Baffinland Iron Mines Corporation
Mary River Project

Waste Management Plan Pre-Development Work

Appendix B.6

2011-09-14	A	Approve for Permitting - PDW	A. Grzegorczk	J. Binns	J. Cleland	
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1. Introduction

As demonstrated by Baffinland Iron Mines Corporation (Baffinland) Sustainable Development Policy, Baffinland is committed to taking all necessary steps to ensure that the collection, handling, storage, transportation and disposal of wastes generated during the predevelopment of the Mary River Project is conducted in a safe, efficient and environmentally compliant manner. One of the first steps towards achieving these goals is the preparation of this Waste Management Plan (WMP) for Predevelopment Work. The WMP establishes the roles and responsibilities of the all personnel working onsite as well as protocols for handling, storing and disposing of all wastes generated onsite. The intent is to afford a high degree of control over the waste generation and to minimize the adverse environmental effects associated with waste generation.

The basis of a sound waste management program lies in the three R's: reduction, recovery / reuse and recycling of wastes. The main objectives of this WMP are:

- the creation of a framework for the proper handling and disposal of wastes
- the minimization of potentially adverse impacts on the environment
- compliance with all regulatory requirements for waste management.

Waste generation follows the "Cradle to Grave" principle. It is the primary responsibility of all personnel to implement the plan as outlined, in accordance with their contractual and legal obligations, under the supervision of Baffinland Iron Mine personnel as assisted by Construction Manager.

This WMP applies to the predevelopment work of the Mary River Project. This plan will be reviewed on an regular basis and updated as necessary to accommodate any deficiencies, inadequacies or potential improvements that are identified.

1.1 Sustainable Development Policy

SUSTAINABLE DEVELOPMENT POLICY

At Baffinland Iron Mines Corporation, we are committed to conducting all aspects of our business in accordance with the principles of sustainable corporate responsibility and always with the needs of future generations in mind. Everything we do is underpinned by our responsibility to protect the environment, to operate safely and fiscally responsibly and to create authentic relationships. We expect each and every employee, contractor, and visitor to demonstrate a personal commitment to this policy through their actions. We will communicate the Sustainable Corporate Policy to the public, all employees and contractors and it will be reviewed and revised as necessary on an annual basis.
These four pillars form the foundation of our corporate responsibility strategy:

1. Health and Safety
2. Environment
3. Investing in our Communities and People
4. Transparent Governance

1.0 HEALTH AND SAFETY

- We strive to achieve the safest workplace for our employees and contractors; free from occupational injury and illness from the very earliest of planning stages. Why? Because our people are our greatest asset. Nothing is as important as their health and safety.
- We report, manage and learn from injuries, illnesses and high potential incidents to foster a workplace culture focused on safety and the prevention of incidents.
- We foster and maintain a positive culture of shared responsibility based on participation, behaviour and awareness. We allow our workers and contractors the right to stop any work if and when they see something that is not safe.

2.0 ENVIRONMENT

- We employ a balance of the best scientific and traditional Inuit knowledge to safeguard the environment.
- We apply the principles of pollution prevention and continuous improvement to minimize ecosystem impacts, and facilitate biodiversity conservation.
- We continuously seek to use energy, raw materials and natural resources more efficiently and effectively. We strive to develop pioneering new processes and more sustainable practices.
- We understand the importance of closure planning. We ensure that an effective closure strategy is in place at all stages of project development and that progressive reclamation is undertaken as early as possible to reduce potential long-term environmental and community impacts.

3.0 INVESTING IN OUR COMMUNITIES AND PEOPLE

- We respect human rights and the dignity of others. We honour and respect the unique culture, values and traditions of the Inuit people.
- We contribute to the social, cultural and economic development of sustainable communities adjacent to our operations.
- We honour our commitments by being sensitive to local needs and priorities through engagement with local communities, governments, employees and the public. We work in active partnership to create a shared understanding of relevant social, economic and environmental issues, and take their views into consideration when making decisions.

4.0 TRANSPARENT GOVERNANCE

- We will take steps to understand, evaluate and manage risks on a continuing basis, including those that impact the environment, employees, contractors, local communities, customers and shareholders.
- We ensure that adequate resources are available and that systems are in place to implement risk-based management systems, including defined standards and objectives for continuous improvement.
- We measure and review performance with respect to our environmental, safety, health, socio-economic commitments and set annual targets and objectives.
- We conduct all activities in compliance with the highest applicable legal requirements and internal standards
- We strive to employ our shareholder's capital effectively and efficiently. We demonstrate honesty and integrity by applying the highest standards of ethical conduct.

Tom Paddon
President and Chief Executive Officer
September 2011

1.2 Project Description

Mary River Project (the Project) is located at Mary River, North Baffin Island, 1000 km north of Iqaluit, 160 km south of Pond Inlet, and 155 km north of Igloolik, in the Qikiqtani Region of Nunavut.

The Project consists of the predevelopment work, construction, operation, closure and reclamation of an open mine pit and associate infrastructure for mining, ore crushing, screening, transportation and shipment of 18 [Mt/a] of high grade iron ore (average of 64.66%) to international markets. Due the high grade of ore, only crushing and screening will be require with no need for secondary processing (chemical processing) and therefore, no tailings will be produced.

The predevelopment of the Project is assumed to start in 2012 during the open water season. The predevelopment work phase for the Project will include the work described in Application for Review and Approval of Pre-Development Work for Baffin Island (H337697-0000-07-124-0002) by Hatch.

All pre-development activities are regulated and will be performed according to the law and regulations applicable to the Project and procedures developed.

The Waste Management Plan (WMP) presented in this document establishes a management strategy for all the wastes generated as a result of the pre-development work of the Project.

1.3 Definitions

The Project	:	All necessary tasks and work forming the pre-development phase of the greater Mary River Project, on the Site.
Site	:	All of the areas occupied by the Project facilities (permanent or temporary) during predevelopment, the construction, operation, closure and reclamation phase of the Project.
Sub Contractor	:	A person or business which provides goods, material, equipment, personnel, and / or services to Baffinland Iron Mines Corporation under terms specified in a contract.
Waste	:	All residual material (hazardous, non-hazardous or putrescible) generated during the construction, operation, closure and reclamation phase of the Project.
Hazardous Waste	:	All kind of wastes generated during the lifespan of the Project and that present a threat to the human health or the environment because they possess one or more of the following characteristics: corrosive, reactive, explosive, toxic, flammable, or biologically infectious.
Non-Hazardous Waste	:	All kind of wastes generated during the lifespan of the Project and that do not present a threat to human health or the environment.

Putrescible Wastes	:	Any wastes generated during the lifespan of the Project and that are degraded very rapidly, i.e., plants, food scraps or animal remains.

2. Purpose and Scope

During the pre-development phase of the Project several types of liquid and solid wastes will be generated including, but not limited to, oil wastes, ashes, contaminated fuel, hazardous wastes, chemical wastes, batteries, packaging wastes, organic wastes and industrial wastes.

Although this waste generation is expected to be minimal, the WMP is an instrument which describes the classification, collection, sorting, storage, treatment and final disposal of wastes generated during the pre-development phase of the Project, and outlines the legal and corporate requirements.

The WMP is based on the principle of replace, reduce, re-use and recycle. Any non-hazardous solid waste generated during the predevelopment activities will be disposed of in the existing camp disposal facilities (landfill, incinerator) or collected and stockpiled in a secured area of the laydown area designated to receive equipment and material. The solid waste will be safely stockpiled until that sites landfill site or incinerator facility is constructed and ready for use.

Any hazardous waste generated during predevelopment activities will be stored in sealed shipping containers in a secured area and will be shipped to an off-site treatment/disposal facility.

The objectives for the WMP presented in this document are:

- creating a guide for classification, collection, sorting, storage, treatment, and final disposal for wastes
- minimize the generation of wastes and reduce the remediation or treatment costs
- minimize the adverse environmental impacts
- compliance with the current regulation associated with the management, transport and final disposal of different kinds of waste.

The WMP presents the type and quantities of wastes generated throughout the lifecycle of the Project and the disposal method, as well as the roles and responsibilities of the parties during the different stages of the Project. The Plan also defines roles and responsibilities, as well as the specific requirements for managing, transporting and disposal of solid wastes generated by the Project.

3. Roles and Responsibilities

The Sustainable Development department is responsible for environmental management, including ensuring compliance with applicable regulations and permit requirements through on-going monitoring, and the development and implementation of operational standards, procedures and employee training. Roles and responsibilities for implementation of the Waste Management Plan – Pre Development Work are described in Table 3.1.

Table 3.1 Position and Responsibilities

Position	Responsibility
HSE Director	- Accountable for the environmental performance on site - Establishes goal and targets for environmental performance - Responsible for the implementation of Baffinland Environmental Management Plans
HSE Manager	- Provides direction on environmental issues to the Site Management Team - Staffing of Environmental Department - Supervise / conduct site inspection and audits - Initiate and manage environmental studies as required - Manage external environmental consultants/specialists - Environmental reporting as required by permits and authorizations - Liaise with regulatory agencies on all environmentally related issues
Environmental Lead	- Provide specialist advice and input on environmental matters, - Conduct environmental studies and monitoring programs - Conducts audits of operations, as requested - Prepare environmental reports

Position	Responsibility
Contractors / Subcontractors	All contractors / subcontractors are considered equivalent to Baffinland staff in all aspects of environmental management and control, and their responsibilities in this respect mirror those of Baffinland personnel. Contractor personnel will be included in the on-site induction process. The responsibilities of the Contractors / subcontractors include the following: - comply with the requirements of the EPP - conduct regular site checks / inspections to ensure that regular maintenance/enhancements are undertaken to minimize potential environmental impacts - provide personnel with appropriate environmental toolbox / tailgate meetings and training - work cooperatively and proactively with Environmental Coordinator and Construction Manager to facilitate implementation of the above.

Table 3.2 presents the management team responsible for overseeing implementation of Baffinland's Environmental Management Plans during the Project Pre-development Phase and their contact information.

Table 3.2 Baffinland Management Members and Contact Information

Position	Individual	Telephone Contact	E-mail Contact
On-site Coordinator	**Cliff Pilgrim or Jeff Bush**	**Emergency After Hours Tel: 403-450-8844** Mine Site Tel: 403-450-7312 Milne Port Tel: 647-723-2077 (24 hours)	cliff.pilgrim@baffinland.com jeff.bush@baffinland.com
Environmental Superintendant	**Jim Millard**	Mine Site Tel: 403-450-8843 Off-Site Cell: 902-403-1337	jim.millard@baffinland.com
Operations Manager	**Dave McCann**	Mine Site Tel: 403-450-8843 Cell: 416-616-8860	david.mccann@baffinland.com
	Erik Madsen	Office Tel: 416-814-3980 Cell: 416-996-5523	erik.madsen@baffinland.com
As of June 2011; Note: This information will need to be reviewed prior to commencement of pre-development work when information is available			

Baffinland's On-Site Coordinators are responsible for enforcement of waste management practices at the Mary River Project. They train and inform site personnel on matters pertaining to waste management practices. He works cooperatively to Baffinland's Environmental Superintendant and reports to the Operations Manager.

3.1.1 HSE Manager

With respect to management of hazardous waste generated on its site, Baffinland's Operations Manager and On-Site Coordinators or their designates, under the guidance of the HSE Director, are responsible for:

- classifying, labelling and storing the hazardous waste properly
- register as a waste generator
- ensure manifest is properly completed and accompanies the shipment
- ensure the waste is transported by a registered hazardous waste carrier to a registered receiver
- registering the hazardous waste management facility as required
- ensuring the proper disposal of hazardous waste by an acceptable method
- ensuring workers are trained in the management of hazardous waste including emergency response in the event of a discharge
- complying with other applicable regulatory requirements for hazardous waste management including transportation, occupational health and public health.

3.1.2 Training programs

Baffinland will identify and document training needs and deliver the appropriate training to all employees and contractors whose work may impact on the risks to health and safety in the work place and whose work may cause a significant environmental impact. Employees and contractors will be made aware of:

- the importance of conformance with this Waste Management Plan and its procedures
- the risk to the environment and health and safety associated with handling of various types of waste products
- the consequences to the environment, health and safety if there are deviations from specified operational controls
- their specific roles and responsibilities in achieving conformance.

Staff and sub-contractors working on site will receive environmental training as part of the Site Orientation, to achieve a basic level of environmental awareness understanding of their obligations regarding compliance with regulatory requirements, commitments and best practices.

Construction Managers and contractor supervisors will be provided this Plan and will receive additional orientation with respect to the requirements outlined.

Targeted environmental awareness training will be provided to both individuals and groups of workers assuming a specific authority or responsibility for environmental management or those undertaking an activity with an elevated high risk of environmental impact. These will be delivered in the form of toolbox/tailgate meetings or other means as appropriate.

The content of the environmental component of the site induction will include at a minimum:

a) location of environmental sensitivities

b) location of additional information on environmental matters

c) due diligence responsibilities

d) responsibilities related to waste management, minimizing noise as necessary, road traffic rules, etc.

e) principles and necessary steps to avoid encounters with bears or other wildlife and what to do if one such encounter occurs.

With respect to waste management, Baffinland will have a written training and awareness plan which will consider:

- the differing level of risks and potential consequences associated with different types of wastes
- the different responsibilities, abilities, and literacy of employees
- the culture of the employees
- contractors involved and their relevant experience/expertise
- the trainers, training methods and settings
- training frequency
- documentation of training and evaluation of training.

Baffinland will regularly review and update the training and awareness plan based on changes in training needs and regulatory required training.

3.1.3 Communication

The types of communications for which members of the team will participate include the following:

a) formal written correspondence and meetings with stakeholders

b) site visits by community representatives

c) design, construction and planning meetings

d) field inspections and monitoring reports disseminated by the Environmental Health & Safety Superintendent

e) electronic communications

f) tailgate/toolbox meetings

g) formal written correspondence and meetings with government regulatory bodies

h) formal environmental awareness training

Communications will be appropriately recorded and filed for future reference. Where appropriate, the copies of communications will be forwarded to the Operations Manager(s), and Vice President Sustainability.

3.1.4 External Communications

Effective forms of communication include the proactive notification to external stakeholders of Project activity. Project activity updates will be provided to the communities of North Baffin through various means including regular meetings, public notices and radio announcements as appropriate. Baffinland will endeavour to maintain Community Liaison Offices to assist in this regard. Information on waste management will be integral to this external communication effort.

4. References

- Mary River Project – Draft Environmental Impact Statement. Volume 3, Project Description.
- Mary River Project – Draft Environmental Impact Statement. Volume 10, Environmental, Health and Safety (EIS) Management System. Appendix 10D-4, Waste Management Plan. SD-EMMP-004.

5. Waste Management Strategy

5.1 Waste Generation Areas

5.1.1 Milne Port

All non-hazardous solid waste generated at Milne Port during predevelopment activities will be incinerated on site or transported to the Mine Site for secure storage and disposal as appropriate.

Waste will be sorted on site as per currently used Baffinland Iron Mines – Mary River Waste Sorting Guidelines (APPENDIX A)

Hazardous waste generated during predevelopment activities will be stored in sealed shipping containers within containment areas and will be shipped from Milne Port to an off-site treatment / disposal facility as per the Basel Convention.

Waste oil or lubricant generated on site will be stockpiled securely on-site until they can be shipped off-site for treatment at a license facility.

Any contaminated soil generated at Milne Port will be sent to landfarm on site. All contaminated snow generated at Milne Port will be placed in a secure containment area for future treatment.

Decommissioning of the bladder farm at Milne Port in 2012 will be performed according to the Action Plan for Decommissioning of Milne Inlet Bulk Fuel Storage Facility and the Construction of New Fuel Tank Storage, 2011 (APPENDIX B).

Estimated quantities and types of waste generated during pre-development work at Milne Port are presented in Table 6.1 and Table 6.2.

5.1.2 Mine Site

During the predevelopment work, the major activity at the Mine Site will be the production of aggregate for use at laydown areas, roads and airstrip construction. Once the laydown areas are prepared work will consist of receiving material in containers and storing it in laydown areas ready for use during the construction phase.

Non-hazardous solid waste generated during the predevelopment activities will be disposed of in the existing Mary River camp disposal facilities (landfill, incinerator). Waste will be sorted on site as per currently used Baffinland Iron Mines – Mary River Waste Sorting Guidelines (APPENDIX A)

Waste oil or lubricant generated on site will be stockpiled securely on-site until they can be shipped off-site for treatment at a license facility.

Hazardous waste generated during predevelopment activities will be stored in sealed shipping containers and will be transported to Milne Port for shipment to an off-site treatment / disposal facility as per the Basel Convention.

Any contaminated soil generated at Milne Port will be sent to landfarm on site. All contaminated snow generated at the Mine Site will be placed in a secure containment area for future treatment.

Estimated quantities and types of waste generated during pre-development work at Milne Port are presented in Table 6.1 and Table 6.2.

5.1.3 Steensby Inlet

During the predevelopment work, the major activities at Steensby Inlet will the production of aggregate for use in the development of the first phase of the air strip, laydown areas and roads. Once the laydown areas are prepared predevelopment work will consist of receiving material in containers and storing it in laydown areas ready for use during the construction phase.

It is estimated that approximately 510 m^3 of solid waste suitable for landfill will be generated during predevelopment work at Milne Port (see Table 6.2). This waste will be collected and stockpiled in a secured area of the laydown area designated to receive equipment and material. The solid waste will be safely stockpiled until the Steensby landfill site is constructed and ready for use.

Waste oil and lubricant generated from the maintenance of mobile equipment will be stored in barrels / shipping containers and will remain stockpiled on-site until they can be shipped off-site for treatment at a license facility.

All waste suitable for incineration from the floating camps during predevelopment work will be treated on board and will not come or remain ashore at Steensby Inlet.

Any hazardous waste generated during predevelopment activities will be stored in sealed shipping containers and will be shipped to an off-site treatment / disposal facility as per the Basel Convention. It expected that waste generation of hazardous wastes caused from predevelopment work will be limited at Milne Port.

5.1.4 Railway Corridor

During predevelopment work the only activity along the rail corridor will be the development of the winter road access to the four rail camps and the staging of camp material and equipment at the camps ready for construction approval. No solid waste should be generated in the rail corridor.

Any incidental, previously unaccounted for solid waste generated at in the Railway Corridor in pre-development work will be transported back to the Mine Site or Steensby Inlet for disposal.

5.2 Waste Disposal Facilities

5.2.1 Mary River Landfill

There is an existing landfill at the Mine Site that will be used to accept waste during pre-development work. In order to maintain the wastes isolated and to prevent of windblown debris, regular cover will be applied to the landfill, and before decommissioning, a cap of native overburden will be placed. The landfill will have a runoff and drainage control in and around the landfill, including erosion and sediment control and proposed restoration measures for erosion.

During the landfill operation and after the placement of the first layer of waste is completed and covered, a second layer will be formed. As part of the operational procedures, compaction of the wastes will be undertaken typically once per week or in combination with collection frequency,

depending on the nature of the waste. Generally the waste will be worked and compacted as it is dumped.

The land size and footprint will be minimized through planned waste minimization and recycling practices, and volume reduction from the incineration of a portion of the waste stream.

The landfill will be used for disposal of inert, non-combustible, non-hazardous wastes generated at the Mine Site during the Project.

The landfill will be operated only by trained personnel who will carry out regular inspection and monitoring of the facility, in order to monitor the volume and waste composition, type and source of wastes, water and soil samples, groundwater temperature and leachate production.

The landfill will be operated in accordance with Baffinland Iron Mines Mary River Landfill Operations Manual, 2011 (APPENDIX B).

5.2.2 Incinerator

When available and if the incinerator has sufficient capacity, combustible non-hazardous wastes generated on-site will be incinerated using an appropriately designed variable flow dual chamber incinerator already existing at Milne Port and the Mine Site.

The justification for using incineration onsite is because this method will divert putrescible waste from the landfill and thus prevent problems associated with odours which attract wildlife, or the creation of poisonous or flammable gases through decomposition of putrescible materials.

The ashes from the incineration process will be placed in closed drums and buried within a designated area of the landfill or remain stockpiled on site until the permanent treatment / disposal facilities are functional. This will only be done however after receipt of TCLP analysis that meets acceptable standards. If the ashes do not meet the standards, they will be treated onsite (if possible) or they will be transported for offsite disposal at a licensed facility.

Only trained personnel will operate the incinerators in accordance with applicable emission requirements. Waste oil will be consumed within waste oil burners in the maintenance shops.

The incinerators used in the Project will meet the requirements of the Canada-wide Standards for Dioxins and Furans and the Canada-wide Standards for Mercury Emissions. Incinerators will be operated in accordance with the Environmental Guideline for the Burning and Incineration of Solid Waste, Department of the Environment, Government of Nunavut 2010 (APPENDIX E).

5.2.3 Hazardous / Medical Waste Storage

The Hazardous / Medical Waste Storage Facility will be used to store Hazardous and Medical Wastes during the pre-development phase of the Project including, but not limited to: chemical wastes, used oils, contaminated laboratory wastes and equipments, batteries, gas cylinders, fluorescent lights, oil wastes, Infectious or pathogenic hospital wastes, expired drugs and sharps.

Hazardous wastes will be temporarily stored in sealed containers at secured designated locations at the Mine Site, Milne Port, and Steensby Port. The waste will be shipped to licensed hazardous waste disposal facilities or to recycling depots as per the Basel Convention.

To ensure safety to the personnel, facility and environment, all hazardous waste will be segregated by chemical compatibility, and emergency response equipment will be provided in the storage site. In addition, only authorized personnel trained in waste-handling procedures will have access to the storage area.

During the lifespan of the Project, regular inspections will be performed and recorded. In order to facilitate the inspection procedure, all the containers will be placed so that each container can be inspected for leaks or deterioration. In case that a container is in a deteriorated condition or presents a leak, the container will be removed immediately and the contents will be transferred to another container.

5.2.4 Landfarm

The landfarm will be used for remediation of soil contaminated with oil spills. The remediation process will occur through volatilization and natural biological processes. After the remediation process is complete (and the levels of hydrocarbon meet the Nunavut standards), the soil will be transported and deposited in the landfill, as a cover material.

Temporary landfarms will be used at the Mine Site and Steensby for all contaminated soil that is generated in pre-development activities. At Steensby the temporary landfarm will be located adjacent to fuel farm in the secured laydown area. At the Mine Site the temporary landfarm will also be located adjacent to fuel farm in the secured laydown area. Temporary landfarm design will ensure that all contamination is properly contained. All contaminated snow, ice and water generated on site will be contained in impermeable containment area for future treatment adjacent to the landfarms.

At Milne Inlet the landfarm will be constructed during the decommissioning of the existing Milne Inlet Bulk Fuel Storage Facility (bladder farm) and will be used for contaminated soil and snow generated during pre-development work as well as rehabilitation of the soil of the decommissioned bladder farm.

All landfarms will be operated in accordance with the EBA Landfarm Operations, Maintenance and Monitoring plan, 2010 (APPENDIX E).

5.2.5 Used Tires

Used tires will either be stockpiled at Milne or Steensby port facilities for shipment offsite to be disposed of, recycled or reused at a licensed facility, or will be disposed onsite in the landfill, or in a designated location within the waste-rock pile footprint at a depth that will allow for permafrost aggradation.

5.3 Ship Wastes

During the lifespan of the Project, no wastes originating from ships will be accepted on-site. In order to treat their own wastes, vessels will be equipped with:

- sewage treatment plant
- a diesel-fired incinerator for incinerating solid, liquid and oil wastes as well as sludge from the sewage plant.

6. Waste Identification

During the predevelopment phase, minimal amounts of hazardous, non-hazardous and putrescible wastes are generated. The types and estimated quantities of wastes generated during the pre-development phase are shown in Table 6.1 and Table 6.2.

Table 6.1 Solid Waste generated during Pre-Development Phase and General Disposal Methods

Waste	Waste Description	Disposal Method	Est. Total Annual Production (tonnes)
Estimated Domestic Solid Non Hazardous Waste[1]			
Organic	Kitchens	Incinerator	173
Paper	Packaging / Offices	Incinerator / On-site landfill	49
Plastic	Offices / Camps	Incinerator[3] / On-site landfill	35
Cardboard	Packaging / Camps	Incinerator	38
Cloth	Camps	Incinerator	11
Multi-Material	Packaging / Camps	Incinerator / On-site landfill	8
Metal	Packaging	On-site landfill	5
Glass	Camps	On-site landfill	5
Wood	Packaging	Incinerator	3
Hazardous Waste [2]			
Waste oils and fluids	Maintenance	Shipped off Site	150
Batteries	Maintenance	Shipped off Site	15
Spent activated carbon	Domestic	Shipped off Site	15
Human Waste	Domestic	Shipped off Site	10
Aerosol containers	Misc.	Shipped off Site	9
Empty compressed gas cylinders	Misc.	Shipped off Site	minimal
Kitchen grease	Kitchen	Shipped off Site	65
Crushed drums / plastic pails	Misc.	Shipped off Site	30
Spoiled CaCl	Drilling	Shipped off Site	5
Contaminated Soils or Snow to Landfarm			
Soils contaminated with Hydrocarbon	Fuel spill	On-site treatment (landfarm)	-
Water/ice/snow contaminated with HC	Fuel spill	On-site treatment (landfarm)	-

Notes:

1. Composition based in part on 2011 Mary River Waste Audit results (Aug 27 - Aug 29).
2. Composition based on Canutuec Hazardous Waste Shipment Manifest from Mary River Project 2011.
3. Poly-chlorinated plastics will be sorted out of waste stream and sent to landfill and will not be incinerated.

6.1 Waste Quantities

For expected quantities of non-hazardous solid waste generated for the pre-development work phase are shown in Table 6.2.

Table 6.2 Waste Quantities

Project Phase and Location	Time Period	On Site Personnel	Total Waste Generated (excluding sludge and ash)[1]	Total Domestic Related Waste Generated	Total Construction Related Waste Generated	Total Waste Expected to be Generated On Site[4]	**Incineration Waste**		**Inert Landfill Waste**			
							33% of Waste Stream - Suitable for Incineration	Total Waste Incinerated	66% of Waste Stream - Suitable for Landfill[6]	Inert Wastes[3]	Ash[2]	Total
			(tonnes)							(m^3)		
Pre-development Work (PDW)												
Mine Site Camp	Daily (avg)	100	1	0	0	1	0	0	0	1	0	1
	Total[7]	36300	203	94	110	203	68	68	136	339	68	407
Steensby Port Camp	Daily (avg)	300	2	1	1	1	N/A[5]	N/A[5]	1	2	N/A[5]	2
	Total[7]	67500	378	174	204	204	N/A[5]	N/A[5]	204	510	N/A[5]	510
Milne Inlet Camp	Daily (avg)	50	0.3	0.1	0.2	0.3	0.1	0.1	0.2	0.5	0.1	0.6
	Total[7]	23400	131	60	71	131	44	44	87	218	44	262
PDW Total			**712**	**328**	**385**	**538**	**269**	**269**	**359**	**1068**	**111**	**1179**

Notes:

[1] Disposal Rate of 5.6 kg/day - Cold Region Utilities Monograph, 3rd edition, pg 14 - 16 1996

[2] Estimated ash density was assumed as 1.0 tonnes/m^3 - AMEC Earth & Environmental. Victor Diamond Mine Project Comprehensive Study. Waste Management Addendum January 18, 2005

[3] Estimated ash density was assumed as 0.4 tonnes/m^3 for moderately compacted solid waste - AMEC Earth & Environmental. Victor Diamond Mine Project Comprehensive Study. Waste Management Addendum January 18, 2005

[4] Assumed no domestic waste will come up ashore at Steensby Inlet

[5] No waste appropriate for incineration will be brought or left on-shore at Steensby Inlet

[6] All waste at Steensby brought on site will be disposed of in landfill

[7] Total amount of people days on site during PDW

7. Waste Monitoring

Waste monitoring includes the visual inspection of the main components of the waste management system (i.e. incinerator, landfill and hazardous waste) and the measurement and recording of all wastes taken off-site. The following information will likely be reported on an annual basis as currently is the practice:

a) the quantities hazardous waste transported off-site for disposal

b) the location and name of the disposal facility for each waste type

c) the date that each was hauled off-site for disposal, for each occasion that these are removed from the site

d) quantities of non-hazardous inert solid wastes disposed in the landfill

e) quantities of hydrocarbon contaminated soils and water processed in treatment facilities.

Inert solid wastes will be stored and disposed in a manner that minimizes the opportunity for wind-blown debris and animal attraction. Any wastes that are shipped off site will be recorded using an Off-Site Waste Disposal Log.

Regular visual inspection of waste management facilities will be conducted by the Environmental Coordinator to ensure proper operation and adequate environmental/health and safety controls are in place.

8. Applicable Legislation

The law and regulations applicable to achieve a minimum standard of acceptability are shown in Waste management practices will comply with all these law and regulations.

Table 8.1 Applicable Legislation

Department	Legislation
Environment and Conservation	Territorial Lands Act 1985
	Territorial Land Use Regulations
	Nunavut Waters and Nunavut Surface Rights Tribunal Act 2002
	Canadian Environmental Protection Act
	Transportation of Dangerous Goods Act and Regulations
	Nunavut Waters and Nunavut Surface Rights Tribunal Act 2002
	Canadian Environmental Protection Act
	Transportation of Dangerous Goods Act and Regulations
	Worksite Hazardous Materials Information Systems Regulations
	Export and Import of Hazardous Waste Regulations
	Spill Contingency Planning and Reporting Regulations
	National Fire Code
	Explosives Act
	Fisheries Act
	Metal Mining Effluent Regulations
	Petroleum Refining Liquid Effluent Regulation
Government Services	Safety Act, Occupational Health and Safety Regulations
	Public Health Act

8.1 Permits and Authorizations

In order to be compliant with relevant legislation, permits and authorizations are required when dealing with specific type of wastes. All parties having responsibility for waste handling shall make themselves aware of any legislation specific to their needs.

AG:ag

APPENDIX A:

Baffinland Iron Mines – Mary River Waste Sorting Guidelines

Baffinland
Iron Mines Corporation

WASTE SORTING GUIDELINES

Why sort waste?

To protect the health and safety of site personnel.

To minimize contamination, wildlife attraction, and other adverse environmental impacts.

Where to sort waste?

Workplaces and the Waste Sorting Area, located next to the incinerator.

Who should sort waste?

Everyone.

All who manage, handle, store and/or dispose of any of the materials mentioned in these guidelines.

- ➡ *All employees and contractors generating the waste are responsible for ensuring that it is labelled and sorted correctly.*
- ➡ *Employees and contractors are also responsible for contacting Site Services Manager on channel 2 when waste containers are full and ready for pick-up.*
- ➡ *For unusual or hard to segregate waste types, please contact the Environment Office.*

INCINERATOR WASTE

Disposal Instructions

Indoors: Black garbage bags in rubbermaid waste bins.

Outdoors: Black garbage bags in 45 gal. drums, consolidation in steel containers with lid.

Acceptable Waste

Cardboard
Food Scraps
Oily Rags
Paper
Scrap Wood
Small Plastic

LANDFILL WASTE

Disposal Instructions

Outdoors: Steel Containers.

Access to the landfill is for Authorized Personnel Only. Landfill Operators should refer to the landfill user rules for more information.

Acceptable Waste

Concrete
Corrugated Cardboard
Empty Clean Container
Glass
Metal
Bulky Wastes (after approval by Environment Office)
Wood Products

HAZARDOUS WASTE

Waste Type	Disposal Instructions
Absorbent (used)	White Quatrex or overpack drums
Aerosol Cans	Labelled bins outside bathrooms; overpack drums outdoors
Antifreeze	Cubes or drums (closed top)
Batteries (AA, 9V, etc)	Labelled bins outside bathrooms
Batteries (vehicle)	Black Quatrex
Contaminated Soils	White Quatrex or overpack drums
Contaminated Water	Drums (closed top)
Electronic Waste	White Quatrex
Fluorescent Bulbs	20L pails outside bathrooms
Mixed Waste Containers	White Quatrex (antifreeze, grease, oil and polymer)
Waste Fuel	Drums (closed top)
Waste Grease	Overpack drums
Waste Oil	Cubes or drums (closed top)
Waste Oil Filters	Drums (open top)

APPENDIX B:

Action Plan for Decommissioning of Milne Inlet Bulk Fuel Storage Facility and the Construction of New Fuel Tank Storage

Action Plan for Decommissioning of Milne Inlet Bulk Fuel Storage Facility and the Construction of New Fuel Tank Storage

PERMIT TO PRACTICE
HATCH LTD.
Signature
Date AUG 08, 2011
PERMIT NUMBER: P 512
The Association of Professional Engineers, Geologists and Geophysicists of NWT/NU

REGISTERED PROFESSIONAL ENGINEER
08/08/2011
R. A. HALIM
LICENSEE
NWT/NU

2011-08-08	3	Incorporate QIA comment	T. Mackay	F. Butts	R. Halim	
2011-06-11	2	Title correction, Issue for Permit	T. Mackay	F. Butts	R. Halim	
2011-06-11	1	Issue for Permit	T. Mackay	F. Butts	R. Halim	
DATE	**REV.**	**STATUS**	**PREPARED BY**	**CHECKED BY**	**APPROVED BY**	**APPROVED BY**
			HATCH			**CLIENT**

Project Report

August 8, 2011

Baffinland Iron Mines Corporation

Mary River Project

Action Plan for Decommissioning of Milne Inlet Bulk Fuel Storage Facility and the Construction of New Fuel Tank Storage

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1. Description and Overview

At Milne Inlet the existing bulk fuel storage facility, consisting of bladders and support infrastructure that is reaching its useful design life, will soon require replacement. This document outlines the plan and schedule for the construction of a 5 M liter storage tank and the decommissioning of the existing bulk fuel facility. These activities will comply with Nunavut and Federal regulatory requirements.

2. Scope

The decommissioning of the existing bulk fuel storage facility requires the construction of a containment area (or dyke) for the new storage tank and supporting facilities. The main components of the fuel storage system that will require delivery to Milne Inlet during the open water shipping season are the steel tank, dispensing unit, spill kits and fire safety system. The storage tank and dispensing unit need to be assembled and tested. Completion of these activities are required before transfer of fuel can occur between the existing and new bulk fuel storage facilities. At the completion of the fuel transfer, the existing bulk fuel storage facilities can be decommissioned. The sections that follow describe these activities in more detail.

2.1 Geotechnical Drilling

During June 2011, geotechnical drilling will confirm the integrity of the ground of the proposed tank location, in addition to the proposed dyke. During the drilling, soil sampling and testing will be done to validate the decision.

2.2 Sea Transport and Delivery

The tank sections, bulk dispensing module, dyke liner, lighting, spill kits and fire safety systems required for the 5M Liter storage tank will be procured in July and early August 2011 and shipped to Milne Inlet during August and September 2011.

2.3 Containment Dyke Construction

Based on the results of the geotechnical drilling, the containment dyke will be constructed during late August so that it is ready to receive the storage tank once it arrives in Milne Inlet (shipping season dependent).

2.4 Storage Tank and Bulk Dispensing Module Erection and Testing

The installation of tanks will be in accordance with API standard 650 and the National Fire Code of Canada. The contractors will take care not to puncture the dyke membrane with scaffolding and/or digging. If any damage to the membrane should occur, it shall be repaired.

The tank sections will be positioned using lifting lugs and hooks, and where necessary spreader bars. No chain will be used in the lifting of tank shell plate in order to prevent damage to the membrane. When installing the tank, sufficient bracing to partially assembled sections of the tank will be maintained to prevent movement and damage.

Field tests for leaks will be completed in accordance with API 650 which is acceptable evidence of testing. The testing will be non-destructive testing of 100% of all the welds. A contractor will

be responsible for confirming that the tank base finish grade elevation tolerances are within acceptable ranges as per API-650 before and after floor plate installation.

Once the non destructive testing has been completed the tank will be cleaned and all debris shall be completely removed from the tank.

The bulk dispensing module will arrive on a skid and be placed into position on the west side of the dyke and commissioned. The spill prevention materials, clean up kits and fire extinguishers will be situated around the dispensing module to effectively control any spills or fires associated with the tank and dispensing unit. To safeguard against spills between the tank and the dispensing unit, the dyke liner will be extended to encompass both the piping and dispensing unit. The bulk dispensing module will comply with the following codes: Canadian Electrical Code – CSA 22.1; National Fire Code of Canada; ASME A31.3 – Process Piping; and B346-M1980 Power Operated Dispensing Device.

2.5 Milne Inlet Fuel Consignment

Fuel for the 2011/2012 season is scheduled to arrive late September and pumped, as per normal, from the fuel supply ship to the bladders. The bladders will hold the fuel until the new storage tank is commissioned.

2.6 Transfer of Fuel

Once the storage tank is commissioned and signed off which could be as late as spring 2012, the fuel from the bladders will be transported by fuel truck between the bladders and the new storage tank.

2.7 Bladder Decommissioning

In the summer of 2012, the existing bulk fuel storage facility, consisting of bladders and support infrastructure will be decommissioned once the facility has been permanently removed from service.

The bladders will be drained of fuel and the vapors purged (aired) from the bladders, piping and support infrastructure. The equipment (including the bladders, piping, liner and support infrastructure) will be removed from site, once it is made safe for ship transportation, and shipped south to a permitted waste disposal facility.

Areas within the current existing storage facility containment area are contaminated with petroleum products. The facility will be characterized using established environmental assessment methodologies to quantify and qualify the extent of the potential soil and water impact. Impacted portions of the facility will be remediated to criteria to be established in consultation with applicable federal, territorial, and Inuit agencies and will be based on applicable federal and territorial guidelines such as:

- Canadian Council of Ministers of the Environment, 1999, Canadian Environmental Quality Guidelines, Winnipeg, Manitoba.
- Canadian Council of Ministers of the Environment, 2008, Canada Wide Standards for Petroleum Hydrocarbons in Soil (CWS PHC). Winnipeg, Manitoba.
- Government of the Nunavut, 2009, Environmental Guideline for Contaminated Site Remediation. Department of Environment.

Residual oily water within the containment facility will be treated and discharged by means of an oily water treatment system similar to that being successfully utilized by the current operation during the open water season. Residual oily concentrate will be stored, reused on site, or transported to Southern Canada for recycling or disposal at an approved waste disposal/recycling facility. The existing liner will be removed, appropriately stored, and shipped south for disposal. The residual contaminated soils will be transported to an on-site landfarm for treatment. The remaining clean soils under the liner and existing containment area will be regraded and reclaimed. In addition, the surrounding area will be tested for residual contamination and all impacted soils, if encountered, will either be treated in situ or removed and taken to an approved site location (landfarm) for disposal, as per the approved Abandonment and Reclamation Plan (2010) for the Mary River Project. A landfarm for receiving and treating contaminated soils has not yet been constructed at Milne Inlet, however, the development of a conceptual design and management plan is currently underway.

3. Schedule

See the schedule below for the activities described.

Activity	2011							2012						
	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July
2.1 Geotechnical Drilling														
2.2 Sea Transport and Delivery														
2.3 Containment Dyke Construction														
2.4 Storage Tank and Bulk Dispensing Module Erection, Testing & Commissioning														
2.5 Milne Inlet Fuel Consignment														
2.6 Transfer of Fuel														
2.7 Bladder Decommissioning														

Note: 2.6 Transfer of Fuel – Could occur earlier than May 2012, assuming successful testing and commissioning of new facilities and available resources.

2.7 Bladder Decommissioning – Soil remediation and land treatment will be undertaken past July 2012 and will likely occur for a further two years.

APPENDIX C:

Baffinland Iron Mines Mary River Landfill Operations Manual

Baffinland
Iron Mines Corporation

BAFFINLAND IRON MINES
MARY RIVER LANDFILL OPERATIONS MANUAL

Revision:	0	**Date Revision Effective:**	May 1, 2010
Date Reviewed:			

1. PURPOSE AND SCOPE

The purpose of this procedure is to ensure that non-hazardous solid wastes are disposed of in compliance with the Mary River Landfill permit, and in an efficient, safe and environmentally sound manner.

This procedure applies to the handling, storage and disposal of all non-hazardous solid industrial waste at the Mary River Project Landfill

This procedure does not apply to hazardous and liquid industrial wastes, hauled sewage or domestic waste.

This manual has been designed to be used both as a field reference document and as a training manual for classroom and self-instruction purposes. Every employee with accountabilities and responsibilities as required by this procedure is expected to be familiar with its use and location at the site. The manual has been divided into two sections: the General Overview; and Standard Operating Procedures. The General Overview contains basic knowledge regarding personnel responsibilities, safety practices, and the overall operations of the landfill. Part B focuses on Landfill Work Instructions and has been formatted to provide supervisors and their employees with a user-friendly method for training and implementation.

2. DEFINITIONS

Waste Management System
A waste management system includes all facilities equipment and operations for the collection, handling, transportation, storage, processing and disposal of waste.

Landfill Site
Controlled site where no hazardous wastes are accepted and only specific wastes as outlined in the Mary River landfill approval permit are allowed. At landfill sites, the waste is regularly compacted and covered.

Mary River Landfill
For the purpose of this document, the Mary River Landfill and the Mary River Non-Hazardous Solid Waste Landfill are one and the same

Non-Hazardous Solid Waste

Non-Hazardous Solid Industrial Waste means a solid waste that is not a liquid and is not hazardous and includes and includes:

a) General Waste (cardboard, treated wood, plastics, etc.)
b) Scrap tires
c) Bulky waste such as heavy equipment, trucks, snowmobiles & appliances. These items will be drained of all fluids (oil, fuel, hydraulic fuel; ozone depleting substances must be removed by a licensed technician prior to disposal).
d) Concrete
e) Glass (industrial)
f) Non-toxic incinerator ash
g) Non-Hazardous Solid Spill Clean-up Material
h) Scrap Steel (Non-recyclable)
i) Pallets (Non-recyclable)

A detailed description of these products is contained in the Appendix A

Hazardous Waste

Material that, given its quantity, concentration and composition or its corrosive, inflammable, reactive, toxic, infectious or radioactive characteristics, presents a real or potential danger to human health, safety and public well-being or poses a danger to the environment if it is not stored, treated, transported, eliminated, used or otherwise managed. Includes all material regulated by the Transportation of Dangerous Goods Regulation and those materials requiring a Material Safety Data Sheet. . Examples include paint, solvents, propane tanks, waste oil, batteries, electronic equipment, and fuel drums (205 liter barrels) or other material previously containing fuel or other hydrocarbons are considered hazardous waste. A detailed description of these products is contained in the Appendix A

Recyclable

Ability of a secondary material to be re-used in the manufacture of a new product or to be re-used.

Domestic Waste

Domestic waste includes waste such as office paper, lunchroom supplies, washroom supplies, food waste, containers contaminated with food. Domestic waste can be considered all bagged & boxed waste originating from offices, kitchens and camps, generally suitable for disposal in the incinerator. A detailed description of these products in contained in Appendix A

Scrap Steel

Scrap steel includes scrap steel material that contains no other non-steel component.

Liquid Industrial Waste

Liquid industrial waste includes “waste that is both liquid waste and industrial waste”.

Empty Container
A container that has been emptied, to the greatest extent possible, using regular handling procedures, but it's content shall not exceed 1% of the container's original capacity or 2 liters, whichever is less. This does not include containers which previously contained :

i. Mercury or other heavy metals
ii. Compressed gas cylinders (TDG Class 2.1-2.4)
iii. Oxidizing substance containers, (TDC Class 5.1)
iv. Poisonous substances containers (TDG Class 6.1)

Part A – Mary River Landfill General Overview

I. Responsibilities

Designated Mary River employees & contractors have specific accountabilities that must be met to ensure the Mary River Landfill is operated in compliance with this procedure and its permit. The following roles and responsibilities of the various employees who work at the disposal site are described below but are not necessarily inclusive of all duties that may required to safely and successfully operate a non-hazardous solid waste landfill.

1. Mary River Camp Manager

The Mary River Camp Manager is accountable for the overall operation of the landfill. Specifically, he/she shall:

a. Organize, oversee and administer the operation of the landfill in accordance with current permits, regulations and all appropriate procedures,
b. Plan and coordinate the most efficient use of landfill areas to conserve landfill space,
c. Help develop, implement and enforce landfill specific safety regulations
d. Meet routinely with the Site Services Supervisors to maintain proper control of the site and to determine what, if any, problems exist or may be anticipated. Consider the following:
    i. Operational issues,
    ii. Regulatory Requirements,
    iii. Equipment issues,
    iv. Special operating instructions; e.g., inclement weather, special waste, emergencies.
    v. Schedule routine work as required, e.g., drainage channel cleaning, landfill surface repairs and litter control, etc,
    vi. Ensure that the need for any special operating conditions have been planned for in advance; e.g., identification of features with steaks in advance of winter and the ground freezing,.
    vii. Handle user complaints or problems that the Site Services Supervisor cannot handle,
    viii. Perform all the duties of the Site Services Supervisor in his absence.

2. Mary River Site Services Supervisor

The Site Services Supervisor, under the general supervision of the Mary River camp manager, is responsible for supervising refuse disposal and associated activities at the Mary River Landfill in accordance with this procedure. Specifically, the Site Services Supervisor shall:

a. Regularly brief the Mary River camp manager on the status of routine operations and any special problems,
b. Implement and enforce the landfill safety regulations and operating procedures
c. Install grade control stakes for landfill operators
d. Check grades and contours to ensure that refuse placement and compaction conforms to engineered specifications and designs,
e. Maintain thorough, accurate and detailed records of landfill operations, and other related matters,
f. Ensure through regular inspection that specified fill cover, spill response equipment etc. is present at the landfill,
g. Respond to incidents, complaints and inquiries promptly to ensure the landfill is operated in compliance with this procedure,
h. Inspect waste and direct site users to proper disposal areas according to waste type,
i. Conduct monthly inspection of berm & cover material for cracks & settlement.
j. Set up and monitor traffic patterns to allow maximum traffic flow and safe working conditions.
k. Instruct all contracted crews on critical landfill procedures and areas of concern and monitor progress, keeping records daily & bi- weekly as required this procedure,
l. Perform all the duties of the Landfill Operator/Labourer in his absence.
m. Perform other duties that may be required as determined by the Mary River Camp Manager

3. Mary River Landfill Operator/Labourer

The Landfill Operator/Labours, under the general supervision of Site Services Supervisor, is responsible for executing the following tasks at the landfill. Specifically the Operator/Labourer shall:

a. Work in conjunction with the Site Services Supervisor in executing general landfill operations
b. Perform daily pre-use equipment checks on landfill mobile equipment ,
c. Maintain a level landfill base at the working face dumping area,
d. Cut, maintain and finish grades as indicated on grade stakes or as directed by the Site Services Supervisor,
e. Construct landfill cells according to this procedure,
f. Spread and compact refuse according to this procedure,

g. Cover refuse efficiently according to this procedure, have area covered walked in tight and surface smooth using no more fill than necessary. Leave surface area smooth with no refuse exposed,
h. Inspect waste and direct site users to proper disposal areas according to waste type,
i. Assist in site maintenance work as required; e.g. grade roads, drive water trucks, resurface roads, construct refuse lifts, and other duties as assigned,
j. Ensure the landfill is maintained free of litter, including the relocation of portable litter fences as necessitated by operational requirements and wind conditions,
k. Complete daily report forms as required, know how to respond appropriately to all emergencies utilizing the emergency procedures listed in Section B of this manual,

4. Project manger – Landfill Waste Designated Inspector

On occasion when a Mary River Project has a large quantity of waste destined for the landfill, the project manager may be provided with specific training to allow he/she to become a designated Mary River Landfill waste inspector to facilitate the source segregation, improve the productivity of the project resources and meet the landfill requirement for waste inspection prior to dumping.

Specifically, the Project Manager - Landfill Waste Designated Inspector shall:

a. Be provided with the necessary training to allow him/her to properly segregate waste by type at the source and pre-inspect waste destined for the landfill
b. Inspect waste and direct site users to proper disposal areas according to waste type,
c. Complete daily report forms as required, know how to respond appropriately to all emergencies utilizing the emergency procedures listed in Section B of this manual,
d. Correct any waste management deficiencies related to the project as identified by landfill staff.

II. Landfill Operations

The Mary River non-hazardous solids landfill is a permitted area method modified landfill as described in the Guidelines for the Planning, Design and Operations and Maintenance of Modified Solid Waste Sites in the Northwest Territories. The landfill has a design life of approximately 3 years and its operation and maintenance is based on the Guidelines to ensure protection of the environment and the health and safety of individuals. The estimated capacity of the current landfill design is 5000 m3 of waste and cover material.

A. Mary River Area Method Landfill Waste Cell Construction

Due to the presence of permafrost, the area method will be used to place waste in the landfill. Waste will be deposited on the ground, worked with appropriate heavy equipment, and packed against a constructed berm. Construction of the berm will be advanced with the advancing face of the landfill. The waste cell is the basic building block of the landfill. It is composed of several layers of solid waste compacted on a slope by heavy equipment and enclosed on all sides by soil. The general placement of waste will progress down-slope from the Northeast rear berm wall towards the northwest end of the site. Basic instructions for constructing waste cells with the materials accepted at the Mary River Landfill are described below in Figure 1.

1. Control of Working Face

The working face is the portion of the uncompleted cell on which additional waste is spread and compacted. The optimal working face width varies depending on the number of vehicles bringing wastes to the site and the equipment available for spreading and compacting. It should be wide enough to prevent a backlog of trucks and productively work; however, the width should not be so wide as to be impractical to operate or to expose an undue amount of refuse to the wind.
The face width should be reduced by compacting and covering portions of the face as soon as a section of the cell meets the grade design. For control of the waste exposure to wind, the width of the face should not exceed 12m at any time.

2. Equipment Movement

Solid waste should be dumped at the toe of the working face by the collection trucks and pushed up the slope. For safety reasons, keep a minimum of 3m separation between the trucks and the dozer. The unloading area is to be maintained level and clear of waste materials.

3. Spreading Waste on a Slope

To maximize compaction, and to provide an optimal weight distribution of the dozer, the waste should be spread up a 3:1 slope in 0.3-0.6 meter layers. Fill in any holes that develop in the face with loose waste.

4. Using Grade Stakes

Use grade stakes to aid operators in keeping the slope of the final top fill surface of at a grade of 0.5%, the slope of the cell face 3:1 and the grade of the landfill base to 0.5%. Grade

stakes should be set according to instructions given by the Engineering Staff. Stakes should be checked frequently enough to allow operators to make sightings to them as required.

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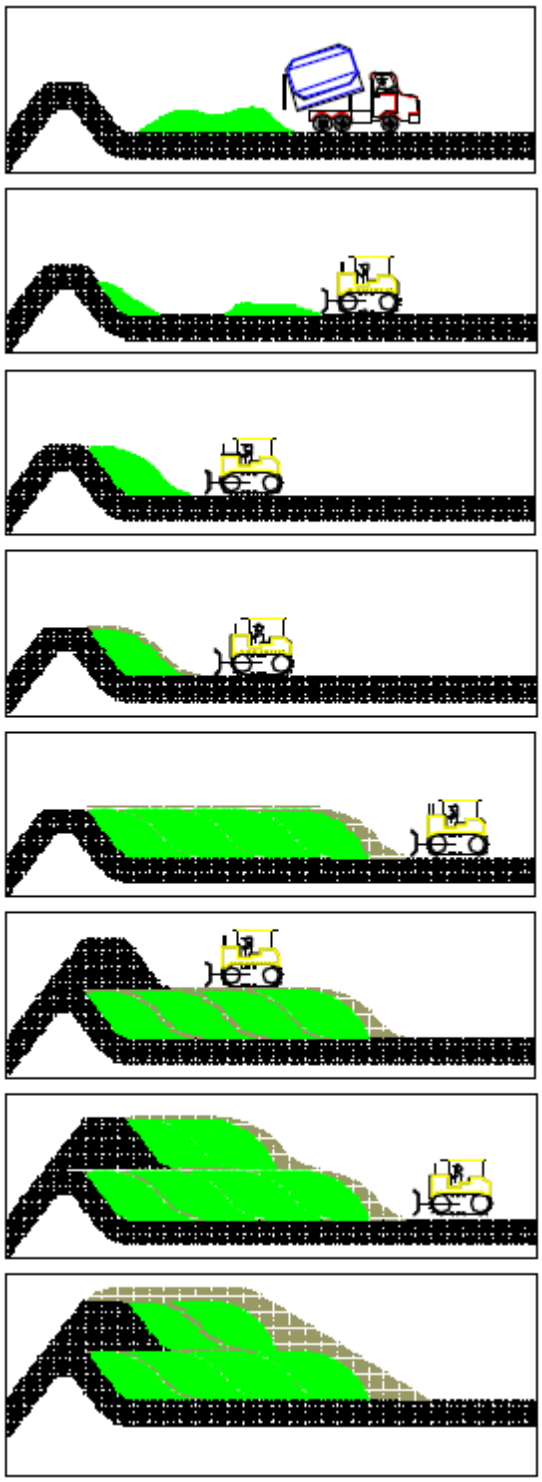

1. Build berm, 2 m high. Dump garbage near the berm. The maximum width of the working exposed face used for dumping should be as small as practical and not exceed 12m
2. Drive over the garbage 3 to 5 times with a dozer. Work the garbage up the berm a little at a time to pack it. Do this daily when material is deposited in the landfill.
3. Alternate between dumping and packing garbage until packed garbage is 2 m high
4. When garbage at the working face is 3 m wide, cover garbage with 0.3m of granular material over the deck of the cell and 0.1m between cells to complete a partial cell. Repeat steps 1 to3 across the width of the landfill until a cell is completed.
5. Repeat steps 1 to 4 until site is full. Then cover all garbage with 0.3 m of granular material. Pack and add more granular material until top is level.
6. Build new 2 m berm on top of cells.
7. Repeat steps 1 to 5.
8. To close out site, put 0.6 m of granular material on cells then pack with bulldozer so that water runs off.

Figure 1. Waste Cell Construction for Mary River Area Method Landfill

5. Waste Compaction

A high degree of compaction extends the fill life, reduces cover material and long-term land requirements, reduces litter problems, and results in other beneficial effects. Good compaction is achieved by operating the dozer up and down the working face between 3 and 5 times on 0.3-0.6 meter layers of waste until no further compaction occurs. The top deck of the cell must also be compacted by running the landfill compactor dozer across the top, keeping it as level as possible. Compaction of the waste will be undertaken if required, depending on the nature of the waste. This will typically occur once per week or in combination with collection frequency and nature of the waste.

6. Cell Completion

Cover soil will be placed over exposed compacted waste cells or portions of waste cells. A minimum of 0.3m of cover shall be placed over the deck and 0.1 meters over the slope of the cell. Use no more fill than necessary. When the cell is completed, no waste should be visible.

B. Cover Soil

1. Excavation

Excavation of soil for cover material shall only be made from designated "borrow" areas. Working cover stockpiles are to be placed within the perimeter of the approved landfill pad where they will be accessible to the working face. However, they are not to be located where they may block truck travel or filling operations.

2. Placement of Final Cell Cover

Use of soil for intermediate and final cover should be placed in the following manner:

a. When using a dozer, push cover soil up the slope and feather it out as evenly as possible. Do not permit the tracks of the equipment to spin as you traverse the compacted slope. This action will tear up the waste and it may be necessary to compact the waste again in order to reapply the cover material.
b. When filling of cell or portion of the cell has reached the final planned grade and width, a final cover of compacted soil should be placed. A minimum of 0.3m of cover shall be placed over the deck and 0.1 meters over the slope of the cell. Use no more fill than necessary.

C. Hard-to-Handle Wastes

Certain wastes acceptable at the Mary River Landfill require special handling. The following are basic methods to be used when managing hard-to-handle waste:

1. Bulky Waste

a. Crushable Items – such as furniture and appliances

Such items should be dumped at the toe of the working face if traffic permits. Use the dozer to crush the item on solid ground, and then push it into the toe of the fill. Fill in any holes with regular waste.

b. Demolition Debris

Spread out bulkier pieces of concrete, lumber, and other debris evenly at the toe of the working face. Place regular wastes on top of the demolition wastes.

c. Long Items

Long, awkward items, such as pipe, rolls of paper and plastic should be dumped at the toe of the face, placed parallel to the working face, and covered with regular waste. The dozer should be driven over these items slowly to prevent overturning.

d. Rubber Tires

Place rubber tires at the toe of the fill, spread them out, and cover them with other wastes. Tires are less likely to work their way to the surface if placed at the bottom of the cell. Do not try to compact unreduced rubber tires.

e. Large Metal Wastes

Metal wastes, such as pipes, rolls of cable, and wires should be placed directly at its position of disposal and covered by household or demolition wastes (bridged). This will prevent unnecessary machine damage and shutdown.

2. Low Density Wastes

Waste types such as organics, synthetic fibers, loose plastic film or foam, and rubber and plastic scraps or shavings, require special handling. These materials present problems because they rebound after being run over by the dozer. Spread the lightweight material into 1 to 2 foot deep layers, and then cover it with regular waste, compacting as usual at base of cell. These wastes should be compacted until the operator can no longer detect that the surface of the waste layer is being depressed more than it is rebounding. The weight of the regular waste tends to keep the low-density material down.

3. Powdery Wastes

Wastes such as sawdust and other dusts also require special handling. These wastes are problems because they are stirred up by the equipment and blown by wind. Once in the air, they may be harmful to personnel if they are inhaled or contact the skin. Personnel not working in enclosed cabs should wear protective clothing and respirators if dust becomes airborne. Some powdery wastes may be wetted down with water from a water truck and then covered immediately with soil or regular refuse. This procedure will help reduce blowing and dusting of the powdery waste. If water is not available, cover the powdery wastes with soil or refuse to reduce blowing and dusting of the waste.

D. Maintenance of Completed Areas

1. Inspection of Completed Areas

A bi-weekly inspection of the berm walls and completed cell will be completed each month for signs of cracks and depressions due to settlement. Cracks and settlement will be filled and compacted back to the original grade

2. Groundwater Protection System

Due to the permafrost in the area, no groundwater protection system has been included.

3. Landfill Gas Assessment

Landfill gas is not expected as the deposited waste will be non-hazardous, non-organic and inert. Also, all chemicals will be diverted for proper hazardous waste disposal. Therefore a landfill gas collection system will not be installed in the landfill site.

4. Leachate Characteristics

Leachate is not expected as the waste to be deposited in the landfill will be relatively dry, inert and non-hazardous. Therefore no leachate collection system has been included in the design. In addition, a perimeter berm will be constructed surrounding the landfill site. This will redirect surface runoff originating upstream of the landfill site, thereby minimizing the amount of water which might infiltrate the deposited waste.

E.. Traffic Control and Unloading of Waste

1. Proper Spotting and Traffic Control

a. Traffic Flow

Traffic should be kept moving at a safe steady rate to avoid backlogs and congestion working face. Drivers are to back to the toe of the slope before he/she starts to dump. The driver is to pull straight away slowly from the slope while s/he is dumping.

b. Aids to Traffic Control

Directional signs, pylons and barricades are to be provided to help control traffic and direct customers to unload the waste at the base of the cell and have them drive their vehicle straight out when unloading is complete. Ensure proper signage and barricades are in the required locations at the beginning of each day. Relocate signs and barricades as required at the end of each day so that they will be in place and ready for the next day's operation.

c. Separation of Vehicles

Due to the risk of dump trucks and trailers overturning, only one vehicle is to be unloaded at the face at a time, this includes vehicles being unloaded by hand.

d. Logging of Unloaded Wastes

A waste unloading logging station will be located in proximity of the working face. The operator of every vehicle that unloads any quantity of waste is required to log the specifics of the load – Date, time, waste type, vehicle type, approximate quantity, etc....

e. Load-on-Fire Procedures

Loads-on-fire are wastes that are either on fire or that are smouldering or smoking within a vehicle or when deposited at working face. All site personnel should be familiar with procedures for handling such loads. Refer to the Emergency Work Instruction in Section B of this manual for proper response procedures.

f. Prevention of Scavenging

Scavenging by employees, visitors and local people travelling through is not permitted. Scavenging in a waste pile is a safety hazard with a high risk of injury and is strictly prohibited

g. Site User Rules

Landfill staff should know all site user rules and watch for violations. User rules (Appendix C) and wastes acceptable for disposal in the landfill (Appendix A) are to be posted at the entrance to the landfill and at the working face. All violation of land fill user rules shall be recorded in the daily log by landfill staff and reported to the Mary River Camp manager.

h. Emergency Procedures

Site personnel shall be familiar with proper fire and accident procedures and are expected to know their role in all possible emergency situations. See the Emergency Work Instructions in Section B of this manual.

F. Landfill On-Site Roadways

1. Road Construction

On-site access roads for use as a thoroughfare for transporting waste to the working face shall only be constructed under the approval of the Mary River Camp Manager and according to engineered design specifications. Landfill maintenance access roads are only to be constructed under the approval of the Mary River Camp Manager.

2. Road Maintenance

a. Maintenance of Gravel Roadways

Roadways that are made in native or filled soil and are heavily travelled required maintenance. These roads should be graded and re-compacted as required to re-establish proper road grades.

b. Filling of Areas Where Settlement Occurs

When all-weather roads are constructed on the tundra, settlement of the filled area may cause cracks to appear in a road or cause the slope of a road to change. Cracks should be filled with material that is compatible with the roadbed. Area of a sloped road, where the slope has changed drastically, it should be built-up with material compatible with the roadway until the desired elevation is achieved.

c. Maintenance of Drainage Culverts

All drainage culverts should be kept free of obstructions and debris. All drainage crossings should be identified with staking prior to winter such that they can be found and opened in advance of freshet. Prior to the onset of freshet, all drainage culverts shall be opened and ready to accept water flow.

G. Inclement Weather

1. Preparation for Weather Conditions Affecting Landfill Operation

Wind, white out conditions caused by blowing storms in winter and spring freshet may have an impact on landfill operations. The following precautions shall be followed:

a. Wind

In preparation for wind storms, the working face shall be compacted and covered as practical to reduce width of the exposed face. Litter fences should be installed prior to windy weather and relocated as required.

b. White Out Conditions Caused by Winter Storms

Under severe white out condition caused by some winter storms, the Mary River camp manager may declare the landfill temporarily closed if conditions at the landfill cannot be made safe to operate.

c. Freshet

Prior to the spring melt of freshet the site services supervisor will take the following precautions to minimize the impact of the water flow from freshet:

i. Ensure all culverts are cleared prior to freshet
ii. Remove all excess snow from the landfill pad and completed cell slope to minimize water accumulation on the pad.
iii. Install silt fencing or other control devices if required on drainage that contain silt as a result of landfill erosion

H. Surface Water Flow and Quality

Flowing surface water will be prevented from entering the landfill site by the construction of a berm along the upper end of the site (i.e. the berm constructed above for waste placement) and berms along the sides of the site. The landfill site area will be graded 0.5% to promote drainage away from the landfill and to prevent pooling of water within the landfill or against the berms.

Appropriate erosion and sediment control measures will be implemented as required through the use of silt fences, etc. Temporary sediment control measures will be used during all construction activities at the site.

I. Inspections and Reporting

a. Reporting

The *landfill daily unloading volume & operations log (See log attached below)* is completed daily and logs waste volumes, compaction and cover application.

b. Routine Inspections

Records of all site operations, including inspections, maintenance, and monitoring will be recorded on designated forms and kept together in the Baffinland office (or other on-site facility used for such purposes). This will be performed and maintained by the landfill Operator.

Routine visual inspections will be completed every two weeks on the *Mary River Landfill bi-weekly Inspection form* (See form attached below) by the Site Services Supervisor or designate for various components of the landfill, including:

- General site area
- Landfill berm and cover survey
- Litter control
- Storm water runoff control
- Vector attractants
- Wildlife observations
- Wildlife signs.

Mary River Landfill Inspection Form.xls

IV. Landfill Safety Practices

A. General Safety Practices

1. Know Procedures

All employees at the landfill are responsible for knowing the proper procedures for reporting accidents, injuries, and fires. Employees must know the procedure to be followed for each type of emergency and be aware of their particular role. Work Instructions for various situations are documented in the Work Instructions section of Part B of this manual.

2. Signage for Traffic Control and Direction

Road boundaries and speed limits on each road shall be clearly posted.

3. Site User Rules

Site user rules are available at the entrance to the landfill and at the working face. Employees are to watch for violations of site user rules and indicate those rules to violators, stressing that the rules are imposed to ensure the safety of people & equipment. Site User Rules are attached in Appendix C.

4. Level Dumping Area

For safe operations, the dumping area shall be kept as flat as possible at all times and kept clear of debris.

B. Safety Precautions for Equipment Operators

1. Heavy Equipment Operation

All mobile equipment in use at the landfill is to be operated in accordance with general Baffinland procedures associated with light truck and heavy equipment.

2. Keep Debris from Cab

Keep operator's compartment, stepping points, and hand holds free from oil, grease, mud, loose objects, and trash.

3. Look in All Directions before Moving

The landfill is a high traffic area - Protect personnel and other equipment in the area by looking to the front, rear, and sides before moving equipment. If the operator is unsure of surrounding conditions, he/she shall dismount and inspect the area.

4. Safety Devices

Proper safety devices, such as safety belts and roll over protection systems, must be installed on all equipment and maintained or replaced to original equipment manufacturer specifications.

5. Carry Blades Low

Equipment attachments such as loader buckets and tractor blades should be set low to improve visibility and enhance breaking capability. Otherwise, collisions may occur, the vehicle may go over an embankment, or it may roll over.

6. Check Blind Areas

Never push waste until you are sure that no person or equipment is in the blind area ahead of the refuse. If the operator is not sure of surrounding conditions, he/she shall dismount the equipment and personally inspect the area.

7. Maintain Adequate Clearance

When pushing waste, maintain adequate clearance from ground personnel, patrons and other vehicles or obstructions to ensure that objects will not strike other equipment or persons. As a rule of thumb use 5 meters as a minimum safe distance to keep away from all people, vehicles, and equipment.

8. Constantly Check Work Area

The operator must constantly check the work area for the location of other persons or equipment. Be especially cautious when several private vehicles are in the area. Remember that many site users are not familiar with the dangers of heavy equipment.

9. Operate Up and Down Slope

Operate up and down slopes. Avoid side hill travel whenever possible to reduce the chance of rolling over.

10. Avoid Excessive Speed

Operating conditions generally determine the speed of heavy equipment. Under no circumstances should heavy equipment be driven at excessive speeds or operated recklessly. Heavy equipment is difficult to control at high speeds and must only be operated at a speed that is safe for existing conditions.

11. Move Cautiously Over Bulky Objects

When compacting or traversing bulky items, such as vehicles and utility poles, the operator must proceed with extreme caution to avoid tipping or sudden lurching movements.

17. No Scavenging

Scavenging will not be permitted. Scavengers are subject to a number of potential injuries and possible death.

C. Personal Protection Equipment

Landfill staff is required to wear the standard Mary River Project personal protective equipment, including:

a. Hard hats,
b. Eye protection,
c. Work boots,
d. Work gloves,
e. Reflective vest

D. Emergency Contact Information

All emergencies shall be reported to the site services supervisor and Mary River camp manager immediately.

Appendix A

Classification of Refuse

1. Acceptable Wastes

Non-Hazardous Solid Waste means a solid waste that is not a liquid and is not hazardous The following wastes are examples of Non-hazardous solid wastes acceptable for disposal at the Mary River Landfill:

a. Wood products (Clean untreated wood should be diverted to the Burn Area)
b. Plastics
c. Cardboard
d. Scrap Tires
e. Bulky waste such as heavy equipment, trucks, snowmobiles & appliances. These items will be drained of all fluids (oil, fuel, hydraulic fuel; ozone depleting substances must be removed by a licensed technician prior to disposal).
f. Concrete
g. Glass
h. Metal
i. non-toxic incinerator ash
j. Non-Hazardous Solid Spill Clean-up Material
k. Empty Container (as defined in this procedure)

2. Inert Wastes & Recyclable material

The following are examples of inert wastes that the Mary River Landfill will accept for disposal. However, these types of materials can generally be recycled and/or reused and it is better to divert this waste stream for reuse when applicable:

a. Clean fill dirt
b. Rock
c. Steel (suitable for reuse)
d. Pallets (suitable for reuse)

3. Hazardous Material / Unacceptable Wastes

There are six general types of materials that are unacceptable for disposal at the Mary River Landfill. They are:

a. Chemicals
b. Liquid Wastes including sewage
c. Radio-nuclides (Radioactive waste)
d. Batteries
e. Infections or medical waste
f. Electronic waste – TVs, computer CRTs (screens) and computer hard drives

In addition, Hazardous Wastes, including household hazardous wastes, are NOT accepted at the Mary River Landfill. The following list of waste, though not all inclusive, is considered hazardous:

a. All material regulated by the Transportation of Dangerous Goods Act,
b. All material requiring a Material Safety Data Sheet,
c. Paint,
d. Chemicals,
e. Solvents,
f. Propane tanks,
g. All pressurized gas cylinders,
h. Fuel drums (205 liter barrels) or other material/container previously containing fuel or other hydrocarbons,
i. Acids,
j. Waste oil,
k. Cleaning solvents,
l. Gasoline, diesel, Jet A and other Petroleum products,
m. Insecticides,
n. Lube Oil,
o. All heavy metals such as Beryllium, Cadmium, Mercury, etc.

Appendix B

Potential Pollutant Source and Best Management Practices Summary Table

Area	Activity	Pollutant Source	Pollutant	Best Management Practices
Landfill	General landfill operations	Soil Erosion	Sediment	- Maintain design slopes - Repair all berm & cover areas experiencing settling or erosion - No cuts permitted in to the tundra during landfill civil construction or operation - Silt fences installed at any drainage experiencing sediment from soil erosion
Landfill	Fueling of heavy equipment	Diesel fuel	Diesel fuel	- Fueling is completed in accordance with Baffinland fueling procedure. - Personnel are trained on the procedure for fueling
Landfill	Unloading waste at landfill	Improper segregation or direction of non-permitted wasted	Hazardous waste or non-permitted waste	- Baffinland Waste management system includes waste type source segregation - Landfill operations procedure contains requirement for waste inspection prior to unloading.
Landfill	Unloading waste at landfill	Hazardous material spill	Hazardous waste	- Baffinland Spill Response Plan in place to respond to spills
Landfill & surrounding area	General landfill operations	Landfill working face	Litter	Landfill operations manual contain best management practices including: - Minimizing active working face - Compaction & cover plan - Use of litter fences

Baffinland
Iron Mines Corporation

Appendix C

Mary River Non-Hazardous Solid Waste Landfill

User Rules

1. All waste is to be inspected prior to dumping – Contact the Mary River Site Services Supervisor prior to delivery
2. No liquid or hazardous waste is accepted at this landfill
3. Vehicles shall follow posted speed limits and directions to unloading area - Unloading in other areas is strictly prohibited
4. Dump waste immediately behind the vehicle as close to the toe of the working face as possible
5. No Unloading by Rapid Acceleration or Deceleration
6. Each vehicle operator is to complete the unloading log for each load
7. No Scavenging is permitted
8. No open fires or the burning of waste is allowed on the site
9. All spills are to be stopped if safe to do so, and immediately reported to the Site Services Supervisor.
10. PPE required to be worn at landfill area
11. In case of Emergency – Immediately contact the Mary River Site Services Supervisor or Camp Manager

Part B – Mary River Landfill Work Instructions

Part B focuses on work instructions and has been formatted to provide supervisors and their employees with a user-friendly method for access, training, and implementation of these procedures

Specific work instructions concerning landfill operations and emergencies and have been documented in order to establish standard policies and practices for the Operations staff. These topics will be reviewed periodically in routine safety meetings, which will allow operators to keep up-to-date on any changes in standard operations. Site services personnel are expected to be familiar and comply with the work instructions relating to their areas of responsibility.

Work Instructions

1. General Site Maintenance
2. Off Road Vehicular Traffic
3. Dust Control
4. Landfill Equipment Fluid Releases
5. Litter Control
6. Vector Control
7. Building & Equipment Fires
8. Fire in Load
9. Hazardous Spill Response
10. Subsurface fires

General Site Maintenance

Work Instructions

Landfills require general maintenance throughout the year in order to keep them orderly and clean. Much of this maintenance is in anticipation of permit requirements and seasonal weather changes

Guidelines:

1. Access roads on the site are to be maintained and graded to eliminate ruts and repaired to eliniante cracks and settling.

2. Maintain drainage, keep road culverts and landfill drainage free of debris.

3. Define critical landfill perimeter and spot locations with stakes and signs prior to winter to facilitate identification

Off-Road Vehicular Traffic

Work Instructions

"Off-Road" refers to any vehicle traveling off of any defined roadway or access-way or landfill pad, regardless of the road surface. Permitted roads are identified on the attached landfill plan and include the gravel access road and the landfill berm perimeter road.

- All off-road vehicular traffic is strictly prohibited without clearance from Mine Manager
- Prior approval is required for any vehicles engaging in off-road activities while on site
- New road construction is not permitted without approval from the Mary River Project Operations Manager

Benefit of Compliance to Instruction:

- Avoid disturbances and impacts to sensitive tundra

Dust Control
Work Instructions

1. Place dusty loads at the toe of the face of the trash and bridge over as quickly as possible.

Benefit of Compliance to Instruction:

- Creates a cleaner, safer work environment
- Ensures compliance with permit requirements and reduces the impact on the natural environment

Landfill Equipment Fluid Releases

Work Instructions

1. Complete a visual "walk around" inspection of all landfill motive equipment prior to starting. Inspect for damaged hoses and for puddles or stains from leaking fluids under your machine. If fluid leaks are evident, do not start equipment. Notify your Supervisor and the mechanic.

2. Periodically scan the equipment management system on the dashboard of the machine for flashing lights and warning horns that may indicate a system failure. Move to a safe area, stop and inspect the machine systems for leaks and malfunctions as necessary.

3. Routinely glance through the windows at the machine components that are susceptible to damage, for example, lift cylinders, hydraulic hoses, grease and oil seals. Listen as you operate your machine for unusual noises that may be an indication of a mechanical failure. If so, move to a safe area, stop the machine and notify your Supervisor and the mechanic.

4. As you make a "pass" in a forward direction and prepare to change direction, look over your shoulder and inspect the ground for streaks of oil or anti freeze. If leaks are observed, move machine to a safe area, shut machine down, contain spill using a bucket or pan and notify supervisor and mechanic.

5. All discharges of fluids from heavy equipment in the landfill are to be treated as a spill. All spills are to be addressed as per the Mary River Spill Response Plan. Key points are:
   - If safe to do so, stop the source of the spill.
   - Immediately report the spill to your supervisor.
   - For large spills initiate the Spill Response Plan.
   - Initiate cleanup of the spilt material using the emergency spill kits
   - Document the spill by the end of shift with a Spill Report Form – these are available from the Operations Department or your supervisor, provide spill report to Environment Department within 12 hrs.

Benefit of Compliance to Instruction:

- Regulatory Compliance
- Operator safety
- Environmental protection

Litter Control
Work Instructions

The control of litter is an essential part of our permit conditions and readily evident to all who drive by or onto the landfill. In an effort to maintain compliance with our permit and reduce the amount of time and effort required for this task the following procedures are to be followed:

Prevention of Litter at Working Face:

1. Minimize the length of the working face to reduce the size of the face exposed to wind. The maximum length of the exposed cell face shall not exceed 12 meters at any time.

2. Keep waste well confined at the working face to reduce the amount of waste susceptible to wind.

3. Deposit waste at the toe of the fill slope face and spread it upward.

4. Cover the compacted waste as soon as possible to minimize blowing litter

Control with Litter Fences

1. Position fences near the working face as wind and fill operations change.

2. Move or lengthen semi-permanent litter fences that are strung around the area to conform to filling operations and prevent migration of litter off the site.

Litter Pickup

1. Litter crews are to pick any litter off the fences to prevent the fence from being clogged and subject to over turning by the wind.

2. Promptly pick up any litter not trapped by the fences to prevent off-site migration.

Litter in Heavy Wind Conditions

1. Install litter fences prior to windy weather and relocate as required.

2. If lightweight material cannot be contained within the site, place intermediate cover over the material to prevent it from blowing.

Benefit of Compliance to Instruction:

- Compliance with operating permit
- Reduction in amount of litter migrating out of waste cell
- Minimize impact to native habitat
- Reduce the rework for picking up litter

Vector Control
Work Instructions

Vectors (any animals that carry diseases) are generally not present at a properly operated and maintained non-hazardous solid waste landfill (No domestic waste). The provisions of source segregation and waste inspection at the landfill prior unloading waste will safeguard against vector problems. Well-compacted wastes and cover material effectively prevent vectors from emerging or burrowing into waste materials. The following are basic guidelines to ensure proper vector control on site:

1. All waste is to be inspected at the landfill prior to unloading to confirm no domestic or food waste is present.
2. Maintain a narrow working face and cover all un-worked areas to minimize animal foraging at the site.
3. Cover waste on all unused slopes.
4. Ensure good compaction of the cover material to discourage animals from burrowing through it.
5. Keep equipment, storage and leisure areas free of debris and food waste to prevent vectors from establishing residence in or near areas where employees, support personnel work.

Benefit of Compliance to Instruction:

- Protects the health and safety of employees
- Eliminates potential exposure pathways to employees
- Reduces risk of contact with vectors and scavengers
- Maintains compliance with operating permit

Building and Equipment Fires
Work Instructions

Fire

1. Attempt to extinguish a small, controlled fire with equipment on site *WITHOUT* endangering yourself or other personnel. When in doubt, evacuate area and notify your supervisor & security immediately, providing all the required information (Your name, fire location, type, size etc…).

2. Keep all unauthorized people away from the area on fire.

3. Report the details of the fire in the *Special Occurrence Log* and, if applicable, complete an investigation report form (see your supervisor for these materials).

Benefit of Compliance to Instruction:

- Safety of all employee's is protected

Fire in Load
Work Instructions

Fire in Load refers to a vehicle load of wastes that are either on fire and/or smoldering or smoking prior to discharge to the landfill. All site personnel are expected to be familiar with the following procedures for handing such loads:

1. Direct the driver to dump the material in a clear area that is away from the fill face and clear of any vegetation and/or debris.

2. Notify your immediate Supervisor and the camp manager of the fire.

3. Spread out the load and extinguish the fire with water or soil

4. Once fire is determined to be completely out, allow the material to remain in the cleared area for the remainder of the working day.

5. If no fire is detected at the end of the working day, place the load into the fill.

6. If fire is discovered after the load has been dumped at the working face, the equipment operator will push the material away from the face (if it is safe to do so) to a cleared area where it can be covered with soil or extinguished with water.

Benefit of Compliance to Instruction:

- Health & safety of employees is protected
- Reduce the risk of a landfill fire

Hazardous Materials Spill Response and Reporting
Work Instructions

The responsibility for implementing this procedure begins with the person(s) responsible for the chemical spill (spill) or the first person(s) to discover the spill. They will be responsible for reporting the spill and completing cleanup actions (small spills) or requesting assistance for large spills.

Spill Reporting:

1. Report all spills of hazardous materials to your supervisor and the camp manager as soon as possible, regardless of the quantity of spilled material.

2. Be sure to provide the following information:

    • Type of spilled material
    • Quantity of spilled material
    • Location where spill occurred
    • Time and date the spill occurred
    • Description of the actions taken to contain and clean up the spilled material

3. The Site Services Supervisor will record the above information in the Log of Special Occurrences.

Spill Response:

All spills are to be addressed as per the Mary River Spill Response Plan. Key points are:

- If safe to do so, stop the source of the spill. Employees may attempt to contain the spill, provided their personal safety or the safety of others is not jeopardized by their actions
- Immediately report the spill to your supervisor.
- For large spills initiate the Spill Response Plan.
- Initiate cleanup of the spilt material using the emergency spill kits
- Document the spill by the end of shift with a Spill Report Form – these are available from the Operations Department or your supervisor, provide spill report to Environment Department within 12 hrs.

Benefit of Compliance to Instruction:

• Employees are trained to safely respond to spills, minimizing the potential impact to personnel or the environment
• Spills documented in accordance with regulatory requirements
• Regulatory Agency notified in a timely manner

Warning signs may include:

- Smoke and/or heat waves emanating from cracks and/or fissures;
- Localized settlement (sinkholes up to several meters in diameter);
- The odor of burning plastic/refuse may be present

BEWARE!

*The surrounding area may not be stable. The rapid decomposition of refuse by burning may have created large voids underground.
*Fumes may be toxic!

Safety Procedures

1. If an area is suspected of having an underground fire, block further access to the area and keep people away. Make sure anyone near the suspected fire is notified and/or vacated as may be necessary. If flames are present above ground, immediately notify the site services supervisor and camp manager through radio dispatch. (Note: Pumping water into the ground may not stop the smoldering and will not prevent future fires. Smothering with dirt is the preferred option).
2. Try to stay upwind of any smoke and not breathe fumes, if any.
3. Secure the site with cones, barricades, survey ribbon, etc. If voids are suspected the ground may be unstable – Do not walk or use heavy equipment on the waste pile.
4. The site services supervisor, camp manager and other staff will evaluate the conditions and develop a plan to safely deal with the fire (almost always smothering with dirt).
5. Notify the Baffinland environment department to evaluate the incident and confirm the repair plan is in compliance with permits
6. Once the fire is extinguished and the situation secured, look for other cracks and/or depressions in the area and schedule their repair. (They could be the source of air that allowed the fire to start originally).
7. Complete repairs to the landfill structure. Note completion of work in site log along with fire location for future reference.

Benefit of Compliance to Procedure:

- Employee's safety protected
- Environment is protected

APPENDIX D:

Environmental Guideline for the Burning and Incineration of Solid Waste, Department of the Environment, Government of Nunavut 2010

Environmental Guideline for the

Burning and Incineration of Solid Waste

Department of Environment
Government of Nunavut

GUIDELINE: BURNING AND INCINERATION OF SOLID WASTE

Original: October 2010

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

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

Copies of this Guideline are available upon request from:

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

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

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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 and modified burn barrel 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 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 the impacts of incineration 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

Biomedical Waste — 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. needles).

Bottom Ash — 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.

Commercial Camp	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.
Commissioner's Land	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.
Contaminant	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.
Determined Effort	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.
De Novo Synthesis	The creation of complex molecules from simple molecules.
Environment	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.
Field Camp	A temporary, seasonal or multi-year facility consisting of tents or other similar 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.
Fly Ash	Unburned material that is emitted into the air in the form of smoke or fine particulate matter during the burning process.
Hazardous Waste	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.
Incineration	A treatment technology involving the destruction of waste by controlled burning at high temperatures.

Incinerator	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.
Inspector	A person appointed under subsection 3(2) of the *Environmental Protection Act* and includes the Chief Environmental Protection Officer.
Modified Burn Barrel	A metal drum or other non-combustible container used to burn waste that has been affixed with devices or features which provide for enhanced heat generation, heat retention and holding time.
Open Burning	Burning of waste with limited or no control of the burn process and where the fly ash is emitted directly into the air without passing through an exhaust pipe. For clarity, open burning includes burning on the open ground or using an unmodified burn barrel.
Qualified Person	A person who has an appropriate level of knowledge and experience in all relevant aspects of waste management.
Responsible Party	The owner or person in charge, management or control of the waste.
Smoke	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.
Solid Waste	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.
Traditional Camp	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.
Unmodified Burn Barrel	A metal drum or other non-combustible container used to burn waste that has not been affixed with devices or features which provide for enhanced heat generation, heat retention and holding time.
Untreated Wood	Wood that has not been chemically impregnated, painted or similarly modified to improve resistance to insects or weathering.
Waste Audit	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 of solid waste and other contaminants on Commissioner's Land, including their proper disposal. 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 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. Some of the other agencies include:

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.*

Indian and Northern Affairs Canada

Indian and Northern Affairs Canada is responsible under the *Territorial Lands Act* and *Nunavut Waters and Nunavut Surface Rights Tribunal Act* for the management of federal lands and waters, including the impact 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 property 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 Claim Agreement have broad authority for land use planning, 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 separate stages. Water is first driven from the unburned waste by heat produced from waste burning nearby or from an auxiliary burner. As the waste heats up, carbon and other substances are released from the waste 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 low burn temperatures is the creation of pollutants that were not originally present. 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^{o}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 these low temperature methods. Dual chamber incinerators, which are designed to burn complex mixtures of waste, hazardous waste and biomedical waste, must provide a temperature higher than 1000^{o}C and 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 using a modified burn barrel 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

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. Extreme care must be exercised when burning or incinerating solid waste.

Many different types of pollutants can be released during burning and incineration. A few of these pollutants include acid gases, trace metals, fine particulates and persistent 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 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 persistent organic pollutants that have drawn the most 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. They persist in the environment for long periods of time, bioaccumulate in plants and animals and 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 ways to reduce or minimize the release of pollutants is to segregate the waste before burning and achieve sufficient temperatures, holding time and turbulence in the burn chamber. Open burning and improperly designed and operated burn barrels produce more smoke and pollutants, including dioxins and furans, than does an incinerator capable of achieving complete combustion.

2.3 Burning and Incineration Methods

The type of burning method is a major factor in determining what type of waste can be safely and effectively burned. Burning and incineration methods commonly used in Nunavut include open burning on the ground, modified burn barrels and various mechanical incineration systems. Each method is discussed separately in the following sections. Other methods include burn cages, burn boxes and air curtain incinerators. These methods are not discussed as they are not widely used in Nunavut.

2.3.1 Open Burning

Open burning means the burning of waste where the burned gases, smoke and fly ash is emitted directly into the air without first passing through an exhaust pipe. This method includes burning solid waste directly on the open ground or in unmodified burn barrels. Open burning provides the operator with limited or no control over the combustion process and as a result, 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 can also be a powerful attractant for animals.

The open burning of solid waste remains a common practice in Nunavut. With few exceptions (refer to section 3.2) it is the policy of the Department of Environment to eliminate or control open burning of mixed solid waste to the extent practicable and to encourage more acceptable methods of disposal and incineration.

2.3.2 Modified Burn Barrel

A modified burn barrel is a metal drum or other non-combustible container that has been affixed with devices or features which result in higher burn temperatures, enhanced heat retention and a longer holding time than does open burning. These modifications include a 'metal basket' or grate to suspend the burning waste and vents or holes cut above the bottom of the barrel. These features provide for enhanced passive under-fire ventilation which promotes good contact between the waste being burned and incoming air. Other features include a hinged top and exhaust pipe attached to the top or side of the barrel. These help to increase heat retention and holding time inside the burn chamber. The hinged top also allows easy loading of waste while the removable basket enables access to the unburned bottom ash.

Figure 1 – Modified Burn Barrel

Although modified burn barrels are an improvement over open burning, it is likely insufficient burn temperatures, turbulence and holding time will result in smoke and incomplete combustion of the waste. Other common problems include overfilling the unit and loading waste that should not be burned (refer to section 3.2). The

process may also not completely burn wet or frozen masses of waste and the resulting partly burned food waste may still attract animals.

Modified burn barrels can be built using commonly available materials. They can either be pre-built locally or transported to the site for assembly. Basic operating instructions are provided in section 4.2 and construction plans are provided in Appendix 2.

2.3.3 Incineration

Solid waste incinerators are engineered systems that are capable of routinely achieving burn temperatures in excess of 1000^{o}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 hazardous and biomedical waste and sewage sludge requires specific equipment, operational controls and training that are beyond the scope of the current document.

Incinerators are described based upon the number of burn chambers they have and the amount of air provided to each chamber. They may also be described based upon how waste is fed into the primary burn chamber.

Dual-Chamber Starved Air System	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.
Single Chamber Excess Air System	More than a sufficient amount of air (as much as 50% more than the amount of air needed) is injected into the primary burn chamber to achieve complete combustion of the waste.
Continuous Feed Incinerator	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.
Batch Feed Incinerator	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.

Dual-chamber controlled air batch feed systems 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 2 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.

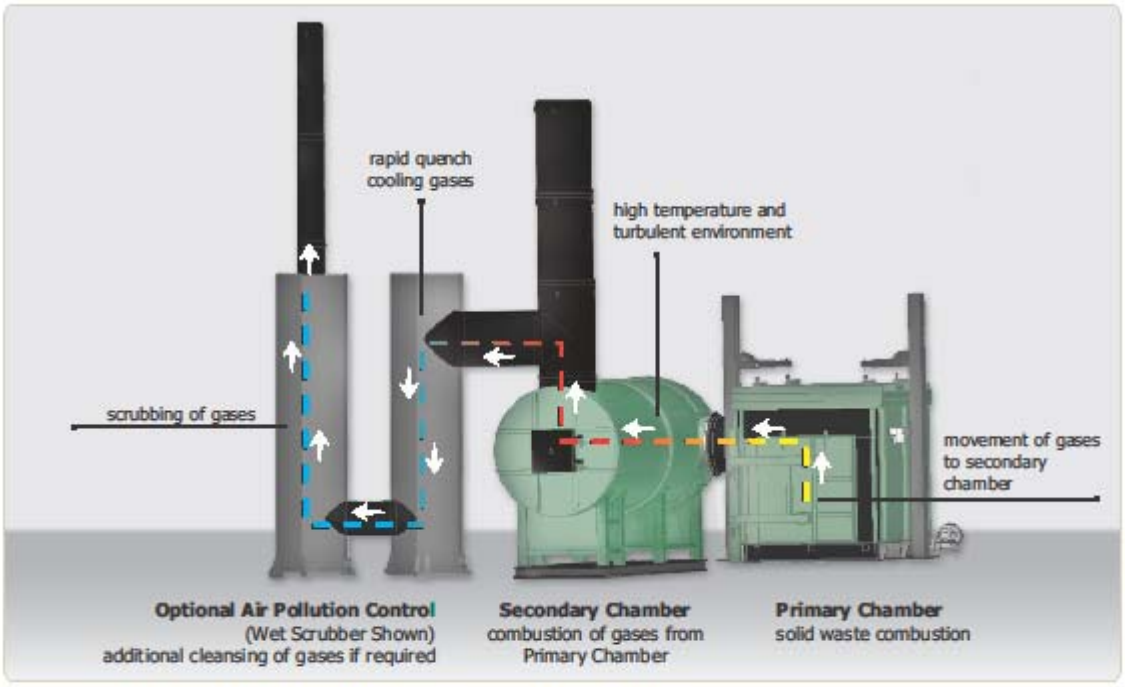


Figure 2 – Typical Batch Feed Dual-Chamber Controlled Air Incinerator with Optional Air Pollution Controls
Illustration courtesy of Eco Waste Solutions

Section 2.3.3 is intended to provide the reader with a brief introduction to incinerators. It is not intended to provide information suitable for the 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.

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 technology or waste diversion practices. The following emission standards apply to 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 and modified burn barrels have not been established.

For existing, new or expanding solid waste incinerators the maximum concentration[1] of dioxins, furans and mercury in the exhaust gases from the stack are provided in Table 1.

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 operation[2]. 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.

Less than 5% Opacity | 20%-30% Opacity | 90%-100% Opacity

Figure 3 - 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

[1] Stack concentrations are always corrected to 11% oxygen content for reporting purposes.
[2] The time during which optimum designed temperature is maintained in the burn chamber, and excludes 'startup' and 'cool down' operations.

2.4.2 Bottom Ash

The *Environmental Guideline for Industrial Waste Discharges* establishes criteria for determining whether process residuals[3] 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* for criteria and additional information on the management of process residuals.

[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 management 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 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 and modified burn barrels are 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 becomes 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 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 burning 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, modified burn barrels 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 open burning than to modified burn barrels 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 be separated from non-combustible waste before being loaded into the burn chamber.

3.3 Keeping Waste Dry

Typical garbage and food waste is at least 20% moisture. 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 modified burn barrel.

Table 2. Waste That Can be Burned or Incinerated

Waste Type	Method		
	Open Burning	Modified Burn Barrel	Dual-Chamber Incinerator
Paper products	✓	✓	✓
Paperboard packing including boxboard and cardboard	✓	✓	✓
Untreated wood including lumber and plywood	✓	✓	✓
Food waste		✓	✓
Food packaging and natural fiber textiles		✓	✓
Plastic and Styrofoam except plastic containing chlorine[4]			✓
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
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 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 burn facility away from areas or features that may trap smoke close to the

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

ground (i.e. located in a valley). Avoid burning waste if people will be living or working within the plume of the 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 accidently starting a tundra fire.

3.5 Maximizing Combustion Efficiency

Avoid smoldering fires when open burning. Burn only dry wood, paper and paperboard packing and periodically add additional waste to the fire in order to maintain high burn temperatures until all waste has been destroyed. 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.

More smoke and other pollutants are released into the air during the 'start-up' and 'cool down' phases of the burn cycle than when high temperatures are maintained in the burn chamber. As a result, the desired operating temperature should be achieved as quickly as possible. A rapid 'start-up' can be achieved in a modified burn barrel by first loading the chamber with dry wood and paper products. Food and other acceptable waste can then be carefully added once the fire is actively burning. Overfilling the 'metal basket' in a burn barrel will also 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.

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 modified burn barrel or incinerator to the final disposal site. This will minimize physical contact with the ash and any 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 and untreated wood waste or unburned materials from modified burn barrels used to burn paper, paperboard packing, untreated wood, food waste, food packaging and natural fiber textiles is suitable for burial in a designated pit or municipal landfill. Because incinerators can be used to destroy a wider variety of waste and the subsequent ash may contain a wider variety of toxic residues, bottom ash from an incinerator is suitable for burial only where it meets the criteria set out in section 3.2 of the *Environmental Guideline for Industrial Waste Discharges*. 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 section 3.2 of the *Environmental Guideline for Industrial Waste Discharges* 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*.

Because food waste has high moisture content, bottom ash from modified burn barrels loaded with these wastes may have to be re-mixed with dry waste and burned again to ensure any food scraps are sufficiently destroyed and do not attract animals.

3.7 Monitoring and Record Keeping

Modified burn barrels and incinerators should be inspected for signs of leakage, 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.

Open burning and modified burn barrels tend to produce 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 how much and what waste was burned, how the waste was loaded into the 'metal basket', 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 Department of Environment or other regulatory agencies if they were to receive complaints of nuisance smoke.

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. Carbon monoxide and oxygen levels in the burn chambers are also useful indicators of combustion efficiency. In-stack monitoring provides the operator with information on the combustion process and on pollutants being released to the environment. A continuous opacity monitor can be installed in incinerator stacks to monitor emissions quantity. Additional in-stack sampling and monitoring (i.e. hydrogen chloride, dioxins, furans, mercury) 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.

Written records should be kept by incinerator operators of what waste is burned, when and how much. Other record keeping requirements 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 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 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 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 once the owner or operator has made reasonable and determined efforts to implement sound waste management planning. 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. This includes waste being kept dry to maximize combustion efficiency and operators being trained in the safe operation of the equipment. Refer to section 3 for additional information on best management practices.

This section provides guidance on the application of burning and incineration of solid waste. Four source categories have been identified including municipalities, traditional camps, field camps and commercial camps. The burning and incineration of solid waste may also be controlled through permits and licenses issued by Nunavut's co-management boards, Indian and Northern Affairs Canada and other regulatory agencies. These permits and licenses must be complied with at all times.

4.1 Municipalities

The burning of unsegregated, or mixed, solid waste within a municipality by open burning or using a modified burn barrel must not occur under any circumstances. Today's household garbage contains many materials which, when burned at low temperature, release high levels of particulates, acid gases, heavy metals, carbon monoxide, dioxins, furans and other chemicals, some of which may cause cancer.

Segregated municipal solid waste that is conditionally suitable for open burning include paper products, paperboard packing and untreated wood waste only. Refer to section 3.2 for further information on what waste can and cannot be burned. This open burning may only take place when the following conditions are met:

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

Written records of open burning should be maintained by the municipality. These record what was burned, when and how much, location, weather conditions at the time and any other relevant information that would 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 and untreated wood waste is suitable for burial in an approved landfill site. Refer to section 3.6 for further information on the management of bottom ash.

4.2 Traditional Camps and Field Camps

For the purposes of the Guideline, a **traditional camp** is a temporary or seasonal camp used primarily for camping, hunting, fishing or other traditional or cultural activities. A **field camp** is a temporary, seasonal or multi-year facility consisting of tents or other similar structures with a capacity of 15 people or less and which has been established for research, commercial or industrial purposes.

Food and food packaging waste make up a significant portion of the kitchen garbage produced at a traditional or field camp. This waste is a powerful attractant for animals and must be segregated daily and stored in wildlife-proof containers for frequent removal to an approved disposal site. Where it is impractical to dispose of this waste in a municipal or industrial landfill, a properly constructed and operated modified burn barrel can be used to burn wood waste, food waste, food packaging and natural fiber textiles. Noncombustible items and items that may explode or cause toxic fumes such as empty aerosol cans, kitchen cleaning powders and sprays, treated or painted wood and batteries must not be burned. Refer to section 3.2 for further information on what waste can and cannot be burned in a modified burn barrel.

Modified burn barrels are able to achieve higher burn temperatures and produce less smoke than open burning when they are properly constructed and operated. Below are some easy-to-do actions to ensure modified burn barrels are used safely, waste is burned to the greatest extent possible and odours are reduced.

- Inspect the equipment for signs of leakage, corrosion or other physical defects before each burn cycle. Any necessary repairs must be completed before the equipment is used.
- Do not overfill the 'metal basket' as air will be unable to mix properly with the waste. The result will be a smouldering, low temperature burn and a lot of smoke. Burn often if a large quantity of waste is generated.
- 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 fuel is completely burned. Carefully adding wet waste to an already hot fire or layering slow burning waste with fast burning waste will also help ensure the complete combustion of all waste.
- Burn only combustible waste. Burning non-combustible waste (i.e. metal, glass, wire) will rob the fire of valuable heat. Non-combustible and other waste that cannot be burned should be segregated and removed from the site for disposal on a regular basis.
- Locate the modified burn barrel in a place predominantly downwind of the camp site or burn only on days when the wind is blowing away from the camp.
- Ensure the modified burn barrel is located on gravel, rocky outcrop or other area free of combustible materials and vegetation to avoid accidently starting a tundra fire.
- A modified burn barrel should not be used unless a responsible adult is available to monitor and watch over it until the fire has completely cooled.

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.

Records should be maintained on how much and what waste is burned, how waste was loaded into the burn chamber, how the fire was started and other information that would 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 burning of paper, paperboard packing, untreated wood waste, food waste, food packaging and natural fiber textiles in a modified burn barrel is suitable for burial in a designated pit or municipal landfill site. Consent to use the landfill should first be obtained from the local government. Because food waste is often wet or frozen, it may not be completely burned the first time. The ash should be re-mixed with dry waste if food scraps remain and burned again to ensure buried ash does not attract animals. Bottom ash must be completely cooled before it can be safely handled and disposed of. Refer to section 3.6 for further information on the management of bottom ash.

4.3 Commercial Camps

For the purpose of the Guideline, a **commercial camp** is 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 (i.e. mineral, oil and gas exploration and development, scientific research). A commercial camp does not include a traditional camp or field camp.

Commercial camps generally produce a wide range of solid waste materials. These include paper and wood products, kitchen waste including food scraps and packaging, construction and demolition debris, batteries, tires, waste fuel, used lubricating oil, hydrocarbon contaminated soil and absorbent materials and many others. Many camps are remote while some are large, multi-year facilities producing a significant volume of waste over their operational life. For these reasons, camp operators may choose to manage waste on-site, rather than transporting the large quantities of waste to a commercial waste disposal facility or pre-existing approved landfill. Whatever method is chosen, the waste must be segregated daily and stored in wildlife-proof containers in order to reduce human-wildlife interactions.

A dual-chamber controlled air incinerator must be used if waste is to be burned on-site at commercial camps[5]. Use of a modified burn barrel is not acceptable because of the quantity of combustible waste normally produced. Incinerators must be designed and sized for the type and quantity of waste to be managed. 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, 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. Camp owners are strongly encouraged to consult system manufacturers or other qualified persons with expertise before purchasing an incinerator.

[5] Equipment that differs from the recommended technologies will be considered if it can be demonstrated to provide an equivalent level of environmental protection.

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,* which is available at http://www.ec.gc.ca/gdd-mw/default.asp?lang=En&n=F53EDE13-1.

Although a wide range of wastes can be destroyed using high temperature incineration, determined efforts must be made 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 3.2 for further information on what waste can and cannot be burned.

The installation and operation of monitoring and control systems is critical for the proper and safe operation of an incinerator. Key operational parameters must be monitored 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 systems required for an incinerator. Requirements differ based upon the quantity of waste expected to be burned[6].

Table 3. Incinerator Monitoring and Control Systems

System Description	Quantity of Waste Burned	
	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 chambers	✓	✓
Opacity in the stack	✓	✓
Oxygen and carbon monoxide in the primary and secondary chambers		✓
Hydrogen chloride, dioxins and furans in the stack[7]	✓	✓

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.

Bottom ash and other solid residue collected from the incinerator is suitable for burial where it meets the criteria set out in section 3.2 of the *Environmental Guideline for Industrial Waste Discharges* or in accordance with land use permits and water licenses issued by Nunavut's co-management boards and Indian and Northern Affairs 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 section 3.2 of the *Environmental Guideline for Industrial Waste Discharges* is considered to be a hazardous waste and must be managed in accordance with the *Environmental Guideline for the General Management of Hazardous Waste*.

[6] 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.
[7] Stack sampling for hydrogen chloride, dioxins and furans must be conducted annually if incinerator feedstock includes organic compounds that contain chlorine (i.e. chlorinated solvents and plastics, PVC piping and marine driftwood).

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, Indian and Northern Affairs Canada and other regulatory agencies. These permits and licenses must be complied with at all times.

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

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

Phone: (867) 975-7729
Fax: (867) 975-7739
Email: EnvironmentalProtection@gov.nu.ca
Website: http://env.gov.nu.ca/programareas/environmentprotection

References

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

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

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

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

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

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

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

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

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

Indian and Northern Affairs Canada (INAC). Handbook of Reclamation Techniques in the Yukon, (1999)

APPENDICES

APPENDIX 1 - *ENVIRONMENTAL PROTECTION ACT*

The following are excerpts from the *Environmental Protection Act*

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

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

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

   "Inspector" means a person appointed under subsection 3(2) and includes the Chief Environmental Protection Officer.

2.2 The Minister may
   (a) establish, operate and maintain stations to monitor the quality of the environment in the Territories;
   (b) conduct research studies, conferences and training programs relating to contaminants and to the preservation, protection or enhancement of the environment;
   (c) develop, co-ordinate and administer policies, standards, guidelines and codes of practice relating to the preservation, protection or enhancement of the environment;
   (d) collect, publish and distribute information relating to contaminants and to the preservation, protection or enhancement of the environment:

3. (1) The Minister shall appoint a Chief Environmental Protection Officer who shall administer and enforce this Act and the regulations.

   (2) The Chief Environmental Protection Officer may appoint inspectors and shall specify in the appointment the powers that may be exercised and the duties that may be performed by the inspector under this Act and regulations.

5. (1) Subject to subsection (3), no person shall discharge or permit the discharge of a contaminant into the environment.

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

(d) the discharge of the contaminant resulted from the burning of leaves, foliage, wood, crops or stubble for domestic or agricultural purposes;
(e) the discharge of the contaminant resulted from burning for land clearing or land grading;
(f) the discharge of the contaminant resulted from a fire set by a public official for habitat management of silviculture purposes;
(g) the contaminant was discharged for the purposes of combating a forest fire;
(h) the contaminant is a soil particle or grit discharged in the course of agriculture or horticulture; or
(i) the contaminant is a pesticide classified and labelled as "domestic" under the *Pest Control Products Regulations* (Canada).

(4) The exceptions set out in subsection (3) do not apply where a person discharges a contaminant that the inspector has reasonable grounds to believe is not usually associated with a discharge from the excepted activity.

5.1. Where a discharge of a contaminant into the environment in contravention of this Act or the regulations or the provisions of a permit or license issued under this Act or the regulations occurs or a reasonable likelihood of such a discharge exists, every person causing or contributing to the discharge or increasing the likelihood of such a discharge, and the owner or the person in charge, management or control of the contaminant before its discharge or likely discharge, shall immediately:
(a) subject to any regulations, report the discharge or likely discharge to the person or office designated by the regulations;
(b) take all reasonable measures consistent with public safety to stop the discharge, repair any damage caused by the discharge and prevent or eliminate any danger to life, health, property or the environment that results or may be reasonably expected to result from the discharge or likely discharge; and
(c) make a reasonable effort to notify every member of the public who may be adversely affected by the discharge or likely discharge.

6. **(**1) Where an inspector believes on reasonable grounds that a discharge of a contaminant in contravention of this Act or the regulations or a provision of a permit or license issued under this Act or the regulations has occurred or is occurring, the inspector may issue an order requiring any person causing or contributing to the discharge or the owner or the person in charge, management or control of the contaminant to stop the discharge by the date named in the order.

7. (1) Notwithstanding section 6, where a person discharges or permits the discharge of a contaminant into the environment, an inspector may order that person to repair or remedy any injury or damage to the environment that results from the discharge.

(2) Where a person fails or neglects to repair or remedy any injury or damage to the environment in accordance with an order made under subsection (1) or where immediate remedial measures are required to protect the environment, the Chief Environmental Protection Officer may cause to be carried out the measures that he or she considers necessary to repair or remedy an injury or damage to the environment that results from any discharge.

APPENDIX 2 – MODIFIED BURN BARREL DESIGN AND SPECIFICATIONS

A modified burn barrel is constructed from a metal drum or other non-combustible container. 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.

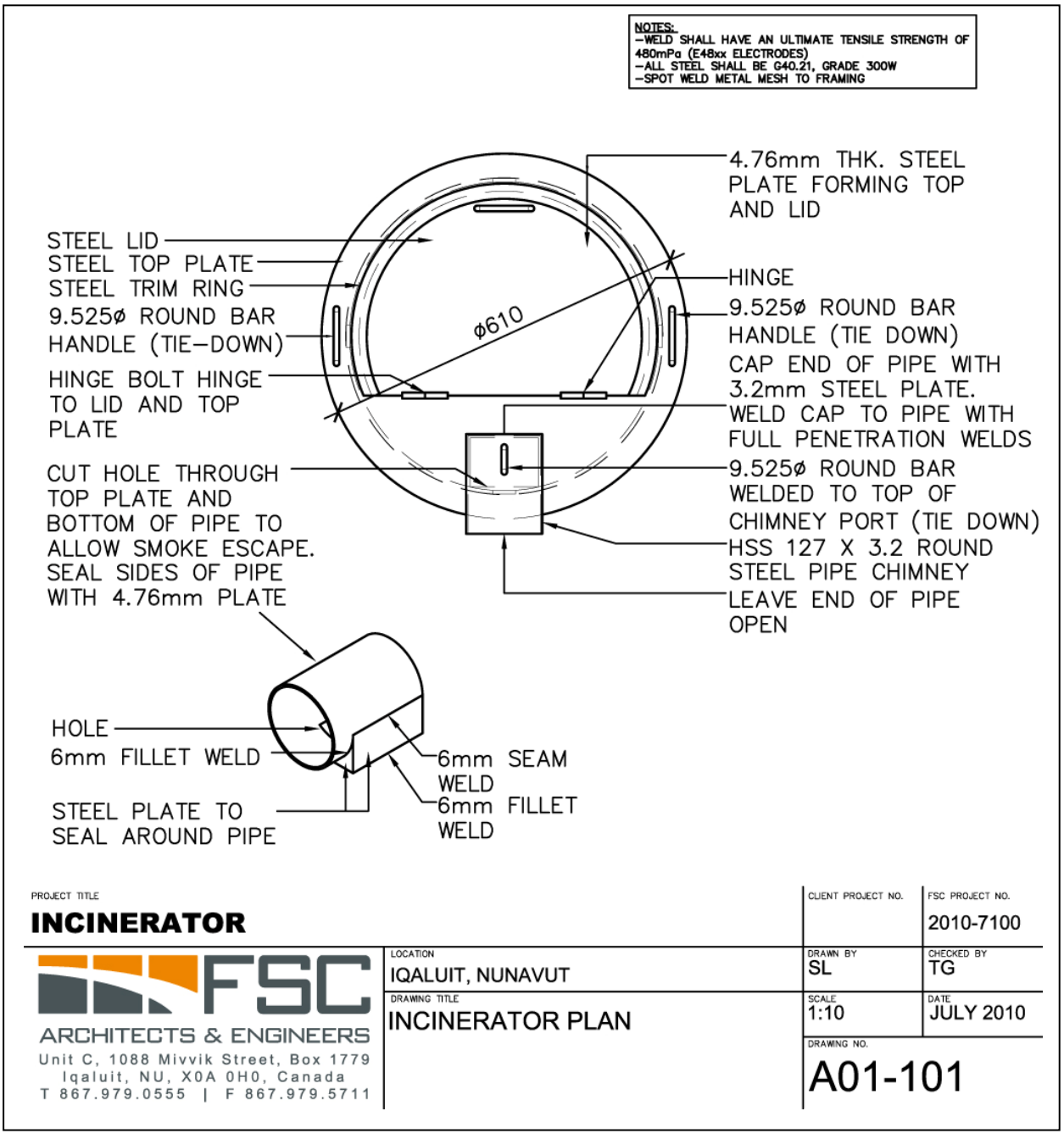
Placing a metal screen over the top of the exhaust pipe may be required to prevent sparks and hot ash from escaping.

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

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

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.

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


NOTES:
-WELD SHALL HAVE AN ULTIMATE TENSILE STRENGTH OF 480mPa (E48xx ELECTRODES)
-ALL STEEL SHALL BE G40.21, GRADE 300W
-SPOT WELD METAL MESH TO FRAMING
4.76mm THK. STEEL PLATE FORMING TOP AND LID
STEEL LID
STEEL TOP PLATE
STEEL TRIM RING
9.525ø ROUND BAR HANDLE (TIE-DOWN)
HINGE BOLT HINGE TO LID AND TOP PLATE
ø610
HINGE
9.525ø ROUND BAR HANDLE (TIE DOWN)
CAP END OF PIPE WITH 3.2mm STEEL PLATE. WELD CAP TO PIPE WITH FULL PENETRATION WELDS
9.525ø ROUND BAR WELDED TO TOP OF CHIMNEY PORT (TIE DOWN)
HSS 127 X 3.2 ROUND STEEL PIPE CHIMNEY
LEAVE END OF PIPE OPEN
CUT HOLE THROUGH TOP PLATE AND BOTTOM OF PIPE TO ALLOW SMOKE ESCAPE. SEAL SIDES OF PIPE WITH 4.76mm PLATE
HOLE
6mm FILLET WELD
STEEL PLATE TO SEAL AROUND PIPE
6mm SEAM WELD
6mm FILLET WELD
PROJECT TITLE
INCINERATOR
CLIENT PROJECT NO.
FSC PROJECT NO.
2010-7100
FSC
ARCHITECTS & ENGINEERS
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LOCATION
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INCINERATOR PLAN
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JULY 2010
DRAWING NO.
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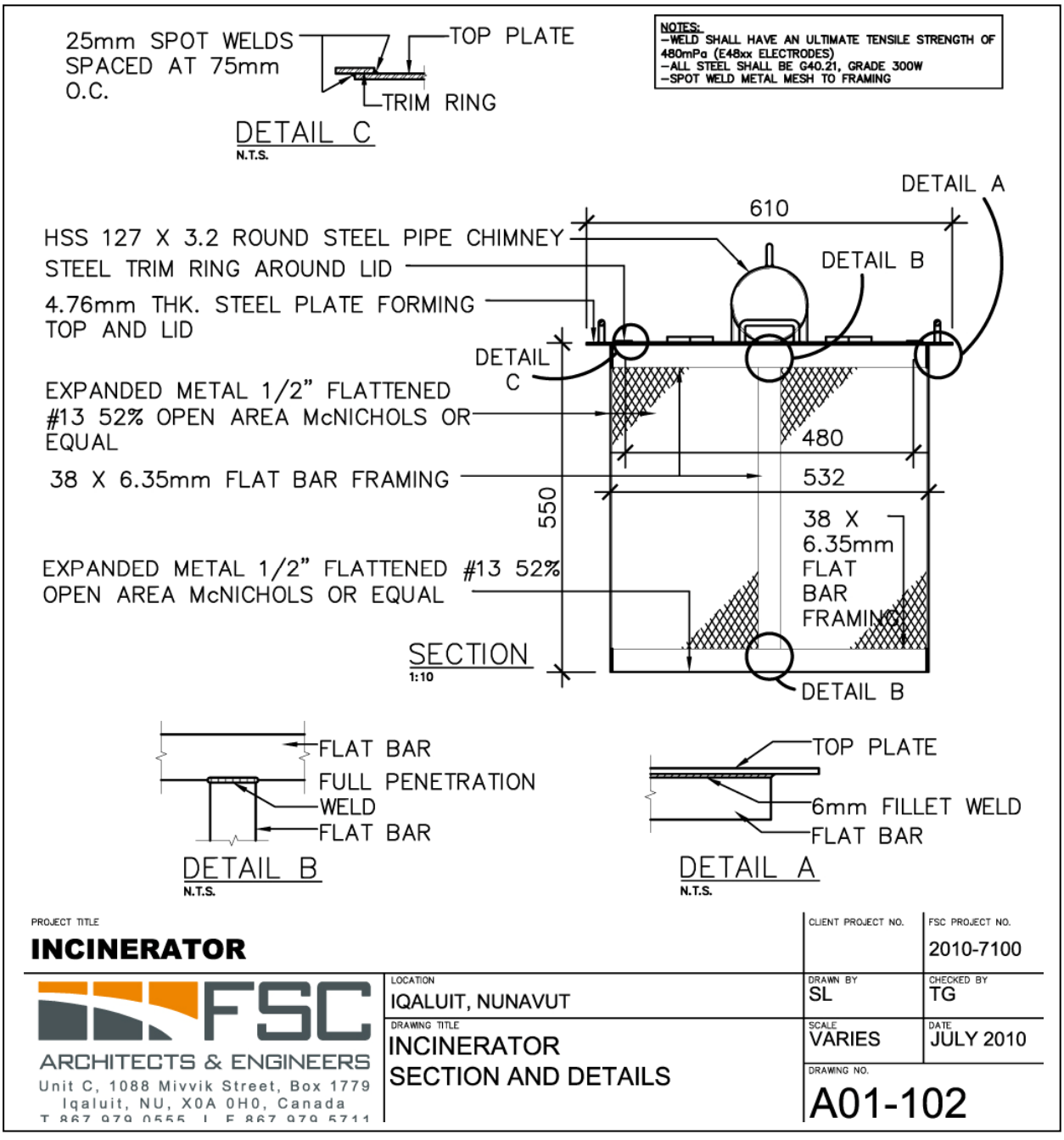
25mm SPOT WELDS SPACED AT 75mm O.C.
TOP PLATE
TRIM RING
DETAIL C
N.T.S.
NOTES:
-WELD SHALL HAVE AN ULTIMATE TENSILE STRENGTH OF 480mPa (E48xx ELECTRODES)
-ALL STEEL SHALL BE G40.21, GRADE 300W
-SPOT WELD METAL MESH TO FRAMING
DETAIL A
610
HSS 127 X 3.2 ROUND STEEL PIPE CHIMNEY
STEEL TRIM RING AROUND LID
4.76mm THK. STEEL PLATE FORMING TOP AND LID
DETAIL B
DETAIL C
EXPANDED METAL 1/2" FLATTENED #13 52% OPEN AREA McNICHOLS OR EQUAL
480
38 X 6.35mm FLAT BAR FRAMING
532
550
38 X 6.35mm FLAT BAR FRAMING
EXPANDED METAL 1/2" FLATTENED #13 52% OPEN AREA McNICHOLS OR EQUAL
SECTION
1:10
DETAIL B
FLAT BAR
FULL PENETRATION WELD
FLAT BAR
DETAIL B
N.T.S.
TOP PLATE
6mm FILLET WELD
FLAT BAR
DETAIL A
N.T.S.
PROJECT TITLE
INCINERATOR
CLIENT PROJECT NO.
FSC PROJECT NO.
2010-7100
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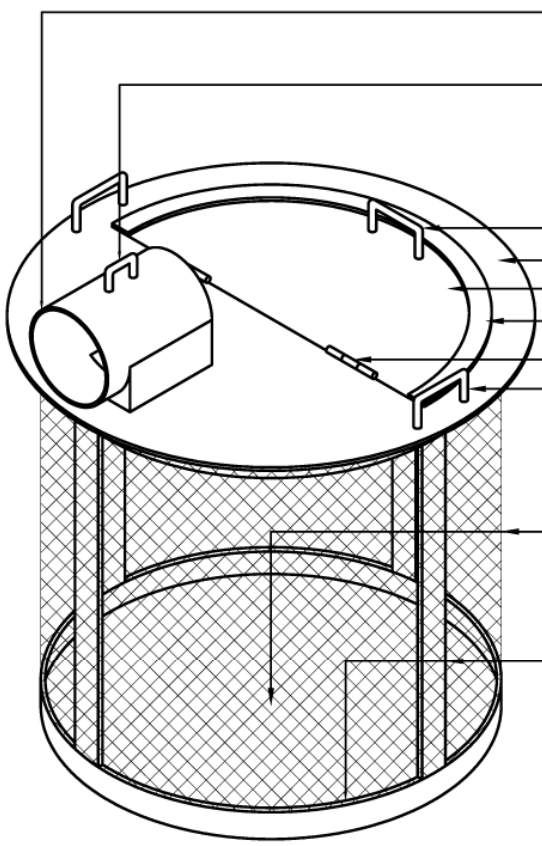

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APPENDIX E:

EBA Landfarm Operations, Maintenance and Monitoring Plan

BAFFINLAND IRON MINES CORPORATION

PRELIMINARY HYDROCARBON IMPACTED SOILS STORAGE AND LANDFARM FACILITY
OPERATIONS, MAINTENANCE AND MONITORING PLAN
MILNE INLET, MARY RIVER PROJECT, NUNAVUT

SEPTMEMBER 2011
EBA FILE: E14101092
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A TETRA TECH COMPANY

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APPENDICES

Appendix A EBA's General Conditions

1.0 INTRODUCTION

Baffinland Iron Mine Corporation (Baffinland) retained EBA, a Tetra Tech company (EBA) to evaluate hydrocarbon-impacted soils within the Milne Inlet lined bladder farm at the Mary River Project located in the Qikiqtani Region of Nunavut.

The original scope of work included post-decommissioning characterization of the hydrocarbon-impacted protective layer of sands in the bladder farm and the development of a soil remedial action plan. It was anticipated that the fuel-impacted soil would be treated with a landfarm to be constructed at Milne Inlet. Baffinland's requirements changed after the original work scope was developed, and the bladder farm remained in service through 2010. For this reason, the bermed soils were not characterized in 2010.

EBA's work scope for the 2010 period was modified to develop a preliminary landfarm design concept for Milne Inlet along with an operations and monitoring manual. A soil sampling and ground truthing program was conducted in the summer of 2011 to determine the volumes and concentrations of soil requiring treatment, to confirm the location of the facility, and to finalize the design details required to issue construction drawings. Preliminary design is based on the assumption that the petroleum hydrocarbon remediation objectives will be met within two to three treatment seasons.

The Milne Inlet landfarm will initially be used to treat sandy soils that were impacted by petroleum hydrocarbons when a fuel bladder ruptured in 2008. An estimated 8,000 L of Jet A diesel fuel was released into the lined containment berm. Contact water within the berm has been collected and treated since 2008, although no soil remediation has yet been conducted.

As per the Nunavut Water Board renewal of Baffinland's Licence No. 2BB-MRY0710, soils affected by hydrocarbons from normal fuel transfer procedures require treatment to meet the objectives included in the 2010 Government of Nunavut's Environmental Guideline for Site Remediation. Also, the Mary River Project Draft Environmental Impact Statement (December 2010) NIRB File No. 08MN053 indicates that a description of how petroleum-impacted soils will be handled on the site is required. Documents provided within the future application to amend the current Nunavut Water Board (NWB) license will consider the relevant Mining and Milling and Industrial Undertaking Hydrocarbon Impacted Soil Storage and Landfarm Treatment Facilities Supplemental Information Guidelines (2010, draft).

2.0 SITE DESCRIPTION

2.1 Project Location

The Milne Inlet facility is located on the northern end of Baffin Island, Nunavut at approximately 71 53' 03" N and 80 54' 12". The nearest communities are Pond Inlet, to the east of the site, and Arctic Bay, to the west. A key plan showing the location of the Milne Inlet Facility is Figure 1. Marine access and shipping through the construction phase and periodically during operation occurs seasonally through Milne Inlet and the existing Milne Inlet Tote Road provides access to the proposed Mary River mine site.

The current facilities at Milne Inlet include an airstrip with tarmack, docking facilities, fuel farm (75 fuel bladders with 113,560 L capacity each), temporary bulk sample ore stockpiles, Shanco Camp, an incinerator, a wastewater treatment facility, a polishing/waste stabilization pond, and laydown areas.

There are currently two alternative locations proposed for the landfarm facility (Figure 2). Both proposed locations are situated south of the camp, within till veneer areas along the tote road from Milne Inlet to Mary River. Proposed Site A is within an existing quarry area approximately 3 km along the tote road. Site A is advantageous because it is within a pre-disturbed area. Proposed Site B is closer, about 1 km from camp along the tote road, and offers an advantage of being less likely to accumulate large quantities of snow that would require treatment after melting in the spring.

Based on aerial photo interpretation, it appears that the aggregate materials in both locations would be suitable for the construction of a landfarm.

2.2 Authorizations

Much of the Mary River site and the land between Mary River and Milne Inlet is located on Inuit-owned land administered by the QIA. Existing permits include Type B Water License number 2BB-MRY0710 issued by the Nunavut Water Board (NWB), valid from February 20, 2007 to February 28, 2010, and extended by amendment to December 31, 2010. The Nunavut Impact and Review Board (NIRB) file number is 08MN053. NIRB is conducting ongoing review of the Mary River Project including the application for pre-development work planned for 2012, including the construction and operation of landfarm facilities.

3.0 MILNE INLET PRELIMINARY LANDFARM DESIGN

3.1 Design Intent

Sandy soils used as a protective layer over the liner system were affected when a fuel bladder at the Mine Inlet fuel facility ruptured on June 16, 2008 (Spill Report # 2008-347), spilling an estimated 8,000 L of Jet A fuel into the containment area. The concentrations of F1 to F4 fractions is unknown, but based on the nature of the fuel spill (Jet A), it is anticipated that the soils require treatment for the F2 and F3 petroleum hydrocarbon fraction.

Figure 3 provides the preliminary plan and sections of the purpose-built facility to treat these designated soils. The preliminary design will be finalized to accommodate the actual construction site topography, borrow material properties, and landfarm sizing requirements.

3.2 Landfarm Dimensions and Components

The landfarm is sized to accommodate an approximate 2,000 m^3 of soil, assuming a treatment soil depth of 0.3 m. Using these assumptions, the preliminary inner dimensions of the facility are 70 m by 100 m. The assumed berm height ranges from 1.3 m to 2.1 m above the natural ground, with a liner keyed in to the soils with at least 1 m of soil, as shown on Figure 3. The crest of the berms maintain a width of 3 m, and slopes will be 2H:1V or less, as shown on the drawings.

Depending on actual site conditions, the foundation base may be constructed directly by grading the natural ground. The proposed liner system consists of 60 mil textured HDPE between two layers of 12 oz. non-woven geotextile. The protective sand layer over the liner is 0.3 m. The less-impacted materials from the bladder farm may be re-used as the protective layer in the newly-constructed landfarm facility.

The final location, shape and overall size of the landfarm will be determined following the site characterization fieldwork to be completed during the summer of 2011. The landfarm access will be selected during the construction works.

3.3 Contact Water Containment

The foundation base will be sloped at 2% towards a sump with preliminary dimensions of 10 m by 70 m. The sump is designed to contain approximately 245 m^3 water, or approximately half the expected snowmelt volume. Based on the landfill dimensions and precipitation assumptions, a narrow strip of soils undergoing remediation adjacent to the sump may be saturated or have free standing water after the freshet. On this design basis, the maximum head on the liner is 1.0 m.

4.0 OPERATION AND MAINTENANCE PROCEDURES

4.1 Safety and Environmental Protection

In addition to adherence to Baffinland's Heath and Safety Plan, staff in charge of operating the landfarm must have valid WHMIS and TDG training and be trained in the procedures associated with landfarm operation, including the use of safety equipment (first aid supplies, eyewash station, fire extinguisher, spill response materials etc), emergency response procedures, soil tilling, record-keeping, soil and water sampling, and groundwater monitoring. It is recommended that activities involving contaminated soils be conducted under the supervision of site staff having a 40-hour Hazardous Waste Operations and Emergency Response Standard (HAZWOPER) or Canadian Hazardous Waste Workers Program.

Before work starts, personnel must be provided with a clear explanation as to the nature of the contamination and the specific personnel protective equipment required to complete the assigned tasks. Personnel should be trained how to decontaminate equipment and personal protective equipment. Personal hygiene, including showering at the end of the day and washing prior to eating, smoking, etc. is important after handling contaminated soils. Workers should be encouraged to watch for and immediately report any unsafe conditions, or to report any damage to the facility, especially any tears in the liner that could occur during operations such as tilling.

If the nature/degree of contamination is such that respiratory protection is required, the workers must be properly fit-tested prior to starting work at the facility. The selection of personal protective equipment is the responsibility of the site Occupational Hygienist, Corporate Safety Officer, or equivalent.

The facility must have warning signs posted in English and local dialect, both to prohibit the dumping of soil materials without the permission of the Site Manager, and to warn personnel of the dangers and risks posed by the facility (slip/trip, hydrocarbon-contaminated material, open water). The sump area should be clearly demarcated to avoid any personnel from breaking through ice at the start and end of the season, when snow cover may conceal the underlying thin ice.

4.2 Soil Acceptance Procedures

Rock fragments and cobble exceeding 100 mm in diameter should not be accepted in the landfarm. The soil originating from the bladder farm is anticipated to consist principally of sand and gravel.

Chemical acceptability criteria include the following parameters:

- Total petroleum hydrocarbons less than 4%,
- Electrical conductivity <4 dS/m; sodium adsorption ratio (SAR) <6,
- pH greater than 5 and less than 10, and
- CCME metals up to Tier 1 values or up to natural background concentrations.

4.3 Landfarming Operations

Landfarming is an ex situ bioremediation treatment that uses naturally-occurring microorganisms to metabolize or breakdown petroleum hydrocarbons in impacted soils. This is achieved by spreading contaminated soil in a thin layer across the landfarm area.

End products of bioremediation are microorganism protein, carbon dioxide and water. Stimulation of microbial growth and activity for hydrocarbon removal is accomplished primarily through the addition of air and nutrients. In a landfarm, the metabolism of hydrocarbon is mediated predominantly through aerobic microbes.

The effectiveness of landfarming depends on three main parameters:

- Soil characteristics; grain size, soil texture, bulk density, moisture content and permeability;
- Type of petroleum hydrocarbon; and
- Climatic conditions.

Climatic conditions including rainfall, snow, wind effects and temperature influence landfarm efficiency. Rain and snow melt will change the moisture content of the treated soil. Runoff and wind also has the potential to cause soil erosion.

The anticipated operational period of the landfarm will depend on the weather conditions, but it is anticipated to be from June to the end of September.

After excavation and transport of contaminated soil to the landfarm area, the soil should be dumped and spread with a front-end loader or bulldozer. The soil should be tilled as it is spread, continuing until all of the soil has been deposited to ensure that the material is well-mixed and aerated. Material placement should maintain a minimum 2 m offset from the inside berm toe.

Soils will be placed in a layer of approximately 0.3 m and should not exceed 0.45 m in any location. At the start of season, the soils should be evaluated for optimal nutrient, moisture and pH conditions. Microorganisms that degrade hydrocarbons require optimal quantities of water, oxygen, and macronutrients (carbon, nitrogen, hydrogen, oxygen, sulphur, phosphorus, potassium, and magnesium), and the soil pH should be between 6 and 8. In addition, excessive salt compounds reduce the osmotic

potential and can slow or even halt biodegradation. Salts that are harmful to biodegradation in excessive concentrations include sodium chloride as well as fertilizer amendments.

Most soil microorganisms that breakdown petroleum hydrocarbons on a landfarm require an aerobic environment. Tilling is conducted to aerate the soils and enhance microbial degradation. The landfarmed soil should be loose and moist. During the summer months, the soils should ideally be tilled every week.

Optimizing the moisture content will enhance biodegradation and to avoid dust generation. Very dry soils should not be tilled. If soils are excessively dry, the landfarm should be irrigated prior to tilling to increase the soil moisture content to 40% to 85% of the water-holding capacity.

Soils that are wet also do not benefit from tilling. Passing equipment over wet soils could compact the material. If the soil appears muddy, or sticks to the tires of the tilling equipment, it is too wet to process.

Tilling could damage the underlying liner so it should be carried out with care by an experience operator. Only tilling equipment should be permitted on the landfarm soil, and only during tilling. Trucks or other vehicles should not drive on the landfarm soil as this will pack the soil down making it difficult to handle, and may prolong the soil remediation timeframe.

During the winter months, soil can be stockpiled to minimize contact with freshet water, although the piles should be no higher than 5 m.

5.0 WATER MANAGEMENT PLAN

5.1 Plan Considerations

All irrigation water, precipitation and snowmelt that collects in the landfarm sump is considered contact water. Average monthly temperatures that are above 0°C occur between July and September, so it is expected that runoff will need to be managed for these three months of the year. Based on historical climate data for Pond Inlet, it is expected that 190 mm of precipitation will fall annually, approximately 50% of which will accumulate as snow. The preliminary landfarm design could accommodate over 4,000 m^3 of water while maintaining a minimum 0.5 m of freeboard.

The yearly monthly wind speed averages are between 5 and 6 m/s during the frost-free months, and the average monthly relative humidity is between 70% and 80%. Ignoring losses (evaporation) or gains to the landfarm (snow drifts), it is expected that approximately 1,150 m^3 of precipitation (snow and rain) will collect annually in the landfarm. The annual quantity of contact water may be higher depending on whether external irrigation water is required to maintain optimal soil moisture conditions during the period of active treatment. The sump is designed to contain approximately 245 m^3 of water, or approximately half the volume of the expected snowmelt.

5.2 Contact Water Recycling and Water Use Minimization Procedures

During the treatment process, contact water that accumulates in the sump may be recycled as irrigation water to add nutrient amendments, to increase soil moisture or to supress dust within the landfarm area during dry periods. Recycled water from the sump should preferably not contain any petroleum

hydrocarbon sheen, which could be removed by using absorbents, or avoided by drawing water from beneath the water surface.

Should external water inputs be required during the landfarm soil treatment operations, consumption of fresh water at Milne Inlet could be minimized by recycling water from other processes, such as waters from the sewage lagoon polishing cell or sewage sludge. Treated wastewater and/or sludge is potentially a valuable source of nutrients (especially nitrogen), and reclaimed water irrigation of the landfarm could reduce or possibly eliminate dry chemical nutrient amendment requirements. In addition to reducing freshwater consumption, recycling nutrients already available in treated sewage use benefits the environment by offsetting greenhouse gas emissions that otherwise would have been generated in the production and shipment of dry chemicals to site.

Such use of reclaimed water would require authorization from the NWB and other stakeholders, and is contingent on the chemistry of the proposed amendment (especially with respect to metals loadings) as well as the effectiveness of the amendment to achieve the remediation targets, such as through a bench-scale or plot tests. The proposed amendment would need prior characterization for suitability, including the COD:N:P ratios, metals, and routine chemistry parameters.

5.3 Contact Water Discharge

To maintain adequate freeboard and avoid flooding the soils undergoing treatment, the landfarm sump contact water should be removed prior to freeze up in September. Water that does not meet the discharge requirements provided in the amended Water Licence 2BB-MRY0710 requires treatment or off-site disposal. Nunavut Water Board (NWB) landfarm discharge limits for mine sites are provided in Section 7.3, as well as monthly testing of chemical parameters.

If reclaimed wastewater is used during the treatment process, the contact water discharge parameters may need to include BOD_5 and faecal coliforms in addition to the standard Water Licence discharge requirements.

After water analyses confirm the water is suitable for release and the AANDC Inspector has been notified of the intended discharge, the water will be released to a nearby Monitoring Station, the location of which will be confirmed on the as-built drawing. The landfarm Monitoring Station discharge point should be at least 30 m away from any surface waterbody, and water discharges should be conducted in a manner that avoids soil erosion.

6.0 SOIL QUALITY REMEDIATION OBJECTIVES

Remediation objectives for the F1 to F4 hydrocarbon fraction will depend on the subsequent use of the treated soils. As per the Nunavut Water Board renewal of Baffinland's Licence No. 2BB-MRY0710, soils affected by hydrocarbons from normal fuel transfer procedures require treatment to meet the objectives included in the 2010 Government of Nunavut's Environmental Guideline for Site Remediation. Industrial criteria are suitable if the treated soils are to remain in place until the landfarm is decommissioned or the term of the commercial lease expires. Without a site-specific risk assessment, agricultural/wildland Tier 1 F1 to F4 hydrocarbon criteria must be met if the soils are to be returned to the environment, or at such time that the commercial lease expires.

Soils that do not respond to bioremediation treatment may be disposed of off-site or, with prior approval, the materials could be used as intermediate fill within an engineered on-site facility (landfill).

7.0 MONITORING PROGRAM

7.1 Soil Sampling

Soil sampling will be conducted to determine acceptability criteria, to monitor the progress of soil remediation, and to verify that soils meet the remediation objectives at the end of treatment.

Chemical analyses for soil acceptance at the landfarm were listed in Section 4.2. For the designated soils, analysis of F1 to F4 hydrocarbon fractions will not be required if sufficient data density is obtained during the soils characterization. Soil bulk density, moisture content, field capacity, and nutrients (nitrogen, phosphorus) are also required testing parameters.

Unless the soils are chemically unsuitable for bacteriological growth, it is highly unlikely that there will not be sufficient microorganisms in the accepted soil to initiate effective bioremediation. For this reason, heterotrophic plate count analyses are generally not necessary.

Soil sampling to verify interim treatment includes the CCME F1 to F4 soil fraction and soil nutrients. Periodic measurement of hydrocarbon vapour emissions by measuring headspace, using a small quantity of soil and a photoionization detector (PID), is a useful indicator of the progress of remediation but should not be substituted for remediation verification sampling.

Soil sampling to verify the completion of the treatment process includes the CCME F1 to F4 soil fraction. Testing for metals is not required at the end of remediation since soils will be tested prior to acceptance at the landfarm, and any landfarm treatment inputs will have known chemistry.

Other soil sample parameters may be added, such as poly-aromatic hydrocarbons (PAH), if the landfarm is retained after the two-year remediation program, or for treatment of other types of hydrocarbon-impacted materials.

7.2 Contact Water Sampling

During the frost-free months, and only if contact water is present in the sump, one or two sets of water samples will be collected and submitted to an accredited laboratory and for the analysis of the following parameters:

- Oil and grease and visual observations of sheen
- F1 and F2 hydrocarbon fraction and BTEX
- Phenols
- Dissolved nutrients: ammonia, nitrate, nitrite, phosphate
- Total nutrients: total phosphorus, total kjeldahl nitrogen
- Solids: total suspended solids, total dissolved solids

- Major Ions/Anions: calcium, magnesium, sodium, potassium; hardness, chloride, sulphate
- Routine chemistry pH, alkalinity, conductivity
- Metals: CCME list including As, Ba, Be, Cd, Cr, Co, Cu, Pb, Mo, Ni, Sb, Se, Ag, Tl, Sn, V, Zn, Hg
- Routine Physical : turbidity, temperature

Parameters including temperature, pH, TDS, and electrical conductivity are to be measured in the field as well as the laboratory.

Other water sample parameters may be added, such as PAH, if the landfarm is retained after the remediation program, for treatment of hydrocarbon-impacted materials that do not originate from the fuel bladder farm.

7.3 Contact Water Discharge Limits

Contingent on the acceptance proposed landfarm and future amendment of the Water Licence, the proposed contact water discharge limits at the additional Monitoring Program Station are as follows:

Parameter	Maximum Concentration of any Grab Sample (mg/L)
pH	6.0-9.5
Total Suspended Solids	15
Oil and Grease	15 and no visible sheen
Total lead	0.001
Benzene	0.370
Toluene	0.002
Ethylbenzene	0.090

Depending on the design life of the landfarm, the installation of permanent groundwater monitoring facilities may be warranted. Alternately, temporary drive point (sand point) wells may be installed in the unconsolidated material using a hardened drive point and a screen (perforated pipe). The point is hammered into the ground, usually with a tripod and "driver" (weighted pipe that is repeatedly dropped).

Experience in similar latitudes in the Arctic indicates that free water will not be available for sampling until mid to late August. Groundwater will be monitored once per year in two downgadient and one upgradient location.

Water samples are to be collected and submitted to an accredited laboratory for the analysis of the following parameters

- F1 and F2 hydrocarbon fraction and BTEX
- Dissolved nutrients: ammonia, nitrate, nitrite, phosphate
- Total nutrients: total phosphorus, total kjeldahl nitrogen
- Solids: total suspended solids, total dissolved solids

- Major ions/anions: calcium, magnesium, sodium, potassium; hardness, chloride, sulphate
- Routine chemistry: pH, alkalinity, conductivity
- Routine physical : turbidity, temperature

Parameters including temperature, pH, TDS, and electrical conductivity are to be measured in the field as well as the laboratory.

7.4 QA/QC

The general quality assurance and quality control are to follow *QA/QC Guidelines for Use by Class "B" Licensees in Meeting SNP Requirements* (INAC, 1996). All samples are to be collected using best industry practices and shall be submitted under a Chain-of-Custody protocol. Sampling protocols adhered to include the following:

- Disposable sampling gloves to be worn during the collection of samples, and discarded between sampling events. Sampling tools are to be decontaminated between sampling points.
- Any sampling and inspection events should be documented in field notes including identification of the person conducting the work. It is beneficial to photograph any work that is conducted.
- For small batches of soil samples (less than 10 samples), at least one blind duplicate should be analyzed per batch of samples. For larger batches of soil samples (greater than 10 samples), 10% duplicates should be analyzed. For groundwater samples, a blind duplicate and field blank sample should be collected and analyzed with each batch of samples tested.
- Samples collected for laboratory analysis are to be placed in coolers and transported to the laboratory via courier.
- Sample holding times are to be adhered to, and water samples are to be preserved for specific analyses.
- All water and soil samples are to be collected in laboratory-supplied bottles and jars, and analyzed at a Canadian Association of Environmental Analytical Laboratories (CAEAL) accredited laboratory. All analytical reports are to include QA/QC reports.

7.5 Summary of Inspections and Reporting

Table 2 provides a summary of inspections and reporting associated with the operation of the landfarm:

Table 2: Monitoring Summary and Documentation

Item	Purpose	Frequency	Type of Record(s)
Landfarm Treatment Operations Inspection	Record keeping of treatment operations and berm performance for due diligence.	Once per day during spring freshet and after rainfall events. Weekly at other times.	• Inspection checklist and field notes including date, weather, facility condition including, any repairs required, odour noted, quantity of water in sump and amount of freeboard. • Record of berm performance with emphasis on observations of cracking or any signs of instability. • Check soils to see if they are too dry or too wet to till. • Record of any unauthorized discharges and follow-up action taken. • Photographic record.
Soil Sampling for Soils Acceptance at Facility	To determine if soils are acceptable for treatment at facility.	For this purpose-built facility, only one time per year at the start of season. Otherwise as circumstances require.	• Soils origin and associated spill report number, • Field notes including frequency of sampling, soil texture, moisture content, colour, odour. • Laboratory-issued reports including QA/QC • Summary tabulation of results. • Documentation of fate of rejected soils. • Record of any treatability tests done.

Table 2: Monitoring Summary and Documentation

Item	Purpose	Frequency	Type of Record(s)
Soil Sampling for Remediation Progress Monitoring	To provide interim indications of how remediation is progressing.	Monthly during the frost-free months.	• Field notes and sketch of location/depth of samples taken. • Photographic record. • Laboratory-issued reports including QA/QC and chain of custody. • Summary tabulation of results. • Analysis of percent removal of hydrocarbon constituent treated and treatment time, evaluation should include weather information, soil texture and soil moisture.
Soil Sampling for Verification of Remediation	To determine if remedial objectives have been met.	For this purpose-built facility, only one time per year at the end of season. Otherwise as circumstances require.	• Field notes and sketch of location/depth of samples taken. • Photographic record. • Laboratory-issued reports including QA/QC • Summary tabulation of results. • Analysis of percent removal of hydrocarbon constituent treated and treatment time. • Documentation of fate of treated soils. • Annual quantities in cubic metres of all soil and types of contaminants.
Contact Water Sampling During Remediation	Due diligence operations monitoring.	One or two times per treatment season	• Field notes and observations made at time of sampling. • Laboratory-issued reports including QA/QC and summary tabulation of results.
Contact Water Sampling prior to Discharge	To conform to Water License Requirements.	As required prior to discharge.	• Document notification of INAC Inspector (written notification at least 10 days prior to discharge). • Record depth of water in sump. • Calculate approximate water volume to be discharged. • Laboratory-issued reports including QA/QC and summary tabulation of results.
Groundwater Monitoring and Sampling	Date, time, weather, water level, in-well parameters (temperature, pH, electrical conductivity), visual observations of water colour and turbidity, odour.	Water sampling one time per year, between mid-August to mid-September.	• Laboratory-issued reports including QA/QC and summary tabulation of results, trend analysis (after a minimum of four years of data, if applicable).

Table 2: Monitoring Summary and Documentation

Item	Purpose	Frequency	Type of Record(s)
Construction Summary Report	As-built and construction report as per Water Licence.	Submit to Nunavut Water Board within 90 days of completion of construction	• Construction field notes and observations • Record and as-built drawings • Monitoring well installation details. • Summary of any geotechnical testing, compaction, moisture content, particle size analysis.
Site Safety Inspections	To identify any new or previously unnoticed physical/chemical hazards.	Monthly, or when conditions change, or when an unsafe condition is reported by a worker.	• Any unsafe condition/near-miss/incident reports and records. • Any unsafe conditions reported by workers must be reported to the Site Manager immediately for prompt action.
Geotechnical Inspection	To ensure facility has not been degraded or damaged, and to identify any maintenance requirements.	Annually	• Inspection of geotechnical performance of facility. • Document recommendations of any repair/maintenance work. • Record of any repair work made to the facility.

8.0 CLOSURE

We trust this report meets your present requirements. Should you have any questions or comments, please contact the undersigned at your convenience.

EBA, A Tetra Tech Company

REGISTERED PROFESSIONAL ENGINEER
W. T. HORNE
LICENSEE
Sept 13, 2011
N.W.T.

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PERMIT TO PRACTICE
EBA ENGINEERING CONSULTANTS LTD.
Signature
Date Sept 13/2011
PERMIT NUMBER: P 018
The Association of Professional Engineers, Geologists and Geophysicists of the NWT / NU

REFERENCES

Aker Kvaerner Ltd., 2008, Definitive Feasibility Study, Mary River Iron Ore Project Northern Baffin Island, Nunavut Yellowknife, Northwest Territories. Project Number 179710

Canadian Council of Ministers of the Environment, 1993. Guidance Manual on Sampling, Analysis and Data Management for Contaminated Sites, Volume I: Main Report and Volume II: Analytical Method Summaries. Winnipeg, Manitoba.

Canadian Council of Ministers of the Environment, 1999, Canadian Environmental Quality Guidelines, Winnipeg, Manitoba.

Canadian Council of Ministers of the Environment, 2008, Canada-Wide Standards for Petroleum Hydrocarbons in Soil (CWS-PHC). Winnipeg, Manitoba.

Environment Canada, 2002, Metal Mining Effluent Regulations under the Fisheries Act, P.C. 2002-987 June 6, 2002.

Ferguson, Simek Clark Engineers & Architects, 2003, Guidelines for the Planning, Design, Operations and Maintenance of Modified Solid Waste Sites in the Northwest Territories. April 21, 2003. Technical Report of the

Government of the Nunavut, 2002, Guideline: General Management of Hazardous Waste in Nunavut. Department of Environment.

Government of the Nunavut, 2009, Environmental Guideline for Contaminated Site Remediation. Department of Environment.

Roger, Pamela, 2005, cold climate Bioremediation: A Review of Field Case Histories. Department of Civil & Environmental Engineering, University of Alberta.

Science Applications International Corporation (SAIC), 2006, Federal Guidelines for Landfarming Petroleum Hydrocarbon Contaminated Soils. Environment Canada. SAIC Canada Project Number 11953.B.S08, CM Number: 0011659.

FIGURES

Figure 1 Site Location Plan
Figure 2 Proposed Locations of Landfarm Facility
Figure 3 Preliminary Landfarm Design Plan, Sections and Details

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NOTES
BASED ON DRAWING PROVIDED BY BAFFINLAND IRON MINES CORPORATION

CLIENT
Baffinland Iron Mines Corporation

Hydrocarbon Impacted Soils Storage and Landfarm Facility

Site Location Plan

PROJECT NO.	DWN	CKD	REV
E14101092	RH	DF	0

OFFICE	DATE
EDM	September 13, 2011

eba A TETRA TECH COMPANY

Figure 1

NOTES
BASED ON 2005 AERIAL PHOTOGRAPH

0 250
Scale: 1: 5 000 (metres)

CLIENT
Baffinland Iron Mines Corporation

eba A TETRA TECH COMPANY

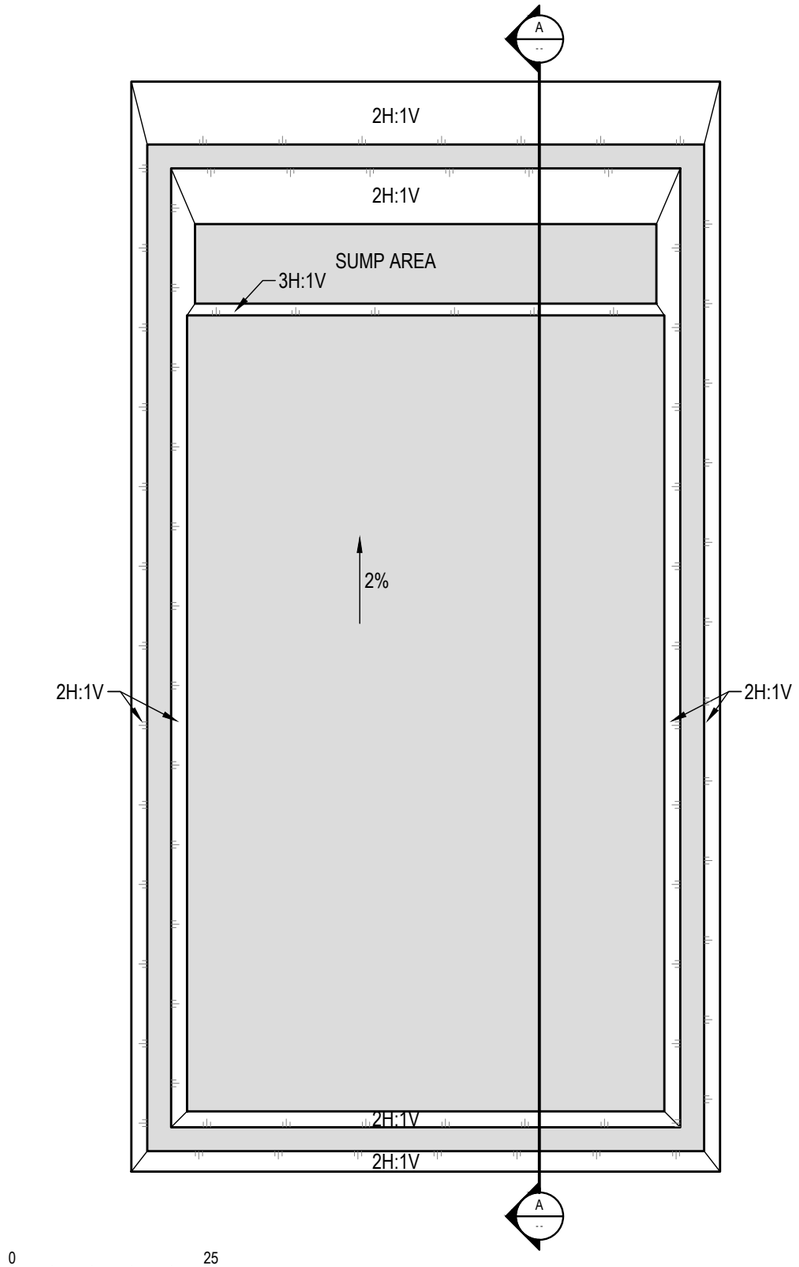
Hydrocarbon Impacted Soils Storage and Landfarm Facility

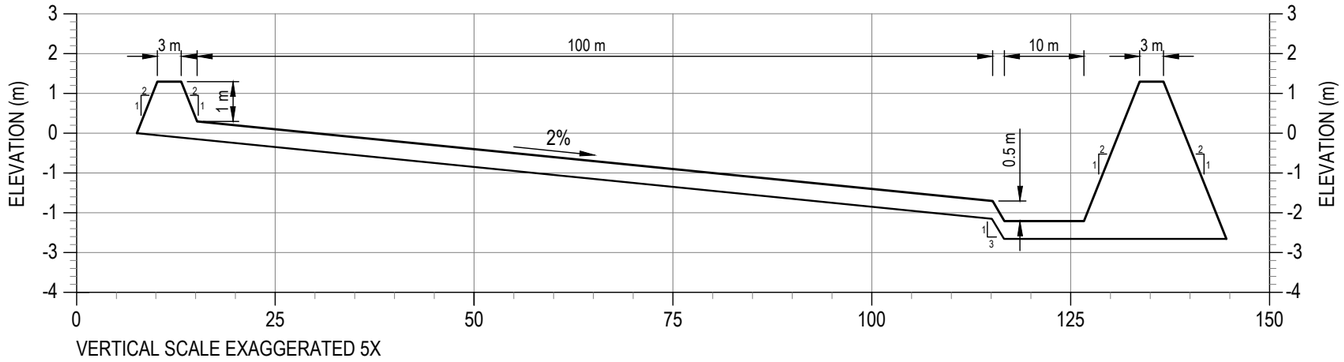
Proposed Landfarm Locations

PROJECT NO.	DWN	CKD	REV
E14101092	RH	DF	0

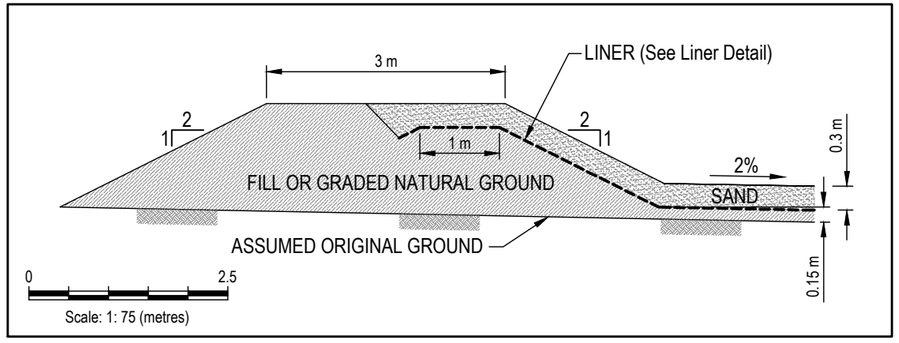
OFFICE	DATE
EDM	September 13, 2011

Figure 2

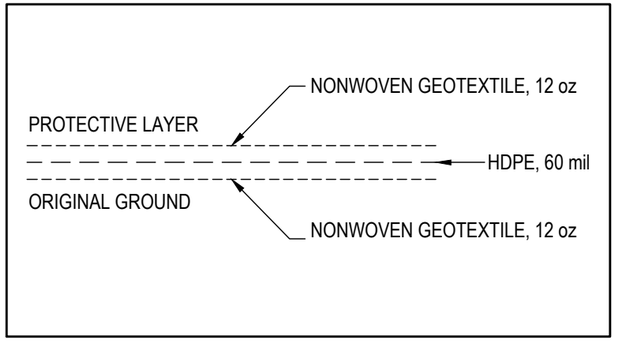




SECTION A



TYPICAL SECTION DETAIL



LINER DETAIL

NOT FOR CONSTRUCTION

NOTES
BERM HEIGHTS AND GRADES TO BE ADJUSTED BASED ON ACTUAL TOPOGRAPHY

CLIENT
Baffinland Iron Mines Corporation

Hydrocarbon Impacted Soils Storage and Landfarm Facility

Preliminary Design of Landfarm Facility

eba A TETRA TECH COMPANY

PROJECT NO.	DWN	CKD	REV
E14101092	RH	DF	0

OFFICE	DATE
EDM	September 13, 2011

Figure 3

APPENDIX A

APPENDIX A EBA'S GENERAL CONDITIONS

GENERAL CONDITIONS

GEOTECHNICAL REPORT

This report incorporates and is subject to these “General Conditions”.

1.0 USE OF REPORT AND OWNERSHIP

This geotechnical report pertains to a specific site, a specific development and a specific scope of work. It is not applicable to any other sites nor should it be relied upon for types of development other than that to which it refers. Any variation from the site or development would necessitate a supplementary geotechnical assessment.

This report and the recommendations contained in it are intended for the sole use of EBA’s Client. EBA does not accept any responsibility for the accuracy of any of the data, the analyses or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than EBA’s Client unless otherwise authorized in writing by EBA. Any unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of EBA. Additional copies of the report, if required, may be obtained upon request.

2.0 ALTERNATE REPORT FORMAT

Where EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed EBA’s instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of EBA’s instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except EBA. EBA’s instruments of professional service will be used only and exactly as submitted by EBA.

Electronic files submitted by EBA have been prepared and submitted using specific software and hardware systems. EBA makes no representation about the compatibility of these files with the Client’s current or future software and hardware systems.

3.0 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, EBA has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

4.0 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. EBA does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

5.0 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

6.0 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. EBA does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

7.0 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

8.0 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

9.0 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

10.0 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

11.0 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

12.0 BEARING CAPACITY

Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

13.0 SAMPLES

EBA will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

14.0 INFORMATION PROVIDED TO EBA BY OTHERS

During the performance of the work and the preparation of the report, EBA may rely on information provided by persons other than the Client. While EBA endeavours to verify the accuracy of such information when instructed to do so by the Client, EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.