

ENVIRONMENTAL MANAGEMENT PLAN

FOR THE ASTON BAY PROPERTY
(Formerly the Storm Property)
NUNAVUT, CANADA



Prepared By:



Effective June 2015

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1. Introduction

This Environmental Management Plan (EMP) applies to mineral exploration activities conducted by, or on behalf of, Commander Resources Ltd. (“Commander”), Aston Bay Holdings Ltd. (“Aston Bay”) and/ or APEX Geoscience Ltd. (“APEX”) at the Aston Bay Property (previously the Storm Property), Somerset Island, Nunavut.

The Aston Bay Property (“the Property”) is a joint venture between Commander Resources Ltd. (“Commander”) and Aston Bay, where Commander is the primary tenure holder and Aston Bay is the operator. APEX has been retained by Aston Bay and Commander as a consultant and is authorized to act on behalf of Aston Bay and Commander with regard to the Aston Bay Property. This EMP will come into effect June 2015, pending approval. Copies and updates to this plan may be obtained via APEX, Commander or Aston Bay.

1.1 Contact Details

Commander Resources Ltd.
11th Floor, 1111 Melville St.
Vancouver, BC V6E 3V6
Tel: (604) 685-5254
Fax: (604) 685-2814
www.commanderresources.com

Aston Bay Holdings Ltd.
222 – 400 E. Evergreen Blvd.
Vancouver, WA 98660
Tel: (360) 262-6969
www.astonbayholdings.com

APEX Geoscience Ltd.
200 – 9797 45th Ave.
Edmonton, AB T6E 5V8
Tel: (780) 439-5380
Fax: (780) 433-1336
www.apexgeoscience.com

1.2 Purpose and Scope

The purpose of the Aston Bay Property Environmental Management Plan is to outline the companies’ environmental policy, and to address environmental issues related to exploration at the Aston Bay Property. The plan includes the following:

- A summary of regulatory requirements;
- An overview of Aston Bay Property environmental protection measures;
- A discussion of stakeholder issues, including procedures for dealing with anthropological or archaeological sites;
- Possible disturbances to land, flora, and fauna related to exploration;
- Wildlife management practices and appropriate use of firearms;
- Environmental requirements for diamond drilling;
- Hazardous material handling and waste management practices;
- A summary of abandonment and restoration plans.

Emergency response guidelines are beyond the scope of this plan. In the event of an environmental emergency, personnel will defer to the Aston Bay Property “Emergency Response Plan” and “Spill Prevention and Response Plan” for guidance.

1.3 Environmental Policy

Commander, Aston Bay and APEX are firmly committed to the protection and conservation of the natural environment, and to ensuring the health and safety of all employees, contractors, and people in surrounding communities. The environmental policy for the Aston Bay Property is to:

- Develop the project in a socially and environmentally responsible manner;
- Fully comply with all applicable environmental legislation and regulations;
- Work in cooperation with federal, territorial, and local governments, as well as other relevant regulatory bodies, and the general public, on all aspects of environmental protection and policy;
- Assess and mitigate any potential environmental impacts and minimize risks to the health and safety of all employees, contractors, and the general public;
- Ensure contractors operate according to the Aston Bay Property environmental policies and procedures;
- Employ an emergency response plan to reduce impacts of unforeseen events;
- Provide ongoing instruction on Aston Bay Property environmental policies and spill prevention and response plans for all employees and contractors;
- Keep employees, contractors, inspectors, government, and regulatory bodies informed of any changes at the site or with project activities.

1.4 Other Plans

The EMP 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)
- Fuel Management Plan (FMP)
- Spill Prevention and Response Plan (SPRP)
- Waste Management Plan (WMP)

1.5 Project and Camp Description

The Aston Bay Property is located east of Aston Bay on Somerset Island, Nunavut, covering an area roughly 63 kilometres (km) long by 42 km wide (Figure 1 in Appendix A). It is approximately 112 km south of the community of Resolute Bay and about 1,500 km northwest of Iqaluit within the 1:250,000 scale NTS map sheet 058C. The Property includes the zinc-silver Seal Prospect and multiple copper showings, collectively known as the Storm Prospect.

Access to the Property is typically restricted to privately chartered helicopter or fixed wing aircraft from Resolute Bay, or the Arctic Watch Lodge, a wilderness adventure resort, located approximately 50 km north of the Property, on Cunningham Inlet. Due to the remoteness of the Property location, the only people, who would be immediately affected by a potential spill, are employees and contractors.

Activities at the Aston Bay Property are anticipated to include regional soil and rock sampling, geological mapping, and ground geophysical surveys as well as diamond drilling at the Storm and Seal Prospects (Figure 1 in Appendix A). Typically, mineral exploration work in the region is seasonal, and can start as early as June and continue until as late as September. All exploration activities at the Aston Bay Property will be helicopter supported.

Commander is currently permitted, licensed and authorized to establish a small camp and conduct the diamond drilling at the Aston Bay Property (formerly Storm Property) in accordance with the Aboriginal Affairs and Northern Development Canada (AANDC) Land Use Permit N2010C0003, Nunavut Water Board (NWB) License 2BE-STO1015 and Nunavut Impact Review Board (NIRB) file number 10EN013. The AANDC permit is set to expire May 16, 2015. A new land use application is currently being applied for in Aston Bay's name, as they are the operator of the project. A water licence amendment and renewal is currently under application in the name of Commander. The water licence amendment will include a relocation of the camp and an increase to the quantity of water. The water licence will ultimately be converted into Aston Bay's name.

A 10 to 12 person seasonal tent camp is proposed to support exploration activities at the Aston Bay Property. A small temporary camp was constructed in the summer of 2014, at the site of an abandoned Cominco Ltd. ("Cominco") exploration camp, located at approximately 73°42'30" N latitude and 94°43'15" W longitude (Figures 1 and 2 in Appendix A). The abandoned camp site included a small air strip and is the storage site for the historic Cominco drill core. It is adjacent to a river, from which camp water was drawn. Upon completion of the 2014 program, the camp was removed, with the exception of the Cominco drill core, 10 drums of aviation fuel, 17 drums

of diesel fuel, 2 propane tanks, one wooden emergency structure and an outhouse, all of which are intended to be used in the 2015 program. In addition, 90 empty drums are stored at the camp site and at a fuel cache near Aston Bay. The empty drums will be removed during the 2015 field program. Spill kits will be located at the 2014 cache until all the fuel and drums are removed and the old camp site is decommissioned. All 2014 wastes were separated into combustible, recyclable or hazardous (petroleum products, batteries, etc.), subsequently removed from site and properly disposed of at an authorized facility in Resolute Bay.

During the 2014 program, a new camp location was scouted due to the limitations of the airstrip located at the current camp. A suitable new camp location was located at approximately 73°39'20" N latitude and 94°27'34" W longitude (Figure 2 in Appendix A). While the new camp is being constructed, the old camp will be used as an emergency backup and then subsequently removed and the site remediated. The AANDC Inspector will be notified upon completion of the site remediation, and a summary of the remediation efforts will be submitted as part of the 2015 annual report.

The proposed camp location is along the Aston River, from which camp water can be drawn (Figure 2 in Appendix A). Structures for the proposed camp may include 6 sleeper tents, medical tent, kitchen, dry, office, shop, core shack, generator housing, incinerator, and 2 outhouses. The majority of the structures will be insulated Weatherhaven tents, or similar, with plywood floors. Figure 3 in Appendix A shows a possible layout for the proposed camp.

A drill program of 5,000 to 10,000 m is proposed for the 2015 season, utilizing one to two diamond drills. The average hole depth is expected to be approximately 200 m, up to a maximum proposed depth of 700 m. Similar programs are anticipated for 3 to 4 subsequent years. The areas for the proposed diamond drilling at the Storm and Seal Prospects are defined in figures 1 and 2 in Appendix A.

A fuel cache of up to 40,000 L (~ 200 drums) will be established on stable ground near to the camp, primarily to store diesel and jet fuel. Small quantities of gasoline and propane will also be stored. Arctic Insta-Berms, or other similar industry standard containment berms, will provide secondary containment for the camp fuel cache. Small temporary fuel caches of less than 4,000 L may also be required to supply the drilling and exploration programs. Within 30 days of establishing any temporary fuel cache, the AANDC will be notified of the details of the cache including: location, fuel type, container sizes, method of storage and date of removal.

2. Applicable Legislation and Guidelines

Exploration at the Aston Bay Property will be conducted in accordance with various Acts, Regulations, Guidelines, and Recommendations including, but not limited to:

2.1 Federal

- Canadian Environmental Protection Act
- Canada Wildlife Act
- Fisheries Act
- Nunavut Waters and Nunavut Surface Rights Tribunal Act
- Public Health Act
- Species at Risk Act
- Territorial Lands Act
- Nunavut Land Claims Agreement
- Department of Fisheries and Oceans Canada Operational Statements
- Guidelines for Spill Contingency Planning (AANDC)

2.2 Territorial

- Nunavut Environmental Protection Act
- Nunavut Wildlife Act
- Caribou Protection Plan / Caribou Protection Measures
- Environmental Guideline for the Burning and Incineration of Solid Waste

3. Environmental Protection Measures

Exploration activities at the Aston Bay Property will be assessed for environmental impact risks and every measure available will be taken to ensure the protection and preservation of the natural environment. For the duration of the program, all activities will be documented and sites photographed to comply with environmental due diligence. All on-site employees and contractors will be provided with environmental training, and will become familiar with relevant regulations. The Project Supervisor will be responsible for implementing environmental policies and training, and managing the environmental monitoring program.

Environmental training, monitoring, reclamation, and site clearance surveys will be built in to the program budget to ensure adequate resources are being allocated to environmental

management. Preference will be given to contractors with high standards of environmental stewardship, and who have a proven track record of sound environmental practice.

4. Stakeholders

Stakeholders may be individuals or groups concerned with, or affected by, exploration activities at the Aston Bay Property. Stakeholders will be identified and consulted with for the duration of the exploration program. Approvals will be sought from stakeholders and regulatory bodies pertaining to relevant environmental, social, and cultural issues.

4.1 Archaeological or Paleontological Sites

Tent rings and remains of camps from Thule culture (AD 1000 - 1400) can be found near the Arctic Watch Lodge, along the northern coast of Somerset Island. No known archeological or paleontological sites or artifacts have been discovered on the Aston Bay Property.

In the event that any cultural, archaeological, or paleontological sites, artifacts or fossils are encountered, the Nunavut Department of Culture and Heritage will be contacted immediately. A report will be prepared documenting the discovery and sent to the Department of Culture and Heritage and AANDC. Reports will include GPS coordinates of the discovery, a brief description of the site or artifact, and photos (if possible). No sites or artifacts will be intentionally disturbed, handled, or removed.

Nunavut Department of Culture and Heritage:

Phone: 867-975-5500

Fax: 867-975-5504

5. Identification of Potential Impacts and Proposed Mitigation Measures

5.1 Designated Environmental Areas

The Aston Bay Property is not located within any federal terrestrial or marine Protected Areas, as defined by Environment Canada, although two important bird areas are identified on Somerset Island. Batty Bay is one of Canada's northernmost Black-legged Kittiwake colonies and Creswell Bay has the highest abundance and diversity of shorebirds north of 70°N latitude. Neither of these areas is in the vicinity of the Aston Bay Project, as they are located on the east coast of Somerset Island.

The nearest National Parks are Polar Bear Pass National Wildlife Area located on Bathurst Island, north of Somerset Island and Sirmilik National Park on northern Baffin Island, east of

Somerset Island. The nearest Marine Protected Area surrounds the Prince Leopold Island Migratory Bird Sanctuary located to the northeast of Somerset Island.

The Property does not contain any territorial areas of special interest or sensitivity, including parks, wildlife sanctuaries, caribou migration routes, or calving grounds.

5.2 Wildlife Disturbance Mitigation

5.2.1 Wildlife and Habitat

Very little wildlife has been observed within the Property during previous exploration programs, although limited muskox, seal, arctic fox and lemmings have been observed in recent years. A number of species considered to be “at risk” listed under the Species at Risk Act (SARA), including the Peary Caribou, may inhabit the area of Somerset Island. Measures will be taken to avoid these species to reduce the chance of adverse effects.

As a general rule, all interaction with wildlife is discouraged; however, employees and contractors will be trained in the appropriate actions to take when encountering wildlife in the field. Intentionally approaching, disturbing, or feeding wildlife is strictly prohibited. Any incidents will be thoroughly investigated and disciplined. All wildlife, and their dwelling sites, will be respected and efforts will be made to avoid them. All personnel will be required to record any wildlife sightings and will be instructed on the appropriate action to take when encountering wildlife in the field.

Animal sightings will be recorded in the “Wildlife Record Log” and reported to AANDC and the Nunavut Department of Environment as part of the “Wildlife and Environment” section of the Aston Bay Property Annual Report. If any wildlife enters any of the area of operations at the Aston Bay Property, protection measures will be followed and operations will be halted until the animal has moved out of the vicinity. Any bears or nuisance wildlife will be immediately reported to the project manager, the AANDC and the Nunavut Department of Environment. Emergency Wildlife Contacts are listed in Appendix B.

The majority of field activities planned for the Aston Bay Property are very low impact. Geochemical sampling and geological mapping require no mechanized equipment and ground geophysical surveys do not require the use of any sizable or noisy machinery. Diamond drilling may cause noise disturbances to passing animals, but care will be taken to position drill sites away from any wildlife nests or dwellings. There is also the potential for a fuel or oil spill at the camp or drill sites. Policies and procedures outlined in the Aston Bay Property “Fuel

Management Plan” and “Spill Prevention and Response Plan” will be followed at all times to mitigate the chance of a spill.

Aircraft support is required to carry out daily operations at the Aston Bay Property. Fixed wing aircraft will be required to support the mobilization/demobilization of the camp including movement of people, equipment and samples. Helicopter support will be required for daily operations including pick up/drop off of field personnel and drill rig and fuel moves. Possible impacts that may arise from the use of aircraft include fuel spills, and noise disturbance. When low altitude flights are necessary, such as deploying field personnel, all efforts will be taken to avoid wildlife, dwellings, and nests. Pilots will be instructed not to land where wildlife is present unless it is an emergency situation. If a landing occurs for any reason in the presence of wildlife, it will be documented and submitted to AANDC and the Nunavut Department of Environment as part of the “Wildlife and Environment” section of the Aston Bay Property Annual Report.

Appropriate screens will be placed over all water intakes at camp and at the drill in order to reduce the potential for fish entrapment.

5.2.2 Firearms

Registered firearms will be located in camp and at drill sites to ensure the safety of all personnel on the Property. All firearms in camp will be stored unloaded in a locked cabinet and regulated by the Project Manager. Firearms at drill sites will be stored unloaded in gun cases.

All persons carrying or handling a firearm must have a valid Firearms License and be approved by the Project Manager. Hunting is strictly prohibited for all employees and contractors, and will result in immediate termination and potential charges for any territorial hunting violations. Firearms discharge of any kind must be reported immediately to the Project Manager. Use of firearms against nuisance or aggressive wildlife is considered only as a last resort.

5.3 Vegetation, Soil and Permafrost Disturbance Mitigation

Vegetation at the Aston Bay Property consists mainly of moss, lichens, stunted plants and Arctic grasses. The grasses are typically observed growing at lower elevations in areas associated with river drainage basins.

Vegetation and permafrost can potentially be impacted by camp and drilling activities. Mitigation measures to reduce the impact include limiting the amount of vegetation disruption to ensure proper shade coverage and reduction in the potential for ground thaw and subsidence. Footpaths can be marked using stakes and flagging tape to ensure that impacts to vegetation are confined to a small area or boardwalks can be built between camp buildings to

reduce damage to vegetation on high-traffic footpaths. Areas that have patterned ground, clay-rich soil and or wetlands will be avoided. Heat radiating from camp buildings may thaw permafrost, so all heated camp structures will be slightly elevated above the ground to allow air circulation. Earth may be required to be moved in order to construct sumps in camp and at drill sites; however natural depressions and areas free of vegetation will be used whenever possible. Any topsoil moved will be collected to use in re-vegetation efforts. If a sump is excavated, it will be barricaded until it can be back-filled.

Soil quality can be impacted from spills of fuel and other materials and waste discharge. Preventative measures include appropriate and approved storage locations and containers with secondary containment. All fuel, hazardous materials and drilling will be a minimum 31 metres away from any watercourses. Refueling will be done with precision and appropriate due-diligence will be taken. Drums and hoses will be inspected regularly for leaks and pans or absorbent pads will be placed below fuel transfer areas and stationary machinery. See the Aston Bay Property “Spill and Response Plan” attached for more information.

5.4 Air and Noise Quality

Impacts on air quality can result from discharge of exhaust from airplanes, helicopters, drilling operations and diesel generators, as well as emissions from incineration. Given the remote location with lack of air quality issues which currently exists within the project location, the short duration and small scope of activities are not expected to result in any measurable air quality impacts. An Environment Canada approved batch waste, controlled air, dual chamber incinerator will be selected to burn combustible waste, therefore reducing harmful emissions.

Noise can result from the use of planes, helicopters and drills and to a lesser degree from activities within the camp, which can disturb wildlife. Mitigation measure include, but not be limited to: helicopter avoidance of any raptor nests, bear dens and wolf dens, waterfowl and shorebird staging areas during critical seasons and near large mammals. In addition drill activities and associated work will cease if caribou cows and/or calves appear nearby.

5.5 Drilling Operations

Drilling contracts will be awarded to companies that exhibit high standards of environmental practice and who are willing to adhere to the environmental policies for the Aston Bay Property. The following conditions are imposed for drilling activities:

- Sites will be as small as possible while still allowing adequate area for fire protection;

- All stored fuel and drill additives will be stored in secondary containment.
- Biodegradable drill additives will be used whenever possible.
- 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 water will be contained in sumps. Sumps will be positioned down slope from the drill collar in such a manner that runoff flows into the sump. Sumps will be positioned a minimum of 31 metres from the normal high water mark of any water body.
- If any artesian water flow is detected, the hole will be plugged and cemented in bedrock to prevent continued flow. Any artesian water flow will be reported to AANDC and the Nunavut Water Board.

6. Hazardous Materials

All hazardous materials will be handled and stored in accordance with the Aston Bay Property “Fuel Management Plan” and “Spill Prevention and Response Plan”. Fuels and other hazardous materials will be stored within “Arctic Insta-Berms”, or similar products, for secondary containment. Hazardous material storage sites will be located a minimum of 31 metres from the normal high water mark of any water body. Electric or hand wobble pumps equipped with filtration devices will be used for the transfer of diesel, jet fuel, and gasoline from their storage containers directly to their end-use fuel tanks. Portable drip trays or mini-berms will be used to mitigate the risk of any spillage, and fully stocked spill kits will be available at all refueling stations, drill sites, and at various locations throughout camp.

All hazardous materials will be clearly labeled in accordance with the Workplace Hazardous Materials Information System (WHMIS) and other applicable legislation. Labels will include, but not limited to, the type of fuel, safe handling procedures, reference to Material Safety Data Sheets (MSDS), company name, and the date of delivery to site. Signs with the same information, along with MSDS for each fuel type will be posted at each hazardous material storage or transfer site. “No Smoking” signs will be posted at each fuel cache, drill site, and fuel transfer area.

All personnel required to handle hazardous materials will be trained in WHMIS, the Transportation of Dangerous Goods Act, and the Aston Bay Property “Spill Prevention and Response Plan” and “Emergency Response Plan”.

Monitoring of the condition of stored fuel drums, berms, and other vessels containing hazardous materials will be ongoing throughout the project. Daily inspections will be conducted to identify any damaged or leaking containers, and the findings reported in the “Daily Fuel Inspection Record”. The Project Manager is responsible for maintaining a detailed fuel and hazardous material inventory, and is in charge of overseeing the maintenance and monitoring of all fuel and hazardous material caches.

Contacts for Hazardous Waste Issues are listed in Appendix C of this plan.

7. Waste Management Planning

All wastes will be handled and disposed of in accordance with the Aston Bay Property “Waste Management Plan” and will comply with federal and territorial legislation. 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 manner. Wastes will be separated at the source into a number of categories including: materials for incineration, inert recyclables, inert non-combustible materials, and hazardous materials.

Combustible waste will be burned in a batch feed dual-chamber controlled air incinerator, in accordance with the *Environmental Guideline for the Burning and Incineration of Solid Waste* by the Nunavut Department of Environment (Appendix D) and the *Canada-Wide Standards (CWS) for Dioxins and Furans* by the Canadian Council of Ministers of the Environment (Appendix E). 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.

All inert materials that cannot be incinerated will be placed in appropriate sealed containers and removed from site for reuse, recycling or proper disposal at an accredited facility.

All hazardous wastes will be sealed in appropriate containers, labeled, documented and removed from site for proper disposal at a licensed disposal facility. A waste manifest will accompany hazardous waste in transit and all parties involved will be properly accredited.

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 a water body. If available, coarse gravel will be placed in the bottom of the sump to provide filtration, and supports will be built on the sides to prevent slumping. Filters will be installed on kitchen drains to ensure solid food wastes do not enter the sumps and have the potential to attract wildlife. The sump will maintain a minimum 1 metre freeboard at all times. The sump and pipe will be inspected at regular intervals for leaks or overflow. When full, greywater sumps will be covered with enough material to allow for future ground settlement.

Privy pits (outhouses) will be located at least 31 m away from a water body. To control sewage pathogens, outhouses will be periodically treated with lime. When full, the pits will be covered with at least 30 cm of compacted soil.

8. Abandonment and Restoration

Prior to land use permit, claim or lease termination, all structures, equipment, supplies, fuel, and wastes will be removed from the Property with the exception of core box stacks, which will be permanently secured on site. Materials of value will be salvaged. Local businesses and residents will have the opportunity to salvage any remaining materials that will otherwise be disposed of. A thorough inspection of all areas of activity will be conducted, and photographs will be taken to include in the final reports submitted to the Water Resource Inspector and as part of the Annual Report submitted to AANDC and the Nunavut Water Board. All relevant regulatory agencies will be notified once the final clean-up has concluded.

Areas disturbed by activities related to exploration at the Aston Bay Project will be fertilized as necessary to encourage re-vegetation. Any eroded or washed out areas related to exploration activities will be filled and re-contoured to natural levels.

After site reclamation is complete, annual monitoring may occur. The monitoring may include soil and water testing, measuring and documenting plant re-growth, examining potential runoff and erosion problems, and checking the stability and condition of core racks and boxes. Reports, including photographs, will be submitted to all appropriate regulatory bodies.

Further details on abandonment and restoration can be found in the Aston Bay Property “Abandonment and Restoration Plan”.

Appendix A: Figures

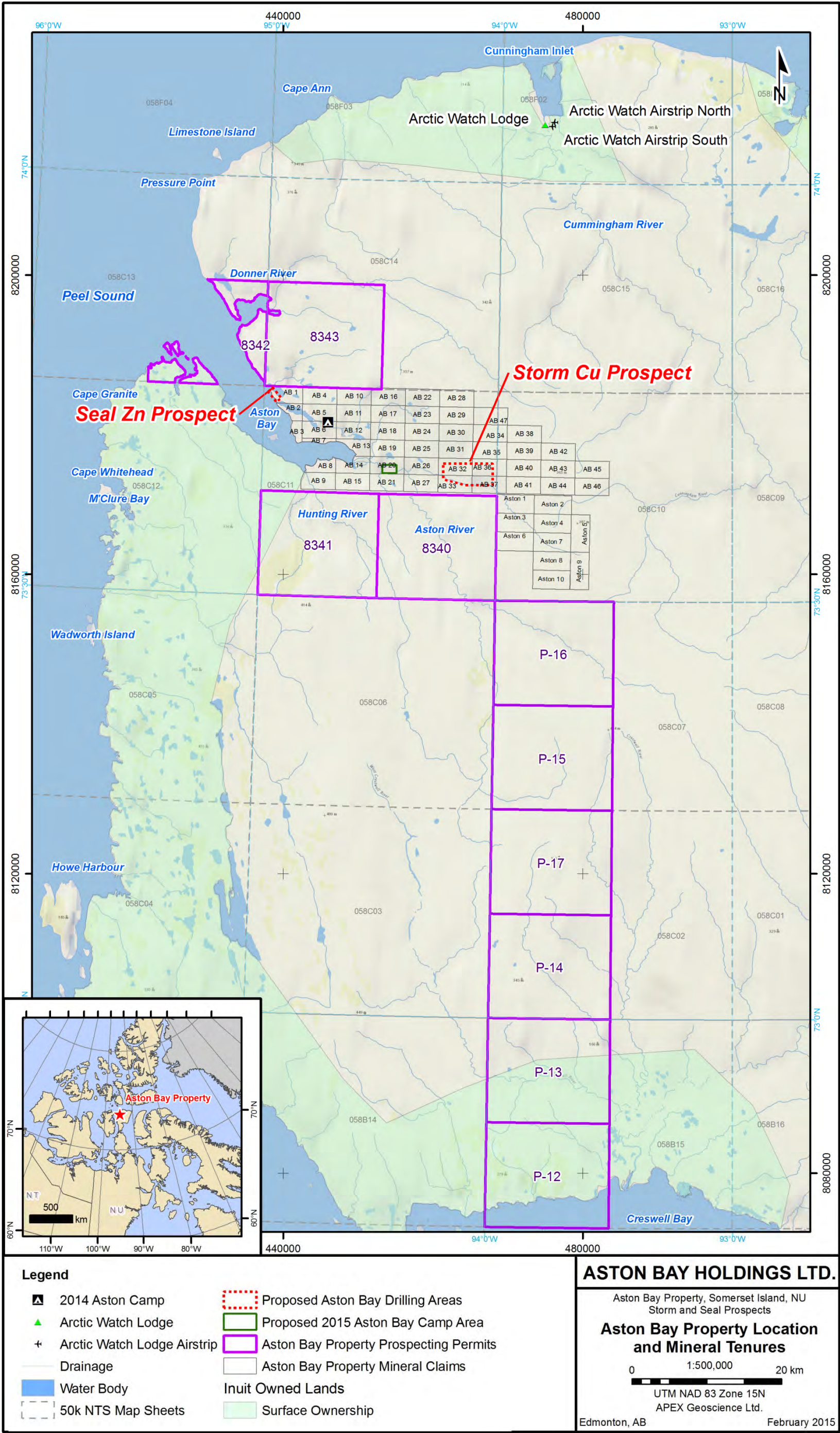


Figure 1

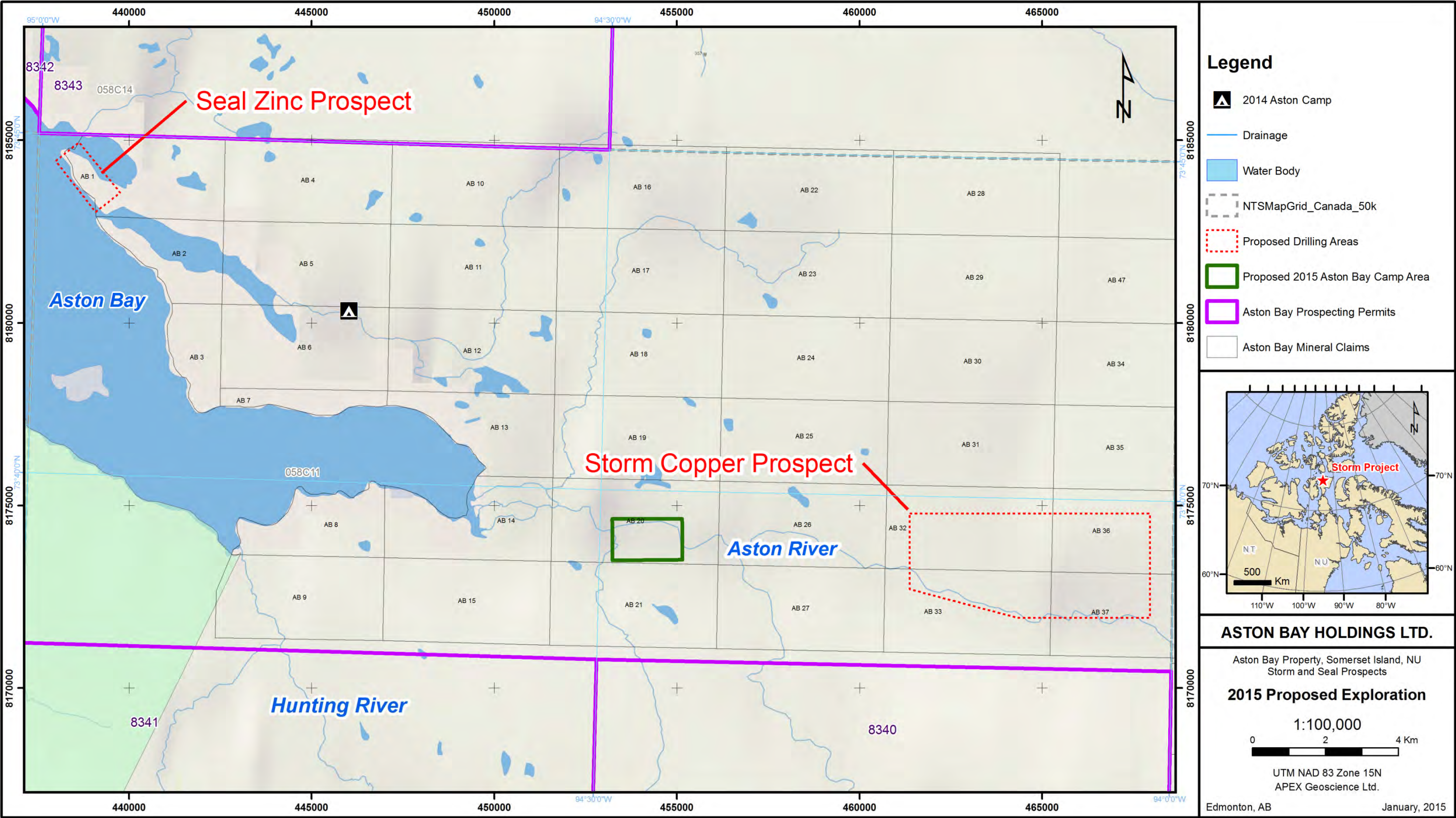


Figure 2



Figure 3

Appendix B: Wildlife Emergency Contacts

Wildlife Emergency Contacts

Name	Company/Position	Phone Number(s)
Rob L'Heureux	Project Supervisor (APEX)	780-439-5380 (office) 780-916-5482 (mobile)
Bruce Counts	Chief Operating Officer (Aston Bay)	360-262-6969
Eric Norton	President and CEO (Commander)	604-484-4077
Nunavut Department of Environment	Iqaluit Main Office	867-975-7700
Nunavut Department of Environment	Resolute Conservation Office	867-252-3879

Name	Position	Community	Phone
Aliqatuqtuq, Jason	Wildlife Manager - South Baffin	Iqaluit	(867) 975-7900
Aliqatuqtuq, Jaypootie	Wildlife Guardian (Casual)	Iqaluit	(867) 927-8966
Avingaq, Elizabeth	Wildlife Division Assistant	Igloolik	(867) 934-2005
Awan, Malik	Wildlife Biologist - Carnivores	Igloolik	(867) 934-2179
Dumond, Mathieu	Manager Wildlife - Kitikmeot	Kugluktuk	(867) 982-7441
Gissing, Drikus	Wildlife Director	Iqaluit	(867) 975-7734
Goorts, Jaylene	Wildlife Technician II	Pond Inlet	(867) 899-8775
Harte, Mike	Wildlife Technician II, Polar Bear Lab	Igloolik	(867) 934-2184
Issigaitok, Albert	Wildlife Division Assistant	Igloolik	(867) 934-2067
Karetak, Robert	Wildlife Technician	Arviat	(867) 857-3170
Kublu, James	Environment, Wildlife Reseach	Igloolik	(867) 934-2177
Lamont, Myles	Wildlife Technician II	Kugluktuk	(867) 982-7465
Leclerc, Lisa-Marie	Regional Wildlife Biologist	Kugluktuk	(867) 982-7444
Mikeeuneak, Florence	Wildlife Clerk	Arviat	(867) 857-3170
Ogina, Margaret	Wildlife Clerk	Kugluktuk	(867) 982-7440
Orman, Lynda	Manager Wildlife Reseach	Igloolik	(867) 934-2183
Owlijoot, Kelly	Wildlife Technician	Arviat	(867) 857-3173
Panipakoocho, Brenda	Wildlife Manager - North Baffin	Pond Inlet	(867) 899-8034
Peck, Kristen	Wildlife technician - raptor project	Igloolik	(867) 934-2177
Pretzlaw, Troy	Regional Wildlife Biologist	Pond Inlet	(867) 899-8876
Qaqqaq, Lars	Wildlife Offcier (Summer Student)	Baker Lake	(867) 793 2944
Qaunaq, Jeffrey	Assistant Wildlife Officer	Iqaluit	(867) 980-4164
Sather, Shane	Wildlife Officer III	Cambridge Bay	(867) 983-4167
Szor, Guillaume	Wildlife Technician II carnivores	Igloolik	(867) 934-2191
Williams, Alden	Wildlife Officer III	Iqaluit	(867) 979-7900

* Wildlife contacts obtained from the Government of Nunavut Directory (<http://www.directory.gov.nu.ca/>)

Appendix C: Hazardous Waste Contacts

Hazardous Waste Contacts

AANDC Manager of Field Operations 867-975-4295

Environmental Protection Division
Nunavut Department of Environment
Inuksugait Plaza, P.O. Box 1000, Stn. 1300
Iqaluit, NU X0A 0H0
Tel: 867-975-7700
Fax: 867-975-7742
Email: environment@gov.nu.ca

Dr. Maureen Baikie
Office of Chief Medical Officer of Health
Nunavut Department of Health
P.O. Box 1000, Stn. 1000
Iqaluit, NU X0A 0H0
Tel: 975-5743
Email: mbaikie@gov.nu.ca

Workers' Safety and Compensation Commission
Qamutiq Building, 2nd Floor
611 Queen Elizabeth Way, Box 669
Iqaluit, NU x0A 0H0
Tel: 867-979-8500
Fax: 867-979-8501

NU-NT 24 Hour Spill Report Line
Tel: 867-920-8130
Fax: 867-873-6924
Email: spills@gov.nt.ca

Nunavut Emergency Management
Emergency 24 Hour
Headquarters: 867-979-6262 / 1-800-693-1666
Qikiqtaaluk: 1-888-624-4043

Nunavut Department of Community
and Government Services
W.G. Brown Building, 4th Floor
P.O. Box 1000, Stn. 700
Iqaluit, NU X0A 0H0
Tel: 867-975-5400/5413
Fax: 867-975-5305

Robert Prima
Office of the Fire Marshall
Protection Services
Nunavut Department of Community
and Government Services
Tel: 867-975-5310
Fax: 867-979-4221

Emergency Measures 24 Hour TOLL Free 1-800-693-1666
Emergency Services Response 24 Hours 867-979-6262
Emergency Services Response 24 Hours 867-979-0211, Press 911 at prompt
Emergency Measures Operations FAX 867- 979-4221/979-3364

Appendix D: Burning Guidelines

Environmental Guideline for the Burning and Incineration of Solid Waste



Department of Environment
Government of Nunavut

GUIDELINE: BURNING AND INCINERATION OF SOLID WASTE

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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:

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

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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.

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<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 Nova 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.

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<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.

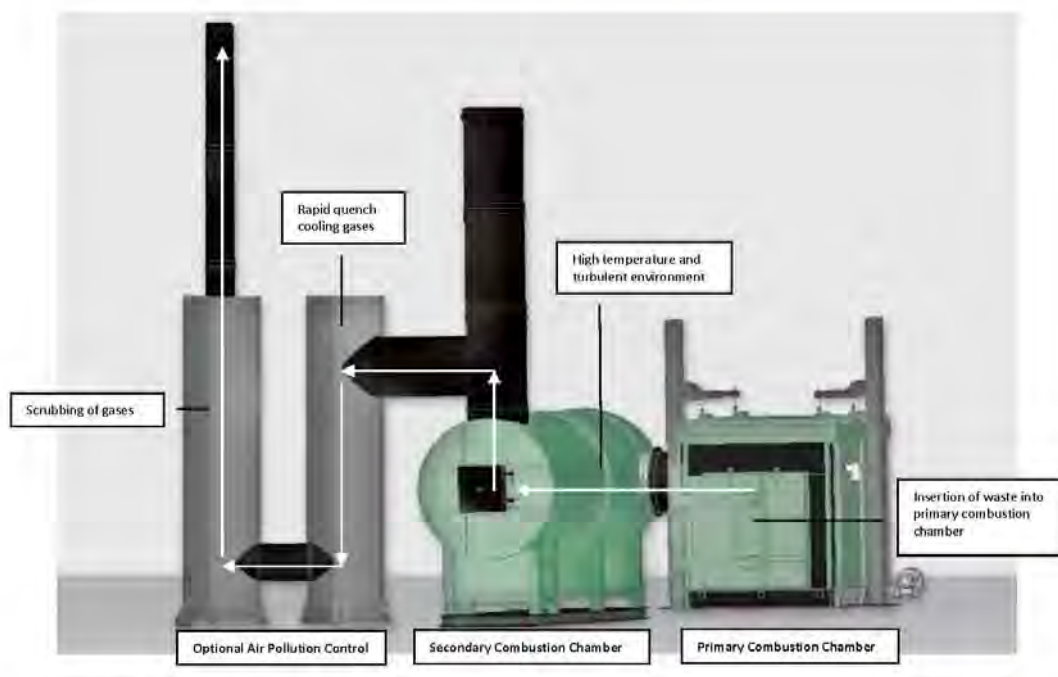


Figure 5 – Typical Batch Feed Dual-Chamber Controlled Air Incinerator with Optional Air Pollution Controls
Illustration courtesy of Eco Waste Solutions

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.

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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

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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 ¹	
	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 ²	✓	✓
Initial Certificate of Operation ³		✓

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.

¹ 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.

² An acceptable alternative to monitoring opacity is to continuously monitor particulate matter in the stack.

³ 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.

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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>

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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;

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- (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.

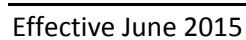
Evenly spaced vents or holes cut above the bottom of the barrel enable fresh air to mix with waste inside the metal basket.



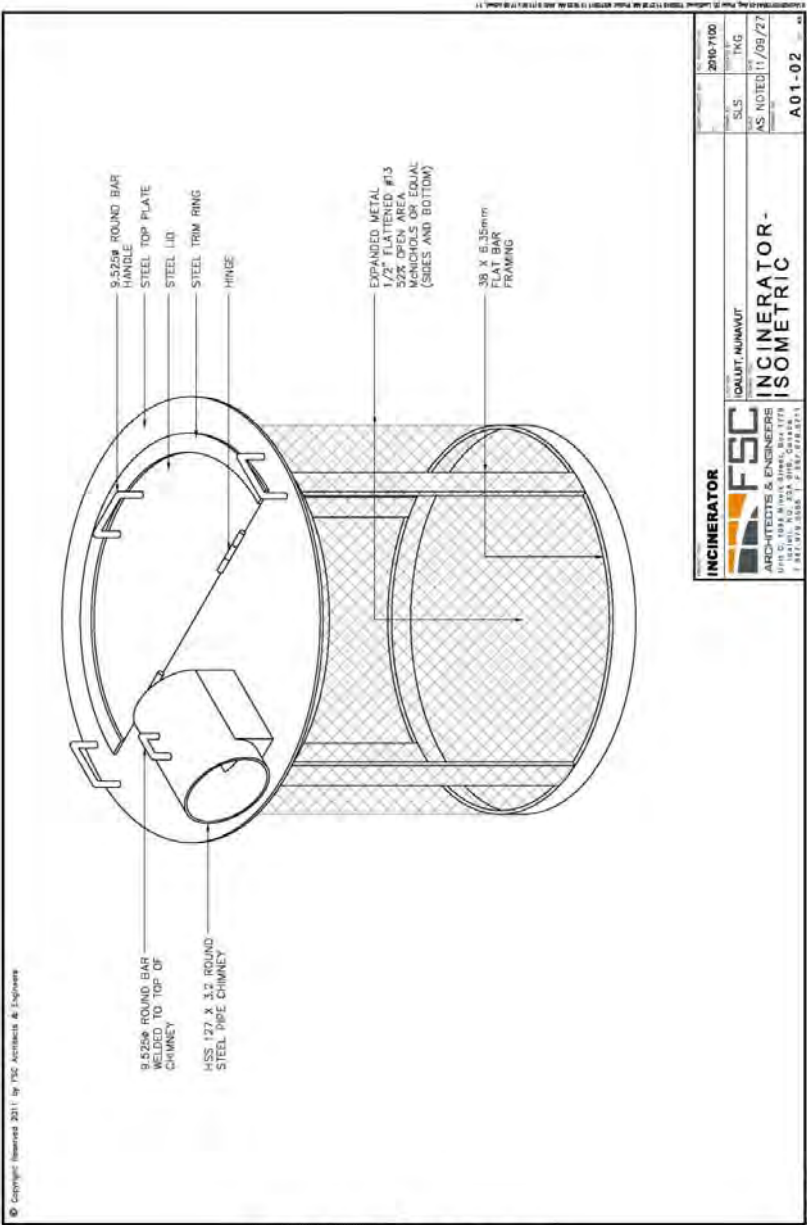
A hinged top helps to capture heat and enables easy loading and mixing of waste.

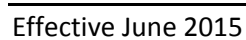


A metal basket or grate suspends the burning waste and enables mixing with the incoming air. The removable basket also enables access to any unburned ash that may collect in the bottom of the barrel.



Guideline for the Burning and Incineration of Solid Waste





Appendix E: 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 Effoda
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