division for further information and guidance.

Department of Community and Government Services

The Department of Community and Government Services is responsible under the *Commissioners' Lands Act* for the issuance of land leases, reserves, licenses and permits on Commissioner's Lands. The Department, in cooperation with communities, is also responsible for the planning and funding of municipal solid waste and sewage disposal facilities in most Nunavut communities. Emergency planning responsibilities under the *Emergency Measures Act* include developing territorial emergency response plans, coordinating emergency operations at the territorial and regional levels and supporting community emergency response operations.

The Office of the Fire Marshal is responsible for ensuring the safe storage, handling and use of flammable and combustible liquids and materials. The Office of the Fire Marshal derives its authority from the *Fire Prevention Act*, National Fire Code and National Building Code.

Department of Health and Social Services

Activities related to the generation, storage, transportation, treatment and disposal of hazardous waste may have an impact on public health. The Office of the Chief Medical Officer of Health and Regional Environmental Health Officers should be consulted regarding legislated requirements under the *Public Health Act*.

Environment Canada

Environment Canada is responsible under the *Canadian Environmental Protection Act* for ensuring the safe management of designated hazardous waste at federal facilities and on federal lands. The management, disposal and export of polychlorinated biphenyl (PCB) waste is controlled under the *PCB Regulations*, the *Federal Mobile PCB Treatment and Destruction Regulations* and the *PCB Waste Export Regulations*. The interprovincial and international transport of waste is controlled under the *Interprovincial Movement of Hazardous Waste Regulations* and the *Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations*. Environment Canada is also responsible for administering the pollution prevention provisions of the federal *Fisheries Act*.

Indian and Northern Affairs Canada

Indian and Northern Affairs Canada is responsible under the *Territorial Lands Act* and *Nunavut Waters and Nunavut Surface Rights Tribunal Act* for the management of federal lands and waters in Nunavut, including the impact hazardous waste may have on the quality of these lands and waters.

Natural Resources Canada

The *Explosives Act* provides Natural Resources Canada with authority to manage explosives in Canada, including waste explosives. The Canadian Nuclear Safety Commission, which reports to Parliament through the Minister of Natural Resources, administers the safe handling and disposal of radioactive materials and licenses institutions and companies to possess and use radioactive materials under the *Nuclear Safety and Control Act* and *Nuclear Liability Act*.

Local Municipal Governments

The role of municipal governments is important in the proper local management of hazardous waste. Under the Nunavut Land Claim Agreement, municipalities are entitled to control their own municipal disposal sites. Hazardous waste may be deposited into municipal landfill sites and sewage treatment facilities only with the consent of the local government. Local environmental and safety standards are determined, in part, by how the property is designated under municipal government development plans (i.e. land use zoning). The local fire department may also be called upon if a fire or other public safety issue is identified.

Co-management Boards and Agencies

Co-management boards and agencies established under the Nunavut Land Claim Agreement have broad authority for land use planning, impact assessment and the administration of land and water. Activities involving hazardous waste may be controlled through the setting of terms and conditions in plans, licenses and permits issued by the Nunavut Water Board and other co-management boards and agencies.

Appendix 3 provides further assistance in determining the primary regulatory agency contact for managing hazardous waste in Nunavut.

Appendix 11 provides mailing addresses, phone and fax numbers for each of the regulatory agencies.

Management of Hazardous Waste

2.1 What is Hazardous Waste?

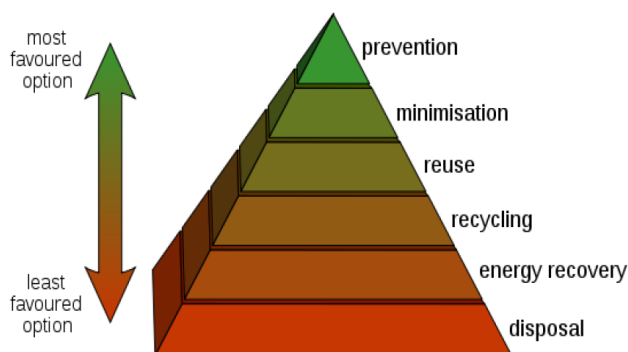
Hazardous waste is unwanted material or products that can cause illness or death to people, plants and animals. It may be a liquid, solid, sludge or gas and contain chemicals, heavy metals, radioactives, infectious organisms or other toxic substances. It may be a single product or a combination of many hazardous and non-hazardous materials (i.e. mixed waste). Its harmful effects may exist for a relatively short period of time (i.e. oil-based paint before hardening) or continue for hundreds of years. It can persist in soil, water and sediment (i.e. radioactive materials) or bioaccumulate in plants and animals (i.e. mercury, PCBs).

Hazardous waste is generated by everybody. Households commonly generate unwanted gasoline, brake and windshield wiper fluid, cleaning supplies, paints and paint thinners, lead acid batteries, used computer equipment and construction materials (i.e. asbestos), pesticides and others. Hospitals and nursing stations generate unwanted needles and waste human tissue, body fluids and biotic cultures. Business and industry generate many different types of hazardous waste including used motor and lubricating oil, cleaning solvent, drilling fluid and cuttings and mine tailings.

2.2 Waste Management

Proper waste management simply makes good sense. Minimizing or eliminating the generation of hazardous and other waste helps to reduce the hazards and costs associated with its handling, storage, transport, recycling, treatment and disposal. It also reduces the impacts waste could have on the environment, human and worker health and safety and reduces the global emission of greenhouse gases by minimizing the use of raw materials. Another term commonly used to describe activities that reduce the amount of material entering a waste stream or being released to the environment is 'pollution prevention'.

Once a waste is created, the generator is responsible for its safe management from cradle-to-grave. Waste generators can prevent pollution and reduce costs by implementing various waste reduction, reuse and recycling programs through changes to operational procedures, maintenance practices and raw material use. Treating and disposing of waste either locally or outside of Nunavut should be considered only if reuse and recycling options are not available or practical.



2.2.1 Reduce and Minimize – the first option

Using raw materials efficiently and reducing the amount of waste generated is the first and most important step in effective waste management. Both environmentally and economically, consuming less is the most fundamental and effective step to reducing waste.

A waste audit should be undertaken to inventory and study the waste produced at a location or business. The audit should identify the type and amount of waste being generated, the costs of current management methods including handling, storage, treatment, transport and disposal, and examine opportunities and set targets for reducing or reusing waste. These opportunities include awareness and education, the substitution or reduction of purchased raw materials, production redesign, process changes and improved maintenance activities. Other opportunities include purchasing products that are durable or are manufactured from environmentally-friendly materials (i.e. biodegradable or post-consumer materials), avoiding products that are designed for single or short life usage and buying only the quantity that is needed. Effective communications is critical to the success of any waste reduction program.

2.2.2 Reuse and Recycle

Even with effective waste reduction measures in place there will be waste generated. Reusing the waste product for a different but related purpose (reuse) or producing a new product from the original material (recycle) is an effective way to reduce the volume of waste. The waste audit should identify whether opportunities are available for reusing or recycling waste within the generating facility. Alternatively, other local or distant users may be found to reuse or recycle the waste that would otherwise require treatment or disposal.

The Department of Environment encourages the reuse and recycling of hazardous and other waste in the following ways:

- Local reuse and recycle programs are available in various communities for some types of hazardous waste including used oil and waste fuel. Generators should contact the Department of Environment or local municipal government for the names of registered waste receivers or other opportunities to reuse or recycle wastes locally.
- Waste exchanges and associations offer opportunities for waste generators to transfer unwanted, overstocked, obsolete, damaged, contaminated and post-dated material to another person or company that can use it. In some cases, the receiving company will purchase the waste from the generator. Appendix 10 provides a listing of several waste exchanges and associations in Canada.

2.2.3 Treatment and Disposal in Nunavut

Treatment and disposal of a hazardous waste is the last step in effective waste management and should be undertaken only after all other practical reuse and recycle options have been examined.

Treatment covers a broad spectrum of activities. It includes any method, technique or process that will change the physical, chemical or biological character or composition of a hazardous waste so as to reduce its volume, neutralize or make the waste less hazardous and make it safer to transport or store

prior to its disposal. In some cases, more than one process may be required to treat the waste. Facilities in Nunavut at which hazardous waste is stored, treated, recycled or disposed of for commercial purposes must be registered as a hazardous waste management facility. The owner or operator of a facility should refer to section 3.2.2 and Appendix 7 for further information.

It is a contravention of the *Environmental Protection Act* for hazardous waste to be abandoned or disposed of on land or into water in Nunavut. Although a detailed discussion on specific hazardous waste disposal methods is beyond the scope of the Guideline, the following are general points for consideration:

- Hazardous waste must not be mixed or diluted with another substance, or divided into smaller quantities, simply to avoid meeting the definition of a hazardous waste.
- The generator is responsible for determining how hazardous waste can be safely disposed of and to comply with all applicable statutes, regulations, standards, guidelines and local by-laws. The Department of Environment will provide advice and guidance on the management of hazardous waste. Other sources of information and assistance include:
 - Manufacturer or distributor of the new product;
 - Manufacturer's Material Safety Data Sheets (MSDS); and
 - Waste exchanges and associations, other regulatory authorities, waste management consultants and other qualified persons with expertise in the management of hazardous waste.
- Hazardous waste that meets standards set out in the Environmental Guideline for Industrial Waste Discharges may be directed to municipal landfills and sewage treatment systems for disposal. The local municipal government must be consulted and consent to the use of their facility prior to the waste being disposed. Waste that does not meet the standards set out in the Environmental Guideline for Industrial Waste Discharges must be treated prior to disposal or transported to a facility that is registered to accept the waste.
- The open burning of hazardous waste is not an acceptable practice as toxic substances may be released into the atmosphere.
- Incompatible hazardous waste should not be mixed, combined or stored together in the same container as new hazards may be created. Combining or mixing one waste with another waste may also prevent its reuse or recycling and increase disposal costs.
- Containers that previously held a hazardous waste must be emptied to the greatest extent practical or triple rinsed with an appropriate cleaning agent prior to disposal. The rinsings must then also be managed according to their waste characteristics. Cleaned containers should be rendered unusable by puncturing or crushing prior to disposal to prevent their reuse. This is especially important for containers that could be reused for water or food storage.

The Department of Environment will consider alternate hazardous waste management and disposal measures that provide an equivalent level of environmental protection to those identified in this Guideline.

2.2.4 Treatment and Disposal Outside Nunavut

Hazardous waste can be sent to a receiver or hazardous waste management facility located outside of Nunavut only where the receiver or facility has been registered in the receiving province or territory to

accept that waste. The generator must comply with all applicable statutes, regulations, standards, guidelines and local by-laws of the receiving jurisdiction.

Within Canada, Environment Canada monitors and controls the interprovincial movement of hazardous waste under the *Interprovincial Movement of Hazardous Waste Regulations*. Waste manifests must accompany each shipment of waste in accordance with the Transport Authorities' requirements. Generators and carriers should refer to section 3.3 of the Guideline for additional information on transport and waste manifest requirements.

The international movement of hazardous waste is controlled under the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. Known simply as the Basel Convention, it is an international treaty to control and reduce the transfer of hazardous waste from developed to less developed countries. Environment Canada monitors and controls the international movement of hazardous waste under the *Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations*.

A listing of Canadian waste management facilities may be obtained by contacting the waste exchanges and other organizations listed in Appendix 10.

General Requirements

Hazardous waste is classified using the system developed under the *Transportation of Dangerous Goods Act (Canada)*. Wastes are categorized into one of nine classes according to their chemical, physical or biological properties. Each waste, or group of similar wastes, is then identified using a specific 'UN' number assigned under the *Transportation of Dangerous Goods Regulations*. Refer to Appendix 2 for additional information on dangerous goods classifications.

3.1 Storage

Storage refers to containment of a hazardous waste for transport, or while awaiting treatment and disposal. Except under extraordinary circumstances (i.e. radioactive materials), storage should always be considered as a temporary measure and is not acceptable for the long-term management of hazardous waste.

Recognition of the incompatibility of different wastes during storage is important in order to avoid the possibility of violent, explosive reactions and toxic fumes. Various systems have been developed to ensure compatible storage including the 'Hazardous Waste Compatibility Chart' adopted by the United States' Environmental Protection Agency¹.

3.1.1 Containers

Hazardous waste storage containers are designed to hold, store and transport small quantities of waste. Many different types of containers are available (i.e. barrels, bottles, bags and boxes) and are made from a variety of materials (i.e. aluminum, plastic, steel, and stainless steel). Selecting the proper container requires an understanding of the properties of the waste to be stored. If transport is to be undertaken, the generator should consult the Transport Authority to confirm the container meets all legislated requirements.

The following are additional general points for consideration:

- Hazardous waste should be stored in their original containers where possible or in containers specially manufactured for the purpose of storing hazardous waste. The containers must be sound, sealable and not damaged or leaking.
- Containers should be clearly labeled to identify their contents according to requirements of the Workplace Hazardous Materials Information System (WHMIS) and the relevant Transport Authority, if transport is planned.
- Small quantities of compatible hazardous waste should be bulked into 16 gauge or equivalent metal or plastic 205 litre (45 gallon) drums for the purpose of secondary containment.
- Containers should be closed and sealed at all times, except while waste is being added or removed.

¹ EPA-600/2-80-076 April 1980. A Method for Determining the Compatibility of Chemical Mixtures.

3.1.2 Facilities

A hazardous waste storage facility is a specially designed building or area that helps to ensure the safe and secure storage of hazardous waste. Detailed storage facility building designs are beyond the scope of the Guideline. The Department of Environment or other qualified person should be consulted prior to designing and constructing a storage facility.

The following are general points to consider when establishing a storage facility:

- The facility should meet all local and territorial siting and construction requirements and be readily accessible for fire fighting and other emergency responses. The local Fire Chief should be advised of the storage facility and its contents for emergency planning and response purposes.
- The facility should be secure. Access should be limited where practical to employees who have been trained in safety and emergency procedures. These procedures should be documented and a copy made available to those employees who have access to the facility.
- Inspections of the facility and stored wastes should be performed and recorded at least once every week.
- Containers should be placed so that each can readily and easily be inspected for signs of leakage, corrosion or deterioration. Leaking, corroded or deteriorated containers should immediately be removed and their contents transferred to a sound container.
- Records should be maintained indicating the type and quantity of waste being stored along with the date, type and quantity of hazardous waste brought into or removed from the facility.
- Drainage into and from the storage facility site should be controlled to prevent spills or leaks from leaving the site and to prevent run-off from entering the site.
- All waste should be stored on a firm working surface that is impervious to leaks.
- Incompatible waste must be stored in a manner that contact in the event of a spill or accidental release is not possible.
- Emergency response plans should be developed in cooperation with local emergency response personnel and emergency response equipment should be locally available in the event of a spill, fire or other emergency situation.

Where the facility is used for commercial purposes and is used to store hazardous waste for periods of 180 days or more or the quantity of waste stored on-site exceeds the criteria set out in Appendix 8, the facility must be registered with the Department of Environment as a hazardous waste management facility.

3.2 Registration

3.2.1 Hazardous Waste Generators, Carriers and Receivers

Generators, carriers and receivers of hazardous waste must be registered before undertaking activities involving these wastes. Completion of the approved form and submission of accurate information enables the Department of Environment to quickly complete the registration process. Registration enables the government to track the generation, transport and disposal of hazardous waste in Nunavut. It also provides assurance that the company has the necessary emergency response and spill

contingency plans in place should an accident or other incident occur involving a hazardous waste. Upon registration, the applicant will be assigned a unique identification number. This number is required in order to complete the waste manifest form.

Appendices 4, 5 and 6 provide samples of registration forms required for generators, carriers and receivers to apply for registration in Nunavut. Original forms and users' guides are available from Nunavut's Department of Environment or by downloading through the department's web site. Incomplete applications will result in delays in completing the registration process.

Generators and receivers of hazardous waste located in Nunavut must be registered with the Department of Environment. Carriers may be registered either in Nunavut or in the province or territory in which the company is based.

3.2.2 Hazardous Waste Management Facilities

A hazardous waste management facility is a facility or specially-designated area that is used for the collection, storage, transfer, treatment, recycling or disposal of hazardous waste for commercial purposes. Where the facility is used solely for the collection, storage or transfer of hazardous waste, the facility must be registered where waste is stored for a period of 180 days or more or the quantities exceed those set out in Appendix 8 of the Guideline. Where the facility is to be used for the treatment, recycling or disposal of hazardous waste, the facility must be registered where the quantity treated, recycled or disposed of in any single month exceeds a 'small quantity'.

The collection, storage, transfer, treatment, recycling or disposal of hazardous waste on behalf of a third-party does not remove the obligation of the owner or operator of a hazardous waste management facility to register the facility.

Appendix 7 includes a sample of the registration form required for the owner or operator of a hazardous waste management facility to apply for registration of the facility. The owner or operator may obtain an original form and users' guide by contacting Nunavut's Department of Environment or by downloading through the department's web site. Incomplete applications will result in delays in completing the registration process.

Registration of a hazardous waste management facility does not remove the obligation to comply with all other applicable municipal, territorial and federal statutes, regulations, standards, guidelines and by-laws. Guidance on planning for and achieving territorial environmental requirements for new industrial projects may be found in the *Environmental Guideline for Industrial Projects on Commissioner's Lands*.

3.3 Transportation

Carriers must ensure hazardous waste is packaged, documented, labeled and placarded in compliance with the method of transport used - road, rail, air or marine. A completed waste manifest must accompany each shipment of hazardous waste. Completion of the manifest together with proper marking and placarding of containers and vehicles enables police, ambulance, fire and other first responders to react effectively and safely in the event of a spill or other accident involving hazardous waste while in transit.

The transport of hazardous waste by road in Canada is controlled under the territorial and federal *Transportation of Dangerous Goods Acts* and the federal *Interprovincial Movement of Hazardous Waste Regulations* and *Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations*. These Acts and Regulations require that personnel are trained, containers and transport vehicles are labeled and placarded and a completed waste manifest accompanies each shipment. The generator, carrier and receiver must each complete their portion of the manifest form and provide copies to the Department of Environment at various stages in the transport process. Refer to Appendix 9 for a copy of the manifest. Original manifest forms are available from Nunavut's Department of Environment and completion instructions are included on the reverse side of each manifest. Further assistance in completing a waste manifest may be obtained by referring to the *User's Guide for the Hazardous Waste Manifest* produced by Environment Canada or by contacting the Motor Vehicles Division of the Department of Economic Development and Transportation.

The International Air Transport Association (IATA) requires that all shipments of hazardous wastes tendered to air carriers be accompanied by the IATA Shipper's Declaration of Dangerous Goods. The consignor is responsible for completion of the form in accordance with IATA requirements and to ensure all packaging, placarding and labeling is consistent with the product being transported.

The International Marine Dangerous Goods Code requires use of the International Marine Organization's Multimodal Dangerous Goods Form when transporting dangerous goods or hazardous waste by ship or barge.

Further information on transporting hazardous waste by air or marine can be obtained by contacting Transport Canada. Information and instructions on manifesting, placarding and labeling hazardous waste commonly generated in Nunavut can be obtained by referring to waste-specific guidelines produced by the Department of Environment. A complete listing of guidelines is available at <http://env.gov.nu.ca/programareas/environmentprotection>.

Conclusion

This is a general introduction to the risks associated with hazardous waste and is intended to inform the reader about the proper handling, storage and transportation of hazardous waste in Nunavut. Detailed guidance on the management of specific waste types can be obtained by referring to other guidelines developed by the Department of Environment.

For additional information on the management of hazardous waste, or to obtain a complete listing of available guidelines, contact the Department of Environment at:

Environmental Protection Division
Department of Environment
Government of Nunavut
Inuksugait Plaza, Box 1000, Station 1360
Iqaluit, Nunavut, X0A 0H0

Phone: (867) 975-7729

Fax: (867) 975-7739

Email: EnvironmentalProtection@gov.nu.ca

Website: <http://env.gov.nu.ca/programareas/environmentprotection>

References

Government of Alberta, Department of Environment. Alberta Users Guide for Waste Managers, (Catalogue # ENV-266-O/P).

Government of Alberta, Department of Environment. Hazardous Waste Storage Guidelines, (1988).

Government of the Northwest Territories, Department of Environment and Natural Resources. User's Guide for Hazardous Waste Movement Documents in the NWT, (2009).

Government of the Northwest Territories, Department of Municipal and Community Affairs. Guidelines for the Planning, Design, Operations and Maintenance of Modified Solid Waste Sites in the Northwest Territories, (2003).

Government of Nunavut, Department of Environment. Environmental Guideline for General Management of Hazardous Waste, (2002).

Government of Nunavut, Department of Environment. Environmental Guideline for Industrial Projects on Commissioner's Lands, (2002).

Government of Nunavut, Department of Environment. Environmental Guideline for Industrial Waste Discharges, (2002).

APPENDICES

APPENDIX 1 - ENVIRONMENTAL PROTECTION ACT

The following are excerpts from the *Environmental Protection Act*

1. "Contaminant" means any noise, heat, vibration or substance and includes such other substance as the Minister may prescribe that, where discharged into the environment,
 - (a) endangers the health, safety or welfare of persons,
 - (b) interferes or is likely to interfere with normal enjoyment of life or property,
 - (c) endangers the health of animal life, or
 - (d) causes or is likely to cause damage to plant life or to property;

"Discharge" includes, but not so as to limit the meaning, any pumping, pouring, throwing, dumping, emitting, burning, spraying, spreading, leaking, spilling, or escaping;

"Environment" means the components of the Earth and includes

 - (a) air, land and water,
 - (b) all layers of the atmosphere,
 - (c) all organic and inorganic matter and living organisms, and
 - (d) the interacting natural systems that include components referred to in paragraphs (a) to (c).

"Inspector" means a person appointed under subsection 3(2) and includes the Chief Environmental Protection Officer.
- 2.2 The Minister may
 - (a) establish, operate and maintain stations to monitor the quality of the environment in the Territories;
 - (b) conduct research studies, conferences and training programs relating to contaminants and to the preservation, protection or enhancement of the environment;
 - (c) develop, co-ordinate and administer policies, standards, guidelines and codes of practice relating to the preservation, protection or enhancement of the environment;
 - (d) collect, publish and distribute information relating to contaminants and to the preservation, protection or enhancement of the environment;
3. (1) The Minister shall appoint a Chief Environmental Protection Officer who shall administer and enforce this Act and the regulations.

(2) The Chief Environmental Protection Officer may appoint inspectors and shall specify in the appointment the powers that may be exercised and the duties that may be performed by the inspector under this Act and regulations.
5. (1) Subject to subsection (3), no person shall discharge or permit the discharge of a contaminant into the environment.

(3) Subsection (1) does not apply where the person who discharged the contaminant or permitted the discharge of the contaminant establishes that

 - (a) the discharge is authorized by this Act or the regulations or by an order issued under this Act or the regulations;
 - (b) the contaminant has been used solely for domestic purposes and was discharged from within a dwelling house;
 - (c) the contaminant was discharged from the exhaust system of a vehicle;
 - (d) the discharge of the contaminant resulted from the burning of leaves, foliage, wood, crops or stubble for domestic or agricultural purposes;

- (e) the discharge of the contaminant resulted from burning for land clearing or land grading;
 - (f) the discharge of the contaminant resulted from a fire set by a public official for habitat management of silviculture purposes;
 - (g) the contaminant was discharged for the purposes of combating a forest fire;
 - (h) the contaminant is a soil particle or grit discharged in the course of agriculture or horticulture; or
 - (i) the contaminant is a pesticide classified and labelled as "domestic" under the *Pest Control Products Regulations* (Canada).
- (4) The exceptions set out in subsection (3) do not apply where a person discharges a contaminant that the inspector has reasonable grounds to believe is not usually associated with a discharge from the excepted activity.
- 5.1. Where a discharge of a contaminant into the environment in contravention of this Act or the regulations or the provisions of a permit or license issued under this Act or the regulations occurs or a reasonable likelihood of such a discharge exists, every person causing or contributing to the discharge or increasing the likelihood of such a discharge, and the owner or the person in charge, management or control of the contaminant before its discharge or likely discharge, shall immediately:
- (a) subject to any regulations, report the discharge or likely discharge to the person or office designated by the regulations;
 - (b) take all reasonable measures consistent with public safety to stop the discharge, repair any damage caused by the discharge and prevent or eliminate any danger to life, health, property or the environment that results or may be reasonably expected to result from the discharge or likely discharge; and
 - (c) make a reasonable effort to notify every member of the public who may be adversely affected by the discharge or likely discharge.
6. (1) Where an inspector believes on reasonable grounds that a discharge of a contaminant in contravention of this Act or the regulations or a provision of a permit or license issued under this Act or the regulations has occurred or is occurring, the inspector may issue an order requiring any person causing or contributing to the discharge or the owner or the person in charge, management or control of the contaminant to stop the discharge by the date named in the order.
7. (1) Notwithstanding section 6, where a person discharges or permits the discharge of a contaminant into the environment, an inspector may order that person to repair or remedy any injury or damage to the environment that results from the discharge.
- (2) Where a person fails or neglects to repair or remedy any injury or damage to the environment in accordance with an order made under subsection (1) or where immediate remedial measures are required to protect the environment, the Chief Environmental Protection Officer may cause to be carried out the measures that he or she considers necessary to repair or remedy an injury or damage to the environment that results from any discharge.

APPENDIX 2 - DANGEROUS GOODS CLASSIFICATIONS

Class 1 – Explosives¹



Class 2 – Compressed Gases

Division 2.1 – Flammable Gases

Division 2.2 – Non-flammable and Non-toxic Gases

Division 2.3 – Poison Gases



Class 3 - Flammable Liquids



Class 4 – Flammable Solids

Division 4.1 – Flammable Solids

Division 4.2 – Spontaneously Combustible

Division 4.3 – Water Reactive



Class 5 - Oxidizing Substances and Organic Peroxides

Division 5.1 – Oxidizing Substances

Division 5.2 – Organic Peroxides



Class 6 - Toxic and Infectious Substances

Division 6.1 – Toxic Substances

Division 6.2 – Infectious Substances



Class 7 - Radioactive Materials²



Class 8 - Corrosives

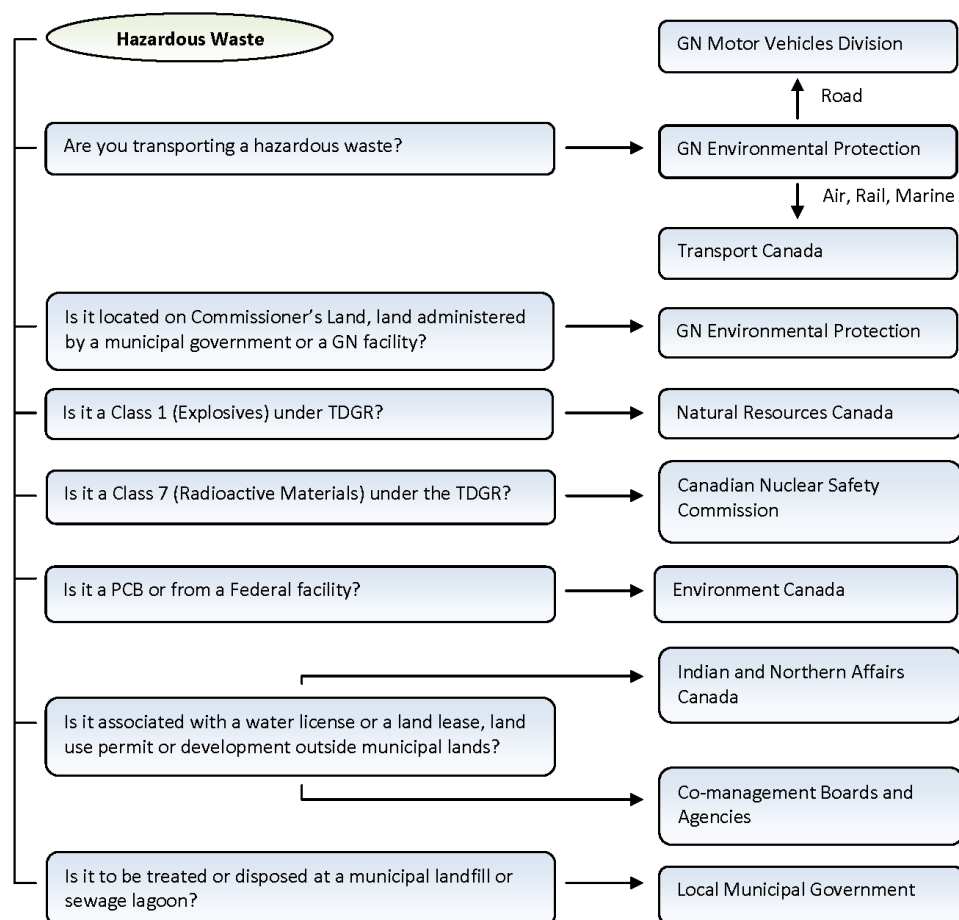


Class 9 - Miscellaneous



1. Class 1 substances (Explosives) are regulated by Natural Resources Canada under the *Explosives Act*.
2. Class 7 substances (Radioactive Materials) are regulated by the Canadian Nuclear Safety Commission under the *Nuclear Safety and Control Act* and *Nuclear Liability Act*.

APPENDIX 3 - DETERMINING REGULATORY AGENCY CONTACTS



APPENDIX 4 – REGISTRATION FORM – HAZARDOUS WASTE GENERATOR

A copy of the generator registration form and users' guide is available by contacting the Department of Environment or by downloading at <http://env.gov.nu.ca/programareas/environmentprotection>.

Instructions				
1. The following information must be provided in order to register as a hazardous waste generator in Nunavut and to obtain a generator number. Incomplete applications will be returned to the applicant. 2. Completed registration forms are to be forwarded to the Manager of Pollution Control, Department of Environment, Government of Nunavut, Box 1000, Station 1360, Iqaluit, Nunavut, X0A 0H0. Electronic registration forms are preferred and may be forwarded to EnvironmentalProtection@gov.nu.ca . 3. Use additional pages to provide information as required. 4. Applicants should refer to the accompanying users' guide for further assistance on completing the generator registration form.				
Section 1 - Identification				
Generator (Legal Name) _____				
Mailing Address _____			Postal Code _____	
Principle Contact Person _____			Title _____	
Phone _____			Email _____	
Alternate Contact Person _____			Title _____	
Phone _____			Email _____	
Section 2 - Description of Waste Generated (provide a separate table if required)				
Site Location(s) where Waste is Generated _____				
Shipping Name (Description)	TDG Number	TDG Class	Quantity Generated each Month (L or Kg)	Frequency of Generation
Section 3 - Waste Management Information				
General Type of Business _____				
Source of Waste _____				
Hazardous Waste Carrier(s) Used _____				
Hazardous Waste Receiver(s) Used _____				
Do you have an approved Emergency Response and Spill Contingency Plan? Yes ☐ (attach copy) No ☐				
Section 4 - Certification				
<i>I certify that the information provided on this form is correct, accurate and complete.</i>				
Signature of Contact Person _____			Date (dd/mm/yy) _____	
Print Name of Contact Person _____			Title _____	
Phone _____			Email _____	
For Department Use Only Generator Number NUG# _____ Approved by _____ Date _____				

APPENDIX 5 – REGISTRATION FORM – HAZARDOUS WASTE CARRIER

A copy of the carrier registration form and users' guide is available by contacting the Department of Environment or by downloading at <http://env.gov.nu.ca/programareas/environmentprotection>.

Instructions				
1. The following information must be provided in order to register as a hazardous waste carrier in Nunavut and to obtain a carrier number. Incomplete applications will be returned to the applicant. 2. Completed registration forms are to be forwarded to the Manager of Pollution Control, Department of Environment, Government of Nunavut, Box 1000, Station 1360, Iqaluit, Nunavut, X0A 0H0. Electronic registration forms are preferred and may be forwarded to EnvironmentalProtection@gov.nu.ca . 3. Use additional pages to provide information as required. 4. Applicants should refer to the accompanying users' guide for further assistance on completing the carrier registration form.				
Section 1 - Identification				
Carrier (Legal Name) _____				
Corporate Address _____				
Site (Dispatch) Address _____				
Principle Contact Person _____			Title _____	
Phone _____			Email _____	
Alternate Contact Person _____			Title _____	
Phone _____			Email _____	
Section 2 - Description of Waste Transported (provide a separate table if required)				
Shipping Name (Description)	TDG Number	TDG Class	Quantity Transported each Month (L or Kg)	Frequency of Transport
Section 3 - Waste Management Information				
Mode of Transport (check all that apply) Road _____ Rail _____ Marine _____ Air _____				
Hazardous Waste Generator(s) Used _____				
Hazardous Waste Receiver(s) Used _____				
Do you have an approved Emergency Response and Spill Contingency Plan? Yes _____ (attach copy) No _____				
Section 4 - Certification				
<i>I certify that the information provided on this form is correct, accurate and complete.</i>				
Signature of Contact Person _____			Date (dd/mm/yy) _____	
Print Name of Contact Person _____			Title _____	
Phone _____			Email _____	
For Department Use Only				
Carrier Number NUC# _____		Approved by _____		Date _____

APPENDIX 6 – REGISTRATION FORM – HAZARDOUS WASTE RECEIVER

A copy of the receiver registration form and users' guide is available by contacting the Department of Environment or by downloading at <http://env.gov.nu.ca/programareas/environmentprotection>.

Instructions				
1. The following information must be provided in order to register as a hazardous waste receiver in Nunavut and to obtain a receiver number. Incomplete applications will be returned to the applicant. 2. A receiver who operates a commercial business for the purpose of collecting, storing, transferring, treating, recycling or disposing of hazardous waste may be required to register the facility as a hazardous waste management facility. Refer to section 3.2.2 of the <i>Environmental Guideline for the General Management of Hazardous Waste</i> for further information. 3. Completed registration forms are to be forwarded to the Manager of Pollution Control, Department of Environment, Government of Nunavut, Box 1000, Station 1360, Iqaluit, Nunavut, X0A 0H0. Electronic registration forms are preferred and may be forwarded to EnvironmentalProtection@gov.nu.ca . 4. Use additional pages to provide information as required. 5. Applicants should refer to the accompanying users' guide for further assistance on completing the receiver registration form.				
Section 1 - Identification				
Receiver (Legal Name) _____				
Mailing Address _____			Postal Code _____	
Principle Contact Person _____			Title _____	
Phone _____			Email _____	
Alternate Contact Person _____			Title _____	
Phone _____			Email _____	
Section 2 - Description of Waste Received (provide a separate table if required)				
Site Location(s) where Waste is Received _____				
Shipping Name (Description)	TDG Number	TDG Class	Quantity Received each Month (L or Kg)	Frequency of Acceptance
Attach a brief description of the proposed facility. _____				
Section 3 - Waste Management Information				
General Type of Business _____				
General Type of Activity _____				
Hazardous Waste Generator(s) Used _____				
Hazardous Waste Carriers(s) Used _____				
Hazardous Waste Management Facilities Used _____				
Do you have an approved Emergency Response and Spill Contingency Plan? Yes _____ (attach copy) No _____				
Section 4 - Certification				
<i>I certify that the information provided on this form is correct, accurate and complete.</i>				
Signature of Contact Person _____			Date (dd/mm/yy) _____	
Print Name of Contact Person _____			Title _____	
Phone _____			Email _____	
For Department Use Only				
Receiver Number NUR# _____		Approved by _____		Date _____

APPENDIX 7

REGISTRATION FORM – HAZARDOUS WASTE MANAGEMENT FACILITY

A copy of the management facility registration form and users' guide is available by contacting the Department of Environment or by downloading at <http://env.gov.nu.ca/programareas/environmentprotection>.

Instructions				
1. The following information must be provided in order to register as a hazardous waste management facility in Nunavut and obtain a management facility number. Incomplete applications will be returned to the applicant. 2. Completed registration forms are to be forwarded to the Manager of Pollution Control, Department of Environment, Government of Nunavut, Box 1000, Station 1360, Iqaluit, Nunavut, X0A 0H0. Electronic registration forms are preferred and may be forwarded to EnvironmentalProtection@gov.nu.ca . 3. Use additional pages to provide information as required. 4. Applicants should refer to the accompanying users' guide for further assistance on completing the management facility registration form.				
Section 1 - Identification				
Applicant (Legal Name) _____				
Corporate Address _____				
Facility Address _____				
Principle Contact Person _____		Title _____		
Phone _____		Email _____		
Alternate Contact Person _____		Title _____		
Phone _____		Email _____		
Section 2 - Description of Waste to be Managed (provide a separate table if required)				
Site Location(s) where Waste is Managed _____				
Shipping Name (Description)	TDG Number	TDG Class	Quantity Managed each Month (L or Kg)	Frequency of Acceptance
Attach a complete description of the proposed facility, safety measures, equipment and management processes to be used. Include engineered drawing where applicable.				
Section 3 - Waste Management Information				
General Type of Business (check all that apply)	Receiver of Waste _____	Manage Self-generated Waste _____		
Type of Activity (check all that apply)	Collect and Store _____	Transfer _____		
Treat _____	Recycle _____	Dispose _____		
Hazardous Waste Generator(s) Used _____				
Hazardous Waste Carriers(s) Used _____				
Do you have an approved Emergency Response and Spill Contingency Plan? Yes _____ (attach copy) No _____				
Section 4 - Certification				
I certify that the information provided on this form is correct, accurate and complete.				
Signature of Contact Person _____		Date (dd/mm/yy) _____		
Print Name of Contact Person _____		Title _____		
Phone _____		Email _____		
For Department Use Only Management Facility Number NUF# _____ Approved by _____ Date _____				

APPENDIX 8 - CRITERIA FOR REGISTERING A HAZARDOUS WASTE MANAGEMENT FACILITY

A facility must be registered with the Department of Environment as a hazardous waste management facility where it is used for commercial purposes to store hazardous waste for a period of 180 days or more or the quantity of hazardous waste¹ stored on-site at any one time exceeds the criteria established in the following table. Where the facility is to be used for the treatment, recycling or disposal of hazardous waste, the facility must be registered as a hazardous waste management facility where the quantity treated, recycled or disposed of each month exceeds a 'small quantity'².

	Description	Quantity ³ (Kg or L)
Class 1	Explosives	50
Class 2	Division 2.1 – Flammable Gases	500 ⁴
	Division 2.2 – Non-flammable and Non-toxic Gases	5000 ⁴
	Division 2.3 – Poison Gases	200 ⁴
Class 3	Flammable Liquids	4000
Class 4	Division 4.1 – Flammable Solids	5000
	Division 4.2 – Spontaneously Combustible	1000
	Division 4.3 – Water Reactive	500
Class 5	Division 5.1 – Oxidizing Substances	1000
	Division 5.2 – Organic Peroxides	50
Class 6	Division 6.1 – Toxic Substances	1000
	Division 6.2 – Infectious Substances	500 ⁴
Class 7	Radioactive Materials	Any amount
Class 8	Corrosives	1000
Class 9	Miscellaneous	1000
	PCB Materials	50
	Environmentally Hazardous Substance Solid – UN3077	5000
All Classes	Total Aggregate Quantity	5000

1. Applies to hazardous waste only and not to dangerous goods.
2. Small quantity means hazardous waste that is generated in an amount that is less than five kilograms per month if a solid or less than five litres per month if a liquid, and where the total quantity accumulated at any one time does not exceed five kilograms or five litres. This does not include hazardous waste that is mercury or Class 2.3, 5.1 or 6.1 materials. These wastes must be generated in an amount that is less than one kilogram per month if a solid or less than one litre per month if a liquid, and where the total quantity accumulated at any one time does not exceed one kilogram or one litre.
3. Quantity applies to solids when expressed in kilograms (kg) and liquids when expressed in litres (L).
4. Total liquid capacity of the container.

MOVEMENT DOCUMENT / MANIFEST
DOCUMENT DE MOUVEMENT / MANIFESTE

THIS DOCUMENT IS UNCLASSIFIED / **CE DOCUMENT EST NON CLASSÉ**

Movement Document / Merit Reference No.

[illegible]

Alberta Environment (2007)

☐ Copy 1 ☐ Copy 2 ☐ Copy 3 ☐ Copy 4 ☐ Copy 5 ☐ Copy 6

APPENDIX 10 - WASTE EXCHANGES AND ASSOCIATIONS

The concept of exchanging waste began in Canada in the 1980s. It involves the transfer of unwanted, overstocked, obsolete, damaged, contaminated or post-dated material and waste to another company or person who would reuse it. Various waste exchanges and associations have been established in Canada to facilitate these transfers. Several, but not all, waste exchanges and associations are listed below.

Northern Territories Water and Waste Association
201, 4817- 49 Street
Yellowknife, Northwest Territories X1A 3S7
(867) 873-4325
<http://www.ntwwa.com>

Recycling Council of British Columbia
Unit #10, 119 West Pender Street
Vancouver, British Columbia V6B 1S5
(604) 683-6009
<http://www.rcbc.bc.ca>

Alberta Waste Materials Exchange
Building #350, 6815 Eighth Street NE
Calgary, Alberta T2E 7H7
(403) 297-7505

Calgary Materials Exchange
809 Fourth Avenue NE
Calgary, Alberta T2P 0K5
(403) 230-1443
<http://www.cmex.ca>

Saskatchewan Waste Materials Exchange
515 Henderson Drive.
Regina, Saskatchewan S4N 5X1
(306) 787-9800

Manitoba Waste Exchange
1329 Niakwa Road
Winnipeg, Manitoba R2J 3T4
(204) 257-3891

Ontario Waste Exchange
OCETA 63 Polson Street, 2nd floor
Toronto, Ontario M5A 1A4
(416) 778-4199
<http://www.owe.org>

Canadian Waste Materials Exchange
2395 Spearman Drive
Mississauga, Ontario L5K 1B3
(416) 822-4111

Canadian Chemical Exchange
900 Blondin
Ste-Adele, Quebec J0R 1L0
(450) 229-6511
<http://www.stobec.com>

Quebec Waste Materials Exchange
14 Place du Commerce, Bureau 350
Le-des-Squeurs, Quebec H3E 1T5
(514) 762-9012

APPENDIX 11 – GOVERNMENT CONTACTS

Government of Nunavut

Environmental Protection Division
Department of Environment
Inuksugait Plaza
P.O. Box 1000, Station 1360
Iqaluit, Nunavut X0A 0H0
Telephone: (867) 975-7729 Fax: (867) 975-7739

Motor Vehicles Division
Department of Economic Development and
Transportation
P.O. Box 10
Gjoa Haven, Nunavut X0B 1J0
Telephone: (867) 360-4615 Fax: (867) 360-4619

Workers' Safety and Compensation Commission
P.O. Box 669
Baron Building/1091
Iqaluit, Nunavut X0A 0H0
Telephone: 1-877-404-4407 (toll free) Fax: 1-866-
979-8501

Department of Community and Government
Services (all Divisions)
P.O. Box 1000, Station 700
4th Floor, W.G. Brown Building
Iqaluit, Nunavut X0A 0H0
Telephone: (867) 975-5400 Fax: (867) 975-5305

Office of Chief Medical Health Officer of Health
Department of Health and Social Services
P.O. Box 1000, Station 1000
Iqaluit, Nunavut X0A 0H0
Telephone: (867) 975-5774 Fax: (867) 975-5755

Government of Canada

Indian and Northern Affairs – Nunavut Region
P.O. Box 2200
Iqaluit, Nunavut X0A 0H0
Telephone: (867) 975-4500 Fax: (867) 975-4560

Environment Canada (NWT and Nunavut)
5019 52nd Street
Yellowknife, Northwest Territories X1A 1T5
Telephone: (867) 669-4730 Fax: (867) 873-8185

Department of Transport – Road, Rail, Marine, Air
P.O. Box 8550
344 Edmonton Street
Winnipeg, Manitoba R3C 1P6
Telephone: 1-888-463-0521 (toll free)
Fax: (204) 983-8992 Road, Rail and Marine only
Fax: (204) 983-1734 Air only

Appendix E: Technical Document for Batch Waste Incineration



Technical Document for Batch Waste Incineration

January 2010

Canada

Acknowledgements:

Environment Canada would like to acknowledge the work of A.J. Chandler & Associates Ltd. in the preparation of this technical document.

En14-17/1-2010E-PDF
978-1-100-14950-9

© Her Majesty the Queen in Right of Canada,
represented by the Minister of the Environment, 2010.

Aussi disponible en français.

Table of Contents

Executive Summary	i
Overview of the Six-Step Process for Batch Waste Incineration	iii
1.0 Introduction	1
1.1 Purpose	1
1.2 Background	1
1.2.1 Substances of Concern	2
1.2.2 International and National Initiatives	2
1.2.3 Provincial / Territorial Initiatives	5
2.0 The Waste Incineration Process	6
2.1 Controlling Combustion	6
2.1.1 Overview of the Waste Incineration Process	6
2.1.2 Controlling Combustion	7
2.1.3 Reducing Dioxin and Furan Emissions	8
2.2 Waste Incineration Technologies	8
2.3 General Design and Operation Considerations	11
2.3.1 Design and Operation	11
2.3.2 Heat Recovery	12
2.3.3 Air Pollution Control Systems	12
3.0 The Six-Step Process for Batch Waste Incineration	14
3.1 Step 1: Understand Your Waste Stream	14
3.1.1 Conducting a Waste Audit or Estimating Waste Characteristics	14
3.1.2 Choosing Appropriate Waste Management Options	15
3.2 Step 2: Select the Appropriate Incinerator (or Evaluate the Existing System)	16
3.2.1 Classification of Batch Waste Incinerators	16
3.2.2 Incinerator Selection Considerations	17
3.3 Step 3: Properly Equip and Install the Incinerator	20
3.3.1 Building Considerations	21
3.3.2 Equipment Considerations	21
3.4 Step 4: Operate the Incinerator for Optimum Combustion	23
3.4.1 Operation	24
3.4.2 Training	33
3.5 Step 5: Safely Handle and Dispose of Incinerator Residues	34
3.5.1 Residue Handling Practices	34
3.6 Step 6: Maintain Records and Report	35

Executive Summary

Incineration is recognized as an effective and environmentally sound disposal method for a wide range of wastes, and is used in facilities and jurisdictions across Canada. Waste generators located in remote areas may have limited options for cost-effective and environmentally sound waste management, and incineration may therefore be considered an appropriate waste management option. Remote commercial activities, such as exploration and development of natural resources, can create large volumes and varieties of wastes that must be managed appropriately. Residual wastes from industry, research activities, and the health care sector may require thermal treatment as an environmentally sound method to control the spread of disease from plants, animals or humans. Furthermore, there are certain locations in Canada where incinerating waste is an important means of avoiding potentially dangerous interactions between humans and wildlife. In all cases, reduction and diversion should be the primary waste management objectives, prior to considering any disposal option.

There are, however, some important potential environmental concerns associated with waste incineration that must be addressed through proper equipment selection, operation, maintenance and record keeping. These include potential releases of mercury, as well as dioxins and furans (PCDD/F), which are persistent organic pollutants (POPs). Mercury and POPs bio-accumulate in the environment and may cause adverse effects to human health and the environment. They can also be transported over long ranges; data from measurements in the North reveal concentrations far greater than what might be explained by local production. Dioxins/furans can be generated when inadequate incineration technology is used or when an incinerator is improperly operated. Mercury is not created in an incineration system; emissions are directly related to the presence of mercury in certain waste materials. Therefore, the best method to control mercury emissions is to limit the quantity of mercury in the waste fed to the incinerator.

The *Stockholm Convention on Persistent Organic Pollutants (POPs)* (which entered into force in May 2004 and to which Canada is a Party), identifies incineration as a potential source of POPs, and establishes a range of measures to reduce and, where feasible, eliminate their release. It also requires that the best available techniques (BAT) and best environmental practices (BEP) be applied for both new and substantially modified sources of POPs. Additionally, the Canadian Council of Ministers of the Environment (CCME) adopted the Canada-wide Standards for Dioxins and Furans in 2001, identifying incineration for action to reduce emissions, and adopting specific air emission standards. The CCME also adopted the Canada-wide Standards for Mercury Emissions in 2000 which include limits on mercury emissions from incinerators. Both mercury and dioxins/furans are on the List of Toxic Substances in Schedule 1 of the *Canadian Environmental Protection Act, 1999* (CEPA 1999).

The Technical Document for Batch Waste Incineration was developed to provide guidance for owners and operators on proper system selection, operation, maintenance and record keeping, with the goals of achieving the intent of the Canada-wide Standards for dioxins/furans and mercury, and reducing releases of other toxic substances. The document includes:

- A discussion of the importance of reducing, reusing and recycling to divert wastes from disposal;
- Methods for the selection of appropriate incineration technologies to meet specific waste management requirements;

- Operational requirements that should allow batch incinerators to meet the intent of the Canada-wide Standards for dioxins/furans and mercury, and to reduce the release of other toxic substances; and
- Recommendations on record keeping and reporting.

This Technical Document focuses on minimizing dioxins/furans and mercury emissions from batch waste incinerator systems ranging in size from 50 kg to 3000 kg of waste/batch, the latter representing the largest batch incinerator currently in use in Canada. Batch waste incinerators are those that operate in a non-continuous manner (i.e. they are charged with waste prior to the initiation of the burn cycle, and the door remains closed until the ash has cooled inside the primary chamber). Air emission testing completed by Environment Canada in 2002 using a modern Canadian-built batch waste incinerator demonstrated that, when properly operated and maintained, these systems are capable of meeting the Canada-wide Standards for dioxins/furans (80 pg I-TEQ/Rm³ @ 11% O₂) and mercury (20 µg/Rm³ @ 11% O₂). Stack testing can be carried out as required by the regulatory authorities (e.g. federal, provincial/territorial) to verify that these standards are met.

The Technical Document recommends and describes a six-step process for batch waste incineration:

- Step 1 – Understand Your Waste Stream
- Step 2 – Select the Appropriate Incinerator (or Evaluate the Existing System)
- Step 3 – Properly Equip and Install the Incinerator
- Step 4 – Operate the Incinerator for Optimum Combustion
- Step 5 – Safely Handle and Dispose of Incinerator Residues
- Step 6 – Maintain Records and Report

This process will assist owners and operators of batch waste incinerators to achieve the intent of the Canada-wide Standards for dioxins/furans and mercury, and reduce the potential for releases of other toxic substances to the environment.

Overview of the Six-Step Process for Batch Waste Incineration

Step 1: Understand Your Waste Stream

The first step in managing waste is to understand the quantity and composition of the waste that is generated. A waste audit should be completed, where practical, to:

- Determine the quantity of waste generated in the various parts of an operation;
- Characterize the waste from each type of operation;
- Examine the waste stream to determine what opportunities exist for:
 - Reducing the quantity of waste generated;
 - Reusing materials; and
 - Recycling as much as possible before considering disposal.

Where waste audits are not practical, it is still necessary to develop an estimate of the waste quantities and characteristics before a strategy for waste diversion and disposal can be completed. Owners should investigate waste generation and diversion data from similar operations/facilities in order to estimate the waste types and quantities that will be generated at their own facilities. Sources of such information may include industry associations, waste industry consultants, provincial/territorial authorities and other regulatory bodies.

Based on the results of the waste audit/characterization, an assessment of appropriate disposal options should be undertaken. Where possible, disposal alternatives (other than incineration) for the residual waste stream (i.e. post 3Rs – Reduce, Reuse, Recycle) should be examined. When assessing disposal options, it is important to note that waste should neither be open-burned nor burned in a barrel. In both cases, the appropriate temperatures for a clean burn will not be achieved, and toxic contaminants, in particular dioxins and furans, will be released.

Step 2: Select the Appropriate Incinerator (or Evaluate the Existing System)

The characteristics of the residual waste stream destined for incineration should be incorporated into a call for proposals from incinerator manufacturers. Specifying the quantity and composition of the waste stream will ensure that proposals include suitable incinerators. It should be noted that incinerators built for a specific waste stream, such as animal carcasses, liquid wastes and hazardous wastes, are available and should be used as required.

For facilities with existing incinerators, owners/operators should reassess the suitability of the existing system to manage the current waste stream.

For facilities incinerating **more than 26 tonnes of waste per year**, dual chamber controlled air incinerators are the recommended configuration. These systems are capable of incinerating a wide range of wastes and, when properly maintained and operated, will achieve emissions of PCDD/F and mercury below the level of the Canada-wide Standards. These systems should be equipped with a large secondary chamber sized to provide a residence time of at least one second at a temperature higher than 1000°C, to ensure complete combustion and minimize PCDD/F emissions.

iii

For facilities incinerating **less than 26 tonnes of waste per year**, “determined efforts” as defined in the Canada-wide Standards for dioxins and furans¹ should be undertaken. Should circumstances restrict the ability to use a dual-chamber incinerator with a large secondary chamber, a single chamber incinerator with an afterburner should be used. It should be noted that such systems are less likely to be able to meet the emission standards than dual chamber incinerators.

Step 3: Properly Equip and Install the Incinerator

Building Considerations

- Incinerators should be installed inside a building to protect the equipment and the operators from weather conditions.
- In designing the installation site, care should be taken to maximize clearance between incinerator components, including the stack, and combustible construction materials.
- Insulation should be used to protect combustible building materials.
- The building should be equipped with sufficient fresh air inlet capacity for the incinerator. Both combustion air and dilution air for the barometric damper are required. Care should be taken to introduce air in a manner that does not lead to low-temperature operating problems.

Equipment Considerations

The incinerator system should come complete with the following equipment to monitor and record performance parameters:

- A scale to measure the weight of all materials charged to the incinerator; and
- A computerized process control and data acquisition system to store operating data from the incinerator.

Operational data should be collected and stored, at a minimum, every minute that the system is operating. The intent is to be able to summarize operating parameters during start-up, operation and cool-down for every cycle. If the required operating conditions are not achieved these data will allow the operators, the manufacturers and the regulator to identify the contributing factors for the failure. From this information, operating procedures can be adjusted to improve performance. Provisions should be made for the manufacturers to be able to remotely access and review the operating data for trouble shooting purposes.

It is highly recommended that batch incinerators not be equipped with heat recovery devices. The temperature of the stack gases in heat recovery systems will be lower than in systems without heat recovery, and may be in a temperature range that can lead to the formation of greater quantities of PCDD/F. Similarly, air pollution control systems are not recommended for batch waste incineration systems to control PCDD/F emissions. Stack gases should be released directly to the atmosphere at temperatures higher than 700°C to reduce the chances of the inadvertent formation of PCDD/F through the *de novo* synthesis process.

¹ Available on-line at: http://www.ccme.ca/ourwork/air.html?category_id=97

If it is necessary to introduce additional waste to the incinerator during the burn cycle, the incinerator should be equipped with a ram charge system to limit the disruption of combustion in the primary chamber during the waste charging process.

Step 4: Operate the Incinerator for Optimum Combustion

Operational Considerations

Wastes received at the incinerator building should be separated according to their heating value characteristics: wet or low-energy wastes (e.g. food waste); mixed wastes with average energy values; and other materials with high energy values, such as oily waste materials. To facilitate this separation, all waste should be collected in transparent bags. To further assist with separation, wastes could be collected in coloured-coded bags.

Batch incinerators are designed to accept wastes within a specified range of energy (i.e. calorific) values. The operator should select waste from each category and mix it to achieve the manufacturer's specified input calorific value. Each bag should be weighed, its source should be noted, and the total weight of each category should be tallied before completing the loading. This information should be recorded by the computerized data acquisition equipment installed with the incinerator. (Refer to step 6 for further record keeping requirements).

Batch incinerator systems have limited charging capacity (both in terms of waste quantity and the calorific value of the waste charge). To assist the operator with the charging task, particularly for smaller incinerators, several batches could be weighed and placed in their own containers prior to loading the incinerator. The same weighing and logging procedures should be used for each batch and, once recorded, the batch can be charged when appropriate.

When the incinerator is charged with the appropriate mix and quantity of waste, the operator should close the door, ensure all interlocks are engaged, and start the burn cycle. The operator should observe the burn for at least 15 minutes after ignition of the primary chamber burner to ensure the volatility of the waste charged is not creating too much gas for the secondary chamber to handle. The rate of combustion can be slowed by reducing the quantity of under-fired air. The primary chamber should be operated in the temperature range specified by the manufacturer (typically 500°C to 800°C).

When satisfied that the burn is proceeding in a controlled manner, the operator may leave the incinerator area while the equipment completes the burn cycle.

The burn cycle should not be interrupted by opening the charging door until after the burn is complete and the unit has cooled down. No additional waste should be added to the primary chamber unless the incinerator is equipped with an appropriate ram feed device.

When the burn is complete and the unit has cooled, the operator should open the door only when wearing protective equipment such as gloves, dust mask, face shield and goggles.

The operator should remove the ash from the previous burn cycle before reloading the incinerator. Any unburned materials found in the ash should be recharged to the primary chamber after the operator has cleaned the air ports, and before putting a fresh charge into the incinerator.

v

Training Considerations

Operators should be properly trained by the incinerator manufacturer. The training course should include, as a minimum, the following elements:

- System safety including identification of hazards that the operator should recognize;
- Waste characterisation and how waste composition can affect operation;
- Loading limitations, including materials that should NOT be charged to the incinerator, and the allowable quantities of different types of wastes that can be charged;
- Start-up procedures for the incinerator and the normal operation cycle;
- Operation and adjustment of the incinerator to maximise performance;
- Clean out procedures at the end of the cycle;
- Troubleshooting procedures;
- Maintenance schedule; and
- Record keeping and reporting.

Managers should be involved in the training session so that continuity can be maintained with different operators.

Step 5: Safely Handle and Dispose of Incinerator Residues

Ash from the primary chamber of the incinerator can contain materials deleterious to the operator's health and the environment. Operators should use personal protective equipment when handling this material. The material should be carefully removed from the hearth and placed in covered metal containers suitable for transporting the ash to an approved disposal site. The operator should weigh, and maintain records of, the quantity of ash produced.

Step 6: Maintain Records and Report

To demonstrate appropriate operation and maintenance of the incinerator, the facility should maintain records and prepare an annual report containing at least the following information:

- A list of all staff who have been trained to operate the incinerator; type of training conducted and by whom; dates of the training; dates of any refresher courses;
- All preventative maintenance activities undertaken on the equipment;
- Records of operation of the incinerator - in electronic format with full data backup;
- Summarized annual auxiliary fuel usage;
- A list of all shipments of incinerator residues, including the weight transported and disposed of by type if necessary, and the location of the disposal site;
- Results of any emissions measurements or any ash sampling data collected during the period.

All raw data records from the operation of the incinerator should be retained for inspection by the appropriate authorities for the period designated by those authorities, or for at least 2 years. The owner should work with the incinerator manufacturer or supplier and the regulators to determine the appropriate level of summary data that should be sent to the regulatory body (e.g. federal, provincial/territorial). The reports should be approved by the facility's senior management before submission.

vi

1.0 Introduction

1.1 Purpose

This *Technical Document for Batch Waste Incineration* was developed to provide guidance for owners and operators of batch waste incinerators regarding proper system selection, operation, maintenance and record keeping, with the goals of assisting them in achieving the intent of the Canada-wide Standards (CWS) for dioxins/furans and mercury, and reducing releases of other toxic substances. This technical document focuses on batch waste incinerators ranging in size from 50 to 3,000 kg of waste/batch. Batch waste incinerators are those that operate in a non-continuous manner (i.e. they are charged with waste prior to the initiation of the burn cycle, and the door remains closed until the ash has cooled inside the primary chamber). Air emission testing completed by Environment Canada in 2002 using a modern Canadian-built batch waste incinerator revealed that, when properly operated and maintained, these systems are capable of meeting the CWS for dioxins/furans (80 pg I-TEQ/Rm³ @ 11% O₂) and mercury. Stack testing can be carried out as required by the regulatory authorities in order to verify that these standards are met.

The document includes:

- A discussion on the importance of reducing, reusing and recycling to divert wastes from disposal;
- Methods for the selection of appropriate incineration technologies to meet specific waste management requirements;
- Operational requirements that should allow batch waste incinerators to meet the intent of the CWS for dioxins/furans and mercury, and to reduce the release of other toxic substances; and
- Recommendations on record keeping and reporting.

Owners and operators are advised to undertake a full review of relevant local legislation and consult with the appropriate regulators before proceeding with any waste management operation.

1.2 Background

Incineration is recognized as an effective and environmentally sound disposal method for a wide range of wastes, and is used in facilities and jurisdictions across Canada. Waste generators located in remote areas may have limited options for cost-effective and environmentally sound waste management, and incineration may therefore be considered an appropriate waste management option. Remote commercial activities, such as exploration and development of natural resources, can create large volumes and varieties of wastes that must be managed appropriately. Residual wastes from industry, research activities, and the health care sector may require thermal treatment as an environmentally sound method to control the spread of disease from plants, animals or humans. Furthermore, there are certain locations in Canada where incinerating waste is an important means of avoiding potentially dangerous interactions between humans and wildlife. In all cases, reduction and diversion should be the primary waste management objectives, prior to considering any disposal option.

This section provides background information on batch waste incineration, including: substances of concern; international and national initiatives; and provincial/territorial initiatives.

1.2.1 Substances of Concern

There are some important potential environmental concerns associated with waste incineration that can be addressed through proper equipment selection, operation, maintenance and record keeping. These include potential releases of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/F), which are persistent organic pollutants (POPs), and mercury.

Dioxins and Furans

Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/F), commonly known as dioxins/furans (D/F), are toxic, persistent, bioaccumulative, and result predominantly from human activity.

Data from the measurement of dioxins/furans in the North shows that these chemicals are frequently found at concentrations far in excess of those that might be explained by local production. With the increased social and economic development in Canada's North, it is important to control these persistent chemicals.

Dioxins and furans can be generated from incomplete combustion resulting from the use of inadequate technology and/or operating the incinerator improperly.

Mercury

Another possible contaminant released from incinerators is mercury. Mercury bio-accumulates in the environment and, like POPs, is found in polar regions at higher concentrations than can be explained by local anthropogenic releases.

Mercury is not emitted from the incinerator unless items containing mercury are placed into the incinerator. The best method to control mercury releases is therefore to limit the amount of mercury in the waste fed to the incinerator.

1.2.2 International and National Initiatives

Over the years, Canada has participated in numerous initiatives to reduce dioxins and furans as well as mercury releases such as:

- Stockholm Convention on Persistent Organic Pollutants;
- CCME Policy for Management of Toxic Substances;
- Federal Toxics Substances Management Policy (TSMP),
- Canada Wide Standards for Dioxins and Furans;
- Canada Wide Standards for Mercury; and,
- Chemicals Management Plan.

Stockholm Convention on Persistent Organic Pollutants

Canada is a Party to the Stockholm Convention on Persistent Organic Pollutants (POPs), which entered into force in May 2004. The Stockholm Convention sets out a range of measures to reduce and, where feasible, eliminate POP releases².

Incineration was identified as a potential source of the POPs listed in Article 5 of the Stockholm Convention. Article 5 of the Convention requires Parties to take measures to reduce, and where feasible, eliminate releases of unintentionally produced POPs, including dioxins, furans, hexachlorobenzene (HCB) and dioxin-like polychlorinated biphenyls (PCBs) which are *"unintentionally formed and released from thermal processes involving organic matter and chlorine as a result of incomplete combustion or chemical reactions"*.

Article 5 also requires that Best Available Techniques (BAT) and Best Environmental Practices (BEP) be applied for both new and substantially modified sources. "Best Available Techniques" are defined as using the most effective and advanced techniques that can be practically adopted to:

- *prevent or minimize* harmful emissions of by-product POPs and other environmental impacts; or,
- *reduce* by-product POPs releases to acceptable limits.

"Best Available Techniques" techniques can be applied by an operator to a specific facility since they have been developed to a state that they are economical and technically viable. Similarly, "best environmental practices" implies the application of the most appropriate combination of environmental control measures and strategies. Annex C states that for the purposes of the Convention there are a series of measures that are appropriate:

"Improvements in waste management with the aim of the cessation of open and other uncontrolled burning of wastes, including the burning of landfill sites. When considering proposals to construct new waste disposal facilities, consideration should be given to alternatives such as activities to minimize the generation of municipal and medical waste, including resource recovery, reuse, recycling, waste separation and promoting products that generate less waste."

CCME Policy for Management of Toxic Substances and the Federal Toxics Substances Management Policy

Canada took steps to improve the management of POPs even before the Stockholm Convention was adopted. Polychlorinated dioxins-*p*-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) were designated as Track 1 substances and scheduled for virtual elimination from the Canadian environment under the 1995 federal *Toxic Substances Management Policy*³ and the 1998 CCME *Policy for the Management of Toxic Substances*⁴.

² At the Conference of Plenipotentiaries on the Stockholm Convention on Persistent Organic Pollutants, held May 22 to 23 2001 in Stockholm, Sweden, the Convention was adopted and opened for Signature. It remained open for signature at the United Nations Headquarters, Treaty Section, in New York, until May 22, 2002. Available on-line at: <http://chm.pops.int/>

³ Environment Canada, Toxic Substances Management Policy. 1995. Available at <http://www.ec.gc.ca/toxics/TSMPE/ent/smp.pdf>

⁴ CCME, 1998. CCME Policy for the Management of Toxics Substances. January 29, 1998. Available at http://www.ccme.ca/assets/pdf/toxics_policy_e.pdf

PCDD/F are on the List of Toxic Substances in Schedule 1 of the *Canadian Environmental Protection Act, 1999*⁵.

Under the federal 1995 *Toxic Substances Management Policy* and the 1998 *CCME Policy for Management of Toxic Substances*, mercury was designated as a Track 2 substance. As such, mercury must be managed through its life cycle to minimize releases. Mercury is on the List of Toxic Substances in Schedule 1 of the *Canadian Environmental Protection Act* (CEPA 1999).

Canada-wide Standards for Dioxins and Furans

The Canadian Council of Ministers of the Environment (CCME) examined the incidental release of dioxins and furans in emissions from various combustion systems. This led to the development of the *Canada-wide Standards for Dioxins and Furans*, which were adopted by the CCME in 2001. The standards identify incineration for action to reduce emissions, and include specific air emission standards.

In a 2007 review of the Dioxins and Furans Canada-wide Standards for waste incineration⁶, a series of recommendations were made by the Dioxins and Furans Incineration Canada-wide Standards Review Group regarding batch incinerators in remote locations. These recommendations suggest that:

- The company/department should take appropriate measures to ensure good operation and provide adequate records of such operation;
- The company/department should only use incinerators that are equipped with monitoring equipment (temperature probes, differential pressure meters and auxiliary fuel flow) to ensure that proper operation is maintained. The monitoring equipment should be connected to a computer which will continuously log the data recorded;
- All installations should install weigh scales to record the weight of each load charged to the incinerator;
- All data from these systems should be available to inspectors;
- The computerized data acquisition equipment should be integrated with all the operating controls of the incinerator in a manner that would facilitate remote access to the data to enable the manufacturer to assist the operator with trouble shooting the operation;
- Operators should be trained, either through an appropriate site specific training program or through a certification program provided by a qualified body;
- Operators should be instructed to distinguish between broad categories of waste, in terms of their calorific value, and be given clear instructions on how much from each category is suitable for charging to the primary chamber for a given batch;
- All facilities should be required to file, with the appropriate regulatory authority, their annual waste throughput data. This filing should include details on the quantity and disposition of residues discharged from the facility.

⁵ CEPA, 1999. Canadian Environmental Protection Act, 1999. 1999, c. 33 (Assented to September 14, 1999). Available at http://www.ccme.ca/assets/pdf/mercury_emis_std_e1.pdf

⁶ Chandler, A.J., 2007. Review of Dioxins and Furans from Incineration In Support of a Canada-wide Standard Review: A Report Prepared for The Dioxins and Furans Incineration Review Group through a contract associated with CCME Project #390-2007. Available at: http://www.ccme.ca/assets/pdf/1395_d_f_review_chandler_e.pdf

Canada-wide Standards for Mercury

The Canada Wide Standards for Mercury Emissions were adopted in 2000 in order to reduce atmospheric emissions derived from both deliberate use of mercury and from incidental releases of mercury⁷. The standards include limits for mercury emissions from waste incinerators.

The Mercury Containing Product Stewardship: Manual for Federal Facilities⁸ provides useful information on how to develop an inventory of mercury within a facility, reducing mercury through life-cycle management practices, and monitoring and reporting on mercury stewardship activities.

Chemicals Management Plan

Canada's efforts to improve the environment have also led to new measures under the Chemicals Management Plan (CMP)⁹, which was first brought forward in 2006. The CMP develops measures to better protect human health and the environment from the risks posed by chemical substances. Since CEPA was adopted, all new chemicals have received rigorous pre-market assessments; however, approximately 23,000 "legacy" chemicals were in use in Canada before CEPA came into effect. The CMP identified a list of 193 substances as priority for action. Industry is required to provide Environment Canada and Health Canada with information regarding these substances on a quarterly basis within the next three years. The information that is received, along with that gathered from other sources, will be assessed and used to decide, if necessary, the appropriate actions required to protect the health of Canadians and the environment.

The Waste Sector has been identified as a sector under the CMP due to potential releases to the environment from incinerators and landfills.

1.2.3 Provincial / Territorial Initiatives

The CWS for both dioxins/furans and mercury have been incorporated into regulations related to new incinerators in various provinces. One example is the Ontario Guideline A-7¹⁰ which incorporated the CWS emission values for new incinerators shortly after they were adopted and Guideline A-7¹¹ which clarified the approach for existing facilities in 2004. In many cases, the adoption of the CWS by provincial regulators has resulted in the closure of older incineration facilities. Some facilities have been upgraded to meet the new standards.

⁷ Canadian Council of Ministers of the Environment (CCME). Canada-wide Standard for Mercury Emissions, 2000. Available at: http://www.ccme.ca/ourwork/air.html?category_id=87

⁸ Mercury-containing Product Stewardship: Manual for Federal Facilities. (2004). Environment Canada. Available at <http://www.ec.gc.ca/Mercury/ffmis-simif/Manual/index.aspx?lang=E>

⁹ Chemicals Management Plan (CMP), 2006 Notice of intent to develop and implement measures to assess and manage the risks posed by certain substances to the health of Canadians and their environment. Under the *Canadian Environmental Protection Act*, 1999. <http://www.chemicalsubstanceschimiques.gc.ca/en/index.html>

¹⁰ Ontario Ministry of the Environment, 2004. GUIDELINE A-7 Combustion and Air Pollution Control Requirements for New Municipal Waste Incinerators. Legislative Authority: *Environmental Protection Act*, Part V, Section 27, and Part II, Section 9. Last revision February, 2004. Available at: <http://www.ene.gov.on.ca/envision/gp/1746e.pdf>

¹¹ Ontario Ministry of the Environment, 2004. GUIDELINE A-8 Guideline for the Implementation of Canada-wide Standards for Emissions of Mercury and of Dioxins and Furans and Monitoring and Reporting Requirements for Municipal Waste Incinerators Biomedical Waste Incinerators Sewage Sludge Incinerators Hazardous Waste Incinerators Steel Manufacturing Electric Arc Furnaces Iron Sintering Plants. Legislative Authority: *Environmental Protection Act*, Part V, Section 27, and Part II, Section 9, August 19, 2004. Available at: <http://www.ene.gov.on.ca/envision/gp/4450e.pdf>

2.0 The Waste Incineration Process

This section provides background information on the waste incineration process in order to provide a basis for understanding the recommendations contained later in the report. This chapter discusses: controlling combustion and emissions; waste incineration technologies; and, general design and operation considerations.

2.1 Controlling Combustion

2.1.1 Overview of the Waste Incineration Process

Gases, liquids and solids containing carbon and hydrogen can be burned. The way each state of matter burns is different. In the context of this document, waste being incinerated is mostly in solid form as opposed to a liquid or a gas.

Most solid fuels contain both volatile materials and fixed carbon. During combustion, two different processes occur: the gaseous volatile materials are released and oxidised; and, the fixed carbon is oxidised.

In the first process, the volatile materials are released by pyrolysis reactions that convert the waste into gases consisting of hydrogen, carbon monoxide (CO), light hydrocarbons and tars. Once released in the high temperature environment, the hydrogen reacts instantaneously with oxygen to form water vapour. The CO oxidises to form carbon dioxide (CO₂) at a slightly slower rate. The hydrocarbons and tars react to form hydrogen and carbon, which in turn are oxidised. The gaseous reactions require oxygen and an elevated temperature. If the gases and the air are not well mixed some of the reactions do not go to completion and tars and other products of incomplete combustion, such as dioxins/furans, can also be released to the flue. Under these circumstances, the stack gases will be cooler and tars and other products of incomplete combustion will condense on the flue walls as soot or tar deposits.

In the second process, the remaining fixed carbon oxidizes and releases CO. This reaction takes longer than the release of the volatile materials because oxygen must diffuse to the material's surface where it can react. The rate of this reaction is proportional to the exposed surface area available.

Throughout the combustion process, the oxidation of CO to CO₂ occurs through reactions with hydroxyl (OH) radicals. If excessive air is present in the combustion zone, the combustion temperature and the concentration of hydroxyl radicals will be reduced and the CO oxidation reaction will be inhibited. This results in elevated concentrations of CO in the exhaust gases. Insufficient air can also lead to high CO concentration because there will be insufficient oxygen to oxidise the CO.

The burning of waste in an incinerator is essentially a rapid oxidation process that generates heat and converts the waste to the gaseous products of combustion, namely carbon dioxide and water vapour, which are released to the atmosphere. At the end of the burning process, there may be residual materials and ash that cannot burn.

2.1.2 Controlling Combustion

Controlling combustion during the waste incineration process is very important for in order to minimize the formation and release of products of incomplete combustion such as dioxins and furans. The intent is to ensure that the combustion process is as complete as possible, yielding residues with little carbon, and stack gases containing only carbon dioxide and water vapour.

Solid waste is generally characterized as heterogeneous, with materials that burn at different rates. The rate of burning is determined by the amount of air added to the waste. When burning waste in a well designed incinerator, air flows are controlled to ensure high temperatures and a clean burn.

Burning is an oxidation reaction that requires a precise amount of oxygen to mix with the material being burned. This is termed the stoichiometric oxygen requirement. There must be just enough oxygen molecules to combine with the carbon and hydrogen from the waste to create carbon dioxide and water. If the quantity of oxygen available is just enough, the temperature generated by the reactions will reach its maximum. If too little or too much oxygen is present, the temperature achieved in the system will be lower.

In batch incinerators, the waste sits stationary on a solid surface referred to as the hearth. The heterogeneous mix of waste on the hearth changes as the waste is reduced to ash through gasification and oxidation reactions. The initial heat required to ignite the waste is supplied by a burner that uses propane, natural gas or oil. Since the fuel supply to the burner is continuous, the burner can stay on indefinitely during the burn cycle. However, this would increase operating costs, and so the incinerator controls shut off the burner once the waste on the hearth has generated sufficient heat to allow the reactions to become self sustaining.

Air must be provided to sustain the combustion process. In batch incinerators, the air is supplied through holes in the incinerator walls. These holes are positioned so that the air is directed to the base of the hearth. In larger continuously operated incinerators, these air ports are under the fuel bed. In either case the air introduced in this manner is termed "under fired" air to denote where it is injected. Air must also be added above the hearth to burn the gases generated. This air also enters through air ports, and is referred to as "over fired" air. In dual chamber incinerators the over fired air is added in the secondary chamber. It is not sufficient just to add the over fired air, it must be well mixed with the volatile gases to ensure good combustion. This mixing is typically accomplished by passing the volatile gases through a "flame port" that is smaller than the primary chamber dimensions. Air can be added in the flame port or immediately after it. The flame port increases the gas velocity and introduces turbulence into the gas stream to promote mixing.

The oxidation reactions require a finite amount of time for completion, meaning that the duration of exposure at elevated temperatures must be controlled. Since batch incinerators typically lack any mechanism for agitating the waste, the temperature in the system must be maintained by re-igniting the primary burner. The combustion cycle for a batch waste incinerator is thus set to ensure maximum carbon reduction of the waste on the hearth.

The type of waste incinerated can have significant implications for the control of combustion. Paper and plastics have a higher energy value and require more air to complete the combustion process. Food wastes, with lower energy levels, require less air to complete the burning process. However, the moisture in food waste has to be evaporated before the carbon can sustain combustion. Thus, food wastes must be heated for longer periods before the combustion process commences and the primary burner can be shut off.

7

Combustion in the secondary chamber of a dual chamber incinerator will respond to the quantity of volatile gases present. As the volatile gas release rate drops, the temperature in the secondary chamber will also drop. To address this issue, most batch waste incinerators are equipped with secondary chamber auxiliary fuel burners. These burners maintain the desired temperature in the secondary chamber and assist with heating the incinerator during start up. The secondary chamber is typically sized to provide the gases with a one second residence time at 1000°C.

2.1.3 Reducing Dioxin and Furan Emissions

Emissions of air contaminants from batch waste incinerators are a function of the design and operation of the equipment, and the nature of the materials being processed. Heavy metals present in the waste will be released with the exhaust gases. If there is mercury in the waste, mercury will be found in the emissions. If no mercury enters the incinerator, it cannot exit the stack. However, the same approach cannot be used to reduce the emissions of POPs, and in particular, dioxins and furans (PCDD/F).

It is known that at temperatures in excess of 600°C, any PCDD/F will be destroyed. However, even in incinerators with good combustion there is a potential for PCDD/F formation due to *de novo* synthesis reactions. *De novo* reactions occur at temperatures in the 250 - 450°C range when stack gases and fly ash are in contact for periods exceeding a few seconds. It has been postulated that residual carbon in the fly ash reacts with components in the exhaust gases to form PCDD/F. Given this behaviour, it should not be surprising that facilities with low temperatures have been identified as those having higher PCDD/F emissions.

Chemical reactions are driven by concentration gradients, so the higher the concentrations of carbon and fly ash the more likely the reaction will produce high emissions. Similarly, incinerators with higher concentrations of fly ash in zones with lower temperatures are anticipated to produce significantly more *de novo* reactions.

Carbon monoxide (CO) concentrations in the exhaust gases are a good indicator of combustion efficiency. Most incinerators can be adjusted to give a minimum CO concentration. For batch waste incinerators, CO concentrations should be below 50ppm. If the incinerator is not operated appropriately (for instance, if the waste has a high calorific value and insufficient air is provided to complete the combustion process), CO levels will rise and black smoke will be released. Such smoke will contain large quantities of carbon that can react to produce higher PCDD/F emissions. Conversely, if the waste cannot create enough heat in the primary chamber to achieve the target temperatures, perhaps because too much air is leaking into the incinerator, there will be zones in the incinerator where temperatures could be in the *de novo* reaction range. The extra air can also entrain particulate matter from the hearth raising fly ash levels in the gas stream. The result will be higher PCDD/F concentrations than might be found in a properly operating system.

2.2 Waste Incineration Technologies

A waste incinerator is a system constructed to thermally treat (i.e. combust or pyrolyze) a waste for the purpose of reducing its volume, destroying a hazardous substances or pathogens present in the waste. There are two main types of waste incinerators: batch and continuous. Batch waste incinerators are loaded with waste through an open door which is then closed

before the waste is ignited. The door remains closed until the ash residues remaining on the hearth have cooled and can be safely removed. The duration of a batch waste incinerator cycle is measured in hours. In comparison, continuously operated incinerators receive fresh waste and discharge ash residues periodically throughout their operation, which can last from weeks to months. This Technical Document focuses on minimizing dioxins/furans and mercury emissions from batch waste incinerator systems ranging in size from 50 to 3,000 kg of waste/batch.

For facilities incinerating more than 26 tonnes of waste per year (tpy), the preferred incinerator for new installations is the dual chamber controlled air incinerator. The dual chamber controlled air incinerator has two chambers and each chamber is equipped with air ports that allow the quantity of air added in various parts of the incinerator to be controlled. They are capable of achieving the higher operating temperatures required to minimize the emissions of POPs, and particularly dioxins/furans. Figures 2.2 and 2.3 illustrate the design of a typical dual chamber controlled air incinerator.

Batch waste incinerators have a zone where the waste is ignited and mixed with air to promote combustion, and a second zone where additional air is added to complete the combustion process. In large continuously operated incinerators, the energy available in the hot exhaust gas stream may be recovered in a heat recovery steam generator (HRSG) or hot water boiler. The steam generated can be used to produce electricity or it can be used for process or space heating. Heat recovery is not recommended for batch waste incinerators, as it lowers the gas temperatures in the system and can lead to *de novo* synthesis formation of PCDD/Fs.

Large continuously operated incinerators are equipped with air pollution control (APC) systems to treat the hot gases leaving the heat recovery system. The gases leaving the heat recovery system are cooled by a fine water mist to reduce the size of the required air pollution control equipment and to protect the incinerator from high gas temperatures. If a large continuously operated incinerator is not equipped with a heat recovery system, a rapid water quench system is used to achieve the desired gas temperatures. Such quenching will limit the potential for *de novo* synthesis of PCDD/Fs because the gases do not remain in the critical temperature range for sufficient time to allow the *de novo* reactions to proceed.

APC systems are not recommended for batch waste incineration systems to control PCDD/F emissions. Stack gases should be released directly to the atmosphere at temperatures in excess of 700°C to reduce the chances of inadvertent formation of PCDD/F through the *de novo* synthesis process.

After the waste has been oxidized in the primary chamber, residues, generally referred to as bottom ash, must be removed. Bottom ash from well-operated incinerators has been shown to contain low PCDD/F concentrations (<20 pg TEQ/g of bottom ash). Solid residues deposited in the heat recovery system of large continuously operated incinerators typically have <50 pg TEQ/g of PCDD/F whereas residues from air pollution control systems typically have <300 pg TEQ/g of PCDD/F. The deposits from heat recovery systems and air pollution control systems are generally referred to as fly ash because the ash has travelled suspended in the exhaust gases. Because of low gas velocities, batch waste incinerators create much less fly ash than large continuously operated incinerators.



Figure 2.2 Typical Controlled Air Dual Chamber Incinerator

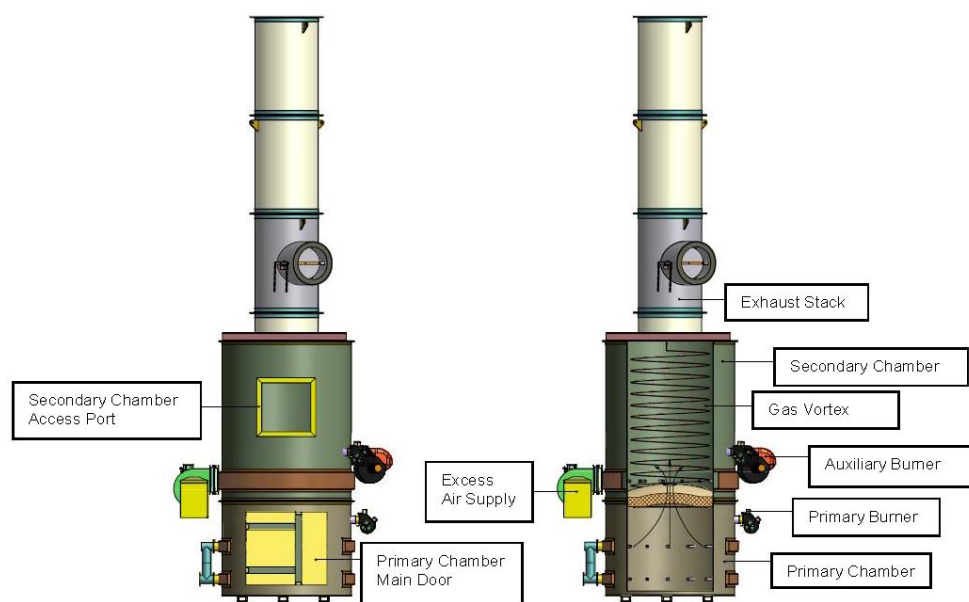


Figure 2.3 Schematic of Typical Controlled Air Dual Chamber Incinerator

2.3 General Design and Operation Considerations

2.3.1 Design and Operation

The design features addressed below are deemed to be most important for those contemplating buying a dual chamber controlled air batch incineration system. As mentioned previously, the emphasis is on batch waste incinerators that are capable of disposing of up to 3,000 kg of waste per batch.

The degree to which the combustion process is completed is a function of:

- the temperature the combusting gases reach;
- the length of time the gases remain at elevated temperatures;
- how well the air and the gases are mixed; and
- whether there is adequate oxygen to permit complete combustion.

Combustion temperatures downstream of the primary chamber and the residence time for gases at this temperature are frequently specified in regulations. In Ontario, for example, waste incinerators must provide a 1 second residence time for gases at 1,000°C¹². In the European Union, the requirements are two seconds at 850°C¹³. These values reflect operating conditions in incinerators with low emissions.

The incinerator designer has more discretion in defining the temperatures in the primary chamber. Primary chambers are designed with consideration of the wastes that will be destroyed. Materials that are harder to burn require higher operating temperatures. The design temperature is governed by the rate at which heat is released in the primary chamber, which is known as the target volumetric heat release rate and expressed in MJ/m³/hour. This value is based upon the calorific value of the waste in MJ/kg, the quantity of waste to be charged to the incinerator in kg/batch, and the volume of the primary chamber in cubic metres. The operating temperature in a system provides a limit for the volumetric heat release rate. For the typical dual chamber incinerator, the primary chamber should operate in the 500 – 800°C range.

Since the temperatures achieved in a specific primary chamber are a function of the heat release rate and the waste mass, it is important that the incinerator be loaded with waste that matches its particular design characteristics. It should be remembered that by design, incinerators are heat release limited devices. Too little heat and the material will not burn properly; too much heat will lead to damage to the incinerator. When the appropriate amount of energy is introduced into the primary chamber, the primary chamber temperature in a batch waste incinerator can be controlled principally through adjusting the air to fuel ratio.

Air addition to the primary and secondary chambers of batch waste incinerators will result in exhaust oxygen concentrations in the range of 6 – 12%. Operation in this zone will minimize the release of CO and thus also minimize trace organic releases. This range can be reduced based upon testing of a given system to produce minimum CO levels. Maintaining oxygen

¹² Ontario Ministry of the Environment, 2004. GUIDELINE A-7 Combustion and Air Pollution Control Requirements for New Municipal Solid Waste Incinerators.

¹³ Directive 2000/76/EC of the European Parliament and of the Council of 4 December 2000 on the incineration of waste. 2000.

concentrations within the manufacturer's recommended range will ensure that the system is operating at in the most efficient manner.

As noted, temperature control involves regulating the air to fuel ratio. To lower the temperature, more air is added, up to the maximum flow. Alternatively the auxiliary fuel flow rate can be reduced. The primary chamber of a batch waste incinerator is designed for a waste mass of a certain calorific value. The air supply system is sized to provide the appropriate level of excess air to control the temperature to the desired level, even if the heat input varies from design.

It is considered poor practice to introduce wastes at either extreme of the calorific value range if good combustion is the objective. In order to prevent any situation where the temperature might be damaging to the primary chamber, the quantity of high calorific waste in any charge must be limited. Wastes should be mixed to achieve a relatively uniform heating value close to the design point of the unit. If the operator controls the quality of the waste mix, any variability in the rate that the waste burns can usually be managed by the control systems of the incinerator.

2.3.2 Heat Recovery

In most cases, batch waste incinerators should not be equipped with heat recovery because this can lower temperatures and lead to *de novo* synthesis formation of PCDD/Fs.

2.3.3 Air Pollution Control Systems

Air Pollution Control (APC) systems with evaporative cooling towers and dry scrubbers are seldom recommended for small batch fed incinerators for two main reasons:

- Due to the non-continuous nature of batch waste incineration, gas temperatures will vary from ambient to operating levels as high as 1,200°C each time the system is operated. When not at high temperature, condensation can occur and cause corrosion in the system. Furthermore, deposits remaining in the duct work during the cool down phase pass through the *de novo* synthesis temperature and can increase the production of PCDD/Fs.
- Since the non-continuous nature of batch waste incinerator operation generally makes it impractical to install a heat recovery system, there will be no initial cooling of the gas stream and higher temperatures will enter the APC system. To prevent equipment damage, some means of rapid gas cooling would need to be installed. This would require large volumes of water, some of which will collect hydrochloric acid and other acidic gases, and would require treatment or at the least re-circulation in the system. In certain areas of the country, obtaining the water and treating it could present significant challenges.

Adding an APC system to a batch waste incinerator will also increase the pressure drop across the system. This will result in the need for induced draft fans to exhaust the combustion gases. The induced draft fan and the air pollution control system will increase the energy requirements of the incinerator.

In most cases, APC systems are not recommended for batch incineration systems to control

PCDD/F emissions. By ensuring good combustion control and exhaust gas temperatures in excess of 700°C, there should be little opportunity for the formation of PCDD/F through *de novo* synthesis

However, in certain jurisdictions and/or operating conditions it may be necessary to employ an APC system. Owners and operators should consult with manufacturers and local regulatory authorities regarding any such requirements.

3.0 The Six-Step Process for Batch Waste Incineration

The recommended Six-Step Process for Batch Waste Incineration includes:

- Step 1 – Understand Your Waste Stream
- Step 2 – Select the Appropriate Incinerator (or Evaluate the Existing System)
- Step 3 – Properly Equip and Install the Incinerator
- Step 4 – Operate the Incinerator for Optimum Combustion
- Step 5 – Safely Handle and Dispose of Incinerator Residues
- Step 6 – Maintain Records and Report

The Six-Step Process will assist owners and operators of batch waste incinerators, ranging from 50 to 3,000 kg/batch, in achieving the intent of the CWS for dioxins/furans and mercury, and reducing the potential for releases of other toxic substances to the environment.

3.1 Step 1: Understand Your Waste Stream

The first step in managing waste is to understand the quantity and composition of the waste that is generated. A waste audit should be completed, where practical, to:

- Determine the quantity of waste generated in the various parts of an operation;
- Characterize the waste from each type of operation;
- Examine the waste stream to determine what opportunities exist for:
 - Reducing the quantity of waste generated;
 - Reusing materials; and
 - Recycling as much as possible before considering disposal.

Where waste audits are not practical, it is still necessary to develop an estimate of the waste quantities and characteristics before a strategy for waste diversion and disposal can be completed. Owners should investigate waste generation and diversion data from similar operations/facilities in order to estimate the waste types and quantities that will be generated at their own facilities. Sources of such information may include industry associations, waste industry consultants, provincial/territorial authorities and other regulatory bodies.

Based on the results of the waste audit/characterization, an assessment of appropriate disposal options should be undertaken. Where possible, disposal alternatives (other than incineration) for the residual waste stream (i.e. post 3Rs – Reduce, Reuse, Recycle) should be examined. When assessing disposal options, it is important to note that waste should neither be open-burned nor burned in a barrel. In both cases, the appropriate temperatures for a clean burn will not be achieved, and toxic contaminants, in particular dioxins and furans, will be released.

3.1.1 Conducting a Waste Audit or Estimating Waste Characteristics

A waste audit is the best way to define the waste stream at a given location. Ideally, an audit should account for seasonal variations in the waste generation rates, so it might have to be conducted in each season.

Performing a waste audit will provide an estimate of the total quantity of waste that could be generated, and allow the user to develop diversion activities that will reduce the amount of material requiring disposal. The residual waste remaining after diversion activities represents the waste requiring disposal. After other disposal options have been investigated, the characteristics of the remaining waste can be used to estimate the energy of the waste that will be charged to an incinerator. This information will be required to select an incinerator.

If the facility is only in the design stage a waste audit cannot be conducted. Even if a facility is operating, the cost of a waste audit could be seen as prohibitive. Where waste audits are not practical, it is still necessary to develop an estimate of the waste quantities and characteristics before a strategy for waste diversion and disposal can be finalized. Owners should investigate waste generation and diversion data from similar operations / facilities in order to develop an estimate of the waste types and quantities that will be generated at their facility. Sources of such information may include: industry associations; waste industry consultants; provincial / territorial authorities; and, other regulatory bodies.

3.1.2 Choosing Appropriate Waste Management Options

In all cases, reduction and diversion should be the primary waste management objectives, prior to considering any disposal option. Facilities should have a Waste Management Plan that outlines waste generation data and defines the acceptable recycling and disposal options. Hazardous waste and hazardous recyclable materials should be handled appropriately in accordance with local, provincial/territorial, and federal legislation.

3.2 Step 2: Select the Appropriate Incinerator (or Evaluate the Existing System)

The characteristics of the residual waste stream destined for incineration should be incorporated into a call for proposals from incinerator manufacturers. Specifying the quantity and composition of the waste stream will ensure that proposals include suitable incinerators. It should be noted that incinerators built for a specific waste stream, such as animal carcasses, liquid wastes and hazardous wastes, are available and should be used as required.

For facilities with existing incinerators, owners/operators should reassess the suitability of the existing system to manage the current waste stream.

For facilities incinerating **more than 26 tonnes of waste per year**, dual chamber controlled air incinerators are the recommended configuration. These systems are capable of incinerating a wide range of wastes and, when properly maintained and operated, will achieve emissions of PCDD/F and mercury below the level of the Canada-wide Standards. These systems should be equipped with a large secondary chamber sized to provide a residence time of at least one second at a temperature higher than 1000°C, to ensure complete combustion and minimize PCDD/F emissions.

For facilities incinerating **less than 26 tonnes of waste per year**, “determined efforts” as defined in the Canada-wide Standards for dioxins and furans¹⁴ should be undertaken. Should circumstances restrict the ability to use a dual-chamber incinerator with a large secondary chamber, a single chamber incinerator with an afterburner should be used. It should be noted that such systems are less likely to be able to meet the emission standards than dual chamber incinerators.

The results of the waste audit conducted for the site should be provided to incinerator suppliers. Suppliers will be able to use these data to provide the appropriate type of incinerator. However, the owner should consider a number of issues when preparing the request for proposals. These include the type of incinerator that should be installed and the size of the incinerator. These issues are discussed in the following sections.

3.2.1 Classification of Batch Waste Incinerators

The emphasis in this report is on batch waste incinerators having a capacity of 50 to 3000 kg/batch. Even with this restriction there are various configurations of incinerators that could be used as noted in Table 3.2.

¹⁴ Available on-line at: http://www.ccme.ca/ourwork/air.html?category_id=97

Table 3.2 Batch Waste Incinerator Types and Features

FEATURE	TYPE
A. Number of chambers	1. Single-chamber (with afterburner)
	2. Dual-chamber
	a. Excess air in primary chamber
	b. Starved air in primary chamber, excess in secondary chamber
B. Waste feeding mode	1. Batch (one load per cycle)
	2. Intermittent (with ram feeder)
C. Ash removal mode	1. Batch
D. Air Pollution Control	1. No
	2. Yes (variety of technologies)
E. Use of blowers and fans	1. Forced air (blower(s) to supply air to combustion chamber(s))
	2. Combination (blower(s) AND an induced draft fan, necessary for APC systems)
F. Heat Recovery System	1. No
	2. Yes

3.2.2 Incinerator Selection Considerations

New Incinerators

For facilities incinerating more than 26 tonnes of waste per year (tpy), the preferred incinerator for new installations is the dual chamber controlled air incinerator. This type of incinerator has two chambers and each chamber is equipped with air ports that allow the quantity of air added in various parts of the incinerator to be controlled. These incinerators are capable of achieving the higher operating temperatures required to minimize the emissions of POPs, and in particular dioxins and furans.

As noted in Table 3.2 there are single chamber incinerators on the market. Suppliers may offer single chamber units equipped with afterburners, but they are not desirable. They are unlikely to provide the low emissions levels achievable by properly sized dual chamber incinerators. A properly sized secondary chamber is required to accommodate the volatile gases that are released from the primary chamber. Small secondary chambers are unlikely to provide sufficient time at elevated temperatures to ensure destruction of volatile compounds.

Another important factor to consider is the frequency of operation of the incinerator. While operating procedures should minimize the release of unwanted contaminants to the atmosphere, even during start-up and shut-down, there is a higher probability of emissions during these transition conditions than during the normal steady-state operation.

Incinerators sized in a way that allow them to operate only on alternate days, or even only 2 or 3 times per week, will generate lower annual emissions than those operated frequently each day. For this reason, a larger incinerator which can be operated less frequently is preferred.

The designer undertakes detailed calculations to size the incinerator and the control systems. Manufacturers recognize that wastes will not be consistent day after day and provide a margin

17

of safety in their instructions. While the manufacturers would prefer tighter control on the feed rate, it is not unusual to see instructions state that the primary chamber should only be half filled. Based on the waste audit data, the manufacturer assumes a density and heat value for the waste and specifies a safe quantity of material that can be burned in a given cycle.

Existing Incinerators

If an existing incinerator is still being used as originally intended (i.e. the nature of the waste has not changed over the intervening years, and the unit has been properly maintained), consideration could be given to the unit's continued operation. Stack testing of the emissions can determine the incinerator's emission performance and allow the status of the emissions to be compared to the Dioxins and Furans Canada-wide Standards for incinerators.

Annual Throughput Considerations

The Canada-wide Standards for Dioxins and Furans¹⁵ distinguishes incinerators by their capacity and use, setting an annual throughput threshold of 26 tonnes.

Any system capable of handling greater than 26 tonnes per year should have a primary chamber and a large secondary chamber sized to match the nature of the waste characteristics developed from the waste audit.

If the unit is unlikely to process 26 tonnes of waste per year, and a smaller secondary chamber is chosen to facilitate transport, additional care must be taken in ensuring the correct types of wastes and volume of material are charged to the primary chamber. This will reduce the possibility of high PCDD/F emissions.

Special Waste

Special wastes such as liquid waste (e.g. waste oil), wet waste (e.g. kitchen wastes, sludges), and animal carcasses require special consideration when selecting an incinerator. Liquid and wet waste in small quantities can usually be mixed with other wastes, but large quantities of either material will require special provisions.

For instance, waste oil can be used as an auxiliary fuel in an incinerator. Should its use be contemplated to offset virgin oils in the incinerator, this strategy should be made known to the manufacturer. They will recommend appropriate systems to separate sludge and moisture from the used oils, and the installation of two burners in each chamber (one for waste oil and one for virgin oil). These are necessary steps to ensure that temperatures in the chambers can be maintained should operating problems arise with the waste oil burner. In the context of the batch waste incinerators addressed in this report, liquid hazardous wastes, other than oil, should not be injected into the incinerator.

The incinerator hearth should be designed to contain any free liquid anticipated in the waste stream. Free liquids can drain into air ports if they are situated below the liquid level in the incinerator. Liquid may also leak through the doors of a standard flat hearth incinerator and damage their seals. Leaks in other areas can lead to poor combustion performance.

¹⁵

Available at: http://www.ccme.ca/assets/pdf/d_and_f_standard_e.pdf

Wet waste is challenging to handle unless the incinerator is properly designed. For example, it is strongly recommended that batch incinerators not be used to treat sewage waste, unless they have been designed specifically for this type of waste. If it is anticipated that the waste to be incinerated on a routine basis will contain wet wastes, the auxiliary burner may need to be larger to dry the waste in a reasonable amount of time.

Unlike sludges and liquids, animal carcasses should not cause liquid leaks from the primary chamber even though they contain high levels of moisture. They must be handled in incinerators that can accept this type of waste. Animal wastes should only be charged to an incinerator that is capable of completely calcining the bones in order to ensure that all pathogens are destroyed in the incinerator. Those anticipating the need to destroy animal carcasses should discuss their needs with regulators and the manufacturers of waste incinerators.

3.3 Step 3: Properly Equip and Install the Incinerator

Building Considerations

- Incinerators should be installed inside a building to protect the equipment and the operators from weather conditions.
- In designing the installation site, care should be taken to maximize clearance between incinerator components, including the stack, and combustible construction materials.
- Insulation should be used to protect combustible building materials.
- The building should be equipped with sufficient fresh air inlet capacity for the incinerator. Both combustion air and dilution air for the barometric damper are required. Care should be taken to introduce air in a manner that does not lead to low-temperature operating problems.

Equipment Considerations

The incinerator system should come complete with the following equipment to monitor and record performance parameters:

- A scale to measure the weight of all materials charged to the incinerator; and
- A computerized process control and data acquisition system to store operating data from the incinerator.

Operational data should be collected and stored, at a minimum, every minute that the system is operating. The intent is to be able to summarize operating parameters during start-up, operation and cool-down for every cycle. If the required operating conditions are not achieved these data will allow the operators, the manufacturers and the regulator to identify the contributing factors for the failure. From this information, operating procedures can be adjusted to improve performance. Provisions should be made for the manufacturers to be able to remotely access and review the operating data for trouble shooting purposes.

It is highly recommended that batch incinerators not be equipped with heat recovery devices. The temperature of the stack gases in heat recovery systems will be lower than in systems without heat recovery, and may be in a temperature range that can lead to the formation of greater quantities of PCDD/F. Similarly, air pollution control systems are not recommended for batch waste incineration systems to control PCDD/F emissions. Stack gases should be released directly to the atmosphere at temperatures higher than 700°C to reduce the chances of the inadvertent formation of PCDD/F through the *de novo* synthesis process.

If it is necessary to introduce additional waste to the incinerator during the burn cycle, the incinerator should be equipped with a ram charge system to limit the disruption of combustion in the primary chamber during the waste charging process.

3.3.1 Building Considerations

The recommendation from the previous section that incinerators be over-sized so they can be operated on a less frequent basis implies that the facility will need to store waste between incinerator operation periods. The incinerator should be installed in a building with sufficient space for waste storage. Operating the unit in a building will ensure that the operators are more comfortable and thus spend more time ensuring proper operation and conducting the necessary maintenance on the system. Furthermore, it will protect the unit from weather conditions, extend its life, and make operation more reliable.

Care must be taken to avoid the exposure of combustible building material to the high temperatures on the surfaces of the incinerator and the stack. Suitable fire proof insulation and air gaps must be provided to avoid igniting the building structure.

Since combustion reactions require air, provisions should be made to ensure that sufficient fresh air is available in the vicinity of the incinerator. The air flow should be unimpeded by louvers or doors in the building. At the very least, if louvers are required to isolate the incinerator room during power outages, their status should be interlocked to the incinerator controls so the incinerator does not operate when the dampers are closed. The manufacturer's advice should be sought on the fresh air supply requirements for the incinerator. It should be remembered that in extremely cold climates, fresh air impinging upon fuel lines or other parts of the operating system can create operating problems so the air should be properly tempered to minimize equipment freezing and/or staff discomfort.

3.3.2 Equipment Considerations

The operation of the incinerator should be monitored at all times and this data should be recorded to provide a record of such operation. A list of monitoring equipment recommended for all installations follows:

- **Weigh Scale:** Every incinerator operation should have a weigh scale so that every load can be weighed and the results recorded.
- **Continuous Monitoring:** In order to confirm the status of the incinerator at all times, it is recommended that measurements of the parameters described below be continuous regardless of the operational status of the incinerator. Gaps in the readings could be interpreted as periods where the incinerator was not operating in an appropriate manner. Thus, continuous readings, once per minute, are the best way of proving that the system is operating in compliance with the various approvals and guidelines. The measurements should be captured in a computerized data acquisition system that logs the date and time of the readings as well as the readings themselves.
 - **Temperature:** The most basic of all measurements associated with incinerator operation is temperature. Temperature should be monitored in both the primary and secondary chamber and the stack at all times. The sampling location for the stack measurement should be above the barometric damper if one is installed. Such measurements will ensure that the system has achieved the desired temperature levels. Temperatures outside the normal range can serve to warn the operator that the system is not working as intended.
 - **Differential Pressure in the Primary Chamber:** A second operating parameter that is important is the differential pressures in the primary chamber. The

primary chamber should operate at negative pressure. Should the differential pressure track towards the positive, it is an indication that insufficient draft is present in the system and combustion fumes could be building in the system. The operator should be able to adjust this parameter either by changing the inlet flows or adjusting the barometric damper. If the pressure goes too negative, the combustion air fans may have failed, or the damper needs adjustment. The data acquisition system can be programmed to warn the operator of potential draft limitations in the system.

- **Auxiliary burner operation:** The auxiliary fuel burners in some incinerators are not reliable. This type of failure will likely be reflected in lower than desired temperatures in the incinerator. A combination of no fuel flow in the auxiliary burners and low temperatures in either chamber could indicate an auxiliary burner failure. The operator should be able to monitor the auxiliary burner operation.
- **Fan Amperage:** Failure of the combustion air fans will lead to inappropriate operating conditions. Recording the fan amperage will provide some indication that the fans are operating at their design loads.
- **Interlocks:** The data acquisition system should monitor the state of all interlocks on the system. Loading doors and other components of the system are frequently connected to the incinerator control system. Recording the status of sensors on various doors or dampers will assist in confirming the system is operating in the desired manner.

The type of data acquisition system described above can store data and can also be used as a means of allowing the manufacturer to look at operational data remotely to assist with trouble shooting the operation. In this manner, the operator can quickly obtain the assistance of the manufacturer. Owners should request that the manufacturer provide recommendations for the data acquisition system. This will likely open up a line of communication concerning what they can do to help operational staff adjust the incinerator if it is not operating correctly.

Other Considerations

Most batch incinerator systems are factory fabricated and shipped to the site where they are to be used. Larger systems may be shipped in sections to be assembled on the site. Typically the stack will be installed on the incinerator as one of the final steps. Stacks should be properly designed to ensure that emissions can freely disperse in the atmosphere and not be re-entrained into fresh air intakes on nearby buildings.

3.4 Step 4: Operate the Incinerator for Optimum Combustion

Operational Considerations

Wastes received at the incinerator building should be separated according to their heating value characteristics: wet or low-energy wastes (e.g. food waste); mixed wastes with average energy values; and other materials with high energy values, such as oily waste materials. To facilitate this separation, all waste should be collected in transparent bags. To further assist with separation, wastes could be collected in coloured-coded bags.

Batch incinerators are designed to accept wastes within a specified range of energy (i.e. calorific) values. The operator should select waste from each category and mix it to achieve the manufacturer's specified input calorific value. Each bag should be weighed, its source should be noted, and the total weight of each category should be tallied before completing the loading. This information should be recorded by the computerized data acquisition equipment installed with the incinerator. (Refer to step 6 for further record keeping requirements).

Batch incinerator systems have limited charging capacity (both in terms of waste quantity and the calorific value of the waste charge). To assist the operator with the charging task, particularly for smaller incinerators, several batches could be weighed and placed in their own containers prior to loading the incinerator. The same weighing and logging procedures should be used for each batch and, once recorded, the batch can be charged when appropriate.

When the incinerator is charged with the appropriate mix and quantity of waste, the operator should close the door, ensure all interlocks are engaged, and start the burn cycle. The operator should observe the burn for at least 15 minutes after ignition of the primary chamber burner to ensure the volatility of the waste charged is not creating too much gas for the secondary chamber to handle. The rate of combustion can be slowed by reducing the quantity of under-fired air. The primary chamber should be operated in the temperature range specified by the manufacturer (typically 500°C to 800°C).

When satisfied that the burn is proceeding in a controlled manner, the operator may leave the incinerator area while the equipment completes the burn cycle.

The burn cycle should not be interrupted by opening the charging door until after the burn is complete and the unit has cooled down. No additional waste should be added to the primary chamber unless the incinerator is equipped with an appropriate ram feed device.

When the burn is complete and the unit has cooled, the operator should open the door only when wearing protective equipment such as gloves, dust mask, face shield and goggles.

The operator should remove the ash from the previous burn cycle before reloading the incinerator. Any unburned materials found in the ash should be recharged to the primary chamber after the operator has cleaned the air ports, and before putting a fresh charge into the incinerator.

Training Considerations

Operators should be properly trained by the incinerator manufacturer. The training course should include, as a minimum, the following elements:

- System safety including identification of hazards that the operator should recognize;
- Waste characterisation and how waste composition can affect operation;
- Loading limitations, including materials that should NOT be charged to the incinerator, and the allowable quantities of different types of wastes that can be charged;
- Start-up procedures for the incinerator and the normal operation cycle;
- Operation and adjustment of the incinerator to maximise performance;
- Clean out procedures at the end of the cycle;
- Troubleshooting procedures;
- Maintenance schedule; and
- Record keeping and reporting.

Managers should be involved in the training session so that continuity can be maintained with different operators.

3.4.1 Operation

3.4.1.1 General Batch Waste Incinerator Operation Considerations

Effect of Waste Characteristics

The characteristics of the waste loaded to the incinerator will affect the temperature profile in the various sections of the incinerator during the burn cycle. These variations will also influence the duration of auxiliary burner operation.

Wastes with a high percentage of volatile matter (e.g. paper >75%, plastics >85%) will release more volatile gases from the primary chamber than wastes with low percentage of volatile matter (e.g. vegetable wastes <20%). When mixed with additional air in the secondary chamber, the combustion of the volatile gases maintains the secondary chamber operating temperatures and limits the need for auxiliary fuel. At this point in the burn cycle, the temperature in the secondary chamber will be higher than that in the primary chamber. However, as the release of volatile gases from the primary chamber decreases, combustion in the primary shifts and begins to consume the fixed carbon. This results in a drop in temperature in the secondary chamber and an increase in temperature in the primary chamber. The secondary temperature can drop to the point where the secondary chamber auxiliary burner must come on to maintain the temperature at or above the required setpoint, typically 1000°C.

Higher moisture levels in the waste require more auxiliary fuel to evaporate the moisture and allow the waste to burn. The moisture released in this way passes through the secondary chamber taking heat from that chamber as well. This could mean that the secondary burner must operate for longer periods during the early phases of the cycle.

The ash percentage in the waste can also influence auxiliary fuel consumption and overall cycle time. The ash must be heated to sufficient temperatures to drive off volatile gases and the fixed carbon. The ash remaining in the primary chamber retains heat and lengthens the time required for the incinerator to cool so it can be handled safely.

Incinerator Loading

To properly load the incinerator, the following steps need to be followed:

- Determine the source of the waste – kitchen, vehicle shop, bunkhouse area, etc.;
- Weigh the waste to determine how much must be disposed; and,
- Proportion the waste fed to the incinerator on the basis of the anticipated heating value.

The wastes from different operations in the facility would need to be designated, either by colour codes or in different waste containers. Each source would be assumed to produce waste that was similar in composition on a daily basis.

For batch waste incinerators with charge sizes between 50 kg and 200 kg, individual bags of waste can be weighed before they are put into the incinerator.

For larger batch incinerators it would likely be onerous to have to weigh each bag in a 1,000 kg charge and alternative approaches could be adopted. The incinerator building should have a tipping floor sized to allow segregation of the various types of waste streams. All waste arriving at the facility should be weighed before being placed in the appropriate area. Knowing the mass of waste in each pile, the incinerator could be loaded with the appropriate volume of a specific type of waste to create a mixed load that has an appropriate calorific input for the incinerator. Possible mixes could be developed from the waste characteristics so the operator has clear guidance on loading the incinerator. For instance adding some higher calorific value plastic waste to the kitchen waste could reduce the amount of auxiliary fuel needed to evaporate the moisture. It is important to segregate known high calorific value materials so that the quantity of these materials in a batch can be limited.

Controlling Air

Ideal combustion is achieved when the exact amount of air needed to oxidize the carbon and hydrogen in the waste is supplied to the incinerator. This stoichiometric air addition rate will result in the highest temperatures from burning a given batch of waste. If too little or too much air is supplied, the temperatures in the primary chamber will change. Indeed, controlling air is the basis of many batch waste incinerators.

The typical starved air incinerator operates by controlling the primary chamber air injection so that the primary chamber operates under sub-stoichiometric or pyrolytic conditions. The air added to the system is only sufficient for the primary chamber to reach pyrolysis temperatures. This is typically between 70% and 80% of the ideal amount of air needed to burn the waste.

The volatile gases from the primary chamber can be burned in the secondary chamber after being mixed with extra air. The amount of air in the secondary chamber is typically 140% to 200% of the amount required to complete the reaction in the secondary chamber. Part of this excess air is added to control temperatures in the secondary chamber as explained below.

If too little air is supplied to the primary chamber the temperature will drop because the waste cannot burn sufficiently to increase the temperature. The operating ideal is to allow the waste to burn at a rate that generates sufficient volatile gases to maintain the desired temperature in the secondary chamber. If too much air is added in the primary chamber the combustion rate is accelerated and much of the volatile gases will be consumed before they get to the secondary chamber. This will lead to higher temperatures in the primary chamber, premature failure of

25

refractory and potentially other damage to the incinerator. In turn, because insufficient volatile gases will pass to the secondary chamber, the temperature in the secondary chamber will be lower and the auxiliary burner will need to operate to maintain temperature. Adding additional air to the secondary chamber will decrease the temperature in the secondary chamber, while limiting air addition will raise the temperature. This is opposite to the temperature response to additional air in the primary.

Controlling the amount of air added to the incinerator can be done in a number of ways:

- Manually by the operator;
- Automatically based upon the temperatures in the primary and secondary chambers; and,
- Automatically based upon changes in the oxygen level in the gas stream.

The control methods represent an increasing level of complexity so oxygen sensors are usually found only on larger systems. The operator must understand the cause and effect when making changes to the system and should be present for the duration of the cycle if manually controlling the operation. For this reason, automatic temperature sensing controls are preferred for batch incinerators.

Controlling Temperature

The primary chamber should be operated in the appropriate temperature range (typically 500°C to 800°C) specified by the manufacturer.

During operation, the secondary chamber temperature is controlled by varying the amount of air introduced to the secondary chamber and by operating the secondary chamber burner. As discussed earlier, regulators usually specify the secondary chamber temperature set point in the range of 850 °C – 1000 °C. The secondary chamber temperature set point may vary by jurisdiction and according to the residence time in the secondary chamber. As noted above, adding air to the secondary chamber decreases its temperature, while decreasing the amount of air raises its temperature. A secondary chamber temperature sensor controls the operation of the secondary burner. This sensor has low and high temperature set points that govern burner operation on pre-heating of the secondary. If the temperature drops below the selected set point the burner comes back on to increase the temperature. To avoid having the air and burner control compete with each other, the set point for the air control system is usually set at least 40°C above the burner's high temperature set point.

Typical Problems

Temperatures indicate how the combustion system is performing. Another way to judge the operation of the incinerator is to observe the colour of the flame in the two chambers. Hotter temperatures will drive the flame colour from dull red, through orange to yellow. In the primary chamber any colour brighter than dull red would suggest that too much air is being introduced into the system. In the secondary chamber, red flames indicate a temperature around 760°C, which is generally considered to be too low. An orange flame will be seen in the 1,100°C temperature range whereas at 1,200°C yellow flames are an indication that the temperature is too high for normal waste destruction.

Typical operating problems with batch waste incinerators are:

- **High fuel consumption**

High fuel consumption occurs when the operator is trying to burn extremely moist waste, or when too much air is added to the system.

As noted earlier, water must be evaporated from the wet waste before volatilization can occur. Since heat is not released from the waste until it starts to volatilize, the auxiliary burner must supply the extra energy needed. To reduce energy consumption, one must limit high moisture waste in any particular load.

If the combustion chambers have leaks, excess air will be introduced to the incinerator. Air could enter the incinerator through doors that have become warped due to over heating, or through deformed seals or holes in the incinerator due to corrosion. If excess air is introduced in the primary chamber, the volatile gases will be partially burned in the primary chamber and will not be available to heat the secondary chamber. If excess air enters the secondary chamber, temperatures will drop and the burner will operate for longer periods.

- **The formation of fused ash, or clinker, in the primary chamber**

Clinkers form when localized temperatures of the ash bed lead to melting of the ash and fusing of the melted material. With municipal solid waste, this occurs at temperatures above 1,200°C. While this should be far above the operating gas temperature of the primary chamber (typically 500°C to 800°C), localized bed temperatures can be higher than the gas temperature. Wherever air is introduced into the primary chamber, there will be zones where the stoichiometric amount of air is present for complete combustion. This air addition rate will result in the highest combustion temperatures possible (in excess of 1,500°C). This condition is more likely to occur if a harsh jet of air is introduced into the primary chamber due to blocked air ports. If this occurs, the flames near the bed would be bright yellow. The operator needs to check the air ports and ensure that the air is evenly distributed throughout the primary chamber each time he removes ash from the incinerator. Cleaning the air injection ports will limit clinker formation.

- **Visible stack emissions**

The appearance of the stack plume can also provide some indication of the adequacy of the combustion process. Typically stack emissions increase when there is one or a combination of the following situations occurring:

- The high set point temperature in the secondary chamber is too low;
- Excessive air infiltration;
- Excessive negative draft;
- Excessive primary air addition;
- Excessive secondary air addition; or,
- Waste characteristics that prevent the unit achieving design settings.

Plume Characteristics

Figure 3.2 shows different conditions that may be observed with malfunctioning dual chamber controlled air incinerators.

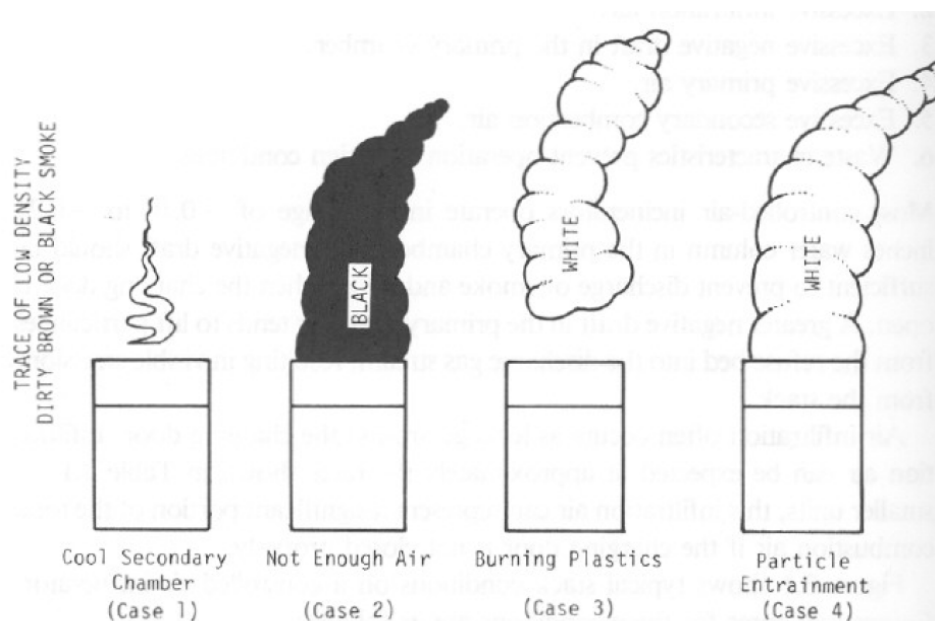


Figure 3.2 Plume Characteristics related to Operating Conditions ¹⁶

Case 1, with traces of dirty brown or black smoke in a wispy plume, generally occurs when the secondary chamber set point temperature is too low. Raising the temperature in the secondary chamber should improve the situation. Secondary chamber temperatures could also be low due to burner failure. Incinerators should not be operated without functioning secondary chamber burners.

Case 2 is the classic “not enough air for the waste being burned” situation as black smoke indicates incomplete combustion. There are a series of steps that the operator should go through to rectify this situation:

- increase the air flow to the secondary chamber to the maximum;
- reduce the air flow to the primary chamber to reduce the rate of volatilisation; and/or
- temporarily increase the set point of the auxiliary burner to 1,200°C to overcome the burning of a very high calorific waste charge.

If the situation persists after these steps have been taken, check the charging capacity for the

¹⁶ Cross, F.R., and H.E. Hesketh, 1985. Controlled Air Incineration. Publishing by Technomic Publishing Company Inc. ISBN No. 87762-396-1

incinerator and the characteristics of the wastes being burned. If the energy content of the waste is very high, the amount of that waste charged to the incinerator will need to be reduced in the future.

Case 3 is a detached white plume that could be the result of burning chlorinated wastes. Hydrogen chloride can cause this type of plume in high concentrations. To rectify this situation, ensure that chlorinated plastics are segregated from the waste stream.

Case 4 is a white plume that persists for long distances downwind. It is indicative of high quantities of fine particulate matter in the stack gases. This can be caused by high rates of air addition to the primary chamber, or by the particular components in the waste stream. If reducing the primary air flow does not rectify this situation, the operator needs to determine the types of materials being burned and take steps to reduce or eliminate their introduction to the system.

High moisture levels in a plume, particularly when exhausting into cold air, will also appear to be white. Water vapour forms a mist as it comes out of the stack and takes on the appearance of a white plume. This plume dissipates rapidly as the plume travel downwind and as the saturated air mixes in the atmosphere reducing moisture levels. The difference between Case 3, Case 4 and a high moisture plume is that typically the moisture plume will only exist for a short distance downstream of the stack. Moreover, the high moisture plume will typically not be visible as the plume exits the stack, but rather appears to form some distance above the stack tip as the vapour condenses in the cold atmosphere.

3.4.1.2 DOs and DON'Ts of Incinerator Operation

It is important to ensure that the incinerator is operating properly according to its design purpose. The following figure provides some significant DOs and DON'Ts to consider when operating a batch waste incinerator.

Some Significant DOs and DON'Ts of Batch Waste Incineration

DO:

- Use specially designed incinerators to dispose of animal carcasses, sewage, liquid wastes, or hazardous waste materials.
- Develop a waste collection and handling program that will allow the operators to mix the waste to provide a uniform heat input to the incinerator;
- Use waste oil and waste fuel for other heating purposes where practical, rather than disposal through incineration;
- Limit the quantity of waste oil or waste fuel in any specific charge to the incinerator to ensure the energy contained in the waste charge is within the limits specified by the manufacturer;

DO NOT:

- Overload the incinerator.
- Put mercury containing waste (e.g. fluorescent lamps, thermometers, thermostats, dental amalgam, batteries) into the incinerator. Limiting the quantity of mercury placed in the incinerator is the most effective way to limit mercury emissions.
- Introduce metal and glass into the incinerator when alternative options exist (e.g. recycling, landfilling). These materials absorb energy from the furnace and increase the wear and tear on various incinerator components.
- Incinerate wastes containing heavy metals (e.g. mercury-containing wastes, wood treated with Chromated Copper Arsenate (CCA), lead paint).
- Incinerate asbestos waste.
- Introduce large quantities of plastics or high calorific wastes into incinerators designed for low calorific value wastes such as animal carcasses and food waste. Incinerators capable of disposing of low calorific value waste are not suited to burning large quantities of high calorific wastes.

3.4.1.3 Standard Operating Procedures

To ensure good operation of the incinerator, there are certain standard operating procedures that should be followed. The list below should serve as a starting point for building the site specific procedures. These procedures must be tailored to the individual facility, and all operators should be trained to follow the site specific version of these procedures.

Cleaning and Loading

- The primary chamber should be cleaned of all ash before any new charge is introduced. Operators should check to ensure that the previous cycle is complete and that the primary chamber has cooled to room temperature before commencing clean out.
- Turn OFF all power to the incinerator before opening the primary chamber door.
- Wear personal protective equipment (gloves, face shield, dust mask) and use appropriate equipment to remove the ash. Rake and shovel the ash from the hearth and place it in a metal container for transport to an approved disposal site.
- Material that was not completely reduced to ash should be placed into the primary chamber for the next burn cycle. If it is necessary to remove this material for inspection and maintenance of the chamber it should be placed in a metal container until it can be reloaded to the incinerator. If this material is still smouldering, it should be sprayed with water when in the metal container.
- Inspect the interior of the primary chamber for wear, or damage to refractory. Refractory that has failed should be replaced before using the incinerator for the next cycle.
- Clean all the air pipes into the primary chamber. Vacuum the pipes to remove fine materials and carefully chip away any slag around the tip of the air pipes, so as not to damage the air pipes.
- Inspect all the door seals to ensure that the door will maintain a tight seal upon closure. Clean any deposits from the seals. Replace seals that are damaged, worn or crushed.
- Clean the inspection view ports.
- Measure and record the weight of the materials to be combusted on the next burn cycle. Fill the primary chamber with the material to be combusted on the next burn cycle. Ensure waste loaded to the primary chamber does not block the burner. Follow the manufacturer's instructions concerning the mass or volume of waste that can be loaded.

Pre-Start Check

- Close and lock the primary chamber door. Ensure that all the latches are properly engaged and that the PRIMARY DOOR CLOSED safety switch is energized.
- Check that no alarms are displayed on the operating panel.
- Ensure that all the temperature set points are at the correct settings.
- Ensure that the cycle times are appropriate for the nature of the waste (volume, energy content, moisture, density, etc.). Typically the burn cycle will be 2 to 6 hours in duration with the cool down cycle being approximately 2 to 3 hours.
- If the incinerator is equipped with an EMERGENCY STOP BUTTON ensure that it is properly armed and that it is unlocked and pulled out.

- Ensure that primary and secondary manual air dampers are 100% open. Set all fuel valves to the open position.

Starting the Burn

Typically the operator will push the start button for the burn cycle and the control system will take over the operation of the incinerator. The operator should observe the operation during start-up to ensure that the following steps are completed.

- Starting the cycle will initiate an air purge of the chambers. This is followed by a purging of the secondary chamber burner prior to igniting. As the secondary burner operates, the temperature in that chamber will rise. When the temperature reaches the appropriate set point, the primary chamber burner will purge and ignite.
- If the secondary burner does not raise the temperature to the manufacturer's recommended set point, the operator should not override the controls and continue the burn. Any failures during the start-up should result in the incinerator shutting down. At this time the operator will need to commence fault identification procedures to overcome the deficiencies.
- The incinerator control system should maintain proper operating conditions throughout the timed burn cycle. Following the burn cycle, the system will go into a cool down mode. During this period air is introduced into the primary chamber to speed the cool down.
- Under no circumstances should the operator attempt to open the primary chamber doors when the system is operating. This practice can cause flashbacks that can injure personnel. The extra air entering the primary chamber will disrupt the combustion process, possibly leading to increased emissions.

3.4.1.4 Preventative Maintenance

All mechanical equipment requires routine preventative maintenance to operate efficiently. The operating conditions for the equipment dictate how frequently maintenance should be carried out. Incinerators have a service cycle that involves repeated heating to high temperatures followed by cooling. This can lead to refractory failures. Furthermore, moving waste and ash into and out of the incinerator creates wear on surfaces. Surfaces need to be refurbished on a routine basis and the seals around the openings require regular inspection and replacement as necessary.

Incinerators are waste disposal devices and should be managed in a manner similar to other disposal options. Incinerator owners need to recognize that money will be required to maintain the facility and to mitigate any unexpected events.

In addition, money should be set aside for routine maintenance. The cost of maintenance will be proportioned between labour, maintenance supplies, and equipment replacement. At least 3-5% of the capital cost of the unit should be set aside for annual maintenance and capital equipment replacement.

The maintenance budget should also include a capital reserve fund to cover repair and upgrades necessitated by unbudgeted circumstances. A suggested allowance for this would be 20% of the annual maintenance costs, labour and supplies, or about 1% of the capital cost.

The owner should consider establishing a service contract with the manufacturer (or a manufacturer-trained/ qualified local technician). These people should visit the site annually, and preferably quarterly if the incinerator is used daily. The owner should discuss the costs of such a program with the manufacturer and inquire about assistance the manufacturer can provide if the incinerator control and operating system can be accessed remotely.

Thus annual maintenance and capital reserve fund costs should be on the order of 4 - 6% of the original cost of the incinerator system.

3.4.2 Training

The cornerstone of ensuring good operation of any incinerator is that the staff understands how the system operates and takes appropriate steps to ensure the continued good operation of the equipment¹⁷.

Every incinerator manufacturer has its own unique approach to designing incinerators. The control systems, while following the general logic of the previous section, are likely to differ as well. Any person who will be operating an incinerator should be trained by the manufacturer before being asked to operate it. It is not good practice to have operators train operators. The manufacturer and its agents are the people most familiar with good operating procedures that will ensure minimal emissions.

Management staff should be involved in the training sessions wherever possible. Management are likely to provide long-term continuity at most sites. They can assist operators with their tasks, and ensure that substitutes or replacements are suitably trained.

¹⁷ Chandler, A.J., 2007. Review of Dioxins and Furans from Incineration In Support of a Canada-wide Standard Review. A Report Prepared for The Dioxins and Furans Incineration Review Group through a contract associated with CCME Project #390-2007. Available at: http://www.ccme.ca/assets/pdf/1395_d_f_review_chandler_e.pdf August 18, 2008.

3.5 Step 5: Safely Handle and Dispose of Incinerator Residues

Ash from the primary chamber of the incinerator can contain materials deleterious to the operator's health and the environment. Operators should use personal protective equipment when handling this material. The material should be carefully removed from the hearth and placed in covered metal containers suitable for transporting the ash to an approved disposal site. The operator should weigh, and maintain records of, the quantity of ash produced.

3.5.1 Residue Handling Practices

The quantity of ash (residues) generated by the facility should be documented, and the facility's weigh scale should be used to determine the mass of ash that is shipped from the facility to the disposal site.

For every 1000 kg of waste burned, approximately 300 kg of bottom ash is generated¹⁸. If the quantity of ash exceeds this amount, the material should be examined to determine whether the increased mass is due to the presence of non-combustible materials, or because there is a high quantity of unburnt carbon in the ash. If the latter situation is the case, operation of the incinerator should be adjusted to enhance the oxidation of carbon.

Representative samples of the bottom ash should be collected and forwarded to a laboratory for leachate toxicity testing. The International Ash Working Group provides guidance on sampling and analysis of ash¹⁹. At least 10 samples of ash are required to adequately characterise the material, and as a precaution it is recommended that testing on each sample be completed in triplicate. The results of the tests should be forwarded to the appropriate regulatory agency.

¹⁸ International Ash Working Group, 1997. Municipal Solid Waste Incinerator Residues. Published by Elsevier, ISBN 0-444-82563-0.

¹⁹ Ibid

3.6 Step 6: Maintain Records and Report

To demonstrate appropriate operation and maintenance of the incinerator, the facility should maintain records and prepare an annual report containing at least the following information:

- A list of all staff who have been trained to operate the incinerator; type of training conducted and by whom; dates of the training; dates of any refresher courses;
- All preventative maintenance activities undertaken on the equipment;
- Records of operation of the incinerator - in electronic format with full data backup;
- Summarized annual auxiliary fuel usage;
- A list of all shipments of incinerator residues, including the weight transported and disposed of by type if necessary, and the location of the disposal site;
- Results of any emissions measurements or any ash sampling data collected during the period.

All raw data records from the operation of the incinerator should be retained for inspection by the appropriate authorities for the period designated by those authorities, or for at least 2 years. The owner should work with the incinerator manufacturer or supplier and the regulators to determine the appropriate level of summary data that should be sent to the regulatory body (e.g. federal, provincial/territorial). The reports should be approved by the facility's senior management before submission.

Recording:

One of the most important records that should be available for review by the regulators is the maintenance log. This should record routine maintenance activities, date completed, by whom, and any problems encountered. This routine maintenance should correspond to the preventative maintenance recommendations provided by the manufacturer. A record should be kept of any upsets or equipment failures that necessitated special maintenance activities. The data for special maintenance activities should include the description of the issue being addressed, the date the work was completed, and who was responsible for that work. Most importantly, the operators/maintenance personnel should analyse the cause of the failure and ascertain if there are operating procedures that can avoid a repeat of the failure.

Continuous monitoring (once per minute) of incinerator operation should be recorded regardless of whether or not the incinerator is in use. To prevent any uncertainty about the waste disposal data, the information on the quantity of waste incinerated should be cross referenced by date and start time to the incinerator operating data. While some might question the usefulness of collecting operating data when the incinerator is not operating, a complete record for all 8760 hours of the year will validate the production data.

Reporting:

Licenses issued to waste disposal operators in all parts of Canada require some degree of reporting on operations to the appropriate authorities. There is some basic information that should be included in any report:

- **Quantity of Waste Incinerated:** Since the CWS for PCDD/F and Mercury both set limits

35

on the amount of waste that can be burned before different levels of proof of compliance are required, the basic measurement for every incinerator site must be the quantity of waste charged to the incinerator during the year. Because the incinerator is limited to a fixed quantity of waste on every charge, each load should be recorded separately, and the quantities totaled for the year, and preferably weekly and monthly. Such data will also assist the owner in determining waste generation rates at the facility, and in turn, provide data on the effectiveness of diversion and reduction programs.

- **Operating Data:** Operating data that is important are temperatures, carbon monoxide, and oxygen levels, along with other data such as differential pressures and auxiliary burner operating times. If the auxiliary burners are of fixed output, it would be satisfactory to record the signal controlling its operation. If the input is variable, motor amperage from the pump would provide some indication of the rate of fuel use. Raw one minute monitoring data should be preserved in electronic format for analysis.
- **Ash shipment weights:** The report should include ash shipment weights and the name of the operator for any particular load along with notes on observations or problems experienced with the load.
- **Auxiliary fuel receipt data:** Auxiliary oil receipt data should be recorded in the log book and receipts for the shipments should be kept for verification by regulators.
- **Training:** The report should contain records of the training received by the staff, who conducted the training and when.
- **Changes in Operation:** Any major changes to the operation should be noted in the annual report, as should the results of any testing undertaken on the stack emissions or ash.

It is important to note that waste any incinerators incinerating: ≥ 26 tonnes of non-hazardous solid waste per year, ≥ 26 tonnes of biomedical or hospital waste per year, hazardous waste, or sewage sludge must report emissions of PCDDF, hexachlorobenzene, and mercury under the National Pollution Release Inventory (NPRI). For more information, please see www.ec.gc.ca/inrp-npri/.

Appendix F: Environmental Guideline for the Burning and Incineration of Solid Waste

Environmental Guideline for the Burning and Incineration of Solid Waste



Department of Environment
Government of Nunavut

GUIDELINE: BURNING AND INCINERATION OF SOLID WASTE

Original: October 2010

Revised: January 2012

This Guideline has been prepared by the Department of Environment's Environmental Protection Division and approved by the Minister of Environment under the authority of Section 2.2 of the *Environmental Protection Act*.

This Guideline is not an official statement of the law and is provided for guidance only. Its intent is to increase the awareness and understanding of the risks, hazards and best management practices associated with the burning and incineration of solid waste. This Guideline does not replace the need for the owner or person in charge, management or control of a solid waste to comply with all applicable legislation and to consult with Nunavut's Department of Environment, other regulatory authorities and qualified persons with expertise in the management of solid waste.

Copies of this Guideline are available upon request from:

Department of Environment
Government of Nunavut

P.O. Box 1000, Station 1360, Iqaluit, NU, X0A 0H0

Electronic version of the Guideline is available at <http://env.gov.nu.ca/programareas/environmentprotection>

Cover Photos: Nunavut Department of Environment (left and bottom right), Aboriginal Affairs and Northern Development Canada (top right)

Table of Contents

Introduction	1
1.1 Definitions	1
1.2 Roles and Responsibilities.....	4
1.2.1 Department of Environment	4
1.2.2 Generators of Solid Waste	4
1.2.3 Other Regulatory Agencies	4
Waste Burning and Incineration	7
2.1 The Combustion Process.....	7
2.2 Pollutants of Concern	8
2.3 Burning and Incineration Methods	9
2.3.1 Open Burning	9
2.3.2 Incineration	11
2.4 Environmental Standards.....	13
2.4.1 Air Emissions	13
2.4.2 Bottom Ash	14
Best Management Practices	15
3.1 Waste Management Planning	15
3.2 Wastes That Can be Burned or Incinerated	16
3.3 Keeping Waste Dry	16
3.4 Locating the Facility	17
3.5 Maximizing Combustion Efficiency	18
3.6 Ash Management	18
3.7 Monitoring and Record Keeping	19
3.8 Operator Training.....	20
The Application of Open Burning and Incineration	21
4.1 Open Burning	21
4.2 Incineration	23
Conclusion	26
References	27

Appendices

- Appendix 1 Environmental Protection Act
- Appendix 2 Modified Burn Barrel Design and Specifications

Introduction

People living and working in Nunavut often have limited options available for cost effective and environmentally sound management of household and other solid waste. The widespread presence of permafrost, lack of adequate cover material and remote locations make open burning and incineration a common and widespread practice to reduce the volume of solid waste and make it less of an attractant to wildlife. A wide variety of combustion methods are used ranging from open burning on the ground to high temperature dual-chamber commercial incinerators. Generally, high temperature incinerators are more expensive to purchase and operate and cause less pollution than do the less expensive and lower temperature methods. However, high temperature incinerators can safely dispose of a wider variety of waste than can the lower temperature open burning methods.

The Guideline for the Burning and Incineration of Solid Waste (the Guideline) is not intended to promote or endorse the burning and incineration of solid waste. It is intended to be a resource for traditional, field and commercial camp operators, communities and others considering burning and incineration as an element of their solid waste management program. It examines waste burning and incineration methods that are used in Nunavut, their hazards and risks and outlines best management practices that can reduce impacts on the environment, reduce human-wildlife interactions and ensure worker and public health and safety. This Guideline does not address incineration of biomedical waste, hazardous waste and sewage sludge. The management of these wastes requires specific equipment, operational controls and training that are beyond the scope of the current document.

The *Environmental Protection Act* enables the Government of Nunavut to implement measures to preserve, protect and enhance the quality of the environment. Section 2.2 of the *Act* provides the Minister with authority to develop, coordinate, and administer the Guideline.

The Guideline is not an official statement of the law. For further information and guidance, the owner or person in charge, management or control of a solid waste is encouraged to review all applicable legislation and consult the Department of Environment, other regulatory agencies or qualified persons with expertise in the management of solid waste.

1.1 Definitions

<i>Biomedical Waste</i>	Any solid or liquid waste which may present a threat of infection to humans including non-liquid tissue, body parts, blood or blood products and body fluids, laboratory and veterinary waste which contains human disease-causing agents, and discarded sharps (i.e. syringes, needles, scalpel blades).
<i>Bottom Ash</i>	The coarse non-combustible and unburned material which remains at the burn site after burning is complete. This includes materials remaining in the burn chamber, exhaust piping and pollution control devices where such devices are used.
<i>Burn Box</i>	A large metal box used to burn solid waste. Combustion air is usually supplied passively through vents or holes cut above the bottom of the box. An exhaust pipe or stack may or may not be attached.

<i>Commercial Camp</i>	A temporary, seasonal or multi-year facility with a capacity greater than 15 people and which has been established for research, commercial or industrial purposes. A commercial camp does not include a traditional camp or field camp.
<i>Commissioner's Land</i>	Lands that have been transferred by Order-in-Council to the Government of Nunavut. This includes roadways and land subject to block land transfers. Most Commissioner's Land is located within municipalities.
<i>Contaminant</i>	Any noise, heat, vibration or substance and includes such other substance as the Minister may prescribe that, where discharged into the environment, (a) endangers the health, safety or welfare of persons, (b) interferes or is likely to interfere with the normal enjoyment of life or property, (c) endangers the health of animal life, or (d) causes or is likely to cause damage to plant life or to property.
<i>Determined Effort</i>	The ongoing review of opportunities for reductions and the implementation of changes or emission control upgrades that are technically and economically feasible and which result in on-going reductions in emissions. Determined efforts include the development and implementation of waste management planning which is focussed on pollution prevention.
<i>De Novo Synthesis</i>	The creation of complex molecules from simple molecules.
<i>Environment</i>	The components of the Earth and includes (a) air, land and water, (b) all layers of the atmosphere, (c) all organic and inorganic matter and living organisms, and (d) the interacting natural systems that include components referred to in paragraphs (a) to (c) above.
<i>Field Camp</i>	A temporary, seasonal or multi-year facility consisting of tents or other similar temporary structures with a capacity of 15 people or less and which has been established for research, commercial or industrial purposes. A field camp does not include a traditional camp or commercial camp.
<i>Fly Ash</i>	Unburned material that is emitted into the air in the form of smoke or fine particulate matter during the burning process.
<i>Hazardous Waste</i>	A contaminant that is a dangerous good and is no longer wanted or is unusable for its original intended purpose and is intended for storage, recycling, treatment or disposal.
<i>Incineration</i>	A treatment technology involving the destruction of waste by controlled burning at high temperatures.

Guideline for the Burning and Incineration of Solid Waste

<i>Incinerator</i>	A device or structure intended primarily to incinerate waste for the purpose of reducing its volume, destroying a hazardous substance in the waste or destroying an infectious substance in the waste. An incinerator has means to control the burning and ventilation processes.
<i>Inspector</i>	A person appointed under subsection 3(2) of the <i>Environmental Protection Act</i> and includes the Chief Environmental Protection Officer.
<i>Modified Burn Barrel</i>	A metal drum used to burn waste that has been affixed with devices or features which provide limited increased heat generation, heat retention and holding time.
<i>Open Burning</i>	Burning of waste with limited or no control of the burn process. For clarity, open burning includes burning on the open ground or using a burn box or unmodified or modified burn barrel.
<i>Qualified Person</i>	A person who has an appropriate level of knowledge and experience in all relevant aspects of waste management.
<i>Responsible Party</i>	The owner or person in charge, management or control of the waste.
<i>Smoke</i>	The gases, particulate matter and all other products of combustion emitted into the atmosphere when a substance or material is burned including dust, sparks, ash, soot, cinders and fumes.
<i>Solid Waste</i>	Unwanted solid materials discarded from a household (i.e. single or multiple residential dwellings, other similar permanent or temporary dwellings), institutional (i.e. schools, government facilities, hospitals and health centres), commercial (i.e. stores, restaurants) or industrial (i.e. mineral, oil and gas exploration and development) facility. For clarity, solid waste does not include biomedical waste, hazardous waste or sewage sludge.
<i>Traditional Camp</i>	A temporary or seasonal camp used primarily for camping, hunting, fishing or other traditional or cultural activities. A traditional camp does not include a field camp or commercial camp.
<i>Unmodified Burn Barrel</i>	A metal drum used to burn waste that has not been affixed with devices or features which provide for enhanced heat generation, heat retention and holding time.
<i>Untreated Wood</i>	Wood that has not been chemically impregnated, painted or similarly modified to improve resistance to insects or weathering.
<i>Waste Audit</i>	An inventory or study of the amount and type of waste that is produced at a location.

1.2 Roles and Responsibilities

1.2.1 Department of Environment

The Environmental Protection Division is the key environmental agency responsible for ensuring the proper management and disposal of solid waste and other contaminants on Commissioner's Land. Authority is derived from the *Environmental Protection Act*, which prohibits the discharge of contaminants to the environment and enables the Minister to undertake actions to ensure appropriate management measures are in place. Although programs and services are applied primarily to activities taking place on Commissioner's and municipal lands and to Government of Nunavut undertakings, the *Environmental Protection Act* may be applied to the whole of the territory where other controlling legislation, standards and guidelines do not exist. A complete listing of relevant legislation and guidelines can be obtained by contacting the Department of Environment or by visiting the web site at:

<http://env.gov.nu.ca/programareas/environmentprotection>.

The Wildlife Management Division is responsible for managing wildlife in Nunavut. Section 90 of the *Wildlife Act* prohibits the intentional feeding of wildlife and the placement of any food or garbage where there is a reasonable likelihood that it would attract wildlife. Once wildlife has been 'conditioned' to obtaining food associated with human activities, it can become dangerous and often will have to be destroyed. Further information on ways to reduce contact between wildlife and humans can be obtained by contacting the local Conservation Officer or by visiting the web site at:

<http://env.gov.nu.ca/programareas/wildlife>.

The Department of Environment will provide advice and guidance on the burning and incineration of solid waste. However, it remains the responsibility of the owner or person in charge, management or control of the solid waste to ensure continued compliance with all applicable statutes, regulations, standards, guidelines and local by-laws.

1.2.2 Generators of Solid Waste

The generator, or responsible party, is the owner or person in charge, management or control of the solid waste at the time it is produced or of the facility that produces the waste. The responsible party must ensure the waste is properly and safely managed from the time it is generated to its final disposal. This is referred to as managing the waste from cradle-to-grave.

Contractors may manage solid waste on behalf of the responsible party. However, the responsible party remains liable for ensuring the method of management complies with all applicable statutes, regulations, standards, guidelines and local by-laws. If the contractor does not comply with the requirements of the *Environmental Protection Act* or *Wildlife Act* and is charged with a violation while managing the waste, the responsible party may also be charged.

1.2.3 Other Regulatory Agencies

Other regulatory agencies may have to be consulted regarding the burning and incineration of solid waste as there may be other environmental or public and worker health and safety issues to consider.

Workers' Safety and Compensation Commission

The Workers' Safety and Compensation Commission is responsible for promoting and regulating worker and workplace health and safety in Nunavut. The Commission derives its authority from the *Workers' Compensation Act* and *Safety Act* which require an employer to maintain a safe workplace and ensure the safety and well being of workers.

Department of Community and Government Services

The Department of Community and Government Services is responsible under the *Commissioners' Lands Act* for the issuance of land leases, reserves, licenses and permits on Commissioner's Lands. The Department, in cooperation with communities, is also responsible for the planning and funding of municipal solid waste and sewage disposal facilities in most Nunavut communities.

The Office of the Fire Marshal is responsible for delivering fire and life safety programs including reviewing plans to ensure incinerators and other heating devices comply with all legislation, codes and standards. The Office of the Fire Marshal derives its authority from the *Fire Prevention Act*, *National Fire Code* and *National Building Code*.

Department of Health and Social Services

Activities related to the burning and incineration of solid waste may have an impact on public health. The Office of the Chief Medical Officer of Health and Regional Environmental Health Officers should be consulted regarding legislated requirements under the *Public Health Act*.

Environment Canada

Environment Canada is responsible for administering the *Canadian Environmental Protection Act* (CEPA) and Canada's Toxic Substances Management Policy. Many pollutants that are released into the atmosphere from the incomplete combustion of unsegregated, or mixed, solid waste are listed as Toxic Substances in Schedule I of CEPA, or are targeted for phase-out through the Toxic Substances Management Policy. Environment Canada is also responsible for administering the pollution prevention provisions of the federal *Fisheries Act* and for regulating the international and interprovincial movement of solid and liquid hazardous waste under the *Interprovincial Movement of Hazardous Waste Regulations* and *Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations*.

The Air Quality Research Division of Environment Canada is responsible for conducting research into atmospheric releases of chemicals in commercial use in Canada, measuring exhaust emissions from stationary and mobile sources and undertaking ambient air quality monitoring in partnership with provinces and territories.

Aboriginal Affairs and Northern Development Canada

Aboriginal Affairs and Northern Development Canada is responsible under the *Territorial Lands Act* and *Nunavut Waters and Nunavut Surface Rights Tribunal Act* for the management of federal lands and waters, including the impact solid waste may have on the quality of these lands and waters.

Local Municipal Governments

The role of municipal governments is important in the proper local management of solid waste. Under the Nunavut Land Claims Agreement, municipalities are entitled to control their own municipal disposal sites. Local environmental and safety standards are determined, in part, by how the land is designated under municipal government development plans (i.e. land use zoning). Solid waste may be deposited into municipal landfill sites only with the consent of the local government. The local fire department may also be called upon if a fire or other public safety issue is identified.

Co-management Boards and Agencies

Co-management boards and agencies established under the Nunavut Land Claims Agreement have broad authority for land use planning, environmental impact assessment and the administration of land and water. Activities involving the burning and incineration of solid waste may be controlled through the setting of terms and conditions in plans, permits and licenses issued by the Nunavut Water Board and other co-management boards and agencies.

Waste Burning and Incineration

2.1 The Combustion Process

The combustion, or burning, of solid waste proceeds through a series of stages. Water is first driven from the unburned waste by heat produced from material burning nearby or from an auxiliary burner. As the waste heats up, carbon and other substances are released and converted into burnable gases. This is referred to as gasification. These gases are then able to mix with oxygen. If the temperature inside the burn chamber is high enough and maintained for a long enough period of time, the hot gases are completely converted into water vapour and carbon dioxide, which is then released into the air. If the temperature inside the burn chamber is not high enough and the burn time is too short, complete conversion of the burnable gases does not occur and visible smoke is released into the air. Another result of burning at low temperatures is the creation of pollutants that were not originally present in the waste. This process is known as *de novo* synthesis. Dioxins, furans and other complex chemical pollutants can be formed through this process.

Ash produced from combustion takes the form of either fly ash or bottom ash. Fly ash is the fine particles carried away in the form of smoke while bottom ash is the coarse non-combustible and unburned material that remains after the burn is complete. The type and amount of pollutants in the fly and bottom ash depend upon what waste is burned and completeness of the combustion process.

The completeness of combustion is determined by all of the following factors:

Temperature

The temperature generated is a function of the heating value of the waste and auxiliary fuel, incinerator or burn unit design, air supply and combustion control. Complete combustion requires high temperatures. Generally, temperatures that exceed 650°C with a holding time of 1-2 seconds will cause complete combustion of most food and other common household waste. Segregation of waste is required when using methods that don't routinely achieve these temperatures. Dual chamber incinerators, which are designed to burn complex mixtures of waste, hazardous waste and biomedical waste, must provide a temperature higher than 1000°C and a holding time of at least one second to ensure complete combustion and minimize dioxin and furan emissions. When these high temperatures and holding times are achieved, waste will be completely burned and ash, smoke and pollutant concentrations will be minimized.

Because exhaust gas temperatures vary from ambient to greater than 1000°C each time a batch waste incinerator is used, optional air pollution control systems with evaporative cooling towers and scrubbers are seldom recommended. However, it may be necessary to employ these systems with large continuous feed incinerators if additional cleaning of exhaust gas is required by regulatory authorities.

Holding Time

Complete combustion takes time. Holding time, otherwise known as retention or residence time, is the length of time available to ensure the complete mixing of air and fuel, and thus the complete burning of waste. Low temperatures, low heating values of the waste and reduced turbulence require that the holding time be increased to complete the combustion process.

Turbulence

The turbulent mixing of burnable gases with sufficient oxygen is needed to promote good contact between the burning waste and incoming air. This will help in achieving the high temperatures at which waste can be completely burned. The amount of mixing is influenced by the shape and size of the burn chamber and how the air is injected. Passive under-fire ventilation achieved during open burning does not result in sufficient turbulence for the burning of a wide variety of waste. Also, it is important not to overfill the burn chamber as airflow may be blocked and the amount of turbulence further reduced. The more advanced incineration designs provide effective turbulence through the forced introduction of air directly into hot zones.

Composition of the Waste

The heating value, wetness and chemical properties of the waste affect the combustion process and the pollutants that are contained in the resulting smoke and ash. The higher the burn temperature, holding time and turbulence that are achieved, the less effect the composition of the waste has on completeness of the burn.

2.2 Pollutants of Concern

Extreme care must be exercised when burning or incinerating solid waste. Open burning and the improper incineration of solid waste can result in environmental, health and safety hazards from the pollutants found in smoke and exhaust gases and in the bottom ash. These pollutants may either be found in the original waste itself, or may be created through *de novo* synthesis if sufficient temperature, holding time and turbulence is not achieved in the burn chamber.

Many different types of pollutants can be released during burning and incineration. A few of these pollutants include acid gases, trace metals, fine particulates, volatile organic compounds and semi-volatile organic compounds. Acid gases such as hydrogen chloride and sulphur oxides result from burning waste that has high levels of chlorine and sulphur (i.e. plastics). Mercury, lead and cadmium are examples of trace metals found in both fly and bottom ash when batteries, used lubricating oil and other metal-containing wastes are burned. Fine particulates are the very small particles found in smoke created by incomplete combustion and can cause respiratory irritation in humans and wildlife.

Dioxins and furans are pollutants that have drawn much attention in recent years because they have been linked to certain types of cancers, liver problems, impairment of the immune, endocrine and reproductive systems and effects on the fetal nervous system. These pollutants persist in the environment for long periods of time, bioaccumulate in plants and animals, result predominantly from human activity and have been identified for 'virtual elimination' in Canada under the federal Toxic Substances Management Policy. The incineration of solid waste accounts for almost 25% of the dioxin and furan emissions in Canada each year. They are formed in trace amounts by *de novo* synthesis during the low temperature burning of waste containing organic compounds and chlorine (i.e. chlorinated plastic, PVC pipe, marine driftwood).

The most effective way to reduce or minimize the release of pollutants is to segregate the waste before burning and achieve sufficiently high temperature, holding time and turbulence in the burn chamber. Open burning produces more smoke and pollutants, including dioxins and furans, than does an incinerator capable of achieving complete combustion.

2.3 Burning and Incineration Methods

The burning and incineration method used is a major factor in determining what type of waste can be safely and effectively disposed of. The methods commonly used in Nunavut include open burning on the ground, unmodified burn barrels and various mechanical incineration systems. Other useful methods include the use of burn boxes and modified burn barrels. Each method is discussed separately in the following sections.

2.3.1 Open Burning

Open burning means the burning of waste where limited or no control of the combustion process can be exercised by the operator. This method includes burning solid waste directly on the open ground or in burn boxes or burn barrels and often does not achieve the temperatures or holding time needed for complete combustion of the waste to occur. This results in the formation of potentially hazardous pollutants and ash, which are likely to impact nearby land and water. Food waste that is not completely burned through open burning can also be a powerful attractant for animals.

The various open burning methods can also present a risk of uncontrolled vegetation and tundra fires through the release of hot sparks or embers. The level of fire risk depends upon the type of open burning used, its location, the skill of the operator and the environmental conditions that exist at the time (i.e. dryness of the surrounding vegetation, wind).

The open burning of solid waste remains a common practice in Nunavut. It is the policy of the Department of Environment to eliminate or minimize open burning of mixed solid waste to the extent practicable and to encourage more acceptable methods of disposal and incineration.

Open Burning on the Ground

Open burning on the ground involves burning solid waste that has been piled directly on the surface of the ground or placed in a small open pit. Many large and small communities and camp operators in Nunavut continue to practice open burning on the ground as a means of reducing the volume of solid waste that must ultimately be disposed of. In general, open burning on the ground results in the incomplete combustion of waste and the release of various harmful pollutants to the air, can cause vegetation or tundra fires through the uncontrolled release of hot sparks and embers, and is actively discouraged by the Nunavut Department of Environment as a method for disposing of unsegregated or mixed solid waste.



Figure 1 – Open Burning on the Ground
Photo courtesy of Aboriginal Affairs and Northern Development Canada

Burn Boxes

There are two basic types of burn boxes. The *enclosed burn box* is constructed using heavy sheets of steel or other metal while the *open burn box* is constructed using expanded metal grating. The latter type is commonly referred to as a *burn cage*. These devices are not commercially-available in Nunavut, but can be constructed using locally available materials. For example, the enclosed metal burn box shown in Figure 2 is made from a dump truck bed and steel plating.



Figure 2 – Enclosed Metal Burn Box
Photo courtesy of Alaska Department of Environmental Conservation

Burn boxes are considered a modification of open burning. Combustion air is provided passively using a natural draft making electricity unnecessary. Burn boxes are single chambered units. Waste is raised off the bottom of the box by placing it on grates inside the unit. Unburned bottom ash falls through the grate during burning making removal easier once a sufficient amount has accumulated. Combustion air in enclosed burn boxes is typically provided by cutting holes near the bottom of the box allowing for better mixing with the burning waste.

Open burn boxes, or burn cages, are an improvement over enclosed burn boxes as the waste is exposed to natural drafts through the metal grating on all surfaces including the bottom. This enables air to better mix with burning waste and promotes more efficient combustion throughout the burning period. Both types of burn boxes are constructed with hinged tops to enable easier loading and cleaning.

Unlike open burning on the ground, burn boxes help to contain the burning waste within a specific location reducing the risk of fire spreading to other disposal areas or surrounding tundra, while still enabling moderate amounts of solid waste to be burned.

Burn Barrels

There are two basic types of burn barrels – the unmodified burn barrel and modified burn barrel.



Figure 3 – Open Metal Burn Box
Photo courtesy of Alaska Department of Environmental Conservation

The *unmodified burn barrel* is normally a 45 gallon, or 205 litre, metal fuel or oil drum with the top removed. These devices typically operate at a low temperature resulting in incomplete combustion of the waste and production of large volumes of smoke and fly ash.

A *modified burn barrel* is a 45 gallon metal fuel or oil drum that has been affixed with devices or features which result in higher burn temperatures, better mixing of the air and a longer holding time. These modifications include a 'metal mesh basket' insert or grate designed to suspend the burning waste. Evenly spaced vents or holes cut above the bottom of the barrel supply combustion air. These features provide for enhanced passive under-fire ventilation and promote better contact between the waste being burned and incoming air. The basket insert is topped with a hinged lid and a chimney port for attachment of an exhaust pipe or stack. The lid helps to increase heat retention and holding time inside the barrel while also allowing for easier loading and mixing of the waste. The removable mesh basket enables access to the unburned bottom ash.

Modified burn barrels can be built using commonly available materials. They can either be pre-built locally or transported to the site for assembly. Detailed construction plans are provided in Appendix 2.

Although modified burn barrels are designed to create an advantage over open burning on the ground, burn boxes and unmodified burn barrels through achieving higher burn temperatures and increased turbulence and holding time, incomplete combustion of waste and the release of pollutants to the atmosphere are still likely. In fact, emissions testing by Environment Canada on a modified burn barrel in April 2011 suggest that these devices do not provide any improvement over open burning on the ground in terms of emissions quality, particularly if wet food waste is added to the waste mixture. Other common problems include easily overfilling the unit and loading waste that should not be burned (refer to section 3.2). Wet or frozen masses of waste are particularly difficult to burn and the resulting partly burned food waste may still attract animals. The proper operation of modified burn barrels is critical to achieving the most efficient burn possible. Basic operating instructions are provided in section 4.1.

Burn barrels are capable of burning only small volumes of solid waste. Like burn boxes, they reduce the risk of fire spreading to vegetation and tundra by containing the burning waste to a specific location.

2.3.2 Incineration

Solid waste incinerators are engineered systems that are capable of routinely achieving burn temperatures in excess of 1000°C and a holding time of at least one second. Properly designed and operated incinerators are able to effectively and safely destroy a wide range of waste. Only incinerators designed for burning mixed municipal solid waste are discussed in the guideline. The incineration of



Figure 4 – Modified Burn Barrel

hazardous and biomedical waste and sewage sludge requires specific equipment, operational controls and training that are beyond the scope of the current document.

There are four basic types of incinerators. They vary based upon the number of burn chambers they have, the amount of air provided to each chamber and how waste is fed into the primary burn chamber.

<i>Dual-Chamber Starved Air System</i>	The primary burn chamber receives less air than is needed to achieve full combustion. Gases from this incomplete combustion then pass into a second burn chamber where sufficient air is injected and complete combustion is achieved.
<i>Single Chamber Excess Air System</i>	More than a sufficient amount of air (as much as 50% more than the amount of air needed) is injected into the single burn chamber to achieve complete combustion of the waste.
<i>Continuous Feed Incinerator</i>	An incineration process that is in a continuous burn cycle. A continuous feed incinerator operates without interruption throughout the operating hours of the facility by having waste continually added to the primary burn chamber.
<i>Batch Feed Incinerator</i>	An incineration process that is not in a continuous or mass burning cycle. A batch feed incinerator is charged with a discrete quantity or single load of waste at the beginning of the burn cycle.

Batch feed dual-chamber controlled air incinerators currently operate at several remote industrial locations in northern Canada and Alaska. Although they are generally considered to have the highest qualities of all the incinerators and open burning methods mentioned, they must be designed for the type and quantity of waste to be burned. Too little heat and holding time will not allow waste to burn properly; too much heat will damage the incinerator.

Figure 5 illustrates the design of a typical batch feed dual-chamber controlled air incinerator. The main features of this type of incinerator are:

- Batch operation allows greater control of temperature and air throughout the burn process.
- Air turbulence can be reduced in the primary chamber so fewer particulates are released into the air from the stack.
- Although a wide range of wastes can be destroyed, waste may have to be segregated and remixed in order to achieve a uniform heating value close to the design point of the incinerator.
- Externally supplied fuel and electricity are needed for the burners and forced air ventilation.
- A properly operating dual-chamber controlled air system will reduce problems with animal attraction as the production of bottom and fly ash and smoke is minimized.

Section 2.3.2 is intended to provide the reader with a brief introduction to incinerators. It is not intended to provide information suitable for the design, selection or operation of an incineration system. Any person considering the purchase of an incineration system should first consult the system's manufacturer or other qualified persons with expertise in the incineration of solid waste.

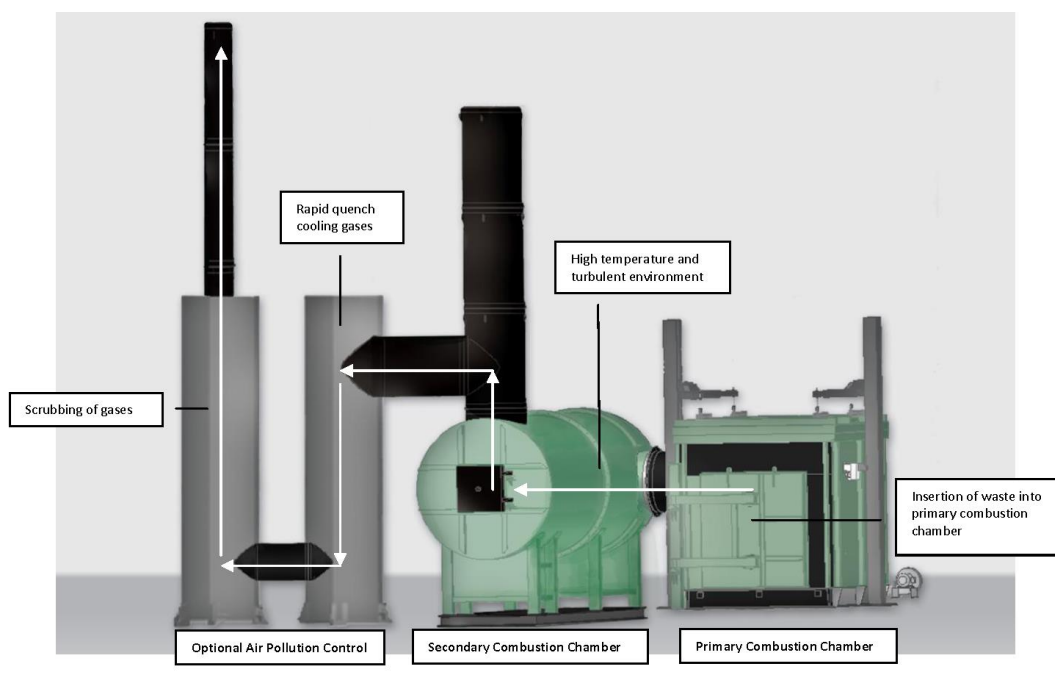


Figure 5 – Typical Batch Feed Dual-Chamber Controlled Air Incinerator with Optional Air Pollution Controls
Illustration courtesy of Eco Waste Solutions

2.4 Environmental Standards

2.4.1 Air Emissions

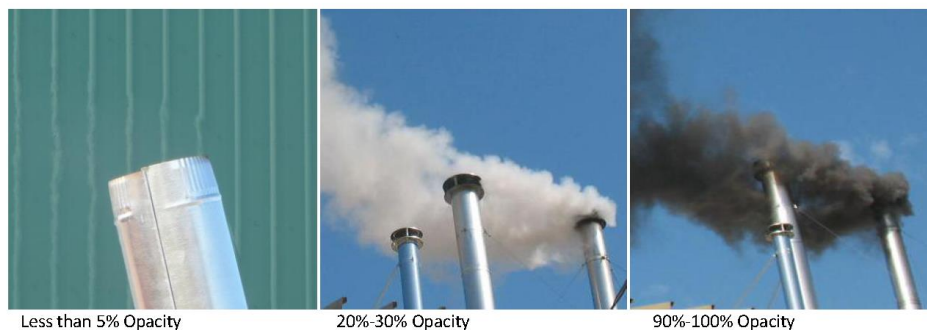
Air emission standards establish limits on the amount of contaminants that can be released into the atmosphere. These standards are expressed as a concentration in the exhaust gases leaving the stack and are capable of being achieved using generally available incineration technology and waste diversion practices. The following emission standards¹ apply to existing, new or expanding solid waste incinerators operating in Nunavut and have been adopted from the Canadian Council of Ministers of the Environment (CCME) Canada-Wide Standards for Dioxins and Furans and Mercury Emissions, respectively. Similar standards for the open burning of solid waste have not been established.

¹ Stack concentrations are always corrected to 11% oxygen content for reporting purposes.

Table 1. Air Emission Standards for Solid Waste Incinerators

Parameter	Numeric Standard	Explanation
Dioxins and Furans	80 pg I-TEQ/cubic metre	Unit of measure is picograms of International Toxicity Equivalents per cubic metre of air
Mercury	20 µg/Rcubic metre	Unit of measure is micrograms per Reference cubic metre (the volume of gas adjusted to 25°C and 101.3 kilopascals)

Opacity is the degree to which the exhaust gases reduce the transmission of light and obscure the view of any object in the background. It is expressed as a percentage representing the extent to which an object viewed through the gases is obscured. Although not an emission standard, opacity provides an indication of the general performance of the incinerator during normal operation². Opacity in the incinerator stack should not exceed 5%. While it is not anticipated that opacity levels would exceed 1% to 2% under normal operation, values greater than 5% indicate the incinerator is not performing properly and additional performance evaluation and adjustment is required.

**Figure 6 - Examples of Smoke Opacity Ratings**

The opacity ratings are estimates and are provided for illustrative purposes only

Centre and right photos courtesy of GNWT Department of Environment and Natural Resources

2.4.2 Bottom Ash

The *Environmental Guideline for Industrial Waste Discharges into Municipal Solid Waste and Sewage Treatment Facilities* establishes criteria for determining whether process residuals³ are suitable for disposal in landfill sites in Nunavut. For the purpose of this Guideline, process residuals include bottom ash from industrial and commercial incinerators. The Toxicity Characteristic Leaching Procedure Test method 1311 (US EPA) is the preferred method to analyze the residuals as this test is designed to simulate the processes a material would be subjected to if placed in a landfill.

Refer to the *Environmental Guideline for Industrial Waste Discharges into Municipal Solid Waste and Sewage Treatment Facilities* for additional information on the management of process residuals.

² The time during which optimum designed temperature is maintained in the burn chamber, and excludes 'startup' and 'cool down' operations.

³ Process residuals are the solid, semi-solid or sludge waste resulting from industrial operations.

Best Management Practices

Best management practices are methods and techniques that have been shown to be effective in preventing or reducing pollution. They include policies, prohibitions of practices, maintenance and monitoring procedures and other practices adopted by the responsible party. Implementing best management practices together with using best available technology is an effective means of reducing costs, reducing pollution and reducing a parties' legal liabilities.

3.1 Waste Management Planning

The generator of a waste is responsible for its safe management from cradle-to-grave. Using raw materials efficiently and reducing the amount of waste generated is the most important step in waste management planning. For example, through improved waste management planning, it may be possible to reduce or eliminate the need to burn or incinerate waste altogether. Undertaking a waste audit will help to identify the type and amount of waste being generated, the costs of current management options and examine opportunities for better managing the waste. This information will also enable the generator to implement a waste management regime that is tailored to its own unique needs, location and circumstances.

Even with improved waste reduction measures in place there will be waste generated. Waste by its nature is usually a mixture of different unwanted materials. The segregation and diversion of different types of waste is an effective way to reduce the amount of waste requiring costly handling, storage, treatment and disposal. Segregation also enables the reuse of certain types of waste for a different purpose. Reuse activities may be undertaken either on-site or off-site.

Treatment and disposal is the last step in effective waste management and should be undertaken only after all other practical reduction and reuse options have been examined. A wide variety of treatment and disposal options exist and each must be examined before deciding on a final method, regardless of whether waste is to be treated and disposed of on-site or off-site. If burning and incineration is the method of choice, equipment must be designed and sized accordingly to accommodate the type and quantity of waste being produced. As described in the following section, open burning is capable of safely destroying a limited number of types of waste. While incinerators are capable of safely destroying a wider range of waste, many types of waste must still be diverted. Because of this, on-site segregation remains a critical component of any waste management plan.

Overall, the following principles should be used to guide responsible solid waste management planning:

- Know your waste by conducting a waste audit.
- Reduce the amount of solid waste produced by implementing strategic purchasing policies that focus on the substitution or reduction of purchased products as well as product design, composition and durability.
- Reuse waste where different purposes can be identified.
- Segregate and divert mixed waste streams enabling waste to be reused or recycled, thereby reducing the amount of waste to be disposed of.
- All practical disposal methods should be examined. Burning and incineration of waste should be considered only where other practical methods do not exist.

- If burning and incineration is used, the equipment chosen should be designed and sized to accommodate the waste produced, minimize fire hazard and result in the complete combustion of the waste.

3.2 Wastes That Can be Burned or Incinerated

Complete combustion converts waste into inert bottom ash with minimal creation of smoke, fly ash and hazardous gases. Several factors influence this process including the heating value, wetness and chemical composition of the waste itself, operating conditions in the burn chamber (i.e. temperature, holding time and turbulence) and operator skill.

The method used is important in determining what can safely be burned. Certain wastes can only be incinerated using equipment that has been specifically designed and equipped with sufficient air pollution controls and that achieve specific air emission standards. For example, waste containing chlorinated compounds (i.e. chlorinated solvents and plastics, PVC piping, wood treated with pentachlorophenol or PCB-amended paint, marine driftwood) must be separated from other waste as their burning will result in the *de novo* creation and emission of various dioxin and furan compounds. Waste containing mercury (i.e. batteries, thermostats and fluorescent light bulbs) and other heavy metals (i.e. lead acid batteries, wood treated with lead paint) should not be burned as the mercury and heavy metals will not be destroyed. Other waste that should not be burned unless using specially designed incinerators include used lubricating oil, hydrocarbon contaminated soil, biomedical waste, sewage sludge or any other waste specifically prohibited by the Department of Environment.

Table 2 provides a listing of common wastes that can be burned and those that require special consideration and treatment. Note that open burning and incineration are identified as separate columns in the table and that different restrictions apply depending upon which method is used. In general, more restrictions apply to the various methods of open burning because of the incomplete combustion achieved. Fewer restrictions apply to incineration because of the operator's ability to control the combustion process.

Non-combustible materials such as metal and glass do not burn and will rob heat away from waste that can be destroyed by burning. Combustible waste should always be separated from non-combustible waste before being loaded into the burn chamber.

3.3 Keeping Waste Dry

Typical mixed garbage has a moisture content of less than 20% while the moisture content of food wastes can range up to 80%. Anything that can be done to reduce the moisture of waste burned will decrease the amount of smoke produced and increase the completeness of combustion. Waste should be covered or stored inside sheds or other secure buildings to keep rain and snow out of the waste. This will also lessen the opportunity for wildlife to access the waste. If wet waste must be burned, the wet waste should be mixed or layered with dry waste to reduce the overall moisture content of the waste burned. Mixing or layering waste in this manner is particularly important when loading wet solid waste into a burn box or modified burn barrel.

Table 2. Waste That Can be Burned or Incinerated

Waste Type	Method	
	Open Burning ⁴	Dual-Chamber Incinerator
Paper products	✓	✓
Paperboard packing including boxboard and cardboard	✓	✓
Untreated wood including lumber and plywood	✓	✓
Food waste		✓
Food packaging		✓
Natural fiber textiles	✓	✓
Plastic and Styrofoam except plastic containing chlorine ⁵		✓
Painted wood except wood painted with lead or PCB-amended paint		✓
Wood treated with creosote or tar oil		✓
Hydrocarbon spill absorbents		✓
Animal carcasses except those affected by disease-causing agents		✓

The following waste requires special consideration. It is not to be burned or incinerated unless the equipment used has sufficient air pollution controls, meets specific air emission standards and has been specifically designed to safely incinerate the waste product.

Hydrocarbon contaminated soil
Radioactive waste including smoke detectors
Organic compounds containing chlorine including plastics, solvents, PVC piping and marine driftwood
Pesticides
Items containing mercury, lead or other heavy metals including paint, computer equipment and fluorescent bulbs
Batteries
Explosives
Pressurized cans, cylinders or other containers that may explode when heated
Synthetic fiber textiles
Biomedical waste and animal carcasses affected by disease-causing agents
Wood treated with pentachlorophenol, inorganic preservatives, lead paint or PCB-amended paint
Sewage sludge
Rubber tires
Used lubricating oil
Waste fuel except limited quantities used solely as a starting fuel
Construction and demolition waste including roofing materials, electrical wire and insulation

3.4 Locating the Facility

Distance from sensitive areas (i.e. camp, work site, drinking water supply) and prevailing wind direction are important factors to consider when locating any facility that burns waste. The facility should be kept

⁴ Includes open burning on the ground and the use of burn boxes, unmodified burn barrels and modified burn barrels.

⁵ Chlorinated plastic materials are identified by the number "3" associated with the mobius loop symbol.



at least 100 metres from any surface water body. Although the objective is to minimize pollutants being released to the air, the site should be selected so that any resulting emissions are adequately dispersed. This includes locating the structure or facility away from areas or features that may trap smoke close to the ground (i.e. located in a valley). Avoid burning waste if people will be living or working within the plume of smoke. The facility should be located on stable and level ground. A gravel, rocky outcrop or other area free of combustible materials and vegetation should be chosen to avoid accidentally starting a vegetation or tundra fire.

3.5 Maximizing Combustion Efficiency

More smoke and other pollutants are released into the air during the 'start-up' and 'cool down' phases of the burn cycle than during the 'full burn phase' when high temperatures are maintained. Low temperature smoldering fires should be avoided. Burn only dry feedstock and periodically add additional waste to the fire in order to maintain high burn temperatures until all waste has been destroyed. If waste is to be open burned on the ground, the use of deep or steep-walled 'pits' should be avoided as this will prevent the necessary turbulent mixing of oxygen with the burnable gases.

Desired operating temperature should be achieved as quickly as possible when operating any burning or incineration device. A rapid 'start-up' can be achieved by first loosely loading dry paper, paperboard packing and untreated wood into the bottom of the device. Dry, loosely loaded material will ignite more quickly and burn more evenly than a wet, tightly packed load. Wet waste should only be added after the fire is actively burning. Overfilling the burn chamber will prevent the turbulent mixing of burnable gases and oxygen, and should be avoided.

Modern batch feed incinerators are designed with primary and auxiliary burners to achieve and maintain the necessary high burn temperatures. Additional waste should only be added to these incinerators once the 'cool down' phase has been completed and it is safe to do so.

3.6 Ash Management

The management of bottom ash and other unburned residue is an integral part of sound waste management and the ash will need to be disposed of. Extreme care must be exercised when handling ash because of its physical (i.e. glass, nails) and chemical hazards. Use closed or covered containers when moving or transporting bottom ash from the burning device or incinerator to the approved disposal site. This will minimize physical contact with the ash and the release of fine ash particles to the environment.

Avoid handling bottom ash until it is completely cool. Hot ash and embers can cause painful skin burns and should never be buried or landfilled as they could cause unburned waste in the disposal area to catch fire.

Bottom ash from the open burning of paper, paperboard packing, untreated wood waste and natural fiber textiles is suitable for burial in a designated pit or municipal landfill. Because incinerators can be used to destroy a wide variety of waste and the subsequent ash may contain a wide variety of toxic residues, bottom ash from an incinerator is suitable for burial only where it meets the criteria set out in Table 1 of the *Environmental Guideline for Industrial Waste Discharges into Municipal Solid Waste and Sewage Treatment Facilities*. Waste originating from outside a municipality and meeting the criteria may be deposited in municipal landfills only with the consent of the local government. Any bottom ash

not meeting the criteria set out in the *Environmental Guideline for Industrial Waste Discharges into Municipal Solid Waste and Sewage Treatment Facilities* is considered to be a hazardous waste. This ash is not suitable for landfilling and its management must comply with the *Environmental Guideline for the General Management of Hazardous Waste*.

3.7 Monitoring and Record Keeping

Burn boxes, burn barrels and incinerators should be inspected for signs of damage, corrosion or other physical defects before each burn cycle. Repairs must be completed before the equipment is used again to ensure the health and safety of the operator, nearby people and the environment.

The various open burning methods tend to produce large quantities of smoke. Burning dry waste, high burn temperatures and sufficient air mixing with the burnable gases will reduce, but not eliminate, the amount of smoke and other pollutants that are generated. Large quantities of dark smoke indicate problems and inefficiencies with the combustion process and the generation of pollutants. Keep records of when, how much and what waste was burned, how the waste was loaded into the burning device or incinerator, the amount of smoke and bottom ash generated, how the fire was started and any other information that would help remind the operator of what worked well, and what didn't. These records would also assist the operator, Department of Environment and other regulatory agencies if complaints of nuisance smoke were to be received.

The operation of incinerators should be monitored using on-line instruments capable of continuously measuring the combustion process and stack emissions. The most basic measurement associated with the combustion process is temperature in both the primary and secondary burn chambers. Temperature readings outside of the normal range can warn the operator that the system is not working properly. In-stack monitoring provides the operator with additional information on the combustion process and on pollutants that may be released to the environment. A continuous opacity or particulate monitor should be installed in the incinerator stack to monitor emissions quantity. Additional combustion chamber and in-stack sampling and monitoring may be required depending upon the type and quantity of waste being incinerated. Each process and in-stack monitor should be equipped with visible and audible alarms to warn operators of poor incinerator operation. Refer to section 4.2 for additional information on incinerator monitoring requirements.

Written records should be kept by incinerator operators of what waste is burned, when and how much. Other record keeping requirements for incinerators may include:

- Operating data including readings from the process and emissions monitoring instruments.
- Weather conditions (i.e. air temperature and wind speed) at the time the incinerator is being operated.
- Repairs and maintenance performed on the incinerator and monitoring instruments.
- Major changes in operation.
- Quantity, condition and disposal location of the collected bottom ash.
- Operator training.

Records should be maintained on-site throughout the operational life of the facility and be made available to Inspectors and other regulatory officials upon request.

3.8 Operator Training

The cornerstone of ensuring proper and safe operation of any equipment is adequate operator training. Facility owners must ensure qualified operators are available and have been properly trained to operate the equipment under both normal and emergency conditions. This will help to ensure the continued operation and maintenance of the equipment and facility, protection of the environment and the continued health and safety of the operator and nearby people. In particular, operators of incinerators should be trained in the following areas:

- Physical and mechanical features of the equipment and facility.
- Operation and trouble-shooting procedures.
- Environmental and safety concerns related to operation of the facility.
- Spill and fire emergency response procedures.
- Emergency and accident reporting procedures including use of the NWT/Nunavut 24-Hour Spill Report Line at (867) 920-8130.

Every incinerator manufacturer has its own approach to designing and building incinerators. Operators should be qualified and trained to safely operate the specific make and model of incinerator they are expected to operate.

The Application of Open Burning and Incineration

The Department of Environment does not promote or endorse the burning and incineration of solid waste. This method of waste management should be implemented only after the owner or operator has made all reasonable and determined efforts to implement sound waste management planning and practices. Opportunities to reduce or eliminate the need for burning and incineration through changes in purchasing practices, reuse, recycling, segregation and diversion, and other changes or emission control upgrades that would result in emission reductions, must be reviewed periodically and implemented where practical. Refer to section 3 for additional information on best management practices.

This section provides guidance on the application of open burning and incineration of solid waste. In addition to the guidance and direction provided through the Guideline, the burning and incineration of solid waste may also be controlled through permits and licenses issued by Nunavut's co-management boards, Aboriginal Affairs and Northern Development Canada and other regulatory agencies. These permits and licenses must be complied with at all times.

4.1 Open Burning

Open burning is the burning of solid waste where limited or no control over the combustion process can be exercised by the operator. For the purposes of the Guideline, open burning includes burning waste that has been piled on the surface of the ground or placed in small open pits, or the use of a burn box, unmodified burn barrel or modified burn barrel. Open burning does not include the destruction of waste using a commercial or manufactured incinerator.

The open burning of unsegregated, or mixed, solid waste must not occur under any circumstances. Today's household, institutional, commercial and industrial garbage contains many materials which, when burned at low temperature, can result in the release of high levels of particulates, acid gases, heavy metals, carbon monoxide, dioxins, furans and other chemicals, some of which may cause cancer. The only solid wastes that may be disposed of through open burning are paper products, paperboard packing, untreated wood waste and natural fiber textiles (i.e. cotton, wool). Refer to section 3.2 for further information on what waste can and cannot be burned.

The open burning of solid waste remains a hazardous practice from a fire prevention and environmental management perspective. **Open burning on the ground** should not take place within a municipality without first obtaining authority to do so from the local community government. It should never occur at a municipal or industrial landfill because of the proximity of other combustible wastes within the working landfill. Where permission has been obtained and paper, paperboard packing, untreated wood waste and natural fiber textiles are open burned on the ground or in a small open pit, the activity must be attended and carefully monitored by a responsible adult at all times.

The preferred alternative to open burning on the ground is the use of an **enclosed burn box or burn cage**. These devices should be used when burning a moderate to large quantity of paper, paperboard packing, untreated wood waste and natural fiber textiles. They are designed to contain the waste while it is burning and reduce the likelihood of sparks or burning embers igniting adjacent vegetation and other combustible materials. When using a burn box or cage at a municipal or industrial landfill, extreme caution must be taken to ensure other areas of the working landfill are not ignited. Their

proper operation includes loading the device with dry waste to about half its capacity before igniting the fire. Additional or wet waste can be added in small batches so as not to dampen the fire once the fire has developed into a good flame and it is safe to do so.

The following general conditions should be met whenever open burning on the ground or burning using an enclosed burn box or burn cage takes place:

- Only paper, paperboard packing, untreated wood waste and natural fiber textiles are burned.
- The waste is burned in a controlled manner and at a site which is separate from combustible vegetation and other materials.
- Burning takes place only on days when winds are light and blowing away from people.
- Waste is burned in manageable volumes so the fire does not get out of control.
- The fire is started, attended and monitored at all times by authorized and qualified personnel.
- The waste is kept dry or covered to the extent practicable prior to burning.
- Where applicable, authority is first obtained from the municipality or other regulatory agencies.

Modified or unmodified burn barrels should only be used to burn small quantities of paper, paperboard packing, untreated wood waste and natural fiber textiles at remote locations such as traditional camps and field camps. Food and food packaging waste, which make up a significant portion of kitchen garbage produced at these camps, should not be burned. These wastes should be segregated daily and stored in wildlife-proof containers for frequent removal to an approved disposal site.

It is important that burn barrels are properly constructed and operated to ensure safety of the operator and the environment. Appendix 2 provides detailed construction drawings for a modified burn barrel. The Department of Environment will consider other designs if they provide an equivalent level of environmental protection.

Below are some easy-to-do actions to ensure unmodified and modified burn barrels are operated safely and waste is burned to the greatest extent possible⁶.

When locating and constructing a burn barrel:

- Locate the burn barrel in a place predominantly downwind of the camp site or burn only on days when the wind is light and blowing away from the camp.
- Ensure the burn barrel is located on gravel, rocky outcrop or other area free of combustible materials and vegetation to avoid accidentally starting a tundra fire.
- Ensure the detailed plans provided in Appendix 2 are carefully followed when constructing a modified burn barrel. The 'exhaust gas to combustion air' ratio is particularly important to achieving the maximum burn rate. A 2:1 ratio of exhaust stack to air intake area consisting of a 6-inch exhaust port and three 2-inch air intake holes positioned equidistantly around the bottom of the barrel a few inches up from the base is preferred.

⁶ Testing of a modified burn barrel was performed by Environment Canada's Air Quality Research Division in April 2011 at the request of Nunavut's Department of Environment. Ten trial burns were completed prior to emissions testing in order to optimize and standardize barrel design and operational procedures. Following the trial burns, four test runs were performed and air emission samples collected for analysis. Results of the emission testing program will be available from Nunavut's Department of Environment. This list of recommended practices reflects the operational observations and measurements made during the testing program.

When operating a burn barrel:

- Inspect the barrel for any signs of leakage, corrosion or other physical defects before each burn cycle. Any necessary repairs must be completed before the equipment is used.
- Burn only dry waste. If wet waste must be burned, mix or batch the waste with other waste that has a low moisture content and high heating value (i.e. dry wood). This will help ensure the slow-burning wet waste is completely burned.
- Burn only paper, paperboard packing, untreated wood waste and natural fiber textiles. Food and food packaging waste should not be burned. Burning non-combustible waste (i.e. metal and glass) will rob the fire of valuable heat and should also be avoided. Food and food packaging, non-combustible and other waste that cannot be burned should be segregated and removed from the site for disposal on a regular basis.
- Do not overfill or densely pack waste into the burn barrel as air will be prevented from properly mixing with the waste. This will result in a smouldering, low temperature burn and smoke.
- Layering wet or slow burning waste with dry fast burning waste will help ensure more complete combustion of all waste.
- The burn barrel should not be used unless a responsible adult is available to monitor and watch over it until the fire has completely cooled.
- When using a modified burn barrel, the exhaust port on the 'metal basket insert' should be aligned between two of the 2-inch air intake holes in order to avoid short-circuiting of the combustion air directly through to the stack. Also, the spark arrest screen should be cleaned following each burn to ensure the stack does not become blocked with soot and other debris. If the barrel lid begins to 'puff' during a burn, inspect the screen to ensure it is not obstructing the flow of exhaust gases.

Care must be taken by the operator at all times to avoid skin contact with hot surfaces and avoid breathing smoke and other exhaust gases.

Written records of open burning should be kept by the operator. These record what was burned, when and how much, how waste was loaded into the device, how the fire was started, its location, weather conditions at the time and any other information that may help remind the operator of what worked well, and what didn't. These records are to be made available for review upon request by an Inspector.

Bottom ash from the open burning of paper, paperboard packing, untreated wood waste and natural fiber textiles is suitable for burial in a designated pit or municipal landfill site. Consent to use a municipal landfill should first be obtained from the local government. Bottom ash must be completely cooled before it can be safely handled and disposed of. Refer to section 3.6 for further information.

4.2 Incineration

Incinerators differ from the simpler methods of open burning as the operator has a higher degree of control over the burning process. The resulting higher temperatures, longer holding times and greater turbulence lead to more complete combustion of the waste. Although a wider range of wastes can be destroyed using high temperature single or dual-chambered incinerators, determined efforts should still be taken to reduce the quantity and type of waste generated and to implement other changes which would result in reductions in air emissions. Refer to section 3 for further information proper waste management practices and a listing of what waste can and cannot be incinerated.

The incinerator manufacturer's operating instructions must be followed at all times to ensure designed temperature, holding time and turbulence conditions are achieved and to avoid damage to the facility. When operating during winter months, additional care must be taken because cold air introduced into the primary and secondary chambers may make it difficult for normal operating temperatures to be achieved. Operators must be properly trained and qualified to operate the equipment under both normal and emergency conditions. Owners are strongly encouraged to consult system manufacturers or other qualified persons with expertise before purchasing an incinerator. Additional guidance on the selection of incinerator technologies and their operational requirements can be obtained by referring to Environment Canada's *Technical Document for Batch Waste Incineration*.

The installation and operation of monitoring and control systems is critical for the proper and safe operation of any incinerator. The design, installation, certification and operation of continuous emissions monitoring systems (CEMS) should comply with the principles described in Environment Canada's *Protocols and Performance Specifications for Continuous Monitoring of Gaseous Emissions from Thermal Power Generation*. While the document is written for power generation facilities, the principles apply equally well to other types of facilities and continuous emissions monitoring systems. For incinerators operating in Nunavut, key operational parameters must be monitored at all times using on-line instruments capable of continuously measuring the combustion process and stack emissions quality. These instruments should be equipped with visible and audible alarms and be on-line whenever the incinerator is in operation, including 'start-up' and 'cool down' phases. Table 3 lists the monitoring and control system requirements.

Table 3. Incinerator Monitoring and Control System Requirements

System Description	Quantity of Waste to be Burned ⁷	
	Less than 26 Tonnes per Year	Greater than 26 Tonnes per Year
Weight and composition of feedstock waste on a batch basis	✓	✓
Temperature in the primary and secondary combustion chambers	✓	✓
Opacity in the stack ⁸	✓	✓
Initial Certificate of Operation ⁹		✓

While not a specific requirement of the Guideline, additional one-time or continuous emissions monitoring may be required depending upon the type and quantity of waste to be incinerated. Examples include monitoring oxygen and carbon monoxide in the undiluted gases exiting the combustion chamber, such as a secondary chamber of a conventional dual-stage incinerator. Annual or periodic stack sampling for hydrogen chloride, dioxins and furans may also be required where the feedstock includes a significant quantity of organic materials that contain chlorine (i.e. chlorinated solvents and plastics, PVC piping, marine driftwood). The reader is encouraged to contact Nunavut's Department of Environment for guidance on additional emissions monitoring requirements.

⁷ The CCME Canada-Wide Standard for Dioxins and Furans Emissions from Waste Incinerators and Coastal Pulp and Paper Boilers (2001) established a criterion of 26 tonnes per year to distinguish between a 'small facility' and 'large facility' incinerator.

⁸ An acceptable alternative to monitoring opacity is to continuously monitor particulate matter in the stack.

⁹ An initial Certificate of Operation includes satisfactory confirmation based on manufacturers' or third-party testing and certification that the unit is capable of complying with the requirements contained in the Guideline when operated in accordance with the manufacturer's recommendations and with minimal requirement for operator attention. The Certificate is to be provided to the Nunavut Department of Environment before the incinerator is placed into routine operational service.

Monitoring and control data should be recorded each time a burn cycle is completed. Records are to be maintained for the operational life of the incinerator and made available for review upon request by an Inspector. Refer to section 3.7 for additional information on monitoring and record keeping.

Bottom ash and other solid residue collected from the incinerator is suitable for burial where it meets the criteria set out in Table 1 of the *Environmental Guideline for Industrial Waste Discharges into Municipal Solid Waste and Sewage Treatment Facilities* or in accordance with land use permits and water licenses issued by Nunavut's co-management boards and Aboriginal Affairs and Northern Development Canada. Where bottom ash meets the criteria and is to be disposed of into a municipal landfill, the quantity transported off-site must be recorded and the consent of the local municipal government first be obtained. Bottom ash not meeting the criteria set out in the *Environmental Guideline for Industrial Waste Discharges into Municipal Solid Waste and Sewage Treatment Facilities* is considered to be a hazardous waste and must be managed in accordance with the *Environmental Guideline for the General Management of Hazardous Waste*.

Conclusion

This is a general introduction to the practice of burning and incinerating solid waste. It is not intended to promote or endorse the practice but to provide the reader with information on the risks, hazards and best management practices associated with this activity. It also provides specific guidance on the application of burning and incinerating solid waste should this practice be undertaken by municipalities and operators of traditional, field and commercial camps.

Familiarity with the Guideline does not replace the need for the owner or person in charge, management or control of the solid waste to comply with all applicable federal and territorial legislation and municipal by-laws. The burning and incineration of solid waste may be controlled through permits and licenses issued by Nunavut's co-management boards, Aboriginal Affairs and Northern Development Canada and other regulatory agencies. These permits and licenses must be complied with at all times.

For additional information on the management of solid waste, or to obtain a complete listing of available guidelines, contact the Department of Environment at:

Environmental Protection Division
Department of Environment
Government of Nunavut
Inuksugait Plaza, Box 1000, Station 1360
Iqaluit, Nunavut, X0A 0H0

Phone: (867) 975-7729

Fax: (867) 975-7739

Email: EnvironmentalProtection@gov.nu.ca

Website: <http://env.gov.nu.ca/programareas/environmentprotection>

References

Aboriginal Affairs and Northern Development Canada (AANDC). Handbook of Reclamation Techniques in the Yukon, (1999).

Alaska Department of Environmental Conservation and Alaska Energy Authority. Burning Garbage and Land Disposal in Rural Alaska, (2004).

<http://www.akenergyauthority.org/AEAdocuments/BurningGarbage.pdf>

Canadian Council of Ministers of the Environment (CCME). Canada-Wide Standards for Dioxins and Furans Emissions from Waste Incinerators and Coastal Pulp and Paper Boilers, (2001).

http://www.ccme.ca/assets/pdf/d_and_f_standard_e.pdf

Canadian Council of Ministers of the Environment (CCME). Canada-Wide Standards for Mercury Emissions from Base-Metal Smelters and Waste Incinerators, (2000).

http://www.ccme.ca/assets/pdf/mercury_emis_std_e1.pdf

Canadian Council of Ministers of the Environment (CCME). National Guidelines for Hazardous Waste Incineration Facilities – Design and Operating Criteria, (1992).

http://www.ccme.ca/assets/pdf/pn_1076_e.pdf

Canadian Council of Ministers of the Environment (CCME). Operating and Emission Guidelines for Municipal Solid Waste Incinerators, (1989).

http://www.ccme.ca/assets/pdf/pn_1085_e.pdf

Canadian Council of Ministers of the Environment (CCME). Provisional Code of Practice for the Management of Post Use Treated Wood, (1996).

http://www.ccme.ca/assets/pdf/pn_1227_e.pdf

Environment Canada (EC). Protocols and Performance Specifications for Continuous Monitoring of Gaseous Emissions from Thermal Power Generation. Report EPS 1/PG/7, (1995).

<http://www.ec.gc.ca/Publications/844D7CF3-2F1D-4CA0-9290-0A885806F792/ProtocolsandPerformanceSpecs.pdf>

Environment Canada (EC). Operation of a Modified Burn Barrel for the Destruction of Food Waste in Remote Locations: Observational Summary. Report ERMS 2011-01.

Environment Canada (EC). Technical Document for Batch Waste Incineration, (2009).

<http://www.ec.gc.ca/gdd-mw/default.asp?lang=En&n=F53EDE13-1>

Government of Nunavut, Department of Environment. Environmental Guideline for General Management of Hazardous Waste, (2010).

<http://env.gov.nu.ca/node/82#Guideline Documents>

Government of Nunavut, Department of Environment. Environmental Guideline for Industrial Waste Discharges into Municipal Solid waste and Sewage Treatment Facilities, (2011).

<http://env.gov.nu.ca/node/82#Guideline Documents>

APPENDICES

APPENDIX 1 - ENVIRONMENTAL PROTECTION ACT

The following are excerpts from the *Environmental Protection Act*

1. "Contaminant" means any noise, heat, vibration or substance and includes such other substance as the Minister may prescribe that, where discharged into the environment,
 - (a) endangers the health, safety or welfare of persons,
 - (b) interferes or is likely to interfere with normal enjoyment of life or property,
 - (c) endangers the health of animal life, or
 - (d) causes or is likely to cause damage to plant life or to property;

"Discharge" includes, but not so as to limit the meaning, any pumping, pouring, throwing, dumping, emitting, burning, spraying, spreading, leaking, spilling, or escaping;

"Environment" means the components of the Earth and includes

 - (a) air, land and water,
 - (b) all layers of the atmosphere,
 - (c) all organic and inorganic matter and living organisms, and
 - (d) the interacting natural systems that include components referred to in paragraphs (a) to (c).

"Inspector" means a person appointed under subsection 3(2) and includes the Chief Environmental Protection Officer.
- 2.2 The Minister may
 - (a) establish, operate and maintain stations to monitor the quality of the environment in the Territories;
 - (b) conduct research studies, conferences and training programs relating to contaminants and to the preservation, protection or enhancement of the environment;
 - (c) develop, co-ordinate and administer policies, standards, guidelines and codes of practice relating to the preservation, protection or enhancement of the environment;
 - (d) collect, publish and distribute information relating to contaminants and to the preservation, protection or enhancement of the environment;
3. (1) The Minister shall appoint a Chief Environmental Protection Officer who shall administer and enforce this Act and the regulations.

(2) The Chief Environmental Protection Officer may appoint inspectors and shall specify in the appointment the powers that may be exercised and the duties that may be performed by the inspector under this Act and regulations.
5. (1) Subject to subsection (3), no person shall discharge or permit the discharge of a contaminant into the environment.

(3) Subsection (1) does not apply where the person who discharged the contaminant or permitted the discharge of the contaminant establishes that
 - (a) the discharge is authorized by this Act or the regulations or by an order issued under this Act or the regulations;
 - (b) the contaminant has been used solely for domestic purposes and was discharged from within a dwelling house;
 - (c) the contaminant was discharged from the exhaust system of a vehicle;

- (d) the discharge of the contaminant resulted from the burning of leaves, foliage, wood, crops or stubble for domestic or agricultural purposes;
 - (e) the discharge of the contaminant resulted from burning for land clearing or land grading;
 - (f) the discharge of the contaminant resulted from a fire set by a public official for habitat management of silviculture purposes;
 - (g) the contaminant was discharged for the purposes of combating a forest fire;
 - (h) the contaminant is a soil particle or grit discharged in the course of agriculture or horticulture; or
 - (i) the contaminant is a pesticide classified and labelled as "domestic" under the *Pest Control Products Regulations* (Canada).
- (4) The exceptions set out in subsection (3) do not apply where a person discharges a contaminant that the inspector has reasonable grounds to believe is not usually associated with a discharge from the excepted activity.
- 5.1. Where a discharge of a contaminant into the environment in contravention of this Act or the regulations or the provisions of a permit or license issued under this Act or the regulations occurs or a reasonable likelihood of such a discharge exists, every person causing or contributing to the discharge or increasing the likelihood of such a discharge, and the owner or the person in charge, management or control of the contaminant before its discharge or likely discharge, shall immediately:
- (a) subject to any regulations, report the discharge or likely discharge to the person or office designated by the regulations;
 - (b) take all reasonable measures consistent with public safety to stop the discharge, repair any damage caused by the discharge and prevent or eliminate any danger to life, health, property or the environment that results or may be reasonably expected to result from the discharge or likely discharge; and
 - (c) make a reasonable effort to notify every member of the public who may be adversely affected by the discharge or likely discharge.
6. (1) Where an inspector believes on reasonable grounds that a discharge of a contaminant in contravention of this Act or the regulations or a provision of a permit or license issued under this Act or the regulations has occurred or is occurring, the inspector may issue an order requiring any person causing or contributing to the discharge or the owner or the person in charge, management or control of the contaminant to stop the discharge by the date named in the order.
7. (1) Notwithstanding section 6, where a person discharges or permits the discharge of a contaminant into the environment, an inspector may order that person to repair or remedy any injury or damage to the environment that results from the discharge.
- (2) Where a person fails or neglects to repair or remedy any injury or damage to the environment in accordance with an order made under subsection (1) or where immediate remedial measures are required to protect the environment, the Chief Environmental Protection Officer may cause to be carried out the measures that he or she considers necessary to repair or remedy an injury or damage to the environment that results from any discharge.

APPENDIX 2 – MODIFIED BURN BARREL DESIGN AND SPECIFICATIONS

A modified burn barrel is typically constructed from a 45 gallon metal fuel or oil drum. The modifications result in greater heat generation and retention, better mixing of the waste with incoming air and longer holding time inside the barrel. Together, these modifications result in more complete combustion of the solid waste than does open burning on the ground or in a pit.

Placing a metal screen over the top of the exhaust pipe may be required to prevent sparks and hot ash from escaping. Care should be taken to ensure the screen does not become blocked with soot.



A stove pipe attached to the top of the barrel allows smoke to escape and creates an effective draft.

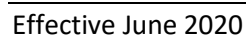
Evenly spaced vents or holes cut above the bottom of the barrel enable fresh air to mix with waste inside the metal basket.



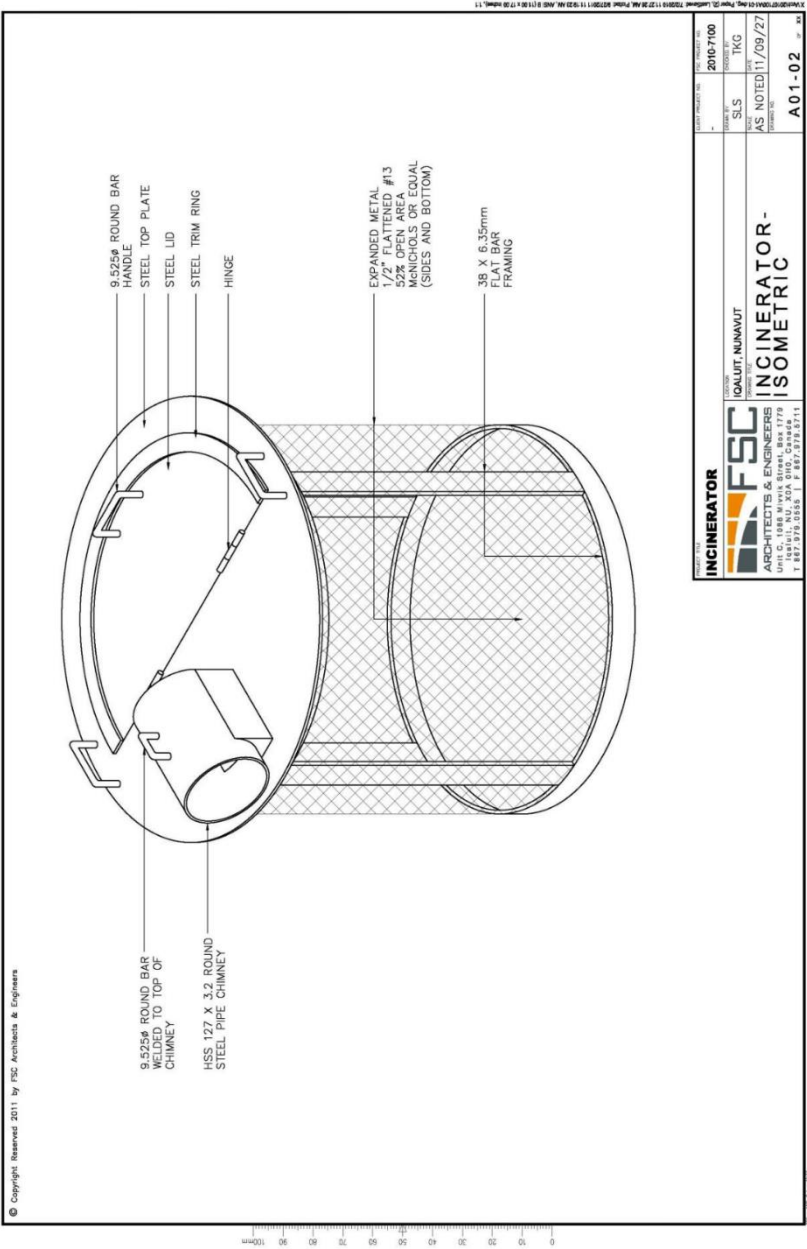
A hinged top helps to capture heat and enables easy loading and mixing of waste.

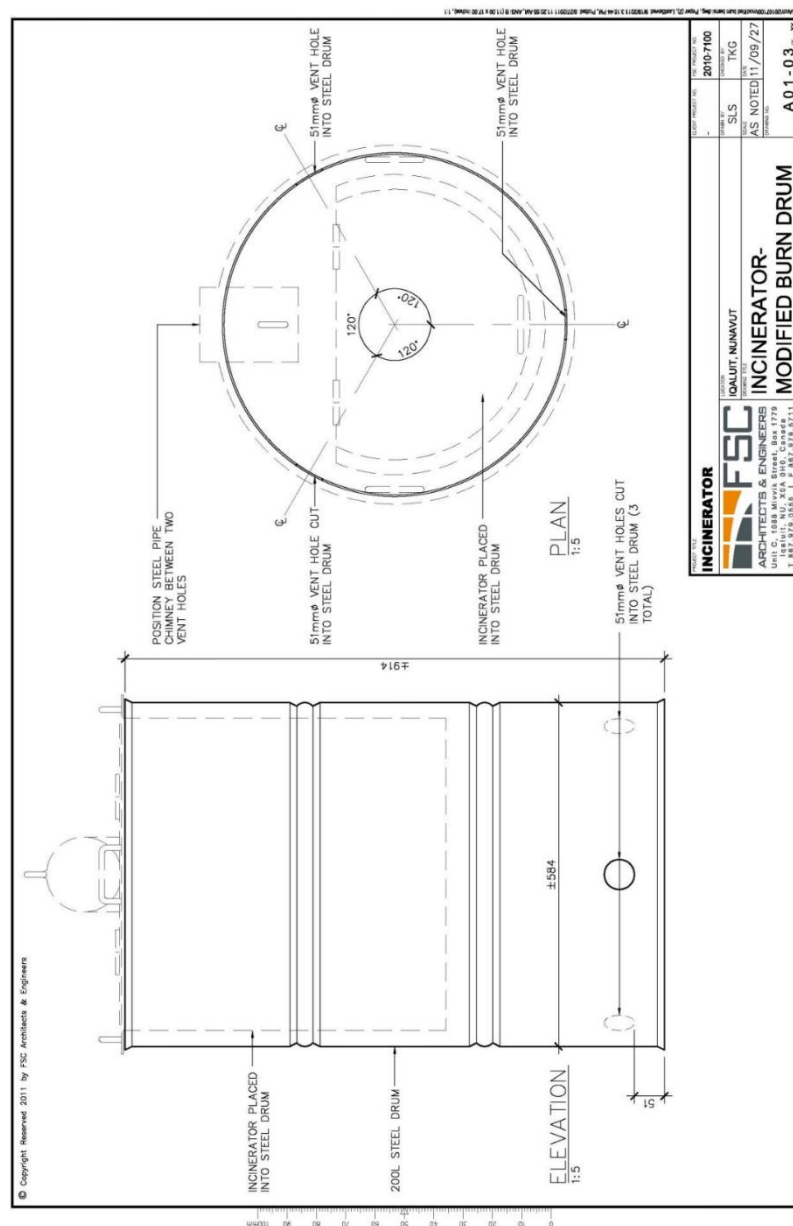


A metal basket or grate suspends the burning waste and enables mixing with the incoming air. The removable basket also enables access to any unburned ash that may collect in the bottom of the barrel.



Guideline for the Burning and Incineration of Solid Waste





Appendix G: Environmental Guideline for Used Oil and Waste Fuel

Environmental Guideline for Used Oil and Waste Fuel



Department of Environment
Government of Nunavut

GUIDELINE: USED OIL AND WASTE FUEL

Original: June 2012

This Guideline has been prepared by the Department of Environment's Environmental Protection Division and approved by the Minister of Environment under the authority of Section 2.2 of the *Environmental Protection Act*.

This Guideline is not an official statement of the law and is provided for guidance only. Its intent is to increase the awareness and understanding of the risks, hazards and best management practices associated with used oil and waste fuel. This Guideline does not replace the need for the owner or person in charge, management or control of the waste to comply with all applicable legislation and to consult with Nunavut's Department of Environment, other regulatory authorities and qualified persons with expertise in the management of used oil and waste fuel.

Copies of this Guideline are available upon request from:

Department of Environment
Government of Nunavut
P.O. Box 1000, Station 1360, Iqaluit, NU, X0A 0H0
Electronic version of the Guideline is available at <http://env.gov.nu.ca/programareas/environmentprotection>

Cover Photos: Government of Nunavut Department of Environment (left and top right)
E. Paquin (bottom right)

Table of Contents

Introduction	1
1.1 Definitions	1
1.2 Roles and Responsibilities	3
1.2.1 Department of Environment	3
1.2.2 Generators and Owners of Used Oil and Waste Fuel	3
1.2.3 Other Regulatory Agencies	4
Characteristics and Potential Effects of Used Oil and Waste Fuel	6
2.1 Characteristics	6
2.2 Potential Effects on the Environment and Human Health	8
Waste Management	9
3.1 Pollution Prevention	9
3.2 Storage	10
3.3 Transportation	11
3.4 Spill Response and Cleanup	13
3.5 Mixing or Blending with Other Materials	14
3.6 Used Oil Filters	14
3.7 Recycling, Reuse and Disposal	15
3.7.1 Reprocessing and Re-refining	15
3.7.2 Burning for Heat Recovery	16
3.7.3 Disposal	18
Conclusion	19
References	20

Appendices

Appendix 1	Environmental Protection Act (excerpts)
Appendix 2	Government Contacts
Appendix 3	Used Oil Furnace and Boiler Manufacturers
Appendix 4	Registration Form – Used Oil or Waste Fuel Appliance

Introduction

The management of used oil and waste fuel is a major concern in Nunavut as large volumes are generated from a wide variety of sources each year. While an up-to-date inventory is not available, a study undertaken by the Government of the Northwest Territories in 1990 concluded that each person living in Cambridge Bay, Kugluktuk, Gjoa Haven and Taloyoak generated almost 14 litres of used crankcase oil annually. Based upon this figure, it is estimated that more than 450,000 litres of used oil was generated in Nunavut communities in 1990. A significant increase in the use of automobiles and four-stroke ATVs, snowmobiles and boat motors, together with an increase in construction and mining activity, means the volume of used oil generated in Nunavut today is likely much greater.

Used oil is oil which is purchased for lubricating or other purposes but has become unsuitable for its intended purpose due to the presence of impurities or the loss of original properties. It includes engine, turbine and gear lubricating oil, hydraulic and transmission fluid and insulating coolant (i.e. transformer fluid). Used oil is generated by a wide variety of commercial and industrial sectors including automotive and heavy equipment servicing, marine and aviation transportation, electrical generation and mining. Household do-it-yourselfers also generate used oil by self-servicing their automobiles, ATVs, snowmobiles and boat motors.

Waste fuel includes gasoline, diesel and fuel oil, aviation fuel, kerosene and naphtha that is no longer suitable for its intended purpose due to impurities or the loss of its original properties. Like used oil, waste fuel is generated by a wide variety of sources including residential, institutional, commercial and industrial users of fuel products. However, unlike used oil, the volume of waste fuel generated each year in Nunavut can vary greatly.

The *Environmental Guideline for Used Oil and Waste Fuel* (the Guideline) is intended to increase the awareness and understanding of the risks, hazards and best management practices associated with used oil and waste fuel. The Guideline provides information on the characteristics and potential environmental and human health effects of these wastes and guidance on its proper storage, transportation, reuse and disposal. It is not an official statement of the law. For further information and guidance, the owner or person in charge, management or control of used oil and waste fuel is encouraged to review all applicable legislation and consult the Department of Environment, other regulatory agencies or qualified persons with expertise in the management of these wastes.

The *Environmental Protection Act* enables the Government of Nunavut to implement measures to preserve, protect and enhance the quality of the natural environment. Section 2.2 of the *Act* provides the Minister with authority to develop, coordinate, and administer the Guideline.

1.1 Definitions

<i>Blend</i>	To mix used oil or waste fuel with another hydrocarbon fuel.
<i>Bottom Ash</i>	The coarse non-combustible and unburned material that remains in the burn chamber, exhaust piping and pollution control devices after burning is complete.

Environmental Guideline for Used Oil and Waste Fuel

<i>Commissioner's Land</i>	Lands that have been transferred by Order-in-Council to the Government of Nunavut. This includes roadways and land subject to block land transfers. Most Commissioner's Land is located within municipalities.
<i>Contaminant</i>	Any noise, heat, vibration or substance and includes such other substance as the Minister may prescribe that, where discharged into the environment, (a) endangers the health, safety or welfare of persons, (b) interferes or is likely to interfere with normal enjoyment of life or property, (c) endangers the health of animal life, or (d) causes or is likely to cause damage to plant life or to property.
<i>Dangerous Good</i>	Any product, substance or organism included by its nature or by the <i>Transportation of Dangerous Goods Regulations</i> in any of the classes listed in the schedule provided in the <i>Transportation of Dangerous Goods Act</i> .
<i>Environment</i>	The components of the Earth and includes (a) air, land and water, (b) all layers of the atmosphere, (c) all organic and inorganic matter and living organisms, and (d) the interacting natural systems that include components referred to in paragraphs (a) to (c) above.
<i>Hazardous Waste</i>	A contaminant that is a dangerous good and is no longer wanted or is unsuitable for its original intended purpose and is intended for storage, recycling, treatment or disposal.
<i>Household Do-It-Yourselfer</i>	An individual who generates used oil or waste fuel through the maintenance of their personal vehicles and equipment.
<i>Inspector</i>	A person appointed under subsection 3(2) of the <i>Environmental Protection Act</i> and includes the Chief Environmental Protection Officer.
<i>Open Burning</i>	Burning of waste with limited or no control of the burn process. For clarity, open burn includes burning on the open ground or in a small open pit, or using a burn box or unmodified or modified burn barrel.
<i>Qualified Person</i>	A person who has an appropriate level of knowledge and experience in all relevant aspects of waste management.
<i>Transport Authority</i>	The statute and regulations controlling the management of hazardous waste under that mode of transport. These include (a) Road and Rail - <i>Transportation of Dangerous Goods Act</i> (Canada) and <i>Regulations; Interprovincial Movement of Hazardous Waste Regulations</i> and <i>Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations</i> .

Environmental Guideline for Used Oil and Waste Fuel

- (b) Air – *International Air Transport Association (IATA) Dangerous Goods Regulations* and *International Civil Aviation Organization (ICAO) Technical Instructions*; and
- (c) Marine – *International Maritime Dangerous Goods Code (IMDG)*.

<i>Used Oil</i>	Engine, turbine and gear lubricating oil, hydraulic and transmission fluid and insulating coolant (i.e. transformer fluid) that is unsuitable for its intended purpose due to the presence of impurities or the loss of original properties, but does not include waste derived from animal or vegetable fat or a petroleum product spilled on land or water.
<i>Used Oil or Waste Fuel Appliance</i>	An incinerator, boiler, furnace or other device that has been certified and approved for the burning of used oil or waste fuel by the Canadian Standards Association, Underwriters' Laboratories of Canada or another certified testing agency acceptable to the Fire Marshal.
<i>Waste Fuel</i>	A flammable or combustible petroleum hydrocarbon that is unsuitable for its intended purpose due to the presence of impurities or the loss of original properties, and includes gasoline, diesel and fuel oil, aviation fuel, kerosene and naphtha, but does not include paint, solvent or propane.

1.2 Roles and Responsibilities

1.2.1 Department of Environment

The Government of Nunavut's Environmental Protection Division is the key territorial agency with responsibility for ensuring parties properly manage used oil and waste fuel. Authority is derived from the *Environmental Protection Act*, which prohibits the discharge of contaminants to the environment and enables the Minister to undertake actions to ensure appropriate management measures are in place. Although programs and services are applied primarily to activities taking place on Commissioner's and municipal lands and to Government of Nunavut undertakings, the *Environmental Protection Act* may be applied to the whole of the territory where other controlling legislation, standards and guidelines do not exist. A complete listing of relevant legislation and guidelines can be obtained by contacting the Department of Environment or by visiting the web site at <http://env.gov.nu.ca/programareas/environmentprotection>.

1.2.2 Generators and Owners of Used Oil and Waste Fuel

Generators, owners or persons in charge, management or control of used oil and waste fuel, also referred to as the responsible party, must ensure the waste is properly and safely managed from the time it is produced to its final reuse or disposal. This includes household do-it-yourselfers and municipal, territorial and federal government, commercial, industrial and institutional operators who may or may not have in-house capabilities for recycling, reusing or disposing of the wastes.

Contractors may manage unwanted used oil and waste fuel on behalf of the responsible party. However, the responsible party remains liable for ensuring the method of management complies with all applicable statutes, regulations, standards, guidelines and local by-laws. If the contractor does not

comply with the requirements of the *Environmental Protection Act* and is charged with a violation while managing the waste, the responsible party may also be charged.

A household do-it-yourselfer and any other person that generates used oil or waste fuel in quantities less than five litres per month is exempt from certain requirements described in the Guideline. These small quantity generators should refer to section 3, *Waste Management*, for information on the applicable exemptions. Any person who generates used oil or waste fuel in quantities greater than five litres each month must comply with all instructions described in section 3, *Waste Management*. In addition, further information on the registration of generators, carriers, receivers and hazardous waste management facilities can be obtained by referring to the *Environmental Guideline for the General Management of Hazardous Waste*.

1.2.3 Other Regulatory Agencies

Other regulatory agencies may have to be consulted regarding the management of used oil and waste fuel as there may be other environmental or public and worker health and safety issues to consider.

Workers' Safety and Compensation Commission

The Workers' Safety and Compensation Commission is responsible for promoting and regulating worker and workplace health and safety in Nunavut. The Commission derives its authority from the *Workers' Compensation Act* and *Safety Act* which require an employer to maintain a safe workplace and ensure the safety and well being of workers. The Workplace Hazardous Materials Information System, or WHMIS, requires information be provided to workers on the safe use of any hazardous material used in the workplace.

Department of Community and Government Services

The Department of Community and Government Services is responsible under the *Commissioner's Lands Act* for the issuance of land leases, reserves, licenses and permits on Commissioner's Lands. The Department, in cooperation with communities, is also responsible for the planning and funding of municipal solid waste and sewage disposal facilities in most Nunavut communities. Emergency planning responsibilities under the *Emergency Measures Act* include developing territorial emergency response plans, coordinating emergency operations at the territorial and regional levels and supporting community emergency response operations.

The Office of the Fire Marshal is responsible for ensuring the safe storage, handling and use of flammable and combustible liquids and materials. The Office of the Fire Marshal derives its authority from the *Fire Prevention Act*, *National Fire Code* and *National Building Code*.

Department of Health and Social Services

Activities related to the generation, handling, storage, transportation, reprocessing, burning and disposal of used oil and waste fuel may have an impact on public health. The Office of the Chief Medical Officer of Health and Regional Environmental Health Officers should be consulted regarding legislated requirements under the *Public Health Act*.

Department of Economic Development and Transportation

The Motor Vehicles Division of the Department of Economic Development and Transportation is responsible for the safe transport of dangerous goods and hazardous waste by road through administration of the *Transportation of Dangerous Goods Act*. The Department is also responsible for driver licensing and various other vehicle and road safety matters under the *Motor Vehicles Act*.

Environment Canada

Environment Canada is responsible for administering the *Canadian Environmental Protection Act* (CEPA). Section 76 of CEPA requires the federal Ministers of Environment and of Health to establish a Priority Substances List identifying substances that are to be assessed on a priority basis to determine whether they are toxic (as defined under section 64 of CEPA) and pose a risk to the health of Canadians or to the environment. An assessment of used crankcase oils was completed in 1994 that concluded existing data was insufficient to determine whether these oils are "toxic" under CEPA.

Environment Canada also regulates the interprovincial and international movement of hazardous waste under the *Interprovincial Movement of Hazardous Waste Regulations* and *Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations* and is responsible for administering the pollution prevention provisions of the federal *Fisheries Act*.

Aboriginal Affairs and Northern Development Canada

Aboriginal Affairs and Northern Development Canada is responsible under the *Territorial Lands Act* and *Nunavut Waters and Nunavut Surface Rights Tribunal Act* for the management of federal lands and waters, including the impact used oil and waste fuel may have on the quality of these lands and waters.

Local Municipal Governments

The role of municipal governments is important in the proper local management of used oil and waste fuel. Under the Nunavut Land Claims Agreement, municipalities are entitled to control their own municipal disposal sites. Unwanted waste may be deposited into municipal landfill sites and sewage lagoons only with the consent of the local government. The local fire department may also be called upon if a fire or other public safety issue involving used oil and waste fuel is identified.

Co-management Boards and Agencies

Co-management boards and agencies established under the Nunavut Land Claims Agreement have broad authority for land use planning, impact assessment and the administration of land and water. Activities involving the management and disposal of used oil and waste fuel may be controlled through the setting of terms and conditions in plans, permits and licenses issued by the Nunavut Water Board, Designated Inuit Organizations responsible for land administration and other co-management boards and agencies.

Characteristics and Potential Effects of Used Oil and Waste Fuel

2.1 Characteristics

The characteristics of used oil are determined in large part by the nature of its virgin state. Lubricating oils consist of a complex mixture of hydrocarbons making up 80 to 90% of its volume. Different additives are then mixed with this base oil to enhance the product's performance and prolong its useful life. These chemical additives improve the oil's lubricating characteristics by stabilizing its viscosity at various temperatures, preventing tackiness, dispersing solid particles and maintaining its characteristics under extreme hydraulic pressure. The product's useful life is ensured by adding chemicals which neutralize acids, form corrosion or oxidation preventing films, inhibit microbial growth and minimize chemical degradation. Table 1 provides the formulation of typical engine oil.

Table 1. Typical Engine Oil Formulation (CCME 1989)

Ingredient	Percent of Volume
Base Oil (solvent 150 neutral)	86
Viscosity Improver (polyisobutylene)	5
Multi-functional Additives (dispersant, pour depressant, viscosity improver)	4
Detergents (barium and calcium sulphonates)	4
Detergent Inhibitors (ZDDP – zinc dialkyl dithiophosphate)	1

Lubricating oils are altered during use through breakdown of the additives, the addition of metals and solids from friction wear on engine parts and contamination with unburned fuel combustion products. Contaminants can also be introduced through poor management after the oil has been removed from the operating equipment (i.e. blending or mixing with other used oil, waste fuel or solvents during collection and transportation, mixing with water during storage). Although the composition of used oil is variable and difficult to characterize, gasoline engine lubricating oils typically contain higher levels of contaminants through use than diesel engine oils, while diesel engine oils contain higher levels of contaminants than hydraulic oils. Table 2 describes how used engine oil can vary because of its original properties, use and through contamination resulting from poor management.

Table 2. Summary of Physical Characteristics of Used Engine Oil (Franklin Associates Ltd., 1985)

Parameter	Number of Samples	Range		Average
		Low	High	
Flash Point (°C)	289	17	290	99
Bottom Sediment and Water (%)	320	0	99	19
Viscosity (cm ² /second at 38 °C)	+	0.01	5.13	0.71
Specific Gravity	48	0.67	0.98	0.89
Heating Value (kJ/kg)	231	9,630	53,600	38,370

+ Inaccurate reporting in source data

The characteristics of waste fuel are also largely determined by the nature of its virgin state. The Canadian General Standards Board (CGSB) maintains a series of standards for gasoline and diesel fuels used in different applications in Canada¹ while the American Society for Testing and Materials (ASTM) Specification for Aviation Turbine Fuels D1655 defines the basic civil jet fuel specifications for Jet-A, Jet-A1 and Jet-B fuels². When one or more of the components of the fuel blend falls outside of the acceptable range specified by these standards, the fuel is referred to as being 'off-specification' or 'off-spec', and is no longer suitable for its intended purpose. Off-specification may result from the introduction of impurities during the fuel's refining, transportation or storage, or through the loss of original properties through aging. Fuels that cannot be brought back into specification with the introduction of additives must be reused for other purposes, returned to refineries for re-refining or managed as a hazardous waste.

Flash point is the temperature at which enough hydrocarbon will evaporate from the fuel so as to burn in the presence of oxygen and an ignition source (i.e. spark). In other words, flash point provides an indication of how easy a fuel or oil will burn. Hydrocarbons with low flash points (i.e. gasoline) are more flammable than hydrocarbons with high flash points (i.e. automotive crankcase oil SAE30). Table 3 describes flash points for several common fuels and oils.

Table 3. Flash Points and Viscosity of Common Fuels and Oils

Fuel type	Flash Point (°C)	Viscosity (cSt ^a)
Gasoline	-43	0.46 to 0.80 ^b
Jet B ³	-1 to -23	1.3 ^c
Jet A and A1	>38	2 to 3.5 ^c
Fuel Oil No. 1 (kerosene)	38 to 72	2.39 to 4.28 ^c
Fuel Oil No. 2 (home heating oil, automotive diesel fuel)	52 to 96	3.0 to 7.4 ^c
Fuel Oil No. 4 (commercial heating oil, marine diesel fuel)	61 to 115	7.4 to 26.4 ^c
Fuel Oil No. 6 (Bunker C)	>65	97.4 to 660 ^d
Automotive Crankcase Oil SAE30	230	66.3 ^e
Freshwater		1.0038 ^c

^a The centistoke (cSt) is the ratio of a liquid's absolute viscosity to its density.

^b Determined at 15 °C

^c Determined at 20 °C

^d Determined at 50 °C

^e Determined at 40 °C

¹ Examples of Canadian General Standard Board standards for fuels include:

CAN/CGSB 3.5 Automotive Gasoline

CAN/CGSB-3.517 Automotive Low-Sulfur Diesel Fuel

CAN/CGSB-3.520 Automotive Low-Sulfur Diesel Fuel Containing Low Levels Of Biodiesel Esters (B1-B5)

CAN/CGSB-3.16 Mining Diesel Fuel

CAN/CGSB-3.6 Regular Sulfur Diesel Fuel

CAN/CGSB-3.18 Diesel Fuel for Locomotive-Type Medium Speed Diesel Engines

CAN/CGSB 3-GP-11d Naval Distillate Fuel

² Jet A is used within Canada and the United States by domestic and international airlines. Jet B is rarely used except in parts of northern Canada where its lower freeze point and higher volatility is an advantage for handling and cold starting.

³ Jet B is typically comprised of 35% kerosene and 65% naphtha.

Viscosity is a liquid's resistance to flow. A hydrocarbon with a low viscosity is 'thinner' and more likely to migrate away from the point of spillage than a hydrocarbon with a high viscosity. Low viscosity hydrocarbons are also more likely to leach through unfrozen soil towards groundwater or an adjacent water body. Besides the hydrocarbon's chemical composition, viscosity is also influenced by the temperature of the liquid. The lower the temperature, the higher the viscosity. Table 3 provides the viscosities of several common oils and fuels and compares them with freshwater.

2.2 Potential Effects on the Environment and Human Health

Used oil and waste fuel have historically been released to the environment through flaring, burning and fire practice, landfilling, indiscriminant dumping, accidental spills and through use as a dust control agent on roads. Burning and use in fire practices can lead to the release of unburned hydrocarbons, acid gases and metals that adhere to particulate matter in air (i.e. solid particles and liquid droplets) and eventually are deposited on soil and plants or in water. When hydrocarbons are released into water, a film of oil is initially formed on the surface where contaminants can be released and mixed with the water column and sediments. There are many ways oil can affect aquatic organisms ranging from coating the organism's skin, ingestion and absorption by surface breathing aquatic insects and tainting the flesh of fish, shrimp, clams and other edible organisms. The direct release of used oil or waste fuel to soil can lead to contaminants entering the environment through volatilization, adsorption to solid organic matter, leaching into groundwater, or through surface runoff to oceans, lakes, rivers and streams. Many different plant species are very sensitive to the toxic effects of oil, while others are more resistant.

The potential effects of used oil and waste fuel on human health is directly related to its physical properties and the types and levels of contaminants present. Highly volatile hydrocarbons are flammable and may present a risk of fire or explosion. Highly volatile hydrocarbons are also more likely to be inhaled into a person's lungs, which can result in inflammation of the tracheobronchial tree, bleeding from alveolar membranes and the displacement of oxygen. Repeated inhalation can affect the central nervous system eventually leading to lethargy, headaches and coma. Ingestion of hydrocarbons can result in irritation of the gastrointestinal tract, abdominal pain, vomiting and nausea.

Prolonged or repeated skin contact with used oil and waste fuel may cause severe irritation and dermatitis, and should be avoided. Heavy metals and other contaminants found in used lubricating oil may also be absorbed through the skin.

Heavy metals such as chromium, copper, lead, manganese, nickel and zinc are commonly found in used lubricating oil from friction wear on engine parts and can influence the effect the waste has on human health. Heavy metals can accumulate in the body and, although symptoms vary with the specific heavy metal, a person may be exhibiting metal poisoning if they experience any of the following: chronic pain throughout the muscles, tendons or other soft tissues of the body; a general feeling of discomfort, fatigue, and illness; forgetfulness and confusion; gastrointestinal complaints such as diarrhea, constipation, bloating, heartburn, and indigestion; dizziness; migraines and headaches; visual disturbances; or nervous system malfunctions including burning or numbness of the extremities.

Waste Management

Minimizing or avoiding the creation of pollutants and wastes can be more effective in protecting the environment than treating or cleaning them up after they have been created.⁴

3.1 Pollution Prevention

Pollution prevention is a term used to describe methods and practices that minimize or eliminate the generation of waste. Employing these methods only makes good sense as they help to reduce the hazards and costs associated with handling, storing, transporting, recycling, treating and disposing of the waste. They also help to reduce the impacts waste can have on the environment, human and worker health and safety and reduce the global emissions of greenhouse gases by minimizing the use of raw materials.

Generators can help prevent pollution and reduce their costs by implementing a range of waste reduction, reuse and recycling initiatives including changes to operational procedures, maintenance practices and raw material use. Several of these initiatives are identified below.

- | | |
|----------------------------|---|
| <i>Reduce</i> | <ul style="list-style-type: none">• Purchase the right type of oil, lubricants and fuel and only the amount needed.• Use re-refined, reconditioned or recycled oils and lubricants by choosing Ecologo certified products. A complete listing of environmentally-preferable products is available for downloading at http://www.ecologo.org/en/index.asp.• Use longer lasting synthetic products or select oils and lubricants that provide for maximum operating life.• Develop effective inventory controls and ensure the stored quantities of oils, lubricants and fuels are completely used before purchasing additional supplies.• Establish and maintain equipment maintenance schedules that are consistent with the manufacturers' suggested schedule. |
| <i>Reuse and Recycling</i> | <ul style="list-style-type: none">• Donate any excess unused oil, lubricant and fuel to reputable companies or individuals.• Make an agreement with your supplier to return un-opened and undamaged containers of oil, lubricant and fuel.• Purchase and install lubricating oil reconditioning equipment. While this form of recycling might not restore the oil to its original condition, it does prolong its useful life. Refer to section 3.7.1 <i>Reprocessing and Re-refining</i> for further information on reconditioning used lubricating oils.• Purchase and install a certified appliance (i.e. incinerator, boiler or furnace) designed to safely burn used oil or waste fuel. Utilizing the oil's heating value can also reduce the purchase and consumption of other virgin fossil fuels. Refer to section 3.7.2 <i>Burning for Heat Recovery</i> for further information on the use of used oil and waste fuel appliances.• Encourage small volume generators to deliver used oil and waste fuel to local collection centers, reusers or recyclers. Contact the Nunavut Department of Environment for the names of registered waste receivers and waste management facilities or your community government for alternative local reuse and recycling options. |

⁴ Source – Canadian Council of Ministers of the Environment.

- Large commercial and industrial generators of used oil and waste fuel should participate in national, provincial, territorial and local waste exchange programs or establish exchange accounts with approved recyclers and re-refiners.

Refer to the *Environmental Guideline for the General Management of Hazardous Waste* for a listing of Canadian waste exchanges and associations.

The *Workplace Hazardous Materials Information System* (WHMIS) is Canada's national hazard communication standard. WHMIS is administered in Nunavut by the Workers' Safety and Compensation Commission. Key elements of WHMIS are the provision of material safety data sheets (MSDS), container labeling and worker education and training programs. A MSDS is available from the chemical manufacturer and contains information on the properties of various oils, lubricants and fuels, along with instructions on their safe use and handling. Refer to the MSDS before purchasing or using oil and fuel products for the first time.

3.2 Storage

Storage refers to the maintenance of used oil and waste fuel while awaiting its reuse, recycling, transport or disposal. Storage is not acceptable for the long-term management of these wastes except under extraordinary circumstances and should be considered as a temporary measure only.

The type of storage method used depends upon the volume of wastes generated. Small volume household do-it-yourselfers should use leak-proof high density plastic jerry cans to store used oil and waste fuel until enough is accumulated to warrant transport to a local treatment or disposal facility. Moderate and large volume commercial and industrial generators should use metal drums or tanks to store used oil and waste fuel until treatment and disposal options are identified. Regardless of the storage method used, used oil and waste fuel should never be mixed with each other or other wastes as this will increase the complexities and costs of treatment and disposal.

Guidelines for the storage of excessive, unwanted or waste oil, lubricant and fuel are provided below:

- Never mix used oil and waste fuels with one another or different wastes (i.e. solvents, paints).
- Store used oil and waste fuel in its original container or another container certified by the Canadian Standards Association (CSA) for this purpose. Containers should be tightly sealed at all times, except when emptying or filling, to avoid spills.
- Small volumes of used oil and waste fuel should be stored in leak-proof high density plastic jerry cans while larger quantities should be stored in 16 gauge or lower steel drums.
- Containers should be sound, sealable and not damaged, rusting or leaking. If the container is leaking, carefully transfer the contents to another sound and sealable container or place the leaking container inside a larger leak-proof container.
- Each container must be clearly labeled to identify its contents – either "Used Oil" or "Waste Fuel". If used oil and waste fuel are being stored in an institutional, commercial or industrial location, the containers must also be labeled in accordance with the *Workplace Hazardous Materials Information System* (WHMIS).
- Place all labeled containers in a secure and clearly marked area which is separate from other waste to prevent its disposal with normal garbage. Access to the storage area should be controlled and the area should have secondary containment in accordance with the *Fire*

Prevention Act and National Fire Code. Spill response equipment should be located nearby to enable quick response in the event of an accident.

- Containers should be located so as to enable their physical inspection for damage or leakage and should be protected from the sun, weather and physical damage.
- Workers should be trained in the safe use, handling and shipping of used oil and waste fuel, be made aware of the importance of not mixing wastes, have access to material safety data sheets and be provided with personal protective equipment. Only trained personnel should have access to the designated storage area.
- Store used oil and waste fuel out of reach of children and pets and a safe distance away from potential sources of ignition. Children and other family members should be made aware of the risks and hazards associated with these wastes.
- Never store used oil or waste fuel in underground tanks as leaks cannot be easily identified.

If a commercial facility is used to store used oil and waste fuel for periods of 180 days or more or the total quantity of waste stored on-site at any one time exceeds the criteria set out in the *Environmental Guideline for the General Management of Hazardous Waste*⁵, the facility must be registered with the Department of Environment as a hazardous waste management facility. Copies of registration forms are available at <http://env.gov.nu.ca/programareas/environmentprotection/forms-applications> or by contacting Nunavut's Department of Environment. Refer to the *Environmental Guideline for the General Management of Hazardous Waste* for additional information on the registration process.

In accordance with the *Spill Contingency Planning and Reporting Regulations* that have been adopted under Nunavut's *Environmental Protection Act*, no person may store used oil and waste fuel in an aboveground facility where the storage capacity of the facility equals or exceeds 20,000 litres unless a spill contingency plan has been prepared and filed with the Chief Environmental Protection Officer. Refer to the *Regulations* or contact Nunavut's Department of Environment for further information on contingency planning and spill reporting requirements.

3.3 Transportation

All used and unused oils, lubricants and fuels are regulated as dangerous goods under the *Transportation of Dangerous Goods Act* when they have a flash point of less than 61°C. Used oil and waste fuel may be subject to additional transportation requirements if the product is regulated as a dangerous good and is intended for disposal or recycling, or if the used oil or waste fuel contains metal wear particles, organic compounds or other contaminants that exceed the concentrations as set out in Schedule 5 of the federal *Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations*. In these cases, the oil or fuel must also be transported as a hazardous waste⁶.

Under the *Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations* and the *Interprovincial Movement of Hazardous Waste Regulations*, a consignment of hazardous waste must be accompanied by a completed waste manifest when the waste is intended for disposal or recycling and is transported in a quantity greater than five litres or five kilograms. An exception to the manifesting requirements is applied when the used oil and waste fuel is either household in origin or is

⁵ The criterion for Class 3 Flammable Liquid waste is 4000 litres and the total aggregate quantity is 5000 litres or kilograms.

⁶ In response to the 2007 federal government direction on streamlining regulation in Canada, the alignment of requirements under the *Interprovincial Movement of Hazardous Waste Regulations* and *Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations* is being undertaken by Environment Canada.

Environmental Guideline for Used Oil and Waste Fuel

being returned directly to the supplier for any reason. In other words, household do-it-yourselfers do not have to complete a waste manifest to transport used oil or waste fuel to a local collection centre and institutional, commercial and industrial owners are exempt from manifesting if the product is being returned to the supplier because it is defective (i.e. off-specification) or was purchased in surplus quantities. In both case, all other requirements as set out in legislation and the Guideline must be complied with.

Given the difficulties associated with precisely characterizing used oil and waste fuel, consideration should be given to the following:

- Assume the flash point and levels as set out in Schedule 5 of the *Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations* are exceeded and transport the waste as a hazardous waste. The Regulations and Schedule 5 can be downloaded from Environment Canada's web site at <http://www.ec.gc.ca/lcpe-cepa/eng/regulations/detailReg.cfm?intReg=84>.
- Submit a representative sample of the used oil or waste fuel to an accredited laboratory for testing to determine whether the flash point and contaminant levels are exceeded.

Waste manifest forms are available in Nunavut from the territorial Department of Environment. Completion instructions are included on the reverse side of each manifest. Further information on manifesting can be obtained by referring to the *Environmental Guideline for the General Management of Hazardous Waste* or Environment Canada's *User's Guide for the Hazardous Waste Manifest*.

When used oil and waste fuel has been determined to be a hazardous waste, its classification, packaging, labeling and placarding must also conform to the federal and territorial *Transportation of Dangerous Goods Act* and *Regulations*. Schedule I of the *Regulations* classifies used oil and waste fuel as follows:

Shipping Name:	WASTE Diesel Fuel; Fuel Oil; Gas Oil; or Heating Oil Light
Classification:	3
Product Identification Number:	UN1202
Packing Group:	III
Special Provisions:	82 and 88
Shipping Name:	WASTE Gasoline; Motor Spirit; or Petrol
Classification:	3
Product Identification Number:	UN1203
Packing Group:	II
Special Provisions:	17, 82 and 88
Shipping Name:	WASTE Kerosene
Classification:	3
Product Identification Number:	UN1223
Packing Group:	II
Shipping Name:	WASTE Petroleum Distillates N.O.S.; or Petroleum Products N.O.S.
Classification:	3
Product Identification Number:	UN1268
Packing Group:	I, II or III

Environmental Guideline for Used Oil and Waste Fuel

Shipping Name:	WASTE Ethanol and Gasoline Mixture with more than 10% Ethanol
Classification:	3
Product Identification Number:	UN3475
Packing Group:	II
Special Provisions:	17, 82 and 88
Shipping Name:	WASTE Environmentally Hazardous Substance, Liquid, N.O.S. ⁷
Classification:	9
Product Identification Number:	UN3082
Packing Group:	III
Special Provisions:	16

When used oil and waste fuel is determined to be a hazardous waste, its transport by air must conform to the *International Air Transport Association (IATA) Dangerous Goods Regulations* and *International Civil Aviation Organization (ICAO) Technical Instructions*. When being transport by marine, it must conform to the *International Marine Dangerous Goods Code*. Further information on transporting wastes by air or marine can be obtained by contacting Transport Canada or by referring to the appropriate Transport Authority.

All hazardous waste generators, carriers and receivers must be registered with the Nunavut Department of Environment before handling the waste. A unique registration number is assigned to each registrant through the registration process, which enables completion of the manifest document. Copies of registration forms are available at <http://env.gov.nu.ca/programareas/environmentprotection/forms-applications> or by contacting Nunavut's Department of Environment. Refer to the *Environmental Guideline for the General Management of Hazardous Waste* for additional information on the registration process.

A listing of registered hazardous waste generators, carriers, receivers and management facilities in Nunavut is available by contacting Nunavut's Department of Environment.

3.4 Spill Response and Cleanup

Spills of used oil and waste fuel can affect soil, groundwater and surface water quality if they are not cleaned up quickly and properly. Spills of gasoline and other highly flammable waste fuels can also present a fire or explosion hazard if sources of ignition are not immediately eliminated.

Taking preventative actions such as ensuring proper handling and storage, training personnel and preparing a spill contingency plan, is the most effective way of reducing the potential environmental and safety hazards and costs associated with spills. When a spill does occur, the waste should be contained as quickly as possible. Small spills on land or impermeable surfaces (i.e. concrete floors) can be recovered using absorbent materials. Underlying and surrounding soil and snow that become contaminated may need to be excavated. All reasonable efforts should be made to prevent spills from entering floor drains, groundwater or surface water bodies as containment and cleanup then becomes very difficult and costly. All cleanup materials, recovered waste and contaminated soil and snow must

⁷ UN3082 should be used whenever concentrations as set out in Schedule 5 of the federal *Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations* are exceeded.

be disposed of properly. Contact the Nunavut Department of Environment or local community government for available treatment and disposal options.

All spills of hazardous materials must immediately be reported to the NWT/Nunavut 24-Hour Spill Report Line at (867) 920-8130 in accordance with the *Spill Contingency Planning and Reporting Regulations*. The local fire department, police, and health and environmental officials should also be notified once initial containment efforts are complete.

3.5 Mixing or Blending with Other Materials

It is good practice to avoid mixing wastes, either intentionally or through poor storage and management practices. Mixing used oil and waste fuel with other hazardous or non-hazardous materials makes management and disposal of the mixture more complicated and costly. Also, how the resulting mixture is regulated can vary greatly depending upon the type of material that is mixed with the used oil or waste fuel. In these cases, it may be necessary to contract an accredited laboratory to analyze the resulting mixture to determine its characteristics and how it should be regulated.

The best means to avoid mixing used oil and waste fuel with other materials is to segregate the various types of waste during storage. The degree of segregation would depend on the amount and variety of used oil and waste fuel generated. The following segregation categories should be pursued:

- Engine lubrication oils
- Unwanted or off-specification fuels
- Hydraulic oils including brake and power steering fluids
- Other oily wastes including oily fluids, oil-in-water emulsions, greases and solvents

No person should blend or dilute used oil or waste fuel with unused hydrocarbons for the purpose of lowering the concentration of metal wear particles, organic compounds or other contaminants so as not to exceed the concentrations as set out in Schedule 5 of the federal *Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations*.

Some materials are incompatible with used oil and waste fuel. In this case, mixing could result in a fire, explosion or chemical reaction. It could also make it more difficult and costly to find a registered carrier and receiver willing to accept the mixture for transport, treatment and disposal.

3.6 Used Oil Filters

Filters may contain significant quantities of used oil after being taken out of service. These filters should be managed in the same way as the used oil they contain and are subject to the storage, transportation, disposal and other requirements described in the Guideline.

When used oil is drained or removed from a filter so there is no visible sign of free-flowing oil left behind, the filter is no longer subject to the Guideline and can be disposed of as regular garbage. The used oil should be removed from the filter by puncturing the filter dome and gravity draining it for at

least 24 hours⁸ or by crushing the filter either pneumatically or hydraulically in a commercially available crusher. A combination of both draining and crushing is considered to be the best practice.

Used oil that is removed from a filter must be managed in accordance with the applicable legislation and the Guideline.

3.7 Recycling, Reuse and Disposal

There are many environmental, economic and resource conservation benefits to reusing and recycling used oil and waste fuel, and many different ways to achieve it. Used oil can be reprocessed or reconditioned so as to conserve the lubricating properties of the oil, prolong its operating life and reduce the consumption of virgin oils. It can also be reused to utilize its heating value. Waste fuel can be returned to re-refiners to be remade into useful fuel products, brought back into specification through the introduction of fuel additives or, like used oil, be used for space heating or other uses. Disposal is less desirable from an environmental and resource conservation point of view and should be considered only where practical alternatives are not available.



Figure 1 – Example of a Used Oil Filter Crusher

3.7.1 Reprocessing and Re-refining

In most cases, the basic lubricating properties of oil are not lost through its normal use, but are simply altered through breakdown of additives, the addition of metals and solids from friction wear on engine parts and contamination with unburned fuel combustion products. During reprocessing, relatively simple treatments such as settling, dehydration, filtration, centrifugation and coagulation are used to remove the contaminants. While reprocessing cannot produce a lubricating product that is comparable to virgin oil, it can clean the oil to the extent necessary for less demanding applications. Used lubricating oils that have been mixed with other products generally cannot be reprocessed using these techniques and therefore, **the segregation of used oil stocks is essential.**

Waste fuel that has lost its original properties through aging can sometimes be reconditioned through the introduction of specific fuel additives. The owner or person in charge, management or control of off-specification fuel should contact the Petroleum Products Division of the Department of Community and Government Services for further information and advice.



Figure 2 – Example of Used Oil Reconditioning Equipment

⁸ Drain time may be reduced by 'hot draining' or maintaining the filter at or near the engine's operating temperature for 12 hours.

Unlike reprocessing, re-refining technologies are designed to fully restore the original properties of the used oil and waste fuel. These processes are industrial in nature and involve the treatments used for reprocessing followed by other techniques such as demetalization, distillation, stripping, clay contacting, solvent extraction and hydrogenation. There are currently no re-refiners located in Nunavut. Used oil or waste fuel that is intended for re-refining would need to be transported to a re-refinery located in southern Canada.

3.7.2 Burning for Heat Recovery

Used oil and waste fuel may be burned in a variety of combustion appliances including boilers, furnaces, space heaters, engines, incinerators and cement kilns. For the purpose of the Guideline, discussion will focus on furnaces and boilers because of their ability to recover heat energy and their relative popularity in northern Canada.

The most common types of used oil and waste fuel appliances are the vaporizing pot and air-atomizing burners. The major difference is that the fuel evaporates into the combustion chamber in a vaporizing pot fuel burner while microscopic fuel particles are formed in an air-atomizing burner by forcing the fuel through a nozzle and spraying it into the combustion chamber. The vaporizing pot burner is most suited to small applications while the air-atomizing burner can be used in a wide range of applications.



Figure 3 – Example of an Air-atomizing Used Oil Furnace

Studies show that design of the burner and feedstock quality greatly influences the environmental performance of the appliance. In general, the vaporizing pot burner retains most of the feedstock metals in the ash residues, while air-atomizing burners release most of the metals up the stack. Conversely, emission levels of unburned organic compounds are higher from vaporizing pot burners than from air-atomizing burners. Other studies show that large commercial boilers generally emit lower levels of pollutants than small boilers and furnaces because operators of large units usually pretreat the fuel feedstock (i.e. settling, centrifugation, vacuum distillation or solvent extraction) and have more consistent operating conditions. Other important factors when considering the design and installation of a waste oil burner is height of the stack and the number of appliances already operating in the area.

Used oil and waste fuel should only be burned using boilers or furnaces that have been certified and approved for that purpose by the Canadian Standards Association (CSA), Underwriters' Laboratories of Canada (ULC) or another certified testing agency acceptable to the Fire Marshal. In all cases, combustion gases must be vented directly to the outside ambient air. Appliances that are not certified or installed in accordance with manufacturers' specifications may represent significant environmental, fire and personal health and safety risks.

Environmental Guideline for Used Oil and Waste Fuel

As described above, the quality of the burner feedstock is one of the greatest determinants of emissions quality. For this reason, no person should burn used oil or waste fuel, either with or without heat recovery, when the undiluted levels of metals, halogens and polychlorinated biphenyls (PCBs) exceed those described in Table 4.

Table 4. Maximum Levels of Impurities in Used Oil and Waste Fuel Burner Feedstock⁹

Impurity	Maximum Concentration (parts per million)	
	Used Oil	Waste Fuel
Cadmium	2	2
Chromium	10	10
Lead	100	100
Total Organic Halogens (as chlorine)	1000	1500
Polychlorinated Biphenyls	2	2
Ash Content		0.6% by weight

Used oil and waste fuel feedstock should not be blended or diluted with other hydrocarbons for the primary purpose of meeting the maximum levels of impurities.

Written records of appliance operation should be kept by the operator. These records should include when and how much used oil or waste fuel feedstock was burned. The quantity and quality of feedstock obtained from any off-site sources should be recorded separately along with any repairs and maintenance performed on the equipment. An Inspector may require the owner or person in charge, management or control of the used oil or waste fuel to obtain a representative sample of the feedstock, have it analyzed by an accredited laboratory and the results submitted to the Inspector.

Used oil and waste fuel appliances should not be operated on property that is zoned residential or, if the property is not zoned, on property in an area that is used primarily for residential purposes.

Bottom ash and other solid residue collected from the appliance is suitable for burial when it meets the criteria set out in Table 1 of the *Environmental Guideline for Industrial Waste Discharges into Municipal Solid Waste and Sewage Treatment Facilities* or in accordance with land use permits and water licenses issued by Nunavut's co-management boards and Aboriginal Affairs and Northern Development Canada. When the residue meets the criteria and is to be disposed of into a municipal landfill, consent from the local community government must first be obtained. Bottom ash not meeting the criteria is considered to be a hazardous waste and must be managed in accordance with the *Environmental Guideline for the General Management of Hazardous Waste*.

Any person who purchases or operates a used oil or waste fuel appliance is strongly encouraged to register the appliance with the Nunavut Department of Environment. Voluntary registration enables the Department to better manage used oil and waste fuel by maintaining an up-to-date inventory of certified appliances operating in Nunavut. Appendix 4 includes a copy of the registration form. The owner or operator may obtain an original form and registration user's guide by contacting Nunavut's

⁹ Adopted from the Northwest Territories' Used Oil and Waste Fuel Management Regulations (2004).

Department of Environment or by downloading the documents through the Department's web site. There is no fee for registering the used oil or waste fuel appliance¹⁰.

Open burning used oil and waste fuel should be avoided because of the inefficient destruction of the waste, limited control over the combustion process and fire hazards. Waste fuel may only be openly burned for the purpose of practicing fire fighting under the direct supervision of a trained firefighter when the practice is conducted in accordance with a standard operating procedure. In all cases, the minimum volume of waste fuel needed to initiate the practice burn should be used and the primary purpose for its use should not be for its disposal.

3.7.3 Disposal

Once in the environment, the hydrocarbons that make up the base oil or fuel, the additives and many of the contaminants that are introduced through usage can significantly impair the quality of local soil, water, vegetation, fish and wildlife resources. For this reason, used oil and waste fuel should never be used as a dust suppressant on local roads, discharged directly to the ground, a lake or watercourse or sewage lagoon, open burned or placed in a landfill. Used oil should also never be used for fire practice although small quantities of waste fuel can be used under the direct supervision of a trained firefighter.

Reprocessing and burning for heat recovery in a certified appliance are the safest, most environmentally responsible and cost effective local options for managing used oil. Businesses and industries that routinely generate large quantities of used oil (i.e. automotive service garages, trucking and aviation companies, heavy equipment operators) should implement one of these options or arrange to transport their waste to a local collection center, reprocessor or registered used oil or waste fuel appliance owner. Small generators and household do-it-yourselfers should donate used oil to local businesses that operate reprocessing or registered burning appliances, where the businesses accept such wastes.

Large generators of waste fuel should investigate the possibility of bringing off-spec fuel back into specification with the introduction of additives before other disposal options are considered.

Where local reprocessing or reuse options are not available, used oil and waste fuel that is generated by commercial, industrial, institutional or government operations should be safely stored until it can be transported to a commercial recycler, re-refiner or registered hazardous waste receiver. Names of Canadian recyclers and disposal companies are available by contacting the waste management exchanges and associations listed in Appendix 10 of the *Environmental Guideline for the General Management of Hazardous Waste*.

Some communities in Nunavut are implementing programs aimed at collecting and safely storing used oil and waste fuel from homeowners and household do-it-yourselfers as part of their garbage collection programs. Residents wishing to locally dispose of used oil, waste fuel and other hazardous waste should contact their local community government for other disposal options.

Consideration will be given by Nunavut's Department of Environment to management methods that differ from instructions provided in the Guideline where it can be demonstrated that the proposal would result in an equivalent level of environmental protection.

¹⁰ Registration of a used oil or waste fuel appliance does not remove the owner's obligation to comply with all other applicable municipal, territorial and federal statutes, regulations, standards, guidelines and by-laws. Further guidance on hazardous waste planning can be found in the *Environmental Guideline for the General Management of Hazardous Waste*.

Conclusion

Used oil and waste fuel are two of the most common and widely generated hazardous wastes in Nunavut. Used lubricating and hydraulic oils are generated by a wide variety of commercial and industrial sectors including automotive and heavy equipment servicing, marine and aviation transportation, electrical generation and mining. Household do-it-yourselfers also generate smaller quantities of used oil by self-servicing their automobiles, ATVs, snowmobiles and boat motors. Waste fuel is also generated by a wide variety of residential, institutional, commercial and industrial users of fuel products.

The *Environmental Guideline for Used Oil and Waste Fuel* is an introduction to the management of these wastes. It provides information on the characteristics of used oil and waste fuel, their effects on the environment and human health and guidance on proper storage, transportation, spill response and cleanup, reuse and disposal.

Familiarity with the Guideline does not replace the need for the owner or person in charge, management or control of used oil and waste fuel to comply with all applicable federal and territorial legislation and municipal by-laws. The management of these wastes may also be controlled through permits and licenses issued by Nunavut's co-management boards, Aboriginal Affairs and Northern Development Canada and other regulatory agencies. These permits and licenses must be complied with at all times.

For additional information on the management of used oil and waste fuel, or to obtain a list of available guidelines, go to the Department of Environment web site or contact the Department at:

Environmental Protection Division
Department of Environment
Government of Nunavut
Inuksugait Plaza, P.O. Box 1000, Station 1360
Iqaluit, Nunavut X0A 0H0

Telephone: (867) 975-7729
Fax: (867) 975-7739
Email: EnvironmentalProtection@gov.nu.ca
Website: <http://env.gov.nu.ca/programareas/environmentprotection>

References

Canadian Council of Ministers of the Environment (CCME). Code of Practice for Used Oil Management in Canada. CCME-TS/WM-TRE006E. 1989.

http://www.ccme.ca/assets/pdf/pn_1042_e.pdf

Environment Canada. Export and Import of Hazardous Waste and Hazardous Recyclable Materials Regulations. 2005.

<http://www.ec.gc.ca/lcpe-cepa/eng/regulations/detailReg.cfm?intReg=84>

Environment Canada and Health Canada. Canadian Environmental Protection Act Priority Substances List Assessment Report – Waste Crankcase Oils. En40-215/36E. 1994.

http://www.hc-sc.gc.ca/ewh-semt/alt_formats/hecs-sesc/pdf/pubs/contaminants/psl1-lsp1/crankcase_oils-huiles_moteur/crankcase_oils-huiles_moteur-eng.pdf

Franklin Associates Ltd. Composition and Management of Used Oil Generated in the United States. EPA Report No. EPA/530-SW-013. 1985.

Government of Nunavut. Consolidation of Regulation R-068-93 Spill Contingency Planning and Reporting Regulations. 1993.

<http://env.gov.nu.ca/sites/default/files/Spill%20Planning%20and%20Reporting%20Regs.pdf>

Government of Nunavut Department of Environment. Environmental Guideline for the General Management of Hazardous Waste. 2010.

<http://env.gov.nu.ca/node/82#Guideline Documents>

Government of Nunavut Department of Environment. Environmental Guideline for Industrial Waste Discharges into Municipal Solid Waste and Sewage Treatment Facilities. 2011.

http://env.gov.nu.ca/sites/default/files/industrial_waste_discharges_2011.pdf

Government of the Northwest Territories, Department of Environment and Natural Resources. Used Oil and Waste Fuel Management Regulations. 2004.

http://www.justice.gov.nt.ca/PDF/REGS/ENVIRONMENTAL%20PROTECTION/Used_Oil_and_Waste_Fuel_Mgmt.pdf

Government of the Northwest Territories, Department of Renewable Resources. Inventory of Waste Oil Volumes Generated in the Western Northwest Territories. 1990.

Government of the Northwest Territories, Department of Renewable Resources. Waste Oil Furnace Emission Testing: Yellowknife and Hay River. 1990.

State of Connecticut Department of Environmental Protection. Used Oil Fact Sheet #4 – Materials Containing or Otherwise Contaminated with Used Oil. 2005.

http://www.ct.gov/dep/lib/dep/waste_management_and_disposal/used_oil/MaterialsContainingUsedOil.pdf

Transport Canada. Transportation of Dangerous Goods Regulations.

APPENDICES

APPENDIX 1 - ENVIRONMENTAL PROTECTION ACT

The following are excerpts from the *Environmental Protection Act*

1. "Contaminant" means any noise, heat, vibration or substance and includes such other substance as the Minister may prescribe that, where discharged into the environment,
 - (a) endangers the health, safety or welfare of persons,
 - (b) interferes or is likely to interfere with normal enjoyment of life or property,
 - (c) endangers the health of animal life, or
 - (d) causes or is likely to cause damage to plant life or to property;

"Discharge" includes, but not so as to limit the meaning, any pumping, pouring, throwing, dumping, emitting, burning, spraying, spreading, leaking, spilling, or escaping;

"Environment" means the components of the Earth and includes

 - (a) air, land and water,
 - (b) all layers of the atmosphere,
 - (c) all organic and inorganic matter and living organisms, and
 - (d) the interacting natural systems that include components referred to in paragraphs (a) to (c).

"Inspector" means a person appointed under subsection 3(2) and includes the Chief Environmental Protection Officer.
- 2.2 The Minister may
 - (a) establish, operate and maintain stations to monitor the quality of the environment in the Territories;
 - (b) conduct research studies, conferences and training programs relating to contaminants and to the preservation, protection or enhancement of the environment;
 - (c) develop, co-ordinate and administer policies, standards, guidelines and codes of practice relating to the preservation, protection or enhancement of the environment;
 - (d) collect, publish and distribute information relating to contaminants and to the preservation, protection or enhancement of the environment;
3. (1) The Minister shall appoint a Chief Environmental Protection Officer who shall administer and enforce this Act and the regulations.

(2) The Chief Environmental Protection Officer may appoint inspectors and shall specify in the appointment the powers that may be exercised and the duties that may be performed by the inspector under this Act and regulations.
5. (1) Subject to subsection (3), no person shall discharge or permit the discharge of a contaminant into the environment.

(3) Subsection (1) does not apply where the person who discharged the contaminant or permitted the discharge of the contaminant establishes that
 - (a) the discharge is authorized by this Act or the regulations or by an order issued under this Act or the regulations;
 - (b) the contaminant has been used solely for domestic purposes and was discharged from within a dwelling house;
 - (c) the contaminant was discharged from the exhaust system of a vehicle;

- (d) the discharge of the contaminant resulted from the burning of leaves, foliage, wood, crops or stubble for domestic or agricultural purposes;
 - (e) the discharge of the contaminant resulted from burning for land clearing or land grading;
 - (f) the discharge of the contaminant resulted from a fire set by a public official for habitat management of silviculture purposes;
 - (g) the contaminant was discharged for the purposes of combating a forest fire;
 - (h) the contaminant is a soil particle or grit discharged in the course of agriculture or horticulture; or
 - (i) the contaminant is a pesticide classified and labelled as "domestic" under the *Pest Control Products Regulations* (Canada).
- (4) The exceptions set out in subsection (3) do not apply where a person discharges a contaminant that the inspector has reasonable grounds to believe is not usually associated with a discharge from the excepted activity.
- 5.1. Where a discharge of a contaminant into the environment in contravention of this Act or the regulations or the provisions of a permit or license issued under this Act or the regulations occurs or a reasonable likelihood of such a discharge exists, every person causing or contributing to the discharge or increasing the likelihood of such a discharge, and the owner or the person in charge, management or control of the contaminant before its discharge or likely discharge, shall immediately:
- (a) subject to any regulations, report the discharge or likely discharge to the person or office designated by the regulations;
 - (b) take all reasonable measures consistent with public safety to stop the discharge, repair any damage caused by the discharge and prevent or eliminate any danger to life, health, property or the environment that results or may be reasonably expected to result from the discharge or likely discharge; and
 - (c) make a reasonable effort to notify every member of the public who may be adversely affected by the discharge or likely discharge.
6. (1) Where an inspector believes on reasonable grounds that a discharge of a contaminant in contravention of this Act or the regulations or a provision of a permit or license issued under this Act or the regulations has occurred or is occurring, the inspector may issue an order requiring any person causing or contributing to the discharge or the owner or the person in charge, management or control of the contaminant to stop the discharge by the date named in the order.
7. (1) Notwithstanding section 6, where a person discharges or permits the discharge of a contaminant into the environment, an inspector may order that person to repair or remedy any injury or damage to the environment that results from the discharge.
- (2) Where a person fails or neglects to repair or remedy any injury or damage to the environment in accordance with an order made under subsection (1) or where immediate remedial measures are required to protect the environment, the Chief Environmental Protection Officer may cause to be carried out the measures that he or she considers necessary to repair or remedy an injury or damage to the environment that results from any discharge.

APPENDIX 2 – GOVERNMENT CONTACTS

Government of Nunavut

Environmental Protection Division
Department of Environment
Inuksugait Plaza
P.O. Box 1000, Station 1360
Iqaluit, Nunavut X0A 0H0
Telephone: (867) 975-7729 Fax: (867) 975-7739

Motor Vehicles Division
Department of Economic Development and
Transportation
P.O. Box 10
Gjoa Haven, Nunavut X0B 1J0
Telephone: (867) 360-4615 Fax: (867) 360-4619

Workers' Safety and Compensation Commission
P.O. Box 669
Baron Building/1091
Iqaluit, Nunavut X0A 0H0
Telephone: 1-877-404-4407 (toll free)
Fax: 1-866-979-8501

Department of Community and Government
Services (all Divisions)
P.O. Box 1000, Station 700
4th Floor, W.G. Brown Building
Iqaluit, Nunavut X0A 0H0
Telephone: (867) 975-5400 Fax: (867) 975-5305

Office of Chief Medical Health Officer of Health
Department of Health and Social Services
P.O. Box 1000, Station 1000
Iqaluit, Nunavut X0A 0H0
Telephone: (867) 975-5774 Fax: (867) 975-5755

Government of Canada

Aboriginal Affairs and Northern Development
P.O. Box 2200
Iqaluit, Nunavut X0A 0H0
Telephone: (867) 975-4500 Fax: (867) 975-4560

Environment Canada (NWT and Nunavut)
5019 52nd Street
Yellowknife, Northwest Territories X1A 1T5
Telephone: (867) 669-4730 Fax: (867) 873-8185

Department of Transport – Road, Rail, Marine, Air
P.O. Box 8550
344 Edmonton Street
Winnipeg, Manitoba R3C 1P6
Telephone: 1-888-463-0521 (toll free)
Fax: (204) 983-8992 Road, Rail and Marine
Fax: (204) 983-1734 Air

Fisheries and Oceans Canada – Eastern Arctic Area
4th Floor - 630 Queen Elizabeth
P.O. Box 358
Iqaluit, Nunavut X0A 0H0
Telephone: (867) 979-8000
Fax: (867) 979-8039
Email: nunavuthabitat@dfo-mpo.gc.ca

APPENDIX 3 – USED OIL FURNACE AND BOILER MANUFACTURERS

The listing of used oil furnace and boiler manufacturers provided in this Appendix is not meant to be exhaustive or complete. Other manufacturers may offer similar products.

The Nunavut Department of Environment does not promote or endorse the specific products and services offered by the listed companies. Any person considering the purchase of a used oil furnace or boiler should first consult the manufacturer or other qualified persons with expertise in used oil furnaces and boilers.

Clean Burn Furnaces

<http://www.cleanburn.com>

EcoHeat Omni

<http://www.econoheat.com>

EnergyLogic (formerly Black Gold)

<http://www.energylogic.com/products/waste-oil-heaters>

Firelake Manufacturing

<http://www.firelakemfg.com>

INov8 International Incorporated

<http://www.inov8-intl.com>

Lanair waste oil-fired heaters and boilers

<http://www.lanair.com/lanairproducts/index.php>

Reznor Group

<http://www.reznorheaters.com>

APPENDIX 4 – REGISTRATION FORM: USED OIL AND WASTE FUEL APPLIANCE

A copy of the Used Oil and Waste Fuel Appliance registration form and user's guide is available by contacting the Nunavut Department of Environment or by downloading the documents at <http://env.gov.nu.ca/programareas/environmentprotection>. Although registration is voluntary, it enables Nunavut's Department of Environment to better manage used oil and waste fuel by maintaining an up-to-date inventory of certified appliances operating in Nunavut.

Instructions

1. The following information must be provided in order to register a used oil or waste fuel appliance and obtain a registration number. Incomplete applications will be returned to the applicant.
2. Completed registration forms are to be forwarded to the Environmental Protection Division, Department of Environment, Government of Nunavut, Box 1000, Station 1360, Iqaluit, Nunavut, X0A 0H0. Electronic registration forms are preferred and may be forwarded to EnvironmentalProtection@gov.nu.ca.
3. Use additional pages to provide information as required.
4. Applicants should refer to the accompanying user's guide for further assistance on completing the generator registration form.
5. There is no fee for registering a used oil or waste fuel appliance with the Department of Environment.

Section 1 - Identification

Applicant (Legal Name) _____
 Mailing Address _____
 _____ Postal Code _____
 Principle Contact Person _____ Title _____
 Phone _____ Email _____

Section 2 – Description of Operation

General Type of Business _____
 Site Location(s) Where the Waste is Generated _____

 Make, Model and Size of the Appliance _____

Section 4 - Certification

I certify that the information provided on this form is correct, accurate and complete.

Signature of Contact Person _____ Date (dd/mm/yy) _____
 Print Name of Contact Person _____ Title _____
 Phone _____ Email _____

For Department Use Only

Appliance Registration Number NUA# _____ Approved by _____ Date _____

Appendix H: Environmental Guideline for Waste Batteries

Environmental Guideline for Waste Batteries



Department of Environment
Government of Nunavut

GUIDELINE: WASTE BATTERIES

Original: January 2002

Revised: January 2011

This Guideline has been prepared by the Department of Environment's Environmental Protection Division and approved by the Minister of Environment under the authority of Section 2.2 of the *Environmental Protection Act*.

This Guideline is not an official statement of the law and is provided for guidance only. Its intent is to increase the awareness and understanding of the risks, hazards and best management practices associated with waste batteries. This Guideline does not replace the need for the owner or person in charge, management or control of the waste to comply with all applicable legislation and to consult with Nunavut's Department of Environment, other regulatory authorities and qualified persons with expertise in the management of waste batteries.

Copies of this Guideline are available upon request from:

Department of Environment
Government of Nunavut
P.O. Box 1000, Station 1360, Iqaluit, NU, X0A 0H0
Electronic version of the Guideline is available at <http://env.gov.nu.ca/programareas/environmentprotection>

Cover Photos: Top: E. Paquin
Bottom Left and Right: Public Domain

Table of Contents

Introduction	1
1.1 Definitions	1
1.2 Roles and Responsibilities.....	2
1.2.1 Department of Environment	2
1.2.2 Generators of Waste Batteries	3
1.2.3 Other Regulatory Agencies	3
Types, Uses and Potential Effects of Batteries	5
2.1 Types and Uses	5
2.2 Potential Effects on Environment and Human Health	5
Waste Management	8
3.1 Pollution Prevention	8
3.2 Storage	9
3.3 Transportation	10
3.4 Disposal	11
Conclusion	13
References	14

Appendices

Appendix 1	Environmental Protection Act
Appendix 2	Government and Industry Contacts

Introduction

Batteries come in many different shapes, sizes and voltages. There are two basic categories of batteries in use: *non-rechargeable*, which are designed to be used once and discarded, and *rechargeable*, which can be recharged and used many times. Non-rechargeable batteries, such as the common alkaline battery, use a *dry cell* where the electrolyte is immobilized as a paste. This enables the battery to be operated in a random position. These batteries are commonly used in household items such as flashlights, calculators, toys, cameras and remote control devices. Rechargeable batteries use either a *dry cell* or *wet cell*. Wet cell rechargeable batteries have a liquid electrolyte and are commonly used by consumers in automobiles, ATVs and snowmobiles, and by industry in large uninterruptible power supplies and for telecommunications standby power. Dry cell rechargeable batteries can be used in many of the same consumer products as non-rechargeable batteries.

Approximately 671 million, or 95%, of the 707 million consumer and industrial batteries sold in Canada in 2007 were non-rechargeable. Of this total, 418 million were alkaline, 188 million were carbon-zinc and 65 million were button cell batteries. Sales of rechargeable batteries were approximately 37 million. Of this total, 16.5 million were nickel-cadmium, 6.4 million were nickel-metal-hydride, 2.8 million were lithium ion and 10.6 million were lead-acid batteries (EC, 2009).

The *Environmental Guideline for Waste Batteries* (the Guideline) provides information on the types, uses and potential environmental and human health effects of waste batteries and guidance on their proper storage, transportation and disposal. It is not an official statement of the law. For further information and guidance, the owner or person in charge, management or control of waste batteries is encouraged to review all applicable legislation and consult the Department of Environment, other regulatory agencies or qualified persons with expertise in the management of waste batteries.

The *Environmental Protection Act* enables the Government of Nunavut to implement measures to preserve, protect and enhance the quality of the natural environment. Section 2.2 of the *Act* provides the Minister with authority to develop, coordinate, and administer the Guideline.

1.1 Definitions

<i>Battery</i>	One or more electrochemical cells capable of storing and transforming chemical energy into electrical energy.
<i>Commissioner's Land</i>	Lands that have been transferred by Order-in-Council to the Government of Nunavut. This includes roadways and land subject to block land transfers. Most Commissioner's Land is located within municipalities.
<i>Contaminant</i>	Any noise, heat, vibration or substance and includes such other substance as the Minister may prescribe that, where discharged into the environment, (a) endangers the health, safety or welfare of persons, (b) interferes or is likely to interfere with normal enjoyment of life or property, (c) endangers the health of animal life, or (d) causes or is likely to cause damage to plant life or to property.

Environmental Guideline for Waste Batteries

<i>Dangerous Good</i>	Any product, substance or organism included by its nature or by the <i>Transportation of Dangerous Goods Regulations</i> in any of the classes listed in the schedule provided in the <i>Transportation of Dangerous Goods Act</i> .
<i>Electrolyte</i>	A gel or liquid that is capable of conducting electricity.
<i>Environment</i>	The components of the Earth and includes (a) air, land and water, (b) all layers of the atmosphere, (c) all organic and inorganic matter and living organisms, and (d) the interacting natural systems that include components referred to in paragraphs (a) to (c) above.
<i>Minister</i>	The Minister of Environment of the Government of Nunavut.
<i>Qualified Person</i>	A person who has an appropriate level of knowledge and experience in all relevant aspects of waste management.
<i>Responsible Party</i>	The owner or person in charge, management or control of the waste.
<i>Transport Authority</i>	The statute and regulations controlling the management of hazardous waste under that mode of transport. These include (a) Road and Rail - <i>Transportation of Dangerous Goods Act</i> (Canada) and <i>Regulations; Interprovincial Movement of Hazardous Waste Regulations</i> and <i>Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations</i> . (b) Air – <i>International Air Transport Association (IATA) Dangerous Goods Regulations</i> and <i>International Civil Aviation Organization (ICAO) Technical Instructions</i> ; and (c) Marine – <i>International Maritime Dangerous Goods Code (IMDG)</i> .
<i>Waste Battery</i>	A battery that is no longer wanted or is unusable for its intended purpose and is intended for storage, recycling or disposal.

1.2 Roles and Responsibilities

1.2.1 Department of Environment

The Environmental Protection Division is the key environmental agency responsible for ensuring parties properly manage waste batteries and will provide advice and guidance on their management. Authority is derived from the *Environmental Protection Act*, which prohibits the discharge of contaminants to the environment and enables the Minister to undertake actions to ensure appropriate management measures are in place. Although programs and services are applied primarily to activities taking place on Commissioner's and municipal lands and to Government of Nunavut undertakings, the *Environmental Protection Act* may be applied to the whole of the territory where other controlling legislation, standards and guidelines do not exist. A complete listing of relevant legislation and guidelines can be obtained by contacting the Department of Environment or by visiting the web site at <http://env.gov.nu.ca/programareas/environmentprotection>.

1.2.2 Generators of Waste Batteries

The owner or person in charge, management or control of waste batteries is known as the responsible party. In general, the responsible party must ensure batteries are properly and safely managed from the time they are manufactured to their final disposal. This is referred to as managing the waste from cradle-to-grave. Information on the general management of hazardous waste in Nunavut, including generator, carrier and receiver responsibilities, can be obtained by referring to the *Environmental Guideline for the General Management of Hazardous Waste*.

Contractors may manage unwanted or waste batteries on behalf of the responsible party. However, the responsible party remains liable for ensuring the method of management complies with all applicable statutes, regulations, standards, guidelines and local by-laws. If the contractor does not comply with the requirements of the *Environmental Protection Act* and is charged with a violation while managing the waste, the responsible party may also be charged.

1.2.3 Other Regulatory Agencies

Other regulatory agencies may have to be consulted regarding the management of waste batteries as there may be other environmental or public and worker health and safety issues to consider.

Workers' Safety and Compensation Commission

The Workers' Safety and Compensation Commission is responsible for promoting and regulating worker and workplace health and safety in Nunavut. The Commission derives its authority from the *Workers' Compensation Act* and *Safety Act* which require an employer to maintain a safe workplace and ensure the safety and well being of workers.

Department of Community and Government Services

The Department of Community and Government Services is responsible under the *Commissioners' Lands Act* for the issuance of land leases, reserves, licenses and permits on Commissioner's Lands. The Department, in cooperation with communities, is also responsible for the planning and funding of municipal solid waste and sewage disposal facilities in most Nunavut communities.

Department of Health and Social Services

Activities related to the handling and management of waste batteries may have an impact on public health. The Office of the Chief Medical Officer of Health and Regional Environmental Health Officers should be consulted regarding legislated requirements under the *Public Health Act*.

Department of Economic Development and Transportation

The Motor Vehicles Division of the Department of Economic Development and Transportation is responsible for the safe transport of hazardous waste and other dangerous goods by road through administration of the *Transportation of Dangerous Goods Act*. The Department is also responsible under the *Motor Vehicles Act* for driver licensing and various other vehicle and road safety matters.

Environment Canada

Environment Canada is responsible for administering the *Canadian Environmental Protection Act* (CEPA) and for regulating the interprovincial and international movement of hazardous waste under the *Interprovincial Movement of Hazardous Waste Regulations* and *Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations*. Environment Canada is also responsible for administering the pollution prevention provisions of the federal *Fisheries Act* and owns the EcoLogo initiative, which is designed to help consumers and industry make more environmentally conscious purchasing decisions.

Indian and Northern Affairs Canada

Indian and Northern Affairs Canada is responsible under the *Territorial Lands Act* and *Nunavut Waters and Nunavut Surface Rights Tribunal Act* for the management of federal lands and waters, including the impact waste batteries may have on the quality of these lands and waters.

Local Municipal Governments

The role of municipal governments is important in the proper local management of waste batteries. Under the Nunavut Land Claims Agreement, municipalities are entitled to control their own municipal disposal sites. Unwanted waste may be deposited into municipal landfill sites and sewage lagoons only with the consent of the local government. The local fire department may also be called upon if a fire or other public safety issue involving batteries is identified.

Co-management Boards and Agencies

Co-management boards and agencies established under the Nunavut Land Claims Agreement have broad authority for land use planning, impact assessment and the administration of land and water. Activities involving the management and disposal of waste batteries may be controlled through the setting of terms and conditions in plans, permits and licenses issued by the Nunavut Water Board and other co-management boards and agencies.

Types, Uses and Potential Effects of Batteries

2.1 Types and Uses

Batteries are classified into two broad categories: *non-rechargeable* and *rechargeable*.

Non-rechargeable batteries, also known as primary batteries, can produce electrical current immediately upon being inserted into a device and are intended to be used and discarded. They are commonly used in portable devices that have a low current drain, are used only intermittently or are used well away from an alternative electrical power source (i.e. a wall plug-in or portable generator). Non-rechargeable batteries cannot be safely recharged since the active materials may not return to their original form and the chemical reactions may not be easily reversible. Common types of non-rechargeable batteries include alkaline, carbon-zinc and button cell. All non-rechargeable batteries are dry cell batteries.



Figure 1 – Common Consumer Batteries
Source: Public Domain

Rechargeable batteries, also known as secondary batteries, are sold in a discharged state and must be charged prior to use. These batteries are designed to be repeatedly charged by applying an electric current, which reverses the chemical reactions that occur during use. The oldest type of rechargeable wet cell battery is the common lead-acid battery used to start cars, trucks, snowmobiles and ATVs. These batteries are heavy because they contain large quantities of lead and can provide significant peak electrical current. A semi-solid electrolyte has replaced sulphuric acid in newer lead-acid batteries to prevent spillage. Other rechargeable batteries include several portable dry cell types including nickel-cadmium, nickel-metal-hydride and lithium-ion. Nickel-cadmium batteries currently have the largest share of the dry cell rechargeable market although nickel-metal-hydride and lithium-ion batteries have begun to replace them in many applications because of their higher capacity.

Table 1 describes the most common batteries in use and their applications.

2.2 Potential Effects on Environment and Human Health

Modern batteries contain a variety of corrosive and poisonous materials (i.e. electrolytes and heavy metals including lead, cadmium and nickel). Some older batteries also contain mercury, although in the 1990s manufacturers started to eliminate or reduce the amount of mercury found in their batteries. These contaminants can leach into water and soil from batteries that have been disposed of in landfills or abandoned on the land. Contact with the corrosive electrolytes can cause chemical burns to eyes and skin while heavy metals can bioaccumulate¹ and biomagnify² in living organisms, affecting these organisms and those that prey upon them.

¹ The accumulation over time of metals and other persistent substances within an organism from both biotic (i.e. other organisms) or abiotic (i.e. land, air and water) sources.

Environmental Guideline for Waste Batteries

Table 1. Common Batteries and Their Applications

Battery Type	Description	Common Applications
Non-rechargeable (Primary)		
Alkaline	Sizes: AAA, AA, C, D, 6V and 9V. Alkaline batteries contain zinc and manganese with an electrolyte of potassium hydroxide or sodium hydroxide. Both electrolytes are strongly alkaline.	Flashlights, clocks, calculators, toys, smoke detectors, remote controls
Carbon-Zinc	Sizes: AAA, AA, C, D, 6V and 9V. Carbon-zinc batteries contain zinc and manganese with an electrolyte solution of ammonium chloride and zinc chloride. Ammonium chloride is a severe eye irritant and zinc chloride is corrosive.	Flashlights, clocks, calculators, toys, smoke detectors, remote controls, garage door openers
Button Cell – Silver-Oxide, Lithium, Alkaline, Zinc-Air	Various sizes. Button cell batteries are single cells shaped like a squat cylinder. Numerous types of button cells exist and may contain zinc, lithium, manganese, silver and other metals. Mercuric-oxide button cells are no longer available due to the toxicity and environmental hazards associated with mercury.	Watches, hearing aids, toys, cameras, pagers, remote controls, greeting cards
Rechargeable (Secondary)		
Vehicle Lead-Acid	Sizes: 6V and 12V. Lead-acid batteries contain lead and a sulphuric acid electrolyte. The battery can contain between 60 and 75% lead, by weight. Sulphuric acid is a strong oxidizing agent and can cause severe skin burns or irritation upon contact.	Cars, trucks, motorcycles, snowmobiles
Sealed Lead-Acid	Sizes: 2V, 6V and 12V. Commonly referred to as the 'maintenance-free battery', sealed lead-acid batteries are similar to the vehicle lead-acid battery except the case is sealed. Safety valves allow venting of gas during charge and discharge.	Video cameras, power tools, wheelchairs, ATVs, computer power backup systems
Nickel-Cadmium (NiCd)	Sizes: AAA, AA, C, D, 6V and 9V. Nickel-cadmium batteries contain cadmium and nickel oxyhydroxide with a potassium hydroxide electrolyte. The electrolyte is strongly alkaline.	Flashlights, toys, cellular phones, handheld power tools
Nickel-Metal-Hydrate (NiMH)	Sizes: AAA, AA, C, D, 6V and 9V. Nickel-metal-hydrate batteries are similar to nickel-cadmium batteries except the cadmium has been replaced with a hydrogen-absorbing metal alloy. NiMH batteries have 2-3 times the capacity of an equivalently sized NiCd battery.	Flashlights, toys, cellular phones, power tools, computer packs
Lithium-Ion	Various sizes. Conventional lithium-ion batteries contain graphite and one of several different lithium metal oxides. The electrolyte is a lithium salt in an organic solvent. Pure lithium reacts vigorously with water to release gases.	Calculators, cameras, laptop computers, computer memory back-up systems

² The progressive buildup of metals or other persistent substances through successive trophic levels – meaning that it relates to the concentration ratio in the tissue of a predator as compared to that in its prey.

Environmental Guideline for Waste Batteries

Charging a battery produces a small amount of hydrogen and oxygen. Overcharging can result in these gases being generated faster than they can escape from within the walls of the battery, resulting in an explosion. This process is known as 'gassing'. Explosions can also occur through the misuse or malfunction of a battery including attempting to charge a non-rechargeable battery or short-circuiting a high output lead-acid battery.

Small button batteries have also been known to be swallowed by children. Although the likelihood of the battery becoming lodged in the throat depends upon the child's age and size of the battery, caution should still be exercised around very young children. While in the digestive tract a battery's electrical discharge could burn the surrounding tissues.

Waste Management

*Minimizing or avoiding the creation of pollutants and wastes can be more effective in protecting the environment than treating or cleaning them up after they have been created.*³

3.1 Pollution Prevention

Pollution prevention is a term used to describe methods and practices that minimize or eliminate the generation of waste. Pollution prevention strategies for waste batteries include the following:

- | | |
|----------------|---|
| <i>Reduce</i> | <ul style="list-style-type: none">• Check to see if you already have the right batteries on hand before purchasing more.• Consider replacing non-rechargeable batteries with rechargeable batteries.• Look for batteries that have less heavy metals and mercury by reading the label and choosing Ecologo certified products. A complete listing of environmentally-preferable products is available for downloading at http://www.ecologo.org/en/index.asp.• Avoid accidental discharge by preventing the battery terminals from contacting conductive (i.e. metal) materials. This includes removing the batteries from equipment when the equipment will not be used for extended periods of time.• Keep batteries cool and dry when not in use. Battery life can be extended further by storage at low temperature (i.e. in a refrigerator) as this slows the chemical reactions. Batteries must be returned to room temperature to achieve their maximum voltage.• Rechargeable lithium and nickel-cadmium batteries should be stored at 40% state-of-charge while nickel-metal-hydride can be stored at any state to extend their operational life. Lead-acid batteries should always be stored at full charge. |
| <i>Reuse</i> | <ul style="list-style-type: none">• Service lead-acid batteries regularly (i.e. electrolyte levels).• Charge rechargeable batteries using a charger specifically designed for the size and type of battery.• Donate unused batteries to others including local theatres, schools, clubs, churches or Hunters and Trappers Associations.• Make an agreement with your supplier to return un-opened or unused batteries. |
| <i>Recycle</i> | <ul style="list-style-type: none">• Send unwanted or spent batteries to registered recyclers. The Rechargeable Battery Recycling Corporation (RBRC) voluntary recycling program accepts nickel-cadmium, nickel-metal-hydride, lithium-ion and small sealed lead batteries at participating retailers across Canada. Check RBRC's web site at http://www.rbrc.org for the nearest drop-off location. The names of commercial and industrial battery recyclers can be obtained by contacting the waste exchanges and associations listed in Appendix 10 of the <i>Environmental Guideline for the General Management of Hazardous Waste</i>. |

The *Workplace Hazardous Materials Information System* (WHMIS) is Canada's national hazard communication standard and is administered by the Workers' Safety and Compensation Commission. Key elements of WHMIS are the provision of material safety data sheets (MSDS), labeling instructions and worker education and training programs. MSDS are available from battery manufacturers and contain information on the properties of batteries, along with instructions on safe use and handling.

³ Source – Canadian Council of Ministers of the Environment.

3.2 Storage

Storage refers to the maintenance of waste batteries while awaiting recycling, transport or disposal. Storage is not acceptable for the long-term management of waste batteries except under extraordinary circumstances and should be considered as a temporary measure only.

Unwanted or waste batteries should be stored in the following manner:

- Large quantities of unwanted wet cell (i.e. vehicle lead-acid, sealed lead acid) batteries should be placed on strong wooden pallets to keep the batteries off the ground and to make relocation with a forklift easier. Batteries should be stacked no more than 3 high and shrink-wrapped with plastic to stabilize the pallet. When stacking batteries, the battery terminals should be protected from short circuit by separating each layer using a non-conductive material, such as a sheet of plywood. When wet-cell batteries are individually stored and packaged for transport, the container must meet the requirements of the Canadian General Standards Board standard CGSB-43.150 (TC, 2010).
- Large quantities of unwanted dry cell batteries should be stored in sound and sealable containers. The containers should be located so as to be protected from sun, weather and physical damage.
- Each container must be clearly labeled to identify its contents. If waste batteries are being stored in an institutional, commercial or industrial location or if the batteries are being stored for transport, the containers must be labeled in accordance with the *Workplace Hazardous Materials Information System* (WHMIS) and relevant Transport Authority.
- Place all labeled containers in a secure and clearly marked area which is separate from other waste to prevent its disposal with normal garbage.
- Workers should be trained in the safe use, handling and shipping of waste batteries, have access to material safety data sheets and be provided with personal protective equipment. Only trained personnel should have access to the designated storage area.
- All types of batteries should be stored out of reach of small children and pets. Children and other family members should be made aware of the hazards associated with batteries.



Figure 2 – The Proper and Improper Storage of Lead-Acid Batteries
Source: Transport Canada

If a commercial facility is used to store hazardous waste for periods of 180 days or more or the quantity of waste batteries and other waste on-site at any one time exceeds the criteria set out in the *Environmental Guideline for the General Management of Hazardous Waste*⁴, the facility must be registered with the Department of Environment as a hazardous waste management facility. Copies of registration forms are available at <http://env.gov.nu.ca/programareas/environmentprotection/forms-applications> or by contacting Nunavut's Department of Environment. Refer to the *Environmental Guideline for the General Management of Hazardous Waste* for additional information on the registration process.

3.3 Transportation

Not all types of waste batteries are subject to the *Transportation of Dangerous Goods Act*. For example, sealed lead-acid and vehicle lead-acid batteries that contain sulphuric acid electrolyte are classified as a dangerous good while household alkaline, nickel-cadmium, nickel-metal-hydride, silver-zinc and some small lithium batteries are not. If in doubt, contact the manufacturer or consignor to determine whether the battery is a dangerous good or simply assume it is and manage it accordingly. Section 3.3 *Transportation* applies only to batteries that are classified as being a dangerous good.

Waste batteries that are classified as being a dangerous good may also be a hazardous waste for the purpose of transportation, depending upon the quantity being transported. Under the federal *Interprovincial Movement of Hazardous Waste Regulations* and *Export and Import of Hazardous Waste and Recyclable Material Regulations*, no person may transport hazardous waste in Canada or internationally for purposes of disposal or recycling in a quantity greater than five litres or five kilograms unless it is accompanied by a completed manifest. Manifest forms are available from Nunavut's Department of Environment and completion instructions are included on the reverse side of each manifest. Further information on manifesting can be obtained by referring to the *Environmental Guideline for the General Management of Hazardous Waste* or Environment Canada's *User's Guide for the Hazardous Waste Manifest*.

When transporting waste batteries as a hazardous waste, the documentation, packaging, labeling and placarding must conform to the federal and territorial *Transportation of Dangerous Goods Act* and *Regulations*. Schedule I of the *Regulations* classifies waste batteries as follows:

Shipping Name:	WASTE Batteries, Wet, Filled with Acid
Classification:	8
Product Identification Number:	UN2794
Packing Group:	III
Shipping Name:	WASTE Batteries, Wet, Filled with Alkali
Classification:	8
Product Identification Number:	UN2795
Packing Group:	III

⁴ The criterion for Class 4.3 Water Reactive Waste is 500 litres or kilograms, for Class 8 Corrosives and Class 9 Miscellaneous Waste is 1000 litres or kilograms and the total aggregate quantity is 5000 litres or kilograms.

Environmental Guideline for Waste Batteries

Shipping Name:	WASTE Batteries, Wet, Non-Spillable Classification: 8 Product Identification Number: UN2800 Packing Group: III Special Provision: 39
Shipping Name:	WASTE Batteries, Dry, Containing Potassium Hydroxide Solid Classification: 8 Product Identification Number: UN3028 Packing Group: III
Shipping Name:	WASTE Lithium Batteries Classification: 9 Product Identification Number: UN3090 Packing Group: II Special Provision: 34
Shipping Name:	WASTE Batteries Containing Sodium or WASTE Cells Containing Sodium Classification: 4.3 Product Identification Number: UN3292 Packing Group: II

The transport of waste batteries in Canada or internationally by aircraft must conform to the *International Air Transport Association (IATA) Dangerous Goods Regulations* and *International Civil Aviation Organization (ICAO) Technical Instructions*, while transport by marine vessel must conform to the *International Marine Dangerous Goods (IMDG) Code*. Further information on transporting waste batteries by aircraft or marine vessel can be obtained by contacting Transport Canada or by referring to the appropriate Transport Authority.

Hazardous waste generators, carriers and receivers must be registered with the Nunavut Department of Environment. A unique registration number is assigned to each registrant through the registration process, which enables completion of the manifest document. Copies of registration forms are available at <http://env.gov.nu.ca/programareas/environmentprotection/forms-applications> or by contacting Nunavut's Department of Environment. Refer to the *Environmental Guideline for the General Management of Hazardous Waste* for additional information on the registration process.

A listing of hazardous waste generators, carriers, receivers and management facilities registered to operate in Nunavut is available by contacting Nunavut's Department of Environment.

3.4 Disposal

Unwanted or waste batteries must be properly recycled or disposed of. Heavy metals found in some types of batteries (i.e. nickel-cadmium, nickel-metal-hydride and lead-acid batteries) are toxic to wildlife and can contaminate food and water supplies. Sulphuric acid electrolyte spilled from lead-acid batteries is corrosive to skin, affects plant survival and leaches metals from other landfilled garbage. Other types of batteries (i.e. household alkaline and carbon zinc batteries) don't have a recycling method and can be disposed of in a landfill along with other household garbage. Table 2 describes disposal methods for common batteries.

Waste batteries that are generated in large quantities by commercial, industrial, institutional or government operations should be safely stored until they can be transported to a commercial recycler or registered hazardous waste receiver. Names of Canadian recyclers and disposal companies are available by contacting the waste management exchanges and associations listed in Appendix 10 of the *Environmental Guideline for the General Management of Hazardous Waste*.

Table 2. Disposal Methods for Common Batteries

Battery Type	Sizes Available	Disposal Method ⁵
Alkaline	AAA, AA, C, D, 6V and 9V.	Dispose along with household garbage.
Carbon-Zinc	AAA, AA, C, D, 6V and 9V.	Dispose along with household garbage.
Button Cell – Silver-Oxide, Lithium, Alkaline, Zinc-Air	Various sizes.	Alkaline – Dispose along with household garbage. All other types – return to a licensed recycler.
Vehicle Lead-Acid	6V and 12V.	Return to a licensed recycler.
Sealed Lead-Acid	2V, 6V and 12V.	Return to a licensed recycler.
Nickel-Cadmium (NiCd)	AAA, AA, C, D, 6V and 9V.	Return to a licensed recycler.
Nickel-Metal-Hydrate (NiMH)	AAA, AA, C, D, 6V and 9V.	Return to a licensed recycler.
Lithium-Ion	Various sizes.	Return to a licensed recycler.

Some municipalities in Nunavut are implementing programs aimed at collecting and safely storing household hazardous waste as part of their garbage collection programs. Residents wishing to locally dispose of waste batteries should contact their municipality for other disposal options.

Consideration will be given by Nunavut's Department of Environment to management methods that differ from instructions provided in the Guideline where it can be demonstrated that the proposal would result in an equivalent level of environmental protection.

⁵ The Rechargeable Battery Recycling Corporation (RBRC) will accept nickel-cadmium, nickel-metal-hydrate, lithium-ion and small sealer lead (up to 2 lbs or 1 kilogram each) batteries only. Check RBRC's web site at <http://www.rbrc.org> for the nearest drop-off location.

Conclusion

Batteries are classified into two broad categories: *non-rechargeable* and *rechargeable* and come in many different shapes, sizes and voltages. Non-rechargeable batteries use a *dry cell* where the electrolyte is immobilized as a paste and are commonly used in small household items such as flashlights, calculators, toys, cameras and remote control devices. Rechargeable batteries use either a *wet cell* or *dry cell*. Unlike dry cell batteries, wet cell rechargeable batteries have a liquid electrolyte and are commonly used where greater electrical current is required such as in automobiles, ATVs and snowmobiles and for large industrial uninterruptable power supplies. Rechargeable batteries can be used for many of the same applications as non-rechargeable batteries.

More than 700 million consumer and industrial batteries are sold each year in Canada. With current recycling rates estimated to be between 5 and 10%, more than 630 million spent or unwanted batteries are stored or disposed of each year in Canada alone. The *Environmental Guideline for Waste Batteries* is an introduction to the management of these wastes. It provides information on the characteristics of batteries, possible effects on the environment and human health and guidance on proper storage, transportation and disposal.

Familiarity with the Guideline does not replace the need for the owner or person in charge, management or control of waste batteries to comply with all applicable federal and territorial legislation and municipal by-laws. The management of batteries may also be controlled through permits and licenses issued by Nunavut's co-management boards, Indian and Northern Affairs Canada and other regulatory agencies. These permits and licenses must be complied with at all times.

For additional information on the management of waste batteries, or to obtain a listing of available guidelines, go to the Department of Environment web site or contact the Department at:

Environmental Protection Division
Department of Environment
Government of Nunavut
Inuksugait Plaza, P.O. Box 1000, Station 1360
Iqaluit, Nunavut X0A 0H0

Telephone: (867) 975-7729

Fax: (867) 975-7739

Email: EnvironmentalProtection@gov.nu.ca

Website: <http://env.gov.nu.ca/programareas/environmentprotection>

References

Environment Canada (EC). Battery Recycling in Canada 2009 Update, (2009).

<http://www.ec.gc.ca/gdd-mw/default.asp?lang=en&n=52DF915F-1>

Government of Nunavut, Department of Environment. Environmental Guideline for the General Management of Hazardous Waste, (2010).

<http://env.gov.nu.ca/node/82#Guideline Documents>

Government of Nunavut, Department of Environment. Environmental Guideline for Waste Batteries, (2002).

Rechargeable Battery Recycling Corporation (RBRC) Webpage.

<http://www.rbrc.org>

Transport Canada. Bulletin RDIMS #5872093 – Transporting Batteries, (2010).

<http://www.tc.gc.ca/eng/tdg/publications-bulletins-transportingbatteries-1099.htm>

APPENDICES

APPENDIX 1 - ENVIRONMENTAL PROTECTION ACT

The following are excerpts from the *Environmental Protection Act*

1. "Contaminant" means any noise, heat, vibration or substance and includes such other substance as the Minister may prescribe that, where discharged into the environment,
 - (a) endangers the health, safety or welfare of persons,
 - (b) interferes or is likely to interfere with normal enjoyment of life or property,
 - (c) endangers the health of animal life, or
 - (d) causes or is likely to cause damage to plant life or to property;

"Discharge" includes, but not so as to limit the meaning, any pumping, pouring, throwing, dumping, emitting, burning, spraying, spreading, leaking, spilling, or escaping;

"Environment" means the components of the Earth and includes

 - (a) air, land and water,
 - (b) all layers of the atmosphere,
 - (c) all organic and inorganic matter and living organisms, and
 - (d) the interacting natural systems that include components referred to in paragraphs (a) to (c).

"Inspector" means a person appointed under subsection 3(2) and includes the Chief Environmental Protection Officer.
- 2.2 The Minister may
 - (a) establish, operate and maintain stations to monitor the quality of the environment in the Territories;
 - (b) conduct research studies, conferences and training programs relating to contaminants and to the preservation, protection or enhancement of the environment;
 - (c) develop, co-ordinate and administer policies, standards, guidelines and codes of practice relating to the preservation, protection or enhancement of the environment;
 - (d) collect, publish and distribute information relating to contaminants and to the preservation, protection or enhancement of the environment;
3. (1) The Minister shall appoint a Chief Environmental Protection Officer who shall administer and enforce this Act and the regulations.

(2) The Chief Environmental Protection Officer may appoint inspectors and shall specify in the appointment the powers that may be exercised and the duties that may be performed by the inspector under this Act and regulations.
5. (1) Subject to subsection (3), no person shall discharge or permit the discharge of a contaminant into the environment.

(3) Subsection (1) does not apply where the person who discharged the contaminant or permitted the discharge of the contaminant establishes that
 - (a) the discharge is authorized by this Act or the regulations or by an order issued under this Act or the regulations;
 - (b) the contaminant has been used solely for domestic purposes and was discharged from within a dwelling house;
 - (c) the contaminant was discharged from the exhaust system of a vehicle;

- (d) the discharge of the contaminant resulted from the burning of leaves, foliage, wood, crops or stubble for domestic or agricultural purposes;
 - (e) the discharge of the contaminant resulted from burning for land clearing or land grading;
 - (f) the discharge of the contaminant resulted from a fire set by a public official for habitat management of silviculture purposes;
 - (g) the contaminant was discharged for the purposes of combating a forest fire;
 - (h) the contaminant is a soil particle or grit discharged in the course of agriculture or horticulture; or
 - (i) the contaminant is a pesticide classified and labelled as "domestic" under the *Pest Control Products Regulations* (Canada).
- (4) The exceptions set out in subsection (3) do not apply where a person discharges a contaminant that the inspector has reasonable grounds to believe is not usually associated with a discharge from the excepted activity.
- 5.1. Where a discharge of a contaminant into the environment in contravention of this Act or the regulations or the provisions of a permit or license issued under this Act or the regulations occurs or a reasonable likelihood of such a discharge exists, every person causing or contributing to the discharge or increasing the likelihood of such a discharge, and the owner or the person in charge, management or control of the contaminant before its discharge or likely discharge, shall immediately:
- (a) subject to any regulations, report the discharge or likely discharge to the person or office designated by the regulations;
 - (b) take all reasonable measures consistent with public safety to stop the discharge, repair any damage caused by the discharge and prevent or eliminate any danger to life, health, property or the environment that results or may be reasonably expected to result from the discharge or likely discharge; and
 - (c) make a reasonable effort to notify every member of the public who may be adversely affected by the discharge or likely discharge.
6. (1) Where an inspector believes on reasonable grounds that a discharge of a contaminant in contravention of this Act or the regulations or a provision of a permit or license issued under this Act or the regulations has occurred or is occurring, the inspector may issue an order requiring any person causing or contributing to the discharge or the owner or the person in charge, management or control of the contaminant to stop the discharge by the date named in the order.
7. (1) Notwithstanding section 6, where a person discharges or permits the discharge of a contaminant into the environment, an inspector may order that person to repair or remedy any injury or damage to the environment that results from the discharge.
- (2) Where a person fails or neglects to repair or remedy any injury or damage to the environment in accordance with an order made under subsection (1) or where immediate remedial measures are required to protect the environment, the Chief Environmental Protection Officer may cause to be carried out the measures that he or she considers necessary to repair or remedy an injury or damage to the environment that results from any discharge.

APPENDIX 2 – GOVERNMENT AND INDUSTRY CONTACTS

Government of Nunavut

Environmental Protection Division
Department of Environment
Inuksugait Plaza
P.O. Box 1000, Station 1360
Iqaluit, Nunavut X0A 0H0
Telephone: (867) 975-7729 Fax: (867) 975-7739

Motor Vehicles Division
Department of Economic Development and
Transportation
P.O. Box 10
Gjoa Haven, Nunavut X0B 1J0
Telephone: (867) 360-4615 Fax: (867) 360-4619

Workers' Safety and Compensation Commission
P.O. Box 669
Baron Building/1091
Iqaluit, Nunavut X0A 0H0
Telephone: 1-877-404-4407 (toll free)
Fax: 1-866-979-8501

Department of Community and Government
Services (all Divisions)
P.O. Box 1000, Station 700
4th Floor, W.G. Brown Building
Iqaluit, Nunavut X0A 0H0
Telephone: (867) 975-5400 Fax: (867) 975-5305

Office of Chief Medical Health Officer of Health
Department of Health and Social Services
P.O. Box 1000, Station 1000
Iqaluit, Nunavut X0A 0H0
Telephone: (867) 975-5774 Fax: (867) 975-5755

Government of Canada

Indian and Northern Affairs – Nunavut Region
P.O. Box 2200
Iqaluit, Nunavut X0A 0H0
Telephone: (867) 975-4500 Fax: (867) 975-4560

Environment Canada (NWT and Nunavut)
5019 52nd Street
Yellowknife, Northwest Territories X1A 1T5
Telephone: (867) 669-4730 Fax: (867) 873-8185

Department of Transport – Road, Rail, Marine, Air
P.O. Box 8550
344 Edmonton Street
Winnipeg, Manitoba R3C 1P6
Telephone: 1-888-463-0521 (toll free)
Fax: (204) 983-8992 Road, Rail and Marine
Fax: (204) 983-1734 Air

Industry

Rechargeable Battery Recycling Corporation
P.O. Box 236, Station E
Toronto, ON M6H 4E2
Telephone: (416) 535-9210
www.rbrc.org