editorial comments by t.pearse and Carole Mills

MINE RECLAMATION GUIDELINES FOR THE NORTHWEST TERRITORIES AND NUNAVUT

Indian and Northern Affairs Canada
Yellowknife, NWT
Iqaluit, NU

D R A F T

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Preface

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Acknowledgements

TABLE OF CONTENTS

List of Figures

List of Tables

1.0 INTRODUCTION

1.1 OVERVIEW

These guidelines are intended to assist proponents of mining companies in understanding the expectations of the Department of Indian Affairs and Northern Development (DIAND) for closure and reclamation of mines in the Northwest Territories (NWT) and Nunavut. These guidelines may also be of interest to land owners and other agencies that play a role in the decommissioning of mines and reclamation of lands and water affected by mining activities. They should be considered as one component of the overall resource management framework for mining activities in northern Canada. DIAND's Water Resources Division publication, *Mine Reclamation in Northwest Territories and Yukon*, (INAC, 1992) may be useful as a reference as it presents an outline of potential technical solutions to reclamation issues. Any specific advice in the 1992 guidelines should be carried into the new one, and the 1992 ones put to rest; avoids confusion and conflicting advice. Additional sources of reference material are identified at the end of this document.

These guidelines discuss the broad objectives for mine closure; design criteria; reclamation measures; temporary mine closure; special mines in northern Canada; considerations for northern mines; reclamation security; and planning, monitoring, and reporting for mines in NWT and Nunavut. The mine components addressed include: open pit and underground mining, tailings containment, mill and effluent treatment, ore and waste rock storage, and water use and waste disposal associated with mining as defined in the *Canada Mining Regulations* under the *Territorial Lands Act*. Although mining exploration activities are not addressed by these guidelines, advanced exploration activities (especially those in or proximal to active workings), and bulk sampling programs may be subject (unless this is made more explicit it should be deleted; not really helpful) to the objectives and principles presented in this document.

1.2 MINE RECLAMATION POLICY

The *Mine Site Reclamation Policies for the NWT and Nunavut* (INAC, 2002) were developed for the protection of the environment and the disposition of liability relating to mine closures. The policies state that all mines in the Northwest Territories and Nunavut should be planned, operated, decommissioned and closed in an environmentally sound manner in accordance with current mine closure and reclamation practices.

These practices include:

- Submission and approval of a mine closure and reclamation plan to regulators and landowners before mine production begins;
- Regular mine closure and reclamation plan updates, and annual reclamation progress reports;
- Best practices as an integral component of reclamation planning;

- Progressive mine reclamation consistent with the approved plans and current mine reclamation practices;
- Financial assurance that fully covers the outstanding liabilities at any period of the mine operations; and,
- Site reclamation and monitoring at the expense of the mining company.

The policies should be used to inform industry of the Department's expectations in project design (as it relates to reclamation planning) and what industry can expect from regulatory decision-makers. The policies will also inform regulatory boards of what to expect in the Department's interventions. (The connection between the policy and guidelines should be made more clear.)

1.3 REGULATORY AND ENVIRONMENTAL AUTHORITY

Enforcement of regulatory provisions related to mine site reclamation exists under various regulatory regimes including the *Territorial Lands Act* and its regulations, the *Northwest Territories Waters Act* and its regulations, *Arctic Waters Pollution Prevention Act, Nunavut Waters and Nunavut Surface Rights Tribunal Act,* and the *Mackenzie Valley Resource Management Act* and its regulations. Other applicable legislation includes the *Canadian Environmental Protection Act, Nuclear Safety and Control Act,* and *Fisheries Act*. Additional territorial acts and regulations are listed at the end of this document. The regulatory framework for the NWT and Nunavut are summarized in Appendices 1 and 3 respectively.

Closure and reclamation planning is considered in the environmental impact assessment process, which precedes regulatory licensing and the commencement of mine production. The environmental assessment process for the NWT and Nunavut are summarized in Appendices 2 and 4 respectively.

1.4 APPROACH AND GENERAL OBJECTIVES

Mining is considered to be a temporary use of the land. At closure, the mine site and the land affected by the mining operations are to be reclaimed to achieve the following objectives, in priority order:

1. Protect public health and safety.
2. Prevent or mitigate environmental degradation caused by mining related activities
3. Ensure the return to stable land use that reflects its original use or an acceptable alternative that considers community input and values (this could be better worded to be clearly consistent with the Policy statement that 'the required standard of reclamation should be based on the 1994 Whitehorse Mining Initiative definition: 'returning mine sites and affected areas to viable and, wherever practicable, self-sustaining ecosystems that are compatible with a healthy environment and with human activities.'

It is convenient to separate mining facilities into components to design and plan reclamation work.. Mining facilities can generally be divided into eight main components:

- Underground mine
- Open pit mine
- Waste rock and overburden piles
- Tailings impoundment system
- Water management system
- Buildings and equipment
- Infrastructure such as roads, bridges, culverts, and airstrips
- Landfills and other waste disposal areas

The general reclamation objectives should be addressed for each component of the mine. A site must have a specific end-use identified prior to closure (why "prior to closure"? objectives for end-use should be identified in the initial Plan prior to project approval.) to aid in determining appropriate reclamation activities and timelines. Proponents must recognize that there may be several options for achieving the objectives and that evaluation of alternative reclamation methods should be presented. The reclamation objectives must take into consideration the physical stability, chemical stability, and land use and aesthetics at the site after closure. These three broad categories are described in the following.

1.4.1 Physical Stability

Any mine component that would remain after mine closure must be constructed or modified at closure to be physically stable such that, in the event of a failure or with physical deterioration, it does not pose a hazard to public health and safety or to the environment. The facility should continue to perform the function for which it was designed for at closure. It should not erode, slump, or move from its intended location under natural extreme events or disruptive forces to which it may be subjected after closure. Post-closure monitoring and maintenance may be needed to ensure such stability. (this is too ambiguous and permissive. reword to state: 'Post-closure monitoring and maintenance should not be needed to ensure such stability.')

1.4.2 Chemical Stability

Any mine component, including waste that remains after mine closure, should be chemically stable. Hazardous, mining-related chemicals should not be released into the environment. Water quality should not endanger public health or safety, or result in the inability to attain water quality objectives in the receiving environment (refer to the water quality criteria set out in the water licence). Soil and air quality can also be affected by the chemical stability of a mine component. The reader should refer to the various Canadian Council of Ministers of the Environment (CCME) publications on soil and air pollution found at: www.ccme.ca. These federal (CCME) guideline documents recognize that unique conditions may require unique approaches and provide protocols for the derivation of site-specific water and soil quality objectives where appropriate.

1.4.3 Land Use and Aesthetics

The selection of reclamation objectives at a project site should consider:

- Naturally occurring bio-physical conditions, including any physical hazards of the area (pre- and post development);
- Characteristics of the surrounding landscape (pre- and post development);
- Local community values and culturally significant or unique attributes of the land;
- Level and scale of environmental impact; and,
- Land use prior to mine development and expected post operational land use activity. (again, no reference to the Policy principle of using the Whitehorse wording)

The site should be compatible (too ambiguous; more precise definition would be helpful) with the surrounding lands once reclamation activities have been completed. Every effort should be made by proponents to achieve the accepted end-use land objectives as reclamation progresses.

1.5 POST-CLOSURE ACTIVITIES

Post-closure activities at a mine site begin once a mine ceases operation indefinitely.(no! this does not recognize progressive reclamation activities that should be taking place during operation. If you are referring to what the term "post-closure activities" means, then reword to say "post-closure activities refer to activities that begin once a mine ceases operation indefinitely)~~)~~ This post-mining (or post-closure?) phase should be of limited duration, typically not more than several years depending on the size and complexities of the mine site.(too ambiguous. why not have the initial closure plan specify a timeline for the post-closure activities and a post-closure target date for abandonment.) Once the reclamation activities have been completed, on-site activity should be reduced to geotechnical and water monitoring in accordance with the water licence and land permits, with limited maintenance or repair activities required. There are three design categories for post-closure mine scenarios: walk-away, passive care, and active care.

1.5.1 Walk-Away

A walk-away post-mine closure and reclamation plan requires neither on-site monitoring nor maintenance once the reclamation activities have concluded. This ~~is an ideal objective~~goal, ~~and may be achieved~~should be established for ~~some portions of a~~the entire mine site. This design category, however, is difficult to achieve for an entire mine site.(no! delete. this should not be admitted. 'doing it right' would require the operator to design for 'walk-away' as the primary goal.) A walk-away plan can include selected short-term monitoring to ensure that the reclamation objectives have been met. A walk-away reclamation plan is the preferred solution for each individual component of a mine site and should be the initial alternative considered.(you say it here, but move it forward)

1.5.2 Passive Care

A passive care post-mine closure and reclamation plan consists of occasional monitoring, coupled with infrequent maintenance, at the end of the primary reclamation activities. This plan could include spillway maintenance or repairs to the waste rock and tailings covers. The majority of mine sites require ongoing passive care, which can be an acceptable practice. (why are you admitting this? the ideal is to move away from this practice. delete)

1.5.3 Active Care

An active care post-mine closure and reclamation plan occurs when sustained monitoring and maintenance of the remaining active facilities is required following the reclamation activities. This could include the operation of an effluent treatment plant or annual maintenance of water management facilities. An active care situation most commonly results from improper reclamation planning. An active care post-mine closure and reclamation plan is not acceptable for a new modern mine development. This option should be avoided wherever possible, however it may be the most practical option for some abandoned or operating mines, due to former mine practices and waste handling. (this sentence totally undermines the preceding one, since it gives the operator an 'out'. The right statement is the preceding one. delete the last sentence.)

2.0 MINE CLOSURE OBJECTIVES

2.1 DESIGN FOR CLOSURE

Preparing an acceptable mine closure and reclamation plan prior to the development of a mine is referred to as *designing for closure*. This concept requires proponents to look well into the future and identify natural processes and forces that may act upon the mine components after mine closure. The operator must design, operate, close, and reclaim the mine so that the risk of negative impacts on the environment, wildlife, and humans is minimized or eliminated. Where deterioration of some residual mine components is inevitable, the operator should identify and plan for the required maintenance.(this is ambiguous and dangerous; post-closure deterioration of mine components should not be permitted.) There should be no ongoing intervention or operating activities, other than periodic inspections and minimal maintenance, after closure ~~if possible~~. (deleted weasel words)

Designing for closure consists of the following four ~~objectives~~goals:

- Mine components are designed and constructed in such a way that they achieve (or can readily be modified I would delete this clause; too much uncertainty) to achieve the reclamation objectives;

- Reclamation costs are determined and accounted for, including the provision of financial security to the regulatory agencies;
- Reclamation activities are incorporated into the design; and,
- Progressive reclamation activities are incorporated into the operation of the mine.

2.2 DEVELOPING THE MINE CLOSURE AND RECLAMATION PLAN

The mine closure and reclamation plan, containing an outline of reclamation activities and schedules, ~~should~~ must be approved before mine development begins. It ~~should~~ must consider projected conditions, such as the expected volatility in demand for the commodity and the current and predicted knowledge (what is 'predicted knowledge'?) of the geologic and geochemical conditions. Reclamation research programs and general advances in mine reclamation technologies ~~may serve~~should be used to refine the reclamation plan on a progressive basis. The mine closure and reclamation plan should be re-evaluated, updated, and submitted to regulatory agencies for approval annually(may be a bit much; how about 'at regular stages throughout the mine life and/or whenever a substantive change in the mine plan occurs'. This would support the policy statement that states "When revisions to mining plans require significant changes in reclamation requirements, an amendment to the plan will be required)~~)~~ or upon request from the regulatory authorities as the mine progresses.

The ultimate closure scenario will depend upon many factors including: the mine plan, reclamation activities and methodologies, environmental factors, community values, technology improvements, and current regulatory and political regimes. A method for developing the mine closure and reclamation plan for a new mine is illustrated in Figure 2.1. Existing mines may need to consider additional steps, such as consideration for reducing existing liability by modifying the mine operation plan.
An important principle in 'designing for closure' is that the closure plan is developed in coordination with the initial mine plan, and transparently so. The scheduling of mining activities must be explicitly linked to progressive reclamation activities during the life of the mine. This is paramount.

Key parts of the mine closure and reclamation plan process, as illustrated in Figure 2.1, are listed as follows:

Step 1: A description and evaluation(not sure what 'evaluation' means; elaborate or delete; analyses?) of historical and existing pre-project conditions (natural environment, land use, unique or significant cultural values and locations, socio-economics, politics).
Step 2: A description of the facilities and components that will be developed and operated.
Step 3: Closure and reclamation objectives (including how they relate to the pre-mining conditions).
Step 4: A description of the proposed progressive reclamation and final closure measures.
Step 5: An impact assessment based upon the proposed development and reclamation measures. If the predicted long-term physical and chemical effects and anticipated land uses do not meet the objectives for the site, then alternative reclamation measures will have to be

considered (Figure 2.1, loop a). If the mine operator evaluates a number of alternative reclamation measures and finds that they all result in unacceptable impacts, then it may be necessary to consider an alternative form of mine development (Figure 2.1, loop b).

Step 6: A description of the monitoring and maintenance requirements, and the proposed methodology.

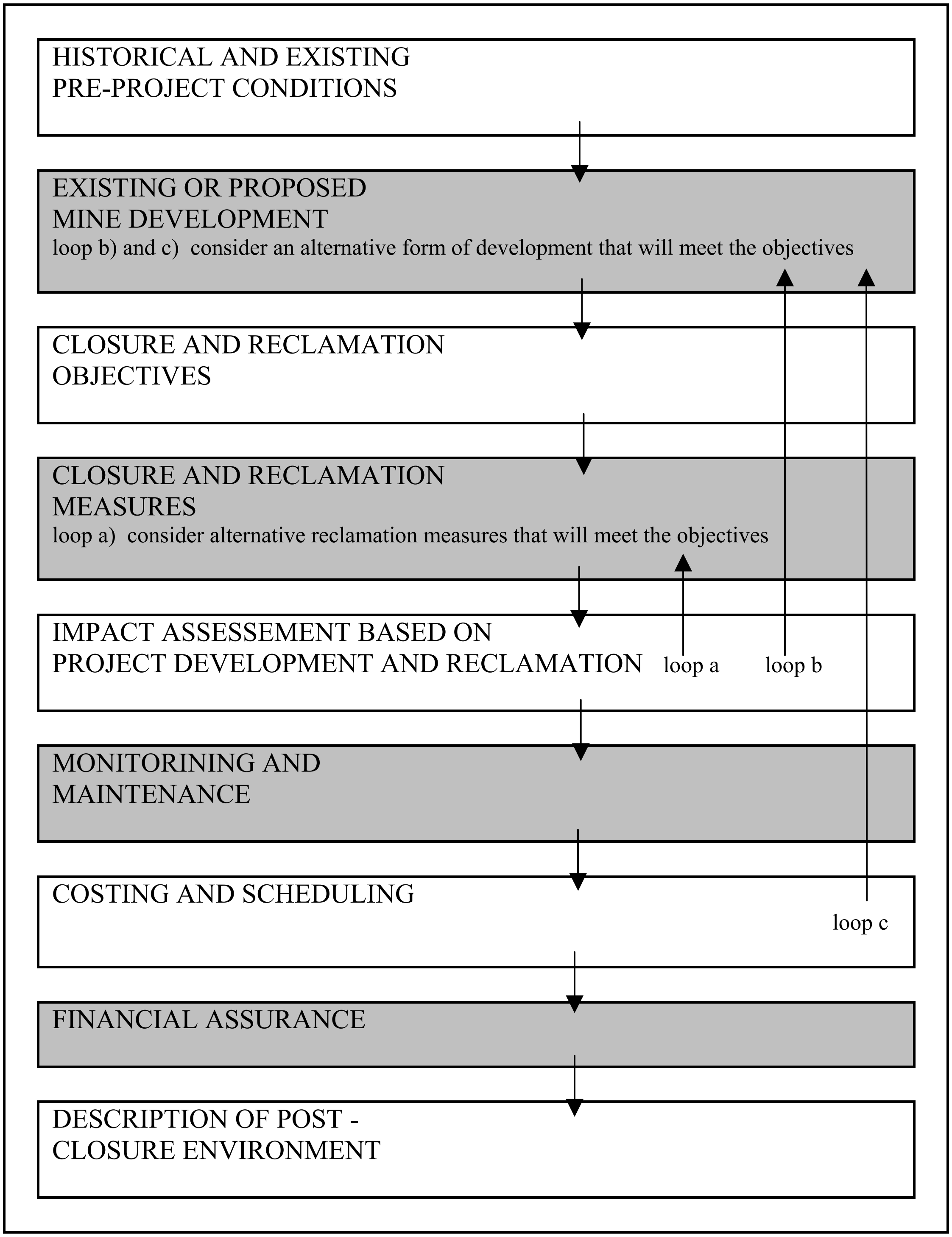
Step 7: A construction and reclamation schedule with project costs, including estimated closure costs. If these costs are not feasible, alternative mining developments will have to be considered (Figure 2.1, loop c).

Step 8: A description of the reclamation cost liability represented by the project developments for various stages of the project. Also, include the proposed means of financial assurance showing that the mine closure and reclamation plan can be implemented if the mine owner defaults.

Step 9: A description of the post-closure environment.

The mine closure and reclamation plan must address the physical stability, chemical stability and land use objectives for each mine component as well as all associated infrastructure. Also, the mine closure and reclamation plan should present a list of alternatives and rationale for selecting the preferred reclamation activities.(repetitious; delete)

Figure 2.1 Mine Closure and Reclamation Plan Development



3.0 DESIGN CRITERIA

The design criteria~~on~~ for physical, chemical, and water quality objectives in reclamation ~~is~~ are site-specific. General rules or guidelines for derivation of risk-based(why only 'risk-based'? other criteria such as 'non-degradation', BAT, or 'precautionary' could also be used. I would delete the adjective) site-specific criteria, such as those published by the CCME Canadian Environmental Quality Guidelines (CEQG), the Canadian Dam Association (CDA), and the Mining Association of Canada (MAC), can be used as aids in determining appropriate design criteria.

3.1 PHYSICAL AND CHEMICAL DESIGN CRITERIA

The design criteria for physical structures ~~that are~~ used to mitigate potential environmental concerns should be based on the associated environmental risk.(If the guideline are to be consistent with the Precautionary Principle, then risk analysis is not appropriate. Federal policy generally is to move toward a precautionary approach and the Precautionary Principle, but these guidelines do not recognize the concept). For example, the design of an engineered cover to control acid rock drainage (ARD) of a waste rock pile must consider (a precautionary approach would say that if there is PAG waste rock, then adopt a sound approach to prevention. A risk assessment is not required to do this.) the environmental risk of the waste rock pile without the cover, and the level of environmental protection required in the receiving land and water environments. Guidance on the selection of reclamation design criteria based upon potential risk categories is presented in Table 3.1. Once the designer has selected the appropriate potential risk category, the design criteria can be obtained from Table 3.2.

3.2 WATER QUALITY CRITERIA

Acceptable water and effluent quality criteria and sampling requirements will be ~~discussed~~ described in the site's current Water Licence and Surveillance Network Program (SNP). Monitoring programs are established on a site-specific basis and take into account local conditions including: the receiving environment, the background water quality, the size of the operation, and the characteristics of the waste to be discharged.

It is important to consider that existing regulations may be amended, new regulations made, or other statutes imposed with conditions relating to the waste deposited over the course of the mine operation. The licensee is responsible for compliance with the current and updated requirements of applicable federal, territorial and/or municipal legislation.
This section lacks discussion of the preferred approach of DIAND for setting WQO's or EQO's at any one site. Are criteria to be developed on a site-specific basis? Will a non-degradation approach, or CCME guidelines for the protection of aquatic life, or ecological risk assessment be used? DIAND should establish some firm principles here, and a hierarchy of preference if appropriate.

Table 3.1 Selections of Reclamation Design Criteria Based on Potential Environmental Risk[1]

Low Risk To be classified as "low risk", the mine component must meet **all** of the following criteria: ➢ Low levels of contaminants (all water quality requirements set out in the water licence are met what about land components? Wastes?) (needs to capture the chemical stability of contaminants,) ➢ Low to no potential for acid generation, (NP:MPA > 3:1)(needs more detail; what if 1 rock type doesn't meet this?) ➢ Low to no potential for the leaching of contaminants ➢ Surface area of 50 hectares or less ➢ No human use of the mine area or potentially impacted downstream area
Medium Risk The mine component will be classified as "medium risk" if it meets **any one** of the following criteria: ➢ Moderate levels of contaminants (minor water quality requirements as set out in the licence are not met and water requires passive or occasional treatment, or at the discretion of the regulating authorities, contained in approved facility) ➢ Moderate potential for acid generation, (1:1 <NP:MPA < 3:1) ➢ Moderate potential for the leaching of contaminants ➢ Surface area greater than 50 hectares but less than 100 hectares ➢ Seasonal human use of the mine area or potentially impacted downstream area
HIGH RISK The mine component will be classified as "high risk" if it meets **any one** of the following criteria: ➢ High levels of contaminants (water quality requirements as set out in the licence are not met and water requires continuous or routine treatment; differentiated from medium impact by discretion of regulatory authorities, chemical stability unknown,) ➢ High potential for acid generation, (NP:MPA < 1) ➢ High potential for the leaching of contaminants ➢ Surface area of 100 hectares or greater ➢ Year-round human use of mine area or the impacted downstream area

1. Table 3.1 is a revised version of Table 1 from the "Guidelines for Abandonment and Restoration Planning for Mines in the Northwest Territories", published by the NWT Water Board (1990).

Table 3.2 Design Criteria for Dams, Spillways, Slopes and Covers[1]

RISK CATEGORY	SLOPE STABILITY MINIMUM FACTOR OF SAFETY		STORM & RUNOFF EVENTS
	STATIC	SEISMIC	FLOOD EVENT
LOW	1.5	1.05 BASED UPON 1:475 YEAR RETURN PERIOD EVENT	MAXIMUM RUNOFF OF THE 1 IN 500 YEAR RETURN PERIOD EVENT
MEDIUM	1.75	1.10 BASED UPON 1:1000 YEAR RETURN PERIOD EVENT	MAXIMUM RUNOFF OF THE 1 IN 1000 YEAR RETURN PERIOD EVENT
HIGH	2.00	1.15 BASED UPON MAXIMUM CREDIBLE EARTHQUAKE	MAXIMUM RUNOFF OF THE PROBABLE MAXIMUM FLOOD EVENT

1. Table 3.2 is a revised version of Table 2 from the "Guidelines for Abandonment and Restoration Planning for Mines in the Northwest Territories", published by the NWT Water Board (1990). (this table has not been revised from 1990, is there no new knowledge out there, or is this still commonly accepted criteria?)

NOTES TO TABLE 3.2

- All stability analyses should be based upon conservative estimates of material strengths and seismic accelerations.
- Stability analyses should consider angle of friction and cohesion values obtained at critical moisture contents for the materials.
- The character and shear strength of all structural components including rock, soil, liners, and sub-grade soils or rock should be presented in the site characterization and baseline data of the design report. All relevant test work should be fully documented.
- Stability analyses must consider all kinematically possible failure modes. Solifluction must be addressed for slope stability and cover designs where frost susceptible soils are involved.
- Consideration should be given to the potential for long-term changes in material strength due to weathering, frost action, degradation seismic events and chemical changes.
- Maximum runoff should be the most critical runoff (precipitation plus snow melt).
- All dams and associated structures shall be designed, constructed, and maintained in consideration of the procedures and requirements set out in the "Dam Safety Guidelines" published by the Canadian Dam Association.
- Spillway design should include consideration of the effects of the failure of water diversion structures during the critical design events.
- Where there is risk of thawing in the long term, stability must be demonstrated for frozen, thawing and fully thawed conditions.

Could the guideline here state simply that the Dam Safety Guidelines (or whatever the appropriate documents are) will be used?

4.0 RECLAMATION MEASURES

The mine closure and reclamation plan should consider the best available technology that is suitable(?) to the physiography and climate of the Northwest Territories and Nunavut. (This statement presents problems. the guideline should state that BAT is to be used, unless the operator can demonstrate why it cannot be applied in this region. The onus should be on the operator, not the regulators, to determine applicability of BAT in the NWT. This issue has already been a problem with the recent Diavik ammonia amendment.) The acceptable form of a reclaimed site will vary for each mine according to the closure and reclamation objectives.(delete; obvious)

Common closure activities and reclamation options for each of the mine components are summarized in Tables 4.1 to 4.8 (prepared with reference to the Ontario Mine Closure Guidelines, NWT Water Board Guidelines, Mining Association of Canada Guidelines, and recent work by the Water Resources Division in the Northwest Territories). Each table addresses the physical stability, chemical stability and land use according to closure criteria, reclamation objectives and reclamation measures. Some additional comments and engineering considerations are provided in the following section.

4.1 UNDERGROUND MINE (this section far too wordy and filled with information not strictly descriptive of guidelines; needs drastic reduction; use bullets)

The surface expression of an underground mine typically include shafts, raises, stope surface openings, or portals, and in some cases, subsidence or other surface disturbances. ARD is the most common chemical stability concern at closure, although leaching from backfill if used should be addressed. Plugging of shafts and portals is almost always required, as stipulated under the *Criminal Code of Canada* *(so is it required in NWT?)*. Flooding a mine by plugging adits is often an effective method to control ARD if permafrost conditions are not present and if a hydraulically competent plug can be installed.(identify the guideline here and delete rest)

Some jurisdictions (within NWT? Nunavut?) require all shafts and raises to be capped with a reinforced concrete collar located on solid rock. Provision for venting accumulated gas is sometimes required. Backfilling with locally available rock is usually an acceptable alternative so long as settlement is minimized. Backfill in wood-lined shafts may not be acceptable because excessive settlement may occur as the wood decays. Backfilling of shafts and raises with demolition waste may not be acceptable because of the potential for hang-ups and future settlement upon collapse of the hang-up. (identify the guideline here and delete rest)

Securing adits to prevent access may (should?) consist of collapsing a section of the adit or constructing a barricade. Wooden barricades are only suitable for temporary control of access. A concrete or rockfill barricade should be installed for long-term control. If the barricade is for access control only, then a reinforced concrete wall or a plug of weakly cemented waste rock is acceptable. If the barricade is to maintain the mine in a flooded condition for ARD control, then a hydraulic plug capable of safely holding water must be installed. The local rock mass must be evaluated to determine whether seepage losses through groundwater may negate the ARD control. As a guide, a plug should not be shorter than the width of the adit, and long enough that the maximum hydraulic gradient through it is safely within the material capabilities. It should be non-reinforced concrete constructed in a single continuous pour. The plug should be located in an area of competent rock, which is thoroughly cleaned and scaled of loose rock prior to construction. Grouting of the rock around the plug is usually required. (identify the guideline here)

If crown pillars remain at closure, they are to be assessed for long-term stability by a qualified geotechnical engineer. Backfilling should be considered in cases where future collapse could result in an open hole or other surface disturbances. Information including the locations, dimensions, geology, and structural features of the pillars should be provided along with surficial data including the topography, overburden, and ground water regimes. (identify the guideline ditto)

Why not require a closure plan which provides for backfilling of underground mines with waste rock or tailings as a matter of course?. The onus should be on the proponent to demonstrate why this cannot be done. but the objective from a regulator's perspective should be to do it!

4.2 OPEN PIT MINE

For open pit reclamation, including quarries, open cuts, and major trenches, one must consider the pit dimensions, geology, structure and stability, along with the local topography and hydrology. After mining, most pit slopes will develop some local instability. Usually gradual slope failure involving rock masses is deemed to be an acceptable consequence of open pit mining. In northern Canada, the effects of annual freezing and thawing may require stabilization measures to mitigate ongoing soil and rock release. Observations of slope performance during operation may identify areas where stabilization measures are required. A riprap cover, thick enough to provide insulation or stabilization against erosion or permafrost degradation, may be necessary. ~~Generally,~~ open pit access routes should be blocked, and the perimeters posted with warning signs and fenced for actively managed sites. Signage and fencing however, is ~~generally~~ not an acceptable long-term closure measure. Control of perimeter access ~~may~~ must be achieved by construction of berms, or other approved techniques, where necessary ~~in some cases~~.

Backfilling with appropriate materials, or flooding(?), ~~may~~ must be required ~~in order to ensure~~where ARD potential of the pit walls is ~~addressed~~a concern. In permafrost regions, by ensuring an appropriate depth of coverage, permafrost will aggrade back into the pit in order to provide stabilization both physically and chemically.(do you have evidence to support this?) In order to prevent or minimize water infiltration, frost heaving(of what?) must be minimized or prevented (how do you do this?). Surficial contouring may also be needed to discourage surface water drainage into pits (why? in most cases wouldn't we want the pits to fill naturally?).

Where practical (by whose definition? the goal should be to fill pits in all cases, except where the proponent can defensibly demonstrate that this cannot be done for good technical reasons or unreasonably high costs), filling the pit with water or allowing the pit to recharge naturally can be an effective way to limit oxidation of acid generating rocks or may be means to support a natural aquatic community. Engineered water inlet and outlet structures would be required for this scenario.

4.3 WASTE ROCK AND OVERBURDEN PILES

It is important that the locations(these will ALWAYS be adjacent to the excavation, so it is unclear what you are driving at) for waste rock piles are selected to complement(?) the desired reclamation objectives and activities. Consideration ~~should~~ must be given to the likelihood of erosion or slumping of the pile, potential reclamation uses for the rock, the geochemistry of the materials, and the desired land use for the site.

Waste rock piles can be constructed in lifts with slopes at the angle of repose in a state of marginal stability(yes, but are you recommending this?). Individual lifts can be set back to create a shallower overall slope that achieves the required safety factors. Waste piles composed of durable(? Chemically stable? physically stable?) rock are sometimes left "as is" at the end of mining if there is no concern for deep-seated failure or erosion, and if the land use objectives can be achieved. Piles constructed of slaking or fine-grained materials may be prone to instability after closure by build-up of pore pressure and loss of material strength. Foundation thawing may also cause deep-seated instability. In these cases, stabilization measures such as re-sloping of rock piles, revegetation, or other physical stabilization techniques may be required as part of the reclamation plan. (so the guideline is…?)

It ~~may be beneficial~~is a closure objective to use waste rock as backfill in mine workings ~~in some situations~~where feasible. Waste rock may be used as fill for underground voids to provide surface stability, to seal portals, or to fill open pits. Waste rock may also be contoured or re-vegetated to blend in with the surrounding environment, or for ramps to facilitate wildlife access. The initial closure plan should explain how waste rock backfill quantities will be maximized as part of progressive reclamation or at closure.

Greater reclamation measures, such as capping or relocating the waste rock to a flooded location, such as underground or a flooded open pit, must be considered if there is a potential for the waste rock to generate acid, leach metals, or have other deleterious effects on the surrounding environment. Geochemical studies to characterize and monitor mine waste rock piles should be ~~considered~~ undertaken before mine development begins.~~deposition of the materials~~.

4.4 TAILINGS IMPOUNDMENT SYSTEM

Embankments, such as dams or dykes that retain tailings or non-compliant water related to the tailings, are the most critical part of a secure tailings impoundment. If the impoundment is to remain after closure and reclamation of the mine site, the embankment must be left in a condition such that release of tailings to the environment does not occur. The proper design and construction of the embankment and spillway are essential for acceptable long-term performance. The control of tailings migration by wind, water, and ice action must also be addressed.

Control of acid generation from tailings is often a primary concern and can sometimes be addressed with a permanent water cover.(is this your priority treatment?) A minimum depth of one metre over the highest point of tailings (usually at the tailings discharge point) during a 100-year dry period should be the minimum design objective. However, local climatic and geochemical conditions must be considered in the determination of water cover requirements. Regional and local precipitation data are required to support on-site water balance calculations and projections. The data and water balance may require additional review of the embankment freeboard and spillway design. Physically capping or promoting neutralization reactions by use of carbonates are other options that should be explored.(what are the guidelines for deciding upon strategy, determining feasibility, desirability- could be incorporated into a new section on consultation, determining options, etc.~~;?~~) The best reclamation strategy will vary from site to site; detailed studies and planning prior to shutdown are imperative.

At closure, any pipes and decant lines that pass through the embankment should be assessed for long-term stability and permanently plugged. The capping of the pipe ends is ~~usually~~ not sufficient because of the potential for piping failure along a decayed or collapsed pipe. High slump (relatively liquid concrete which will flow to fill all voids) or, preferably, expansive concrete should be used to fill these pipes. Seepage collection systems and strategically placed monitoring wells will be needed to detect signs of failure at some sites.

Tailings containment structures can be classified based on the level of risk to the surrounding environment and to human life in the event of a failure. This classification, as described in section 3.1, should be used for reclamation planning. Once the hazard level is assigned, the design criteria can be determined and implemented. Table 3.1 outlines the classification system that should be considered.

The report entitled "*A Guide to the Management of Tailings Facilities"* by the Mining Association of Canada (1998) provides further information on design, management and reclamation of tailings impoundment systems.(why not adopt this as a guideline?)

4.5 WATER MANAGEMENT SYSTEM

The components of a water management system may include embankments, ditches and culverts, pipelines and storage tanks associated with fresh water supply diversion of uncontaminated water, and collection of non-compliant water for treatment. Water storage reservoirs and sediment collection ponds that are not designed for long-term stability should be drained, treated, and the embankments breached. The removal or stabilization of accumulated sediment is required. Tanks and pipelines will normally be dismantled and removed from the site (see section 4.6).

Water management facilities that include post-closure collection and treatment systems should be conservatively designed so that long-term operating, monitoring, and maintenance costs can be minimized.

4.6 BUILDINGS AND EQUIPMENT

Mine site buildings may include: an ore processing/concentrator plant, head frame, service shops, offices, warehouses, fuel tanks, fuel and leach tank farms, assay and analytical labs, chemical reagent and explosive warehouses, boiler houses, generator power plants, and bunkhouses. The equipment may include: all mobile equipment on the surface and underground, shaft installations, distribution piping, and conveyors.
Will any buildings be allowed to remain at closure? If so, can these be identified here? Otherwise the guideline should be that all buildings shall be removed from the site or otherwise disposed of.

When buildings are to be removed and disposed of, the proponents must ~~should~~ consider the following:

- Floor structures over basements and cellars should be removed;
- All excavations below final grade should be backfilled to achieve the final desired surface contours;
- any contaminated Concrete may need to be removed and disposed of in an approved landfill ~~(if it contains contaminants such as hydrocarbons or PCBs that may pose a hazard over time)~~;
- Where approved, concrete floor slabs and walls should be broken or perforated to create a free draining condition in order that vegetation can be established;
- Efforts should be made to reduce dust emission during demolition of buildings that contain or contained asbestos, hazardous chemicals or other deleterious material, and must also consider the potential for PCBs in fluorescent light fixtures, lead-based paints, mercury switches or radioactive instrumentation controls; and,
- Buried material must be left either in an unsaturated zone or below the active layer.

All Equipment should be decontaminated and reused or sold. If sale or salvage is not possible, then the decontaminated equipment should be disposed of in an approved landfill or as recommended by the regulatory authorities. Non-salvageable materials and equipment from underground operations may be left in the underground mine upon approval from the regulatory authorities. Prior to demolition, all hazardous materials and chemicals ~~should~~ shall be removed to national approved hazardous material treatment facilities, recycled or reused through regulated facilities operated for this purpose, or disposed of in an appropriate manner upon approval from the regulatory authorities.

Caution ~~should~~ shall be taken in permafrost zones where buried material can potentially be pushed to the surface years later. Detail should be given as to the considerations that must be made in order that frost-heaving issues are minimized(incomprehensible; reword). Permafrost issues are discussed in greater detail in section 7.

Codes and regulations that should be consulted prior to demolition include, but are not limited to:

- National Building Code of Canada;
- CSA S350-M, Code of Practice for Safety in Demolition of Structures;

- Asbestos Guidelines (Government of the Northwest Territories/Resources, Wildlife, and Economic Development and the Worker's Compensation Board of the Northwest Territories);
- CCME guidelines;
- National Fire Code;
- Canadian Environmental Protection Act; and,
- Canadian Nuclear Safety Commission's Nuclear Safety and Control Act.

Proponents should prepare a quality assurance/quality control (QA/QC) manual prior to decommissioning buildings and equipment. This manual should describe in detail the proposed decontamination and disposal methodologies and protocol.

4.7 LANDFILLS AND OTHER WASTE DISPOSAL AREAS

Landfills and other waste disposal areas may include industrial and domestic waste, sewage, contaminated soils, chemicals, and water treatment sludge. Hazardous waste is to be removed to a national hazardous material treatment facility unless otherwise approved (see section 4.6). Landfills for industrial and municipal waste ~~should~~ shall be reclaimed in accordance with the applicable territorial and federal regulations for these facilities.

Chemicals may require special handling and disposal as specified in the MSDS sheets furnished under the *Workplace Hazardous Materials Information System* (WHMIS) and applicable hazardous materials regulations. Hazardous chemicals ~~should~~ shall be removed from the site.

Contaminated soils and sludge may be excavated and removed to an approved disposal site or contained *in situ* for treatment, depending on the nature of the contamination. Soils that are contaminated with hydrocarbons may be ~~used for~~ bioremediat~~ion~~ed(?). Guidelines set out by Environment Canada and RWED on land-farming ~~should~~ shall be consulted. Contaminated soils ~~should~~ shall be remediated according to the CCME Guidelines and the Canada-Wide Standards for petroleum hydrocarbons in soil. Modified standards based on site-specific risk-based assessments, derived according to regulatory protocols, may be acceptable.

Water treatment sludges may require additional sampling and analysis. T~~he t~~ests ~~should~~ shall be conducted to determine the chemical characteristics, sludge stability, and leachability under the proposed long-term storage conditions.

4.8 INFRASTRUCTURE

Infrastructure may include roads, airstrips, electrical power supply systems, bridges, culverts, railways, ports, barge landings, and ore handling facilities. These facilities should be removed, the area reclaimed, drainage restored, and revegetated~~ where practical~~. In some cases, an operator may apply to leave roads, airstrips, bridges, or railways intact if it is in the public interest to do so (for safety reasons, future uses, or other). The current owner must take responsibility for the infrastructure or find a new owner who will (a government department, agency, or private industry). All culverts should be removed and stable channels should be established in their place. Decommissioning and reclaiming of these items will depend on the final land-use plans of the site. The scheduling for dismantling infrastructure components must be carefully considered in the context of the need for their use during the reclamation and monitoring period.

Table 4.1 Reclamation Measures Underground Mine

ISSUES	RECLAMATION OBJECTIVES	RECLAMATION MEASURES
PHYSICAL STABILITY		
• Openings to surface • Hazards to the public and wildlife (shafts, raises & stopes open to surface, and portals to adits & declines)	• Prevent inadvertent access • Permanently seal openings	• Minimize number of openings (P) • Permanently plug or seal all access openings to surface, and drillholes • Backfill shafts, raises, & stopes ~~if practical~~(or demonstrate why this cannot be done) • Vent water & gas under pressure
• Surface disruption • Hazards to the public and wildlife (caving, collapse of crown pillars)	• Prevent inadvertent access • Stabilize surface • Stabilize underground	• Use mining method resulting in stable surface (P) • Stability assessment prior to closure including installation of ground monitoring devices • Stabilize surface, if necessary • Ditch/berm and, if necessary, fence & post signs in unsafe areas until natural stabilization occurs • Backfill surface openings, ~~if practical~~ (or demonstrate why this cannot be done)
• Surface disturbance (subsidence)	• Prevent surface subsidence • Re-contour surface where beneficial	• Use mining method resulting in stable surface (P) • Re-contour or divert to establish drainage patterns
• Barrier pillars stability • Hazards to the neighbouring operations	• Prevent collapse and flooding of adjacent mine • Prevent collapse and stress transfer to adjacent mine	• Permanently support boundary pillar, if practical and necessary • Ensure access to neighbouring mine and continued pumping, if required
CHEMICAL STABILITY		
• ARD and/or leaching of metals or contaminants • Seepage of mill reagents from backfill	• Meet water quality objectives by: 1) ~~controlling~~ or preventing reactions 2) controlling migration 3) collecting and treating (is it acceptable to licence new mine knowing that water treatment will be required post-closure?)	• Flood workings to prevent and control acid generation and associated reactions • Permanently plug workings & drillholes to control migration • Identify groundwater seepage paths and discharge locations • Collect and treat passively; active treatment to be avoided ~~where possible(weasel word)~~
LAND USE		
• Productivity and aesthetics	• Return to original or approved	• Backfill disrupted portions & openings where

• Drainage interrupted • Disruption or loss of groundwater resource	alternative use • Establish surface & groundwater drainage patterns	feasible • Contour surface • Flood workings • Establish indigenous vegetation

(P) = Option to be implemented at Pre-mining or operating stage.

Table 4.2 Reclamation Measures Open Pits

ISSUES	RECLAMATION OBJECTIVES	RECLAMATION MEASURES
PHYSICAL STABILITY		
• Safety -hazardous open pit -ravelling slopes -hazardous water pit	• Infill open pit • Stabilize slopes • Restrict access to hazardous areas • Provide an emergency exit for flooded pits	• Backfill pit or flood • Ditch, berm, fence and signpost for actively managed sites • Stabilize slope where feasible, by physical modification or freezing into permafrost • Create sloped exit point for flooded pits
• Slope Failure -deep seated or overall slope failure -erosion, ravelling slopes	• Prevent deep seated failure, ~~if feasible~~(the objective should not include "if feasible", surely no mine should have failure as an objective) • Restrict access to unstable areas • Control sediment release, if necessary	• Stabilize by flattening slopes or constructing toe berm, or restrict access with ditch/berm and, if necessary, fence and post signs for actively managed sites • Establish indigenous vegetation or place rip rap insulating/stabilizing layer • Provide stable spillway and overflow channel, rehabilitate for fish, waterfowl, and wildlife habitat ~~where practical~~ • Fill pit ~~where practical~~
CHEMICAL STABILITY		
• ARD and/or leaching of metals	• Meet water quality objectives by: 1) controlling or preventing reactions 2) controlling migration 3) collecting & treating	• Flood to control acid generation and related reactions • Cover to control or prevent reactions and/or migration • Promote freezing of pit walls into permafrost • Collect and treat passively, active treatment to be avoided where possible • Rehabilitate for fish, waterfowl, and wildlife habitat ~~where practical~~
LAND USE		
• Productivity of land • Visual impacts	• Return to original or approved alternative use	• Backfill pit or create aquatic habitat ~~where feasible & beneficial~~

		• Flatten slopes • Contour - blend with natural topography • Establish indigenous vegetation

Table 4.3 Reclamation Measures Waste Rock Piles

ISSUES	RECLAMATION OBJECTIVES	RECLAMATION MEASURES
PHYSICAL STABILITY		
• Slope failure -deep seated or overall slope failure -surface slump -erosion	• Avoid deep seated failure • Avoid large surface slumps and sediment release	• Select site to avoid low strength foundations (P) • Construct in lifts to achieve flatter slopes • Construct internal drains to prevent water table rise (P) • Control infiltration of water by the use of covers and/or ditches • Doze down crest~~, if required~~, or construct toe berm to flatten overall slope • Collect sediment in ponds • Establish indigenous vegetation or place riprap insulating/stabilizing layer
CHEMICAL STABILITY		
• ARD and/or leaching of metals or contaminants	• Meet water quality objectives by: 1) controlling or preventing reactions 2) controlling migration 3) collecting & treating	• Use underwater disposal to control acid generation and related reactions • Consider pre-treatment - blending with alkaline material to mitigate ARD (P) • Cover to control reactions and/or migration • Segregate deleterious materials for controlled disposal or cellular pile construction (P) • Freeze waste into permafrost • Collect and treat passively, active treatment to be avoided ~~where possible~~
LAND USE		
• Productivity of land • Visual impacts	• Return to original or approved alternative use	• Contour - blend with natural topography • Establish indigenous vegetation where practical (it is not only about what is practical but also what is desirable. Some people may not want to encourage wildlife attraction to the top of waste rock piles)

(P) = Option to be implemented at Pre-mining or operating stage

Table 4.4 Reclamation Measures Tailings Impoundment System

ISSUES	RECLAMATION OBJECTIVES	RECLAMATION MEASURES
PHYSICAL STABILITY		
• Tailings -dust -water erosion - stable tailings	• Control or prevent dust migration • Control or prevent tailings erosion • Maximize tailings stability	• Establish erosion resistant cover of indigenous vegetation, soil, riprap or water cover • Minimize ice lensing and other processes which deteriorate the tailings stability
• Dams -deep seated or overall slope failure -surface slump -erosion	• Achieve required Factors of Safety for static and seismic loadings, erosion resistant, overtopping protection • Restrict access if necessary	• Select appropriate site and dam design (P) • Where necessary, stabilize embankments by constructing toe berm to flatten overall slope • Riprap, re-vegetate with natural species, or cover to control erosion • Increase freeboard and/or upgrade spillway to prevent overtopping erosion by extreme events, if necessary • Ditch/berm or fence, for actively managed sites, to prevent erosion by motorized vehicles
• Weathering and deterioration of permanent structures -spillway -decant tower & pipes -drains	• Remove or ensure long-term stability	• Remove or plug/backfill structures, ~~where appropriate~~ • Design diversions and spillways for extreme events with construction suitable for long-term stability • Plug/seal decant lines through embankments • Define and provide for long-term monitoring and maintenance, avoid ongoing operation ~~where possible~~
CHEMICAL STABILITY		
• Tailings & pore water -ARD and/or metal leaching -mill reagents	• Meet water quality objectives by: 1) controlling or preventing reactions 2) controlling or preventing migration 3) collecting & treating	• Implement permanent control measures, which may include: -flood to control acid generation related reactions -pre-treatment: removal of deleterious mineral for controlled disposal elsewhere or blending with alkali material to mitigate ARD (P) -cover to control reactions and/or migration -ditch to divert runoff - promote freezing into permafrost -collect and treat, active treatment to be avoided ~~where possible~~
• Dams, Structures	• Meet water quality objectives by: 1) controlling or preventing reactions 2) controlling or preventing migration	• Do not construct with potential ARD or leachable materials (P) • Decontaminate and/or remove acid generating or leaching materials • Vegetate with natural/indigenous species

ISSUES	RECLAMATION OBJECTIVES	RECLAMATION MEASURES
	3) collecting & treating	(consider those that have an affinity for absorbing potential contaminants no! this could present a pathway for contamination of the animals who are attracted to the vegetation)
LAND USE		
• Productivity of land • Visual impacts	• Return to original or approved alternative use	• Rehabilitate by one or more of the following means: -flood -contour -cover -establish indigenous vegetation -wetland

(P) = Option to be implemented at Pre-mining or operating stage.

Table 4.5 Reclamation Measures Water Management System

ISSUES	RECLAMATION OBJECTIVES	RECLAMATION MEASURES
PHYSICAL STABILITY		
• Water Dams -stability -erosion -overtopping -intakes/decant towers -seepage control	• Ensure long-term stability • Protect erosion-prone slopes • Ensure no overtopping • Seal pipes	• Monitor/maintain embankment indefinitely or breach • Maintain operating spillway preferably in durable rock • Plug intakes with concrete, plug decants and remove towers
• Ditches -overtopping -erosion	• Ensure adequate flood capacity and prevent blockage • Prevent erosion • Provide fish passage and habitat as required under the Fisheries Act or other requirements	• Design for natural extreme events • Construct from materials suitable for long-term stability • Provide riprap protection and/or protect with indigenous vegetation • Define and provide for long-term maintenance, if required
• Culverts -blockage -collapse	• Ensure maintenance free passage of water under modelled flood conditions • Provide fish passage and habitat as required under the Fisheries Act or other requirements	• Remove culvert and breach where not required, otherwise upgrade to pass design flood and define and provide for long-term maintenance
• Storage Tanks -stability	• Remove infrastructure	• Drain and remove or fill and cover if approved
• Pipelines	• Remove surface and large	• Remove all surface and large shallow pipes,

-collapse -obstruction	shallow pipes (collapse of shallow pipes may cause subsidence)	remove or plug those at depth if they are not needed for the future land use
CHEMICAL STABILITY		
• Contaminated Reservoirs, retention and settling ponds	• Meet water quality objectives by: 1) controlling or preventing reactions 2) controlling or preventing migration 3) collecting & treating	• Drain, treat and discharge or, although less desirable, monitor and treat indefinitely (indefinite treatment cannot be an acceptable measure) • Strip and dispose of contaminated soil in tailings impoundment or upon approval from the Regulatory Authorities • Breach dam • Establish indigenous vegetation (no, presents pathway for wildlife contamination)
LAND USE		
• Dams -interruption of drainage patterns	• Restore drainage patterns • Determine if alternative use exists	• Breach and restore to erosion resistant drainage patterns or stabilize to maintain lake
• Reservoirs -productivity of land -potential water supply	• Return to original or approved alternative use	• Maintain lake and transfer ownership (to municipality or other user) or drain and establish vegetation
• Ditches	• Restore drainage patterns	• Grade to restore natural drainage and establish vegetation

Table 4.6 Reclamation Measures Buildings and Equipment

ISSUES	RECLAMATION OBJECTIVES	RECLAMATION MEASURES
PHYSICAL STABILITY		
• Safety and access • Maintenance and stability -buildings -hoist, shaft, & head frame structures -power plant -conveyors -mobile equipment	• Control inadvertent access • Make area safe and stable	• Determine degree of reclamation based on future land use plan • Decontaminate, disassemble, and remove all equipment and buildings if appropriate • Remove buried tanks to prevent subsidence • Restore natural drainage • Re-use, sell, or recycle materials and infrastructure ~~if possible~~
CHEMICAL STABILITY		
• Buildings-insulation • Chemical storage areas • Mill reagents	• Secure • Monitor stored supplies • Meet water quality criteria	• Recycle, return to vendor, sell, or dispose chemicals of all types, as approved by the Regulatory Authorities

• Petroleum products • PCB's • Explosives	and CEPA • Dispose of surplus chemicals off site • Meet WHMIS &Transportation of Dangerous Goods Act (TGDA) requirements	
LAND USE		
• Alternative uses • Productivity • Visual	• Return to original or approved alternative use	• Contour • Vegetate with indigenous species • Break and bury concrete to promote drainage or remove/recycle if burial is not appropriate • Restore acceptable drainage

Table 4.7 Reclamation Measures Infrastructure

ISSUES	RECLAMATION OBJECTIVES	RECLAMATION MEASURES
PHYSICAL STABILITY		
• Roads - erosion - safety • Airstrip - erosion - safety • Power lines - safety	• Control erosion • Make facilities safe	• Reclaim based on future land use plans • Remove culverts and make excavation stable • Remove all bridge and barricade approaches • Rip compact surfaces and establish indigenous vegetation • Restore drainage patterns • Follow Ministry of Transportation (MOT) specifications for preventing inadvertent use • Maintain necessary ditches, culverts and other facilities that are required by MOT • Remove any unnecessary buried wires • Remove all non-essential power lines
CHEMICAL STABILITY		
• Roads and Airstrips - fuel or oil spills	• Control releases to surface and groundwater	• Excavate and either treat and replace or dispose of as approved by the Regulatory Authorities
LAND USE		
• Roads and Airstrips - productivity of land - visual impact • Power lines	• Return to original or approved alternative use	• Reclaim based on future land use plans • Rip compact surfaces and establish indigenous vegetation • Remove all elevated wires and poles

- visual impacts		• Transfer to new owners where appropriate

Table 4.8 Reclamation Measures Landfills and Other Wastes

ISSUES	RECLAMATION OBJECTIVES	RECLAMATION MEASURES
PHYSICAL STABILITY		
• Landfill -erosion • Water treatment sludge -erosion • Sewage lagoon -erosion • Contaminated fill -erosion	• Control erosion • Prevent inadvertent access	• Provide erosion resistant cover • Stabilize slopes • Upgrade run-on diversion structures for appropriate maximum flood control • Ditch/berm and fence/post signs, for actively managed sites, where remaining facilities are hazardous
CHEMICAL STABILITY		
• Landfill -flushing/leaching of metals or organics • Water Treatment Sludge -Remobilisation of metals • Sewage Lagoon Sludge -release of nutrients	• Meet water quality objectives by: 1) controlling reactions 2) controlling migration 3) collecting and treating	• Divert run-off with ditches or covers • Relocate to controlled disposal facility • Consider surface application of sewage for re-vegetation
LAND USE		
• Productivity of land • Visual impacts	• Return to original or approved alternative use	• Where feasible, blend to match topography and establish indigenous vegetation

5.0 TEMPORARY MINE CLOSURE

There are two types of temporary mine closure, short-term and long-term. A short-term closure could last for a period of weeks to several months and may arise due to poor economic and environmental conditions. A long-term mine closure could last from several months to several years due to low commodity prices and unforeseen environmental problems after start up.
The initial closure plan must identify a time threshold for when the project closure becomes 'long-term' and/or 'permanent'. All premature closures are labeled 'short-term' by the operator. This minimizes the investments it has to make if the closure were designated long-term or permanent. Short-term closures can continue for years. The guidelines should identify the point and/or conditions at which 'short-term' becomes 'long-term' or 'permanent'.

Plans for temporary closures will depend on the anticipated duration(this is never known) of the mine closure. Site-specific evaluations will consider the level of site development, site closure conditions, previous reclamation efforts, outstanding reclamation, and hazards at the site. The following sections provide some guidance on measures suitable for temporary closures.

5.1 SHORT TERM CLOSURE

Short-term closure activities must maintain all operating facilities necessary to protect the environment and human health. The following measures should be implemented or completed upon temporary mine closure for the short term:

- Access to the site, buildings, and all other structures should be restricted to authorized personnel only;
- All mine openings should be guarded or blocked with posted warning signs;
- All physical, chemical and biological treatment and monitoring programs should continue according to licences, permits, and leases in order to maintain environmental protection;
- All waste management systems and sites should be secured;
- An inventory of chemicals and reagents, petroleum products, and other hazardous materials must be secured appropriately or removed if required;
- Fluid levels in all fuel tanks should be recorded and monitored for leaks or removed from the site;
- All explosives should be relocated to the main powder magazine, disposed of, or removed from the site;
- All rock piles, stockpiles, tailings, water facilities and other impoundment structures should be stable and maintained in an appropriate manner;
- Drainage ditches and spillways should be inspected and maintained regularly throughout the closure period;
- Facilities and infrastructure shall be regularly monitored; and,
- The reclamation security deposit should be up to date.

All applicable federal and territorial laws and regulations, in addition to the operator's Land Use Permits and Water Licences, must also be adhered to.

5.2 LONG TERM CLOSURE

For an indefinite(no, must define. say, at 3 years 'short' becomes 'long') closure period, any outstanding progressive reclamation including, but not limited to, those activities outlined for short-term closure, should be completed. Care and Maintenance staff must be present at the site and sufficient in number and expertise for the site's conditions. Sufficient equipment must be left on site for maintenance and contingency, and sufficient supplies and reagents must be provided.
The guideline should state that the initial closure plan must describe the conditions, thresholds, and other information for each of the 3 phases of closure.

6.0 SPECIAL MINES IN NORTHERN CANADA

(Is there some reason why this section is necessary. This refers to past mines. Is it possible that new uranium or coal mines will be licenced in the region? If they are, what unique provisions are required that are not covered in other parts of this document? I didn't see any.)

There are unique mines that exist, or did exist, in the Northwest Territories and Nunavut. For example, there are a few abandoned uranium mines (Rayrock, Contact Lake, Eldorado/Port Radium) in northern Canada, and some uranium deposits in Nunavut near Baker Lake (Kiggavik). Coal mining was also present in the north at one time, namely at Ross River Yukon, and could potentially resurface in parts of western Northwest Territories and Nunavut. Special reclamation activities may be needed at these mine sites and additional regulations or Acts may apply.

Sand and gravel (aggregate) mines may not be as destructive as some mining operations; however, depending on the location, geology, and scale of the project, the environmental effects can still be serious (see reclamation measures for open pits section 4.2). Also, large-scale placer mines are not prevalent in the Northwest Territories and Nunavut at present, but this may change in the future. All current and future mines not specifically addressed here should adhere to the principles outlined in these guidelines.

6.1 URANIUM MINES

The major concern at uranium mines is usually the potential for release of radioactive elements from the tailings, although, there may be potential for release from mine rock piles, open pits and the underground mine. The radiological-related concerns increase as the grade of the ore increases. Special reclamation consideration must also be given to mines that have radioactive ores associated with them. This includes mines that use the facilities of old uranium mines.

Reclamation of uranium mines in Canada comes under the jurisdiction of the Canadian Nuclear Safety Commission (CNSC). The *Nuclear Safety and Control Act (NSCA)* prohibits a licensee from abandoning a uranium mining facility except under written approval. The CNSC has developed regulatory policies and guidelines for decommissioning nuclear facilities. Two small booklets published in June 2000 by CNSC, *Decommissioning Planning For Licenced Activities* and *Financial Guarantees for the Decommissioning of Licenced Activities,* can be used as references.

The technology for better controlling the release of radioactive materials has been studied extensively and published by the National Uranium Tailings Program (NUTP), which is administered by the Canadian Centre for Mineral and Energy Technology (CANMET).

6.2 COAL MINES

Major reclamation issues associated with coal mines, especially open pit operations, arise from the very large area of disturbed land. Progressive reclamation is essential to reduce the area of un-reclaimed land and control erosion from mined areas and overburden piles. Coal strip mining is much less invasive than large-scale open pit mining and can be reclaimed relatively quickly and easily. For this reason, mining techniques, as they relate to reclamation, should be considered at the operation planning stage.

ARD and metal leaching from associated sulfides are also important concerns at coal mines. The geochemistry at these sites must be investigated thoroughly and monitored over time. Additional regulations for coal mining can be found in Part 2 of the Canada Labour Code, section 125.3. Also, the *Regulations Governing Coal Mining in Alaska, January 1999* by the Alaska Department of Natural Resources Division of Mining can be used as a reclamation guide for coal mines in northern latitudes. Information on these guidelines is available at http://www.dnr.state.ak.us/mlw/mining/coal/coalreg.pdf.

7.0 CONSIDERATIONS FOR NORTHERN MINES

(this section, like the others, far too wordy)

Reclamation objectives may be slightly different for northern sites compared with sites in temperate climates. As described in Section 1.5, a post-mine closure and reclamation plan that requires ongoing active care is not desirable and should be avoided~~ wherever possible~~. A passive care post-closure scenario may not be effective ~~either ~~because of either high access costs, unacceptable risk of failure, or other limitations related to the climatic setting at the site. The goal for any northern mine ~~should ~~is always ~~be ~~to achieve a walk-away reclamation scenario.

Design, construction and schedules may all be affected by the remoteness and climate of some parts of the NWT and Nunavut. These conditions directly affect the cost and methods of reclamation activities. Special considerations for project design and reclamation in permafrost regions are often required. Additional physical, chemical, and land use challenges relevant to northern sites are discussed in this section.

7.1 LOCATION

Northern mines are often located in remote areas with restricted accessibility. The site location will often dictate the project feasibility with respect to the related costs.

There are relatively few cities or communities across the Northwest Territories and Nunavut. It is not unusual for a mine to be located several hundred kilometers away from the nearest center. Travel costs and the time required to transport personnel and supplies to and from the site are high. Because supplies are not readily available, they must be transported to the site ahead of time when possible. This is particularly true for supplies that are needed for emergencies. Many northern operators keep heavy equipment on the mine site until reclamation has been completed due to the high cost of moving the equipment. This results in periods of low utilization for some equipment and consequently higher unit costs on rental equipment.
(none of this is necessary in the guidelines)
The geologic and geographic setting of a mine site may govern the degree of natural resources that are available for reclamation purposes. For example, much of the Precambrian Shield that dominates parts of NWT and Nunavut has only a veneer of soil cover, generally less than 2 metres. Consequently, construction materials suitable for reclamation activities may not be readily available onsite or may be difficult to obtain. This may be especially true for low permeability soils, such as clays and silts. The supply of soils suitable for construction may decrease as you move north where soil profiles are undeveloped or non-existent. The supply will also be limited in permafrost regions. Reclamation for the borrow sources must be considered in the reclamation plan and included in cost estimates. Local glacial deposits, such as eskers or kames, may be sources of granular borrow materials for construction if borrow developments are allowed under the water licence and land use permits.
(ditto)
The lack of road infrastructure to access distant supplies of materials may make some reclamation options very costly. Where airstrips or roadways can be constructed from local materials, transportation means may include large aircrafts or on-road vehicles. Boat or barge access may be available for coastal projects, while other operations are restricted to small aircrafts or helicopters. Topography and local surface conditions may also dictate the accessibility of a site. Mountainous regions or areas characterized by boulder fields can limit site access or may require additional on-site road or runway preparations. Transportation can also be climate dependant. Periods of ice freeze and thaw can limit access to the sites as many operations utilize open lakes for aircraft landing in the summer and frozen ground and water for airstrips and roadways in the winter. Harsh weather conditions such as extreme cold, fog, and storms may also dictate site accessibility.

7.2 CLIMATE

(all this should be reduced to minimal statements of what is to be done. what is the guideline? Or included in an appendix for those who don't know this already)~~)~~

The climate in the Northwest Territories and Nunavut is characterized by long, dark, cold winters and short, bright, warm summers. Lakes and rivers remain frozen for a large portion of the year and the annual total precipitation is generally low. When temperatures rise, large volumes of snowmelt are added to the spring freshet in a relatively short period.

It is often desirable to conduct reclamation activities during the winter months when the frozen ground and lakes provide stability for haul roads and runways. However, these activities can conflict with accepted practices for earthworks. For example, the placement of low permeability soils in embankments or covers generally cannot be conducted during the winter. Construction planning may need to allow for removal and stockpiling of frozen material from borrow sources. Soil may need to thaw and drain excess moisture before use in reclamation activities. Furthermore, working conditions may not be favorable or safe to laborers at times when temperatures are dangerously low or during periods when there is little to no natural light. It is reasonable to expect a higher degree of equipment failure during periods of extreme cold. Transportation to and from the work site may be delayed due to poor weather or when temperatures fall below safety levels for some small aircrafts. The timing of activities must be carefully planned due to climatic limitations.

High volumes of spring runoff from snowmelt affect the surface hydrology. Where permafrost exists, runoff volumes will be greater. Spillway design should consider the possible onset of permafrost in tailings and its effect on the runoff characteristics of the tailings beach. Impoundments in flooded conditions may be susceptible to ice jams resulting in flow overtopping the embankment. Techniques to prevent spillway blockage by ice jams include seasonal blasting of ice jams (not always effective and constitute active care), or construction of berms of inert material on the tailings to restrict ice movement. Settlement should be considered when designing berms on tailings. Where impoundments are to remain flooded after abandonment, for control of acid rock drainage (ARD) for example, shoreline protection may need to be considered. Rapid erosion, arising from freeze/thaw processes, and high sediment yield from the shoreline of an impoundment can continue for many years after closure. Low precipitation conditions challenge the modeling and long-term management of these facilities.

Proponents must also consider the possible effects of climatic change at northern sites. It is generally accepted that climate change will impact northern Canada. The long-term effects of climate change on the annual temperature range, total precipitation, seasonal variation, peak precipitation events, evaporation, permafrost, and hydraulic routing are difficult to predict. Consequently, where mine components have a medium or high potential for environmental impact if failure occurs, it is necessary to select design parameters, which are based on conservative interpretation of historic records and with consideration for the changes that may occur in the future.

Further guidance on the effects of climate change can be found on the Environment Canada website, http://www.ec.gc.ca.

7.3 PERMAFROST

The presence of permafrost at a mine site requires additional considerations with respect to project planning and reclamation. It is therefore important to understand what permafrost is, where it is likely to occur, and how it can affect mining structures and reclamation activities.

7.3.1 Permafrost Processes

Permafrost is defined as ground that remains at or below 0°C for a minimum of two consecutive years. It may consist of bedrock, unconsolidated sediments (gravel, sand, silt or clay), organic materials (peat), and ice. Permafrost reflects an equilibrium or balanced state in which the sum of heat losses and gains equals zero on an annual basis. A sub-surface soil layer receives heat from geothermal sources below. It also receives heat from the atmosphere during the summer period, and in general, it loses heat to the atmosphere during the winter. Thermal conditions below the ground surface are referred to as the *ground thermal regime* and have a great influence on permafrost. The top layer of ground that is subjected to annual freezing and thawing is termed the *active layer*. The active layer exhibits a significant amount of spatial variability that reflects summer temperature, thickness of surface organic materials, vegetation cover, water content of soils, and depth of winter snow cover. In non-bedrock permafrost regions an ice-rich zone is common. The frozen moisture below the ground surface is termed *ground ice* and acts to provide structure and stability to the ground surface.

Permafrost is present across a significant portion of Canada and can be classified by zones that represent varying degrees of permafrost coverage. Definitions for permafrost zones vary slightly in the literature, but the concept remains the same. According to Natural Resources Canada, continuous permafrost zones represent areas that have greater than 90% permafrost; extensive discontinuous zones represent areas that have between 50% and 90% permafrost; sporadic discontinuous zones represent areas that have between 10% and 50% permafrost; and, areas with less than 10% permafrost are referred to as isolated patches. As you move southward from the Arctic Islands permafrost becomes thinner and less widespread and the active layer becomes thicker. Variations within permafrost zones due to local conditions are hard to track. A general map of Canada's permafrost regions can be found at Natural Resources Canada website, http://atlas.gc.ca/site/english/maps/environment/land/permafrost.

Permafrost may also be classified as warm or cold. Warm permafrost, which has a temperature close to 0°C, exists commonly in areas of discontinuous permafrost, and is characterized by deep active layers. Cold permafrost is found in regions of continuous permafrost and commonly has a shallow active layer. Cold permafrost is more stable than warm permafrost; however, it is important to assess and prevent permafrost degradation for both types.

Atmospheric climate is the main factor contributing to the existence of permafrost. The ground thermal regime and ground-surface interface will, however, play a large role in permafrost distribution, thickness, and temperature. Energy, or heat, is transported via convection, solar and atmospheric radiation, and evaporation at the ground-air interface. Thermal conduction and

possibly convective moisture flow occurs below the surface. Natural factors that affect the balance include: atmospheric conditions, topography, vegetation type and coverage, snow cover, soil conditions, elevation, geological environment and history, and hydrology. Disturbances to the ground surface such as alterations of drainage patterns, water bodies, topography, vegetation cover, or concrete and structure cover, will undoubtedly alter the local ground thermal regime. Disturbances may alter the depth of the active layer, the depth of permafrost, or lead to the creation of *taliks*. Taliks are unfrozen zones that can exist above the permafrost table but below the depth of the active layer, within permafrost layers, or below the permafrost table. They can be below 0^{B}C or above 0^{B}C and are classified as being either open (reaches the seasonally thawed zone) or closed (completely enclosed by permafrost). They may form from local heat sources such as lakes or rivers or result from a change in the ground thermal regime. Taliks that exist below lakes may extend to the bottom of the permafrost zone, connecting the lake to the groundwater system.
(I would delete all of the above background information and simply state the applicable guidelines)

7.3.2 Effects on Mine Activities

There are many benefits to mining in permafrost regions. Permafrost can add stability to the ground, greatly reduce the downward migration of contaminants, or completely contain contaminants. The low temperatures will also slow potentially harmful chemical reactions; including reactions that contribute to acid rock drainage. Ground ice, groundwater hydrology, and groundwater chemistry in permafrost regions all affect the environmental security of a site. When permafrost degradation occurs, many hazards can arise.

Ground ice develops as a function of the ground thermal regime. It occurs in pores, cavities and other openings in soil, sediments, rock, or *massive ice bodies*. Massive ice bodies are large bands of ice, often containing sediments. *Excess ice* is ice that exists within the pore spaces at a volume that is greater than the volume of the pore space had the substance not been frozen. Pores become supersaturated with ice and, thus, can create local topographic relief. It will add stability and strength to a soil which, upon thawing, can lead to slumping, liquefaction, or flooding. Any structure that exists on soils containing excess ice is subject to deformation, subsidence, or failure with a warming of the ground thermal regime. Ground ice may also be used to encapsulate contaminants. Ground ice degradation could lead to the release of solutes or contaminants that were stored in the ice.

The groundwater hydrology in permafrost regions is unique in that the permafrost acts as an impermeable layer, restricting groundwater flow to thawed areas and taliks. Permafrost may restrict infiltration to groundwater, and thus, act as a confining layer for some contaminants. Caution must be taken to ensure that surficial contaminants do not flow into the groundwater system, especially if open taliks are present. Where infiltration is reduced, surface runoff will be higher from rainfall and snowmelt. This leads to dramatic seasonal variations in the local stream flow rates and water chemistry. A shift in the ground thermal regime could destroy the confining layer used to control the spread of contaminants and alter the local flow regime.

Chemical interaction between the active layer and the permafrost interface is minimal in continuous permafrost regions. Reaction and dissolution rates in permafrost regions are generally slow due to the low temperatures. Warming events will affect the rates of reaction and dissolution. Warming of the ground thermal regime could induce the release and transport of solute rich dissolved loads from the upper permafrost layers.

An understanding of the nature and extent of permafrost is essential at the planning stage of a mine. Characterization of the permafrost including but not limited to depth, thickness, location, and type should be made. Similar characterization of the active layer, ground ice, soil, and ground water flow regime should be made. Borehole drilling, air photo interpretation, and a review of the literature can aid in characterizing permafrost.

The technical mine design and reclamation plan must account for permafrost processes. Risks must be identified at the planning stage and measures to remediate potential failures should be presented. Structures should be designed to allow for strength reduction and settlement in the foundation or they should be based on sink piles installed below the active layer. Thermo-siphons or insulators, such as thick gravels, to maintain a frozen ground may be considered for some sites. Development plans should include how structures will be made, the best materials to use, where they will be located, and justifications for that approach. Potential changes to the ground thermal regime over time should be predicted by studying the permafrost conditions and history, monitoring, and in some cases, using computerized models. Regulatory authorities must approve development plans before the project proceeds.

7.4 OTHER CONSIDERATIONS

7.4.1 Physical Stability

Maintaining the physical stability of a closed mine site in the north can be challenging. Climatic conditions, as previously discussed, can have major effects on the physical stability of a site over time. Other disruptive forces, such as disturbances by wildlife, must also be considered.

The breakdown of materials left on northern sites will be slow due to cold temperatures. This means that the when material is left on site, it must be left in a place and manner that is acceptable for the long term. Disposal of items by means of burial must account for the freeze-thaw cycles that may act to push materials towards the surface over time. The best method is to remove the materials from the site. In cases where this is not practical, an appropriate depth and placement of burial must be determined.

Climatic changes, such as extensive warming or natural weather related disasters, are hard to predict but may have drastic consequences to the physical integrity of an area. Climatic changes can lead to permafrost degradation and the melting of ice-cored structures (as previously mentioned); can instigate natural disasters such as flooding, landslides, or increased seismic activity; and can alter wildlife habitats and migration routes.

Anthropogenic disturbances are less likely to occur at northern sites due to the remote locations; however, disturbances from wildlife populations can be anticipated. Burrowing for shelters, digging for food sources, and use as migration routes are some situations that may cause physical damage at a site. Studying the local wildlife at the site, and identifying migratory routes before and during mine operations will help to anticipate problems that may occur when the mine finally closes. Measures to discourage animal use may be needed, such as the application of a coarse gravel cover on old tailings, or, less ideal for the long-term, a fenced off area to deter animal activity. (fencing was ruled out as an acceptable long-term measure for Colomac; DIAND needs to clearly state here what the policy about fencing will be)

The best way to ~~promote~~ achieve a physically stable site after mine closure is to anticipate potential disturbances, plan accordingly, monitor the site over time, and correct any disturbances that do occur.

7.4.2 Chemical Stability

The chemical state of a mine site after closure will greatly affect the site's environmental stability in terms of surface and groundwater quality. Primary considerations are:

- The potential for chemical changes through oxidation (acid generation) or metal leaching, and,
- The potential for release of soluble metals or other contaminants from tailings pore water or sludge disposal ponds upon or following deposition.

The water quality criteria for chemical stability are mentioned in Section 3.2.

Proponents should seek expert assistance in sampling, analysis, and interpretation of test programs for prediction of chemical stability. The reader should refer to DIAND's Water Resource Division report entitled, *Guidelines for Acid Rock Drainage Prediction in the North* (DIAND, 1992), or reports prepared by the Natural Resources Mine Environment Neutral Drainage (MEND) program available at www.nrcan.gc.ca/mms/canmet-mtb/mmsl-lmsm/mend/default_e.htm for guidance and identification of generally accepted methods of prediction. Predictive programs should include both static and kinetic testing in order to fully assess potential long-term impacts resulting from mine development. These programs must be initiated prior to mine development with confirmatory programs carried out throughout the mine life.

Technologies available to ensure chemical stability depend on the mine design, control objectives, and the hydrological, geotechnical, and chemical aspects of the site. It is not possible to address all of the potential solutions here and proponents should seek expert assistance for planning. The Natural Resources Canada - MEND program noted above can provide many references to aid in these matters.

There are three approaches to the control of ARD and metal leaching, in order of decreasing preference:
(the first option is 'avoidance' or 'prevention'; control comes only when ARD generation cannot be prevented. see BC guidelines at:
http://www.em.gov.bc.ca/Mining/MinePer/ardpolicy.htm#Measures%20to%20Prevent for more details.) (you mention prevention below, just need to move it forward)

1) Control of acid generation reactions
2) Control of migration or leaching processes
3) Collection and treatment

Collection and treatment at the end of mining is an active care situation, and is rarely(?) acceptable to regulators (if DIAND is going to allow it, what are the criteria? you've already said that 'active care' is to be avoided. shouldn't the policy be that active care situation will not be permitted?). The focus should be on the control (disagree; the focus should be on 'prevention') of chemical reactions and migration. The logistics and efficiency of chemical treatment may be limited by climatic conditions. While the conditions in the north will slow the oxidizing process, they can also act to extend the duration of the problem. The following ~~should~~ shall be considered for the prevention, mitigation, and control of deleterious, mine related reactions:

1. Prevention of acid generating reactions is the most preferable form of control and ~~should~~shall~~, if possible,~~ be the primary (preferred?) long-term approach. The design for ARD prevention ~~should~~ shall aim to exclude acid generation reactions by removing sulphide minerals, preventing oxidation, and inhibiting drainage.
2. Limiting the availability of oxygen to reactive wastes with a water cover. Underwater disposal or saturated soils or fens for preventing acid generation should be evaluated first. Most of northern Canada experiences low precipitation and summer evaporation rates that are nearly equal to or higher than annual precipitation. Careful attention to the water balance is required for these measures to be effective in the long term. A water cover may not be a suitable option for permafrost regions.
3. Care ~~should~~ shall be exercised when considering flooding existing waste deposits because of the potential for flushing high loads of stored oxidation products from within the waste.
4. Proposals to dispose of mine wastes, such as tailings, into natural water bodies may be opposed by regulatory agencies and the public for environmental and political reasons. The implications associated with the use of water covers and the placement of wastes needs to be fully investigated.(DIAND should take a stand on this issue, or delete this; not helpful as a guideline in this form.)
5. Freezing the reactive waste into permafrost in underground mine workings or under a thermal barrier cover may be a feasible reclamation measure in Arctic areas.(any suggested criteria for what 'feasibility' entails?)
6. A combination of various measures may produce the most efficient control of ARD for both existing and proposed facilities in the short or long-term. Measures for the control of acid generation should be evaluated in conjunction with control of ARD migration, collection, and treatment.(what does this mean?)

7. Construction methods and extraction processes for ARD prevention, such as bulk sulphide flotation of tailings, should be considered for proposed facilities. However, additional control measures are likely to be required for the separated material.
8. Covers and seals show site-specific successes as inhibitors of migration of oxidation products and, to a lesser degree, of acid generation reactions. Covers must be maintained in good order as designed. Selection of a cover suitable to reach the desired objective should be made. Soil covers, for example, are suitable for re-vegetation purposes.

In addition to the above general points regarding ARD control, sub-zero temperatures and permafrost can influence the control of acid generation. These factors may include the following:

- If the voids are filled or partially filled with water and frozen, then the infiltration of oxygen is reduced;
- Within permafrost, the rate of water movement is reduced (but not eliminated. DIAND should be explicit that freezing of PAG wastes is an acceptable mitigation measure, or not), which provides control of migration;
- At low temperatures, both chemical and biological oxidation rates are reduced, which may reduce the loading of oxidation products in an effluent stream;
- Measures such as placement of coarse rock covers which trap cold air can be used to induce permafrost;
- The active layer must contain non-acid generating material where sub-zero temperatures are relied upon for control of acid generation or migration; and,
- A lighter coloured cover material could be used to increase the reflection of the sun's radiation.

Potential control technologies for chemical stability are presented in Table 7.1. Generally, control measures must be specific to the type and source of contaminant. Knowledge of the type, concentration, and volume of an effluent is essential to identifying the most effective and economical control method.

Table 7.1 Chemical Stability Potential Control Technologies

A. CONTROL OF REACTIONS

CONTROL TECHNOLOGY	ARD	METAL LEACHING	MILL REAGENTS
Conditioning of waste/ removal of deleterious mineral.	Yes	Yes	
Covers and seals for exclusion of water.	Yes	Yes	
Covers and seals for exclusion of oxygen.	Yes		
Blending/ base addition.	Yes		
Bactericides (short term only)	Yes		

Change mill process, change reagents.			Yes
Change mill process, add fixing or neutralizing agents.			Yes

B. CONTROL OF MIGRATION

CONTROL TECHNOLOGY	ARD	METAL LEACHING	MILL REAGENTS
Covers and seals to reduce infiltration.	Yes	Yes	Yes
Controlled placement to reduce infiltration.	Yes	Yes	Yes
Diversion of surface water.	Yes	Yes	Yes
Interception of groundwater.	Yes	Yes	Yes

C. COLLECTION & TREATMENT

CONTROL TECHNOLOGY	ARD	METAL LEACHING	MILL REAGENTS
Active treatment in chemical treatment plant.	Yes	Yes	Yes
Passive treatment using wetland.	Yes	Yes	Yes
Passive treatment mixing tailings with alkaline material.	Yes		
Passive treatment using retention pond.			Yes

7.4.3 Land Use and Aesthetics

Acceptable end-use land objectives for northern mine sites will have to consider the pre-mining uses of the land, and possible future uses of the land. The history ~~and culture~~ of these areas are rich and evidence of past generations and ~~lifestyles~~ cultures (lifestyle implies a choice of how you decide to live) are of great importance. Great effort should be made to restore the land to its pre-mining condition and to leave all artifacts and sites of cultural significance untouched. (This is a departure from current practice. BHPB, for example, conducts surveys and removes artifacts if found, then proceeds to mine. If these things are of 'great importance' as stated, then firm clear prescriptions need to be expressed in the guidelines. What is allowable, and what is not?)

Many different species live throughout the north. Animal migration paths should be free of any open drill holes or obstacles that may lead to injuries once mining has ceased.(The guideline would state the idea more directly, 'all open drill holes shall be filled at closure and any obstacles that may harm wildlife should be removed." Structures, such as contoured ramps to facilitate wildlife access, may be needed. Constructed Pathways ~~could~~ will be required in some situations~~also be constructed~~ to encourage wildlife routes away from potentially hazardous areas.

Additional future uses of northern sites could include various forms of eco-tourism such as guided camping tours, and fishing or hunting lodges, or community development. In exceptional circumstances, certain structures or facilities may be left in place for safety measures, such as airstrips, roadways, or emergency shelters upon approval from appropriate authorities. This must be decided upon before mine closure (no, in the initial mine plan), and must insure that no liability could accrue to the Crown from such action. No reference here to the Whitehorse Initiative wording on restoring to functioning ecosystem.

8.0 RECLAMATION SECURITY

The cost of closure and final reclamation of a mine is the responsibility of the mining company. Each new mine will proceed to development(licensed?) only if it can support the estimated full costs of reclamation. Regulators have the authority to establish security deposits for reclamation of projects as indicated in three main pieces of legislation, namely:

- *The Northwest Territories Waters Act* and *Northwest Territories Waters Regulations*;
- *Nunavut Waters and Nunavut Surface Rights Tribunal Act;* and,
- *The Mackenzie Valley Resource Management Act* and *Mackenzie Valley Land Use Regulations*.

There will be an accrual of reclamation liability starting from the date of mine exploration except when offset by progressive reclamation. Most mines should expect to have some post-closure liability associated with maintenance activities such as spillway management, geotechnical and geochemical monitoring, water sampling, and reporting.

The security posted at the beginning of any stage of the project should be equal to the estimated liability at the end of that stage. The form of the security must be in accordance with the requirements of the *Northwest Territories Waters Act and Regulations (1992)* or the *Nunavut Waters and Nunavut Surface Rights Tribunal Act and Regulations (2002)* and the specific requirements of the land owners where applicable. The relevant permitting/licensing board will establish the amount of security required in the water licences and land-use permits, while the Minister of DIAND has the power to determine the form of security.

The amount of security should be based upon a reliable and standard estimate of the cost of the anticipated reclamation work. Key considerations that should guide the development of a reclamation liability estimate by the relevant board are:

- All costs are in Canadian dollars in the year that the estimate is made, not the year in which the work is expected to be conducted;
- Inflation or deflation is considered in annual updates to the cost estimate;
- Past failure of the company to address its liability;

- Allowance for administration and professional services, and post-closure monitoring;
- Allowance for progressive reclamation will not be made until after it is completed according to reclamation criteria identified and approved in the closure and reclamation plan;
- All work is based on independent contractor rates or third party costs;
- The cost estimate does not include revenue from recovery of assets;
- The mine is developed substantially as planned; and,
- The estimate does not include costs for catastrophic events such as failure of dams, dikes or dump slopes.

If the company carries out progressive reclamation as proposed, then in most cases, the company's actual costs will be lower than the estimated cost. A reduction in the security provision for the next licensing phase(?operating phase?) can then be made based upon the reduction in site reclamation liability. (not clear why the licensing phase is the period of adjustment. would be more rational to use annual reviews and adjustments, since the mine plan can change more than once during a typical 5 or 7-year licensing period. Why not during the regular review of security mentioned 3 paragraphs below?)

DIAND may also include the following considerations in their reclamation liability estimate:

- An allowance for poor management or optimistically designed elements of the mine plan;
- An allowance for site access;
- A contingency allowance that reflects risk associated with uncertainties and the degree of confidence in the mine plan; and,
- An allowance for consultation and costs associated with the regulatory process.

DIAND uses the RECLAIM model (Version 4.2) as a preferred tool for estimating reclamation liability. RECLAIM is a spreadsheet developed for the Department for estimation of mine reclamation costs. The model and guidelines for its use are available from the Water Resources Division offices. The model is based, as much as possible, upon costs from other mine reclamation activities completed in the north. Mine proponents are encouraged to use this model. Other equivalent models can be used with the approval of the appropriate regulatory agency (i.e. Land and Water Boards).

Updates to the estimate of reclamation liability should be made in accordance with the Water Licence requirements or other permits, and with amendments to the mine plan and reclamation plan. DIAND will assume that mine construction will proceed as proposed. Any departures from the plan will trigger mechanisms for a review of the reclamation liability.

8.1 LAND AND WATER SECURITY

In most cases it will be necessary to separate the security deposit into costs for land-related reclamation and water-related reclamation. The need for separate security deposits for land and water related disturbances occur because there are separate licensing processes for the parties who have responsibility for protection of water resources and land resources (yet both are admiministered and authorized ultimately by the same Minister) . It is the intent of DIAND, as set out in the Reclamation Policy (INAC, 2002), that the aggregate of various land and water security deposits do not exceed the total estimated reclamation liability for a specific mine site. DIAND, and specifically Land Administration, will also set security provisions for any lands under a lease agreement.

Most projects will have an overlap between land and water liabilities. In these instances, the segregation should be based on professional judgment. For example, a cover over waste rock may have a primary objective to limit infiltration for control of ARD and a secondary objective to be revegetated for land use considerations. It should also be noted that reclaim securities from other agencies or departments might exist. An example of this could be additional securities for fish rehabilitation in affected streams as it relates to the Department of Fisheries and Oceans or for land rehabilitation for mines that exist on Commissioner lands as it relates to the Government of the Northwest Territories or Nunavut. These additional securities may not be accounted for in the RECLAIM model; however, they may be included in the terms of the water licenses or land use permits issued by the Board.

8.2 TYPES OF SECURITY

Security requirements are set by the Board as stipulated under an issued water licence or land use permit, and are subject to specific conditions. The following is a list of acceptable forms of security (NWT Waters Regulations, Section 12(3)):

- A certified cheque drawn on a bank in Canada and payable to the Receiver General;
- A promissory note guaranteed by a bank in Canada and payable to the Receiver General;
- A performance bond approved by the Treasury Board for the purposes of paragraph (c) of the definition of "security deposit" in Section 2 of the Government Contract Regulations;
- An irrevocable Letter of Credit from a bank in Canada; or,
- Cash.

Environmental Agreements have been used in previous projects and may be used for future developments. These are legally binding contracts between parties to ensure that mitigation measures and monitoring provisions (all? or just those for which regulations do not exist?) for projects are implemented. They are not intended to overlap with existing regulatory instruments, but rather to be used as a complementary tool for the management of complex projects. DIAND will provide certainty, clarity, and consistency for Environmental Agreements through the publication of an Environmental Agreement Policy. This Policy may provide guidance to other northern regulators, but it will not apply to projects where DIAND is not a federal or responsible Minister or authority. (why is this paragraph here?—it does not add to the guidelines)

9.0 PLANNING, MONITORING AND REPORTING (the planning portion of this section is very important and should be moved to the front of the document)

It is standard practice and generally a legal requirement in North America for mines to develop a mine closure and reclamation plan for these primary purposes:

- To allow environmental assessment (EA) and licensing agencies to determine if potential impacts of the project are acceptable or can be mitigated, and to determine or evaluate the mitigation measures;
- To identify acceptable end-of-mining conditions in terms of public health and safety, environmental protection and land use; and,
- To provide a basis for the amount of financial security required to ensure that the necessary reclamation work is conducted.

A comprehensive mine closure and reclamation plan is more likely to achieve the reclamation objectives than a cursory or conceptual plan.(some guideance on what these are, or how they differ, would be invaluable—this is currently a big problem in NWT. The guidelines should indicate what level of detail is required for an initial closure plan, an interim closure plan during operations, and a final closure plan at end of mine life. Clear instruction is needed to proponents to ensure that adequate information accompanies the evolving closure plan.) If all of the information necessary to determine the final condition of a mine is not available, a plan could be developed upon assumed conditions (how can accurate security deposits be determined, if a final condition of the mine component is unknown? Will the most protective options be used to estimated security?). The consequence of variations from the assumed conditions could be examined prior to mining and then taken into consideration in mine planning, monitoring, and financial security.

The mine closure and reclamation plan must be developed before mining starts and it is recognized that it must be based in part upon assumed conditions as described in the project application and environmental assessment report. Consequently, it is expected that the mine closure and reclamation plan will continue to evolve as the mine development progresses. Updates to the mine closure and reclamation plan should be submitted annually (agreed, but this inconsistent with your suggested revision periods above, I've heard DIAND (Dave and David) say that they would prefer reviews be done based on changes to the mine plan, not an arbitrary review. Security deposits can be reviewed annually, as one expects that ongoing reclamation research might refine the costs) to regulatory agencies. The annual mine closure and reclamation plan should indicate the extent of mine development completed to date, any variations from the existing plan that have occurred, and detailed plans for the following year. Progressive reclamation, both planned and completed, should be outlined. (Research needed to move a mine component from concept to a viable option, should be identified, usually in a reclamation research plan)

To ensure mine development plans are being carried out as expected (confusing; mine plans change all the time and will not be carried out as expected. need to clarify the message here), ongoing sampling and testing of mine site components (?meaning?) must be conducted throughout the mine life. This applies particularly to the ARD and metal leaching characteristics of waste rock and tailings as well as soil and water quality and movement. Appendices presenting the results of ARD/geochemistry sampling and water quality sampling should be included in the mine closure and reclamation plans as the data become~~s~~ available. (Important—the results should be analyzed by a qualified individual, and the implications of the findings for management should be clearly described.)

Once the end of mining operations can be anticipated(ambiguous; how about 2 years before closure?), the company must present a final mine closure and reclamation plan to regulatory agencies for approval. The final mine closure and reclamation plan will describe a post-closure monitoring program; this may also include ongoing care and maintenance, for a period sufficient to demonstrate that the goals set out in the reclamation plan have been met (too vague; the goal is to discourage ongoing care and maintenance, not encourage it). Terms should be agreed upon with the approval of the final mine closure and reclamation plan.