Guidelines for Abandonment and Restoration Planning for Mines in the Northwest Territories

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and
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Foreword

In the past it was generally accepted that mining operations which ran out of ore would simply leave their buildings and other facilities in place when they shut down. Northern society has, in recent years, indicated that such abandonment practices are no longer acceptable. Reacting to this expression of concern in the early 1980's, the Northwest Territories Water Board and Department of Indian Affairs and Northern Development (DIAND) began to include in Water Licences and Land Leases granted to mining companies, a condition that an Abandonment and Restoration Plan be prepared and submitted for approval.

Mining companies have accepted this condition but have regularly raised questions about what was required in an Abandonment and Restoration Plan. Initially the Board and DIAND responded on an *ad hoc* basis to these inquiries, but it soon became evident that a suitable structure for such plans was required.

The Technical Advisory Committee (TAC) of the Water Board in conjunction with staff of the DIAND Land Resources Division formed a Sub-Committee of the TAC which was asked to draft appropriate guidelines for the abandonment and restoration of mines. This document is the result.

While these are only guidelines, they do cover the important matters which must be addressed and provide a format for preparing Abandonment and Restoration Plans.

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1.0 Introduction

Every water licensee, land lessee or proponent is required to prepare plans for the eventual abandonment and restoration of its property and facilities. The purpose of these guidelines is to provide the mining industry with objectives for, and direction in, the development and preparation of its plans, so that abandonment and restoration can be designed into, rather than retrofitted to, each mining project.

Abandonment and restoration plans may be required before a licence to use water and dispose of waste will be granted. If present restoration technology will not satisfactorily prevent long term degradation of the environment, a water licence may not be issued. Abandonment and restoration plans will be required soon after the issuance of a land lease. The general content of these restoration plans will be outlined in the conditions of lease documents.

Abandonment and restoration plans are also addressed by other legislation. For example, where a property is located on Commissioner's Land, land use approvals and restoration alternatives will be required under the Commissioner's Lands Act. Where the property is located within the boundaries of a municipality, the operator must address the requirements of any by-laws which may have application. Appendix 1 lists several relevant Acts and Regulations.

These guidelines specifically address water and land issues and are based in part on the experiences of a number of North American and European mining operations. Different terms are often used to describe "restoration", such as reclamation and decommissioning. For consistency, the word restoration has been used in these guidelines but it should be interpreted to mean any of the common terms used elsewhere.

1.1 The Goal of Restoration

The goal of restoration is to prevent progressive degradation, and to enhance natural recovery of areas affected by mining.

1.2 The Specific Objectives of Restoration

(a) To ensure that mine facilities, wastes and tailings are abandoned in such a manner that the requirement for long-term maintenance and monitoring is minimized;

(b) To prevent continued loadings of contaminants and wastes to the environment;

(c) To prevent acid mine drainage; and

(d) To return affected areas to a state compatible with the original undisturbed conditions, giving due consideration to practical factors including economics, aesthetics, future productivity, and future users.

A planning approach of addressing abandonment and restoration throughout the life of the project should be taken.

1.3 Precept

Using these guidelines as a base, and considering the project's site-specific implications, the onus will be on the operator to obtain all the information necessary to design for operation, abandonment and the restoration of areas affected by mining and to ensure that the intent of these guidelines will be met.

2.0 Design Guidelines

2.1 Tailings Containment Structures

2.1.1 Design Criteria

Tailings containment structures can be assigned a level of hazard based on the potential impact on the surrounding environment in the event of a failure of the structure. These hazard levels should be considered, in conjunction with the Water Board's "Guidelines for Tailings Impoundment in the Northwest Territories", in the planning for the abandonment and restoration of tailings areas.

The classification scheme for abandoned tailings impoundment structures (Table 1), is based on potential impacts to human life, and/or the surrounding environment. The assignment of a hazard level is based on the worst possible result. For example, a low concentration waste with a surface area of greater than 100 hectares will fall into the High Hazard category, based simply on the potential loading of contaminants. Once the hazard level is determined, the design criteria can be determined from Table 2.

The maximum acceptable concentrations for selected substances in discharges from abandoned tailings areas are listed in Table 3. The limits are derived from the Metal Mining Liquid Effluent Regulations of the Fisheries Act, and may be higher than limits in the water licence during the operation of the tailings pond. The reduction in loadings, normally expected from a tailings area after abandonment, is a reason for this difference. The limits in Table 3 may not provide for adequate protection of the environment in all cases, and lower values should be considered for environmentally sensitive areas.

Table 1

Classification of Abandoned Tailings Disposal Areas Based on Potential Environmental Impact

Low Impact

To be classified as "low impact", the tailings impoundment area must meet all of the following criteria:

1. Low levels of contaminants;
2. No potential for acid generation;
3. No potential for the leaching of contaminants;
4. Surface area of 50 hectares or less;
5. Concentrations of all of the parameters in the liquid discharge are lower than appropriate water quality objectives; and
6. No human use of the impacted downstream area.

Medium Impact

The tailings impoundment area will be classified as "medium impact" if it meets any one of the following criteria:

1. Moderate levels of contaminants;
2. Moderate potential for acid generation;
3. Moderate potential for the leaching of contaminants;
4. Surface area greater than 50 hectares but less than 100 hectares;
5. Concentrations of any one of the parameters in the liquid discharge are higher than appropriate water quality objectives, but lower than the concentrations in Table 3;
6. Seasonal human use of the impacted downstream area.

High Impact

The tailings impoundment area will be classified as "high impact" if it meets any one of the following criteria:

1. High levels of contaminants;
2. High potential for acid generation;
3. High potential for the leaching of contaminants;
4. Surface area of 100 hectares or greater;
5. Concentrations of any one of the parameters in the liquid discharge are higher than the concentrations in Table 3;
6. Year-round human use of the impacted downstream area.

Table 2

Design Criteria for Abandoned Tailings Impoundment Structures

Impact	Design Criteria
Low	Worst case of 1 in 50 year storm or seismic event
Medium	Worst case of 1 in 100 year storm or seismic event
High	Worst case of 1 in 200 year storm or seismic event

Table 3

Maximum Acceptable Concentrations for Selected Substances in Discharges from Abandoned Tailings Areas

Substance	Maximum Acceptable Concentration in a Grab Sample[1]
Arsenic	0.5 mg/l
Copper	0.3 mg/l
Lead	0.2 mg/l
Zinc	0.5 mg/l
Nickel	0.5 mg/l
Radium 226	10 pCi/l
Total Suspended Solids	25 mg/l

[1]This is based on a sampling frequency of one month or less. If more frequent sampling is implemented, the monthly average concentration should meet these concentration limits.

2.1.2 Determining Acid Generation Potential

Tailings, open pits, waste rock piles, and surface disturbances have the potential for acid generation. When acid generation occurs, the concentration of metal contaminants in runoff from or through these areas can increase significantly.

It is important that the potential for acid mine drainage be evaluated at the earliest possible stage of a project so that steps may be taken to control the generation and abate the effects of any such drainage.

To assess acid generation potential, the following information should be evaluated:

1) geochemical characteristics of the ore, gangue minerals and enclosing rock, including the amount and types of sulphide and carbonate minerals present, metal concentrations, calcium carbonate alkalinity, total sulphur content, acidity and paste pH; and,
2) results of acid generation potential tests conducted on representative samples from the ore body and surrounding wastes or tailings. Samples should reflect the range of total sulphur to calcium carbonate alkalinity ratios and range of particle sizes of the tailings.

If initial testing results show that the acid generation potential is marginal, the tests should be repeated. Tests should also be repeated should a change in ore composition or milling technology result in changes in the characteristics of the tailings.

2.1.3 Reducing Acid Mine Drainage

Where the potential for acid mine drainage from tailings exists, steps must be taken to minimize that potential. A number of alternatives exist. These include: blending tailings with additional carbonate material; discharging tailings in a manner that will promote quick dewatering and compaction to a highly impervious mass; and deep water disposal.

Open pits, waste rock piles and surface disturbances also have the potential to produce acid mine drainage. Steps must therefore be taken to minimize acid mine drainage from these sources as well. For example, where sulphides are present in open pit walls, flooding may be a viable way to prevent oxidation and acid formation.

2.1.4 Leachability

The leaching of metals must also be considered at the early stages of a project so that appropriate control steps may be taken.

Leachability potential can be determined by means of bench-scale or pilot-scale lysimeter studies. Study results should be assessed in comparison with local water quality and effluent quality standards.

2.2 Cover Treatments

2.2.1 Objectives

Surface treatments for tailings, and if required for waste rock stockpiles and disturbed areas, should be designed and constructed to optimize the following:

- immobilization of the surface material;
- reduction of capillary action;
- control of infiltration;
- enhancement of runoff;
- diversion of uncontaminated surface water;
- control of erosion; and
- enhancement of natural revegetation.

The toxicity of the waste material must be taken into account when planning cover treatment. Tailings or other areas which are contaminated should receive the maximum design allowances, whereas innocuous material will not require measures.

2.2.2 Revegation Enhancement

Revegetation is not seen as the exclusive method for cover, or for restoration. Instead, revegetation where applicable, should be part of a total restoration plan. The primary objective of revegetation should be to stabilize surface materials and enhance natural vegetation growth. Revegetation should be an ongoing consideration during mine operation and should be implemented as soon as disturbed areas are no longer to be used.

2.3 Pits

The preferred practice in open pit mining is to backfill pits on an ongoing basis. If backfilling is not practical for operational reasons, it is acceptable that open pits remain unfilled. However, access roads should be closed to prevent innocent access by the public. Dewatering open pits through the use of berms and diversion ditches should be avoided.

Pit slopes should be engineered. Overburden blankets on rip-rap, or other materials suitable for supporting vegetative covers may enhance slope stability. When permafrost is encountered, it should be insulated with thick blankets of waste rock, overburden or other insulating materials to prevent thawing and slope failure.

Where open pits will recharge naturally, efforts should be made, where practical, to enhance the potential of the eventual water body to support a natural aquatic community.

2.3.1 Quarry Sites

Test pits and other disturbances created in the

course of searching for quarry materials should be backfilled and levelled to match the original topography.

Upon the exhaustion of material in a quarry pit, or upon abandonment of the pit, the excavation should be re-contoured and topsoil or overburden should be replaced wherever practicable.

The restoration of quarry sites should be an ongoing and progressive activity while the mine is operational. This will minimize the amount of restoration work required at mine abandonment.

2.4 Waste Rock and Overburden Piles

During mine operations, waste rock and overburden not necessary for construction purposes should be stockpiled by type in areas where it can be used during a phased abandonment. Consideration should be given to the location of the pile so that erosion or slumping of the pile does not occur. Tests for acid generation and leachability should be conducted on representative samples of the material before plans are made for its location and subsequent use.

Waste rock and overburden piles should be contoured so as to remain stable. In areas of aesthetic sensitivity, they should blend in with the surrounding topography. In open pit operations, the preferred practice is to dispose of waste rock in abandoned pits. If the rock is not to be reused, completed waste rock piles should be covered with overburden or other materials conducive to vegetative growth, wherever practical.

2.5 Fuel and Chemical Storage Areas

Fuel storage tanks should be removed along with the associated piping and plumbing. Contaminated soils should be ignited to burn residual fuels, then covered with fill. Berms surrounding the area should be levelled and may be used for cover materials. There may be a requirement to remove plastics and other membrane materials to a landfill site. Care must be taken in the final grade design to ensure that the potential for ponding is eliminated.

Chemical storage facilities should be removed and the soils surrounding the site should be surveyed for contaminants. Where contaminants are present, soils must be treated or discharged into the tailings pond. The cleaned storage area should be graded to prevent ponding, using the berm material where possible.

2.6 Roads, Airstrips and Other Drainage Inhibitors

Roads can normally be left in place. Culverts, however, should be removed, and other areas of potential inhibited drainage should be breached. The drainage cut should be backsloped and rip-rapped if the soil is susceptible to erosion.

Airstrips, if not subject to dangerous collapse, should normally be left intact. The airstrip should only be rendered unserviceable if it has a major culvert, or some other internal structure which might collapse and make the strip unsafe. If the strip is removed, or taken out of service, it should be so marked in accordance with Transport Canada regulations. There may be a requirement to scarify, fertilize or seed roads and airstrips.

Other drainage inhibitors, such as spur roads, building pads, foundations, turnouts or parking ramps should be individually examined to determine if they impede natural drainage. If so, measures should be taken to ensure that natural drainage patterns are restored.

2.7 Solid Waste Management

Operators must deal with solid wastes in a responsible manner with ongoing abandonment undertaken during all operational phases. This will minimize disposal efforts required at the time of final abandonment of the property.

All waste management sites should be mapped and inventoried. Consideration should be given to the storage and recovery of recyclable material whenever practical.

For sanitary landfills, site selection is the prime consideration in order to prevent leachate from entering local watersheds. Open pits or tailings ponds may be acceptable locations depending on the nature and volume of the waste, the surface and sub-surface hydrology and the type and depth of cover material.

Hazardous materials such as PCB's, radioactive isotopes and toxic chemicals are unsuitable for disposal on site and must be transported to an approved storage or disposal area.

2.8 Buildings and Other Structures

Buildings and other structures should normally be removed and the foundations left in a safe condition. Disposal methods may include complete removal, burning and burial.

3.0 Plan Development

3.1 Abandonment Scenarios

The proponent is encouraged to consider abandonment scenarios in the development of operational plans. The purpose of these scenarios is to assist in identifying abandonment and restoration options at an early stage of the project. The Water Board and the land administrator will use their best judgement in establishing requirements on a case-by-case basis. Possible scenarios are outlined in the following subsections:

3.1.1 Planned Shutdown

A planned shutdown occurs when mining and milling is stopped due to economic or operational requirements. The company has every intention of continuing when the problems are resolved. A planned shutdown will not normally extend beyond one year. Leases and licences may be renewed as necessary.

3.1.2 Long Term Shutdown

A long term shutdown occurs when mining and milling is stopped due to economic considerations or a reduction in the ore reserves. The project may resume if metal prices increase or more ore is located. Some salvaging of equipment may take place. Licences may be renewed as necessary. Land leases are issued for limited activities. A change in activities may require a change of lease or lease conditions.

3.1.3 Final Abandonment

Final abandonment occurs when the project is completed and there is no intention of mining or milling at the site in the foreseeable future.

3.2 Phased Plan Development

The proponent is encouraged to adopt a phased approach to the development of the abandonment and restoration plan. In this way, the plan can be made flexible and the results of new studies and new technology may be incorporated as necessary.

Three (3) phases are recommended: an Initial Phase, an Interim Phase and a Final Phase.

3.2.1 Initial Phase

In the Initial Phase, the proponent should provide the following:

(a) a commitment to abandonment in a well planned and phased manner;

(b) a commitment to minimizing disturbance;

(c) a commitment to restoration of the site to acceptable standards;

(d) a commitment to a program to finance the restoration program;

(e) a determination of the risk/hazard potential of proposed tailings sites during both operation and abandonment;

(f) an estimate of the acid generation potential of the tailings;

(g) a commitment to the development of programs to:
   i) address acid generation of tailings, waste rock piles and other disturbed areas,
   ii) minimize the leaching of metals into water draining from the property, and
   iii) determine the natural revegetation potential of disturbed areas.

The Initial Phase of the plan will normally be required in support of the proponent's application for a Water Licence.

3.2.2 Interim Phase

In the Interim Phase the operator should provide the following:

a) a cataloguing and large scale mapping of disturbed areas and areas yet to be developed;

b) a proposal for the financing of the restoration program;

c) an assessment to determine the optimal abandoned condition that could be achieved to meet a level of restoration compatible with the surrounding undisturbed area;

d) the development of detailed plans for the restoration of sites based on the results of the completed studies; and

e) a detailed outline of methods to:
   i) minimize contaminant loadings to the environment;
   ii) minimize the development of acid mine drainage; and
   iii) ensure that affected areas will return to a state compatible with the surrounding area;

f) evidence that the restoration treatments will meet the intent of these guidelines without the need for long term maintenance and monitoring;

g) an estimate of the residual impacts which may persist after abandonment; and

h) a plan of restoration which should include, but not be limited to, the following:
   i) buildings and other structures;
   ii) roads and airstrips;
   iii) tailings and disposal facilities;
   iv) waste rock disposal sites;
   v) petroleum and chemical storage areas and facilities;
   vi) garbage, sewage and waste storage or disposal sites and facilities;
   vii) pipelines and electrical transmission lines;
   viii) site drainage systems, granular material deposits and open pit areas; and
   ix) other facilities or sites utilized during the operation.

The information outlined for the Interim Phase of the plan will normally be required within two (2) years of the granting of the initial Water Licence, and will require updating annually thereafter. The Land Lease will also specify requirements for abandonment and restoration, including submission schedules.

3.2.3 Final Phase

In the Final Phase, the operator should provide the following:

a) a description of the location of restoration activities such as road breaching, ditch infilling, site stabilization and revegetation, as well as detailed descriptions of each activity;

b) the implementation plan for the restoration program which best satisfies the requirements of these guidelines;

c) a schedule for the completion of abandonment and restoration; and

d) a commitment to a monitoring program for a period sufficient to demonstrate that the intent of the guidelines has been met.

The information outlined for the Final Phase of the plan will usually be required at least three (3) years prior to the anticipated final abandonment.

4.0 Effectiveness Monitoring

It is not always sufficient to assume that the planned restoration program will function as designed in minimizing environmental degradation and meeting the goals and objectives of restoration. A monitoring program should be implemented to measure the effectiveness of the restoration program. It is also important to monitor progress as restoration proceeds so that long term commitments to monitoring can be reduced wherever possible.

The monitoring program should be a joint effort between the operator and the regulator with the operator assuming the responsibility during the initial phases. As it becomes apparent that the program is achieving its objectives, and as the probability of long term problems and maintenance is lowered, the government may assume the bulk of the monitoring responsibilities.

5.0 Legal Requirements

Both the *Northern Inland Waters Act* (NIWA) and the *Territorial Lands Act* (TLA) address the concerns of government with respect to the abandonment and restoration of mines in the Northwest Territories.

The Department of Indian Affairs and Northern Development administers the TLA and shares the administration of the NIWA with the NWT Water Board.

The TLA is administered under two sets of regulations governing surface use: the Territorial Land Use Regulations (TLUR) and the Territorial Land Regulations (TLR). The relevant control mechanisms for abandonment and restoration of mines are the TLR and the leases issued pursuant to these regulations.

Typically, a prospective mining company will be issued a permit under the TLUR and will register a mining claim under Canadian Mining Regulations. If the initial work leads to a producing mine, long term land leases and mineral leases will normally be granted by the government. The posting of security deposits may be required as a term of a land lease.

The NIWA regulates the use of water and the disposal of waste into the waters of the Northwest Territories. A mining company that wishes to operate a mine must first obtain a water licence.

Section 13(3) of NIWA states:

> "A board may require an applicant for a licence to furnish security, in a form and on terms and conditions prescribed by regulations, for the protection of licensees and owners and occupiers of property who, in the opinion of the board, are liable to be adversely affected as a result of the issuance of a licence to the applicant."

Regulation 13(1) of NIWA specifies that the Board may determine the amount of the security provided that it not exceed $100,000.00 or 10 per cent of the estimated capital cost of the work, whichever is greater. The type of security is described in regulation 13(2) and may take the form of:

(a) a promissory note guaranteed by a chartered bank in Canada payable to the Receiver General;

(b) a certified cheque drawn on a chartered bank in Canada payable to the Receiver General;

(c) a performance bond issued by a surety approved by the Treasury Board for the purposes of the Government Contract Regulations; or

(d) any combination of the securities described in paragraphs a, b and c.

Regulation 13(3) specifies that the security will remain with the Government until the licensee satisfies the terms and conditions of the licence.

If the licensee has not complied with all of the terms and conditions of its licence, regulation 13(4) provides that the Board may retain such part of the security as, in the opinion of the Board, the circumstances justify.

Industrial licences generally contain conditions requiring abandonment and restoration plans and the implementation thereof. Consequently, if the approved abandonment and restoration plan is not satisfactorily implemented, the security deposit or a portion thereof may be withheld by the Water Board.

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Appendix

Relevant Acts

Abandonment and restoration of minesites in the Northwest Territories are subject to a number of statutes. At the time of publishing these Guidelines, the primary Acts and Regulations were those listed below. However, it is incumbent upon the proponent to ensure compliance with all pertinent legislation.

Relevant Acts and Regulations

Federal

Northern Inland Waters Act and Regulations
Territorial Lands Act and Regulations
Fisheries Act and Regulations
Transportation of Dangerous Goods Act and Regulations
Canadian Environmental Protection Act and Regulations

Territorial

Mining Safety Act and Regulations
Environmental Protection Act and Regulations
Commissioner's Land Act and Regulations
Transportation of Dangerous Goods Act and Regulations

Assistance may be obtained from:

Controller of Water Rights, Water Resources Division, Department of Indian Affairs and Northern Development, Yellowknife;

Regional Manager, Land Resources Division, Department of Indian Affairs and Northern Development, Yellowknife;

Chief Mining Engineer, Department of Safety and Public Services, Government of the Northwest Territories, Yellowknife; and

Chairman, N.W.T. Water Board, Yellowknife.