

POST MINING SUSTAINABLE USE PLANS VS CLOSURE PLANS.

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ABSTRACT

Mining is a temporary use of the land. Usually a mining company's interest in the land terminates with the implementation of the Closure Plan. The succeeding custodian's (and associated stakeholder's) interest is in the continued sustainable use of the land and commences only when the Closure Plan is completed. "Mine Closure Plans", while an advance on "Mine Abandonment Plans" suggest a short term planning perspective. 'Design for Closure' still appears shortsighted to the New Custodian. Defects in the Plan, which may become apparent only after a time, become the liability of the New Custodian. Poor experience with the success of closure plans, as well as the recognition that many defects are not apparent (or not recognized) at the time of custodian transfer has resulted in reluctance by the New Custodians to accept transfer. This applies particularly to mine sites where significant risk of physical instability (tailings dams which could breach) or chemical instability (leaching of contaminants) could result in substantial liability. The potential for sustainable land use, including sustained revenue generation and sustained custodial care, becomes particularly important when the reclaimed mining lands require sustained or perpetual care and maintenance (active or passive). Custodial Transfer of land, post mining, requires an extension of the concept of "designing for closure" and the development of a Post Mining Sustainable Use Plan rather than a "Closure Plan". The mining industry can do much to limit the liabilities associated with operating a mine by actively participating in, or leading efforts to define the custodial transfer process, and by developing a sustainable post mining land use. The mining industry can also provide motivation and guidance to assist in the rationalization of the widely disbursed, largely uncoordinated administration and control of post mining sustainable land-use.

INTRODUCTION AND DEFINITIONS

It has always been necessary for mining companies to plan for the operating life of mines. However, it has only been within the last 15 to 20 years, as a consequence of increased concerns regarding environmental and land-use degradation, that mining companies have had to make additional plans for reclamation and circumstances arising post operations. These 'post operational' plans can be so onerous that the economic viability of mining a particular mineral deposit may become uneconomic. The full extent of environmental and economic liabilities associated with a mine may become apparent only at mine closure, but the potential liability exists, and planning for its minimization should start, with initial planning for mine development.

“People do not plan to fail – they fail to plan.” Failure to meet closure requirements may not, however, result only from failure to plan, as failure could result from:

i.	failure to plan,	avoidance requires	'Closure Planning'
ii.	preparation of a flawed plan,	"	'Review of Plan'
iii.	failure to execute the plan, and	"	'Implementation in Operating Plans'
iv.	executing a plan with incorrect objectives.	"	'Knowledge of Closure Requirements'

In Canada much of the mine development has occurred on essentially undeveloped land. Prior to mining the land was essentially ‘self sustaining’ in that it required no intervention by man to maintain this use. There has been a tendency to require mining companies to return mine sites to this condition post closure (to reclaim lands to achieve a land use equivalent to or better than that which existed prior to mining). This cycle is illustrated in Figure 1a). Usually such undeveloped land does not have a significant financial yield. Hence, a return to ‘pre-mining’ conditions does not provide potential for sustained financial yield. If the land had been developed prior to mining then the options would include reclaiming to the prior usage, to either an alternative usage, or to self sustainable use, as illustrated in Figure 1b). A developed use usually implies a financial yield and may require either passive care, such as would apply to rangeland or forestry, or active care, as would apply to any industrial site. Definitions for these terms and other terms relevant to this paper are provided in Table 1. Only when a self sustainable land-use is achieved can the custodian avoid periodic interaction with the site. If periodic interaction with the site is required then the cost of such intervention must be born by the financial yield from the site, or from the financial yield realized from a ‘trust fund’. To avoid the establishment and management of the ‘trust fund’, and the long term financial risks associated with such a fund, it is desirable to develop a post mining sustainable land-use which yield an adequate financial return.



Figure 1a). Reclamation to Self Sustainable Use

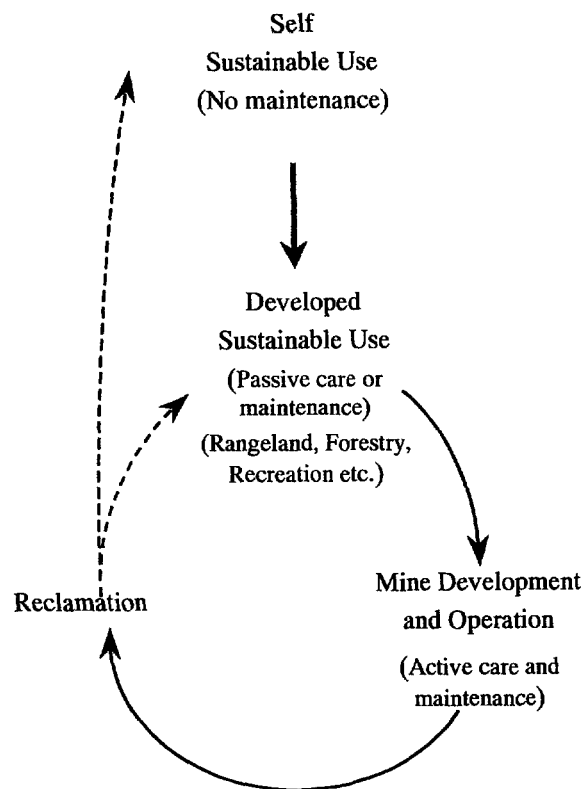


Figure 1b). Reclamation to a Developed Sustainable Use.

Table 1. Definitions for Sustainable Use, Transfer Plans, Disturbance and Reclamation.

TERM	DEFINITION
Sustainable use	Use or uses which can be sustained indefinitely with the resources provided (including fiscal resources), or which can be generated by the use. Renewable resource uses (forestry, hydro power, commercial recreation etc.) are typical examples of uses that may be self funding sustainable uses. Subsidized (from an adequately sized trust fund) managed parkland or recreational use are examples of fiscally augmented but sustainable use.
Self sustainable use	Use which is sustained by natural processes and does not require actions by man. e.g. unmanaged wilderness or nature reserve use. (No maintenance required)
Passive care sustainable use	Use which requires infrequent, periodic and low effort action by man to maintain the sustainable use. e.g. rangeland use requires range land management. (Passive care and maintenance required)
Active care sustainable use	Use which requires frequent or continuous high level effort action by man to maintain the sustainable use. e.g. operation and maintenance of a water treatment plant to remove pollutants from a discharge. (Active maintenance required)
Undisturbed land	land materially unchanged by mans activity.
Disturbed land	land which has been disturbed by man to the extent that there is a material difference in the physical chemical or biological characteristics of the land. Disturbance may either improve or degrade land use. Cleared land, regraded land, land affected by a surface or groundwater pollution plume etc. are examples.
Developed land	land disturbed to achieve an alternative land use. The developed land may be either improved or degraded. Development of managed forests, agriculture, industrial facility etc. are examples.
Reclamation	actions intended to return the land surface to an equivalent undisturbed condition. Reclaimed land has achieved the desired conditions.
Remediation	actions intended to improve disturbed land to achieve a desired land use. Remediated land is disturbed land which has been developed to an alternative desired land use.
Project "initiation"	initiation of land disturbance; assumption of custodian liability for reclamation or remediation of the disturbed land by the current tenant.
Project "closure"	completion of all reclamation and remediation measures to the satisfaction of the succeeding custodian, and of the steward.
Custodian transfer	transfer of custodian responsibility to a new custodian willing to accept residual liability and responsibility for long-term management. In Alberta under current custodial transfer procedures this would be on completion of 'certification'
Deed of Custodial transfer	documentation that reclamation or remediation objectives have been met and custodial transfer has been accepted by the transferee from the transferor. 'The certificate'.
Abandonment	unilateral rejection of custodial responsibility for on-going reclamation or remediation. This could be voluntary or involuntary as in the case of bankruptcy.

LAND USE AND CUSTODIAL SUCCESSION

Figure 2 provides an illustration of a successive cyclic use of land and its reclamation. If, on completion of mining, the site can be returned (economically) to a self sustainable land use then the cycle illustrated for Active Developed Use 1 is achievable. If, on mine closure, it is found that passive or active care must be maintained then it may be necessary or appropriate to reclaim to an alternative developed land use such as illustrated for Active Development Use 2. Mining, since it depletes a finite resource is inherently a temporary use of the land. The alternative (active or passive) development may be sustainable over a much longer period if the activity involves renewable resources, such as a nature or recreational park, forestry or similar.

Current regulatory agency requirements often favor or demand reclamation to pre-mining conditions. Often requirements to regrade to original topography, or re-establish indigenous trees (rather than commercially valuable species) severely limit the potential for development of post mining sustainable uses with adequate potential for financial yield. It may be appropriate for both regulatory agencies and mining companies to broaden the scope of alternative development that should be investigated. What would the touristic appeal be for the world famous Buhart Gardens if this reclaimed quarry site had been reclaimed to the original contours with indigenous vegetation?

A mine site may sometimes be divided into separate areas (Reclamation Units) for reclamation. Progressive reclamation and custodial transfer, as Reclamation Units become available for reclamation, has the advantages that terminal closure liability is reduced, closure technology can be demonstrated and the potential of discovering 'hidden defects', prior to terminal closure, is increased. The risk to both the mining company and the successor custodian is reduced. Progressive reclamation is a 'test' of the succeeding custodian's willingness to accept custodial responsibility and risk. The successor custodian benefits from the ability to test the 'sustainability' of the post mining land-use while the mining company is still operating. Unfortunately current 'closure plans' tend to be 'all or nothing'. If a successor custodian cannot be realized during the period when the mine is operating (and is able to negotiate with economic and political strength) then the company's potential for negotiating conditions for successor transfer, post closure, will reduce.

Closure may occur in accordance with the plans and schedules based on current projections of future mining which may extend far into the future. To plan for this eventuality the mining company must prepare terminal closure plans for times far into the future when the criteria governing custodial transfer

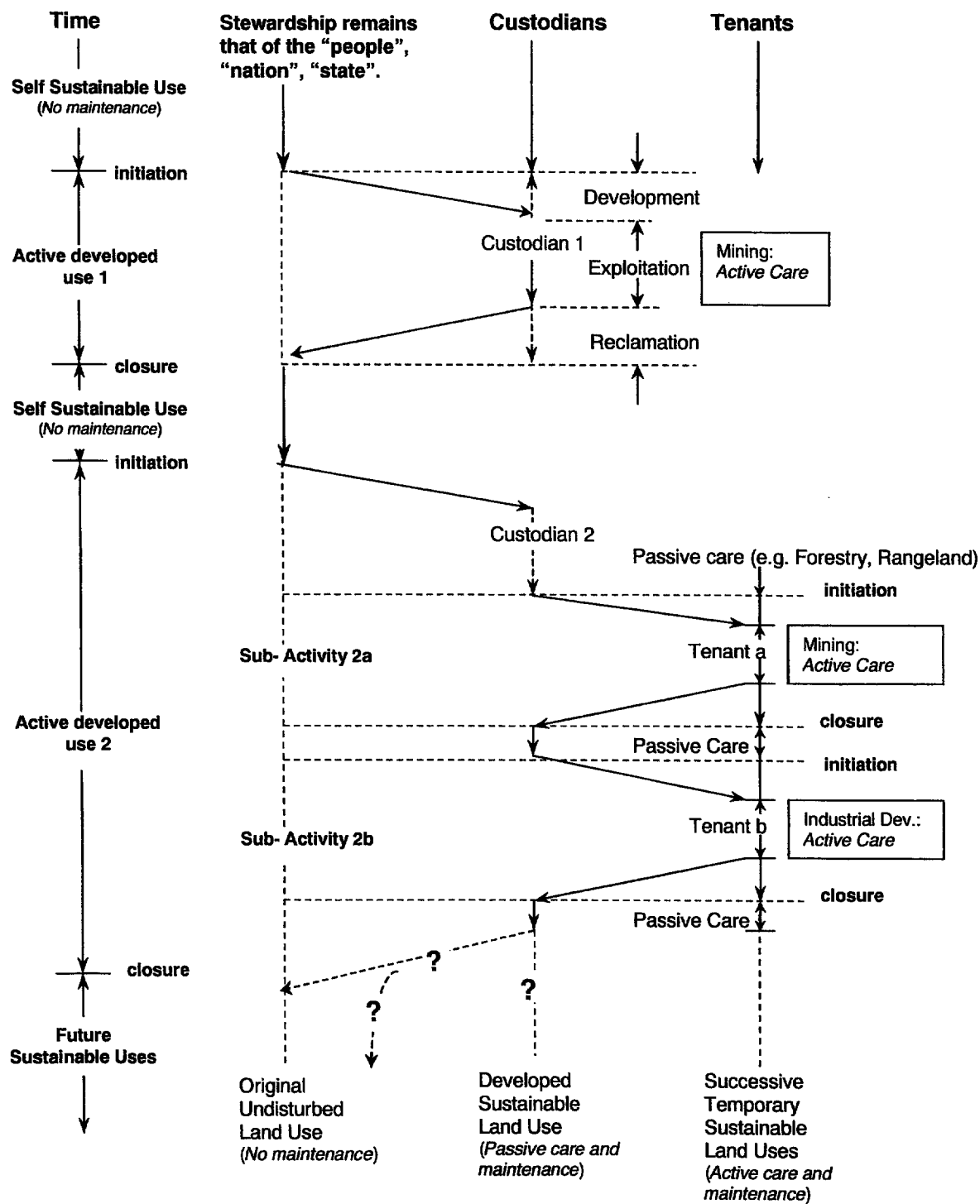


Figure 2. Land Use and Custodian Succession.

are likely to be materially different from those which exist today. Indeed it may be anticipated that environmental and closure requirements will evolve and change as much in the next 50 years as they have in the past 50 years. The anticipation of the correct 'Closure Requirements' for the closure plan represents one of the largest 'risks' in the development of an effective closure plan. Fortunately the potential for alternative development also increases with time as a result of the surrounding land-use development and improved access that results from mine development. The potential for increased regional land-use development is often overlooked, or deliberately minimized by our environmental review process. It may be appropriate to reconsider our tendency to consider mine development in isolation from other potential regional development.

COMPLEXITY PERSPECTIVE

The complexity of developing a Post Mining Land-use Plan and achieving Closure (i.e. successful, complete and irreversible custodial transfer) may be divided into two areas: Technical complexity and Procedural complexity.

The technical complexity of the development of many of the closure measures involves acquiring both the technical resources and understanding necessary to develop the Post Mining Land-use Plan. Individual technical issues can generally be addressed as independent discreet problems and solved individually. Typically, individual issues are adequately addressed, however, what is often incomplete is the technical understanding of overall long-term system performance. For example, there is often uncertainty about the long term stability and performance of the reestablished drainage systems over and through a mine site. The natural processes of erosion, sedimentation, vegetation growth and blockage, biotic activity (beaver) and possibly glaciation (seasonal ice accumulation in drainages causing spring flow blockage) may complicate the performance of such systems. There are also often similar uncertainties about environmental impacts (such as salt migration) on vegetation and aquatic biota. The development of such systems understanding is critical to the definition of the final closure measures, and the willingness of succeeding custodians to accept liability and responsibility at the time of custodial transfer.

Procedural complexity is more difficult to break into independent parts. Figure 3 illustrates some of the key interdependent process components from a hypothetical perspective (that of one mining company). The process is even more complex when it is recognized that the ultimate closure criteria and custodial transfer mechanism may evolve as a result of the combined interaction of all regional mine sites and all stakeholders. The remainder of this section addresses the individual process steps:

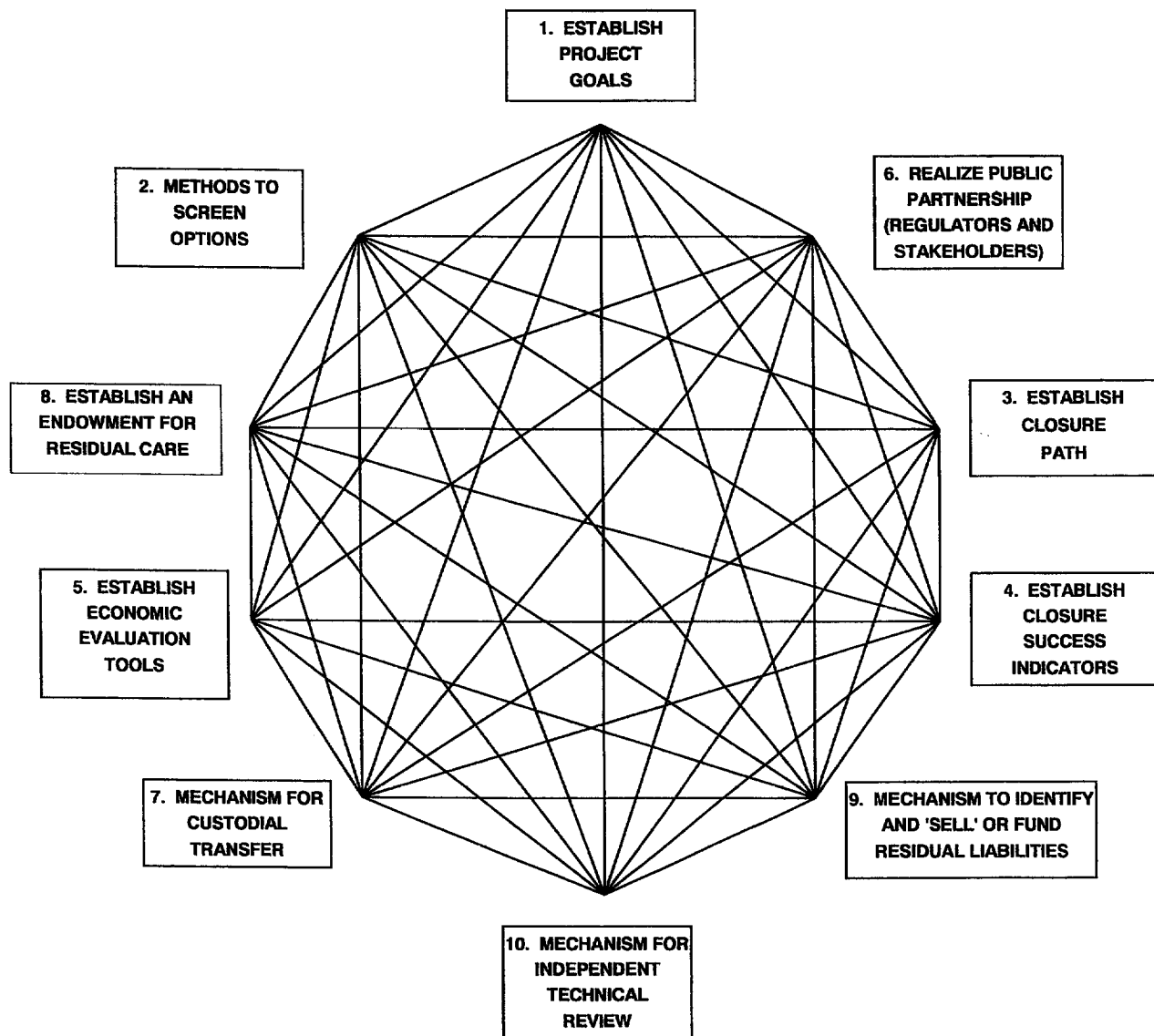


Figure 3. Interdependent components required to achieve sign off on closure.

1. Establish project (Operating and Post Mining Land-use Plan) goals:

For example:

- Operate in an environmentally, safe and responsible manner.
- Reclaim the landscape on an ongoing basis; progressive reclamation
- Provide a landscape that will be physically and chemically sustainable for the long term
- Provide a healthy sustainable ecosystem suited to an agreed land use.
- Achieve reclamation, post mining land-use and custodial transfer in an economical, timely and secure manner.

2. Establish a procedure to screen options

The screening process should involve:

- Knowledge of the relevant factors
- Involve multi disciplinary input
- Address the full life cycle of all interacting components
- Identify work and cost vs. time for each option
- Have the ability to demonstrate viability, monitor (verify) performance, take corrective action if necessary, and to achieve early reclamation success.
- Include a probability and risk analysis
 - Of work to be performed
 - Of cost
 - Of probability of success
- Consider risk adjusted full life cycle economics of all affected actions
- The data, analysis, and conclusions should be verified by a comprehensive independent peer review.

3. Establish a closure path

Establish, early in the life of the project, the project closure path – knowing that it will be adjusted with time. To the maximum extent broaden the group that will establish this path to those likely to be involved in the final path definition (regulatory authorities and stakeholders) such that there is increased probability of the path being correct and durable.

4. Establish success indicators for closure and custodial transfer

Seek binding agreement with stakeholders and the final custodian on what will be considered success in closure. Mine developers are entitled to know what the rules of the game are; insist that the rules be defined and adhered to.

5. Establish economic evaluation tools

Standards exist for conducting normal economic evaluations. However, they do not exist for situations that involve potential environmental liabilities – especially if it is possible to defer corrective action for a decade or more. The mine operator should establish procedures to conduct economic evaluations of different reclamation/remediation options. The procedures should be shared with, and vetted by, key stakeholders.

6. Realize Public Partnership

There needs to be a better understanding of how the public benefits from a profitable operation and why it is in the public interest to seek responsible and economical solutions for closure. The public is a major benefactor from a profitable operation project. A substantial portion of each profit dollar flows to the public. In a similar manner the public ‘pays’ for a large percentage of the cost of reclamation through foregone profits. As a result it is very much in the public interest that the project be profitable and that it be operated and reclaimed in a manner that is responsible and economical. It is not in the public interest to impose excessive demands for site reclamation. Realization of the public partnership is needed to facilitate progress on other issues required to achieve satisfactory closure.

7. Identify the next Custodian and a Mechanism for custodial transfer of reclaimed land

The mechanism to transfer land ownership (and responsibility) when a site has been reclaimed, but will require perpetual care, is not clearly defined in all jurisdictions and circumstances. It should be. This may require that mining companies work actively with stakeholders to define the regional post mining land use as well as the custodian(s) that will manage that land use.

8. How to establish an endowment for residual care

Perpetual care is one post mining option. It may be the only option for some sites. Economic evaluation should determine if it is the preferred option or not. This cannot be done until the post mining land use, succeeding custodian and mechanism to establish an endowment to fund perpetual care is understood. If the current laws discourage this option (e.g. by taxing money earned by the endowment) the problem should be identified and the laws changed. Some stakeholders, mine company owners included, may

insist that reclaimed land be maintenance free. Companies and regulatory agencies should be prepared to educate them about the impracticality and cost of the maintenance free option.

9. Mechanism to identify and transfer residual liabilities

There is a need to establish the “value” of any residual liabilities.

- To identify requirements for financial assurance (to ensure that liabilities are addressed)
- To identify the asset value of a project. (when sold to a new owner – even during the operating phase)
- To identify funding needed to carry on perpetual maintenance. i.e. to establish sustainable land use.

An agreed upon mechanism should be established to identify and to transfer full custodian responsibility, including potential liabilities, to the succeeding custodian. If current laws do not allow the transfer of liabilities – change in legislation should be sought to permit it to be done in a knowledgeable and responsible manner. Failure to address this aspect leaves mine developers with long term land management responsibilities and liabilities that may ultimately put them out of business.

10. Mechanism for independent technical review

An independent technical review (audit) would facilitate the acceptance of closure and custodial transfer.

Key focus areas include:

- Adequacy of plans for closure and custodial transfer
- Adequacy of success indicators
- Appraising if conditions for satisfactory closure have been met
- Identifying residual liabilities and plans to deal with them
- Determining if economic evaluations of options are realistic
- Establishing the “value” of residual liabilities
- Establishing the amount that should be entered into an endowment fund to provide perpetual care – if needed
- Determining that a property is ready for custodial transfer and that terms associated with it are reasonable.
- Determine suitability of the receiving custodian.

It will be difficult to achieve agreement on closure and custodial transfer without an independent review (audit).

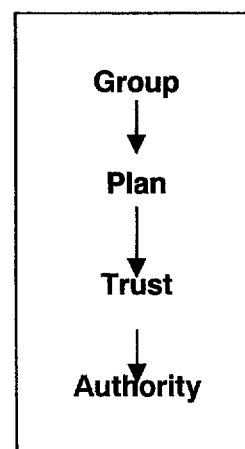
CHANGING OUR THINKING

In order to attain sustainability, the following changes in thinking need to be developed.

1. The combined effects of multiple projects in the project area must be considered in any regional post mining sustainable land-use plan development.
2. It is realistic to expect that nominal long-term maintenance will be required. Natural landscapes experience natural erosion and change and are 'meta-stable' under the long term action of the forces which have 'worn' them to their current shapes. Reclaimed landscapes will be subjected to the same forces, but the areas of erosive weakness (such as embankments and spillways) have not been tested or worn down to more stable profiles. Increased rates of erosion and potential 'failure' of weaker spots must be anticipated. Stability will be complicated by the need to ensure safe containment of some features for long periods of time (e.g. lakes and weak tailings deposits) and to keep newly established streams from migrating away from their desired location. In addition anthropogenic land-use (farming, commercial forests, recreational etc.) can adversely affect stability. It needs to be recognized that a maintenance and (at least passive) management free landscape is generally economically unattainable.
3. The 'moving goalposts' of stakeholder interests and requirements, regulatory criteria, requirements and retroactive standards, and of custodial transfer conditions, will result in long term changes in closure requirements. Mining companies need to position themselves to "manage" these inevitable changes.
4. A change in perspective for mine closure planning may be appropriate. Instead of developing 'Closure Plans' companies should be developing 'Post Mining Sustainable Land Use Plans'.
5. Progressive reclamation and custodial transfer (progressive certification) is desired to establish procedures for custodial transfer and to reduce accumulated closure liabilities. This can best be accomplished by dividing the site into "Reclamation Units" and seeking successful reclamation and custodial transfer as each becomes available.
6. Custodial transfer requirements will change with time reflecting the issues of that time. This is especially true if the Custodian represents a diverse group of stakeholders with complex special interests, and uncertain or conflicting post mining land-use objectives.
7. Stabilization of closure requirements, and hence closure liability, can be achieved only by the establishment of a successor custodian that is capable of stabilizing the temporal demands and activism of the stakeholders. Mining companies can do much to identify and create this successor custodian, and the process by which closure plan acceptance criteria are varied with time.

FRAMEWORK AND PROCESS RATIONALIZATION NEED

Figure 4 shows a matrix of the main elements needed to achieve regional mined land reclamation and long term (post mining) sustainable use. Broadly, a 'group' of individuals or entities, (Mine Planning Group (MG) - the mining company's closure team with input from all stakeholders), must produce a post mining land-use plan (MP) for each Reclamation Unit which, when implemented, together with a mine 'trust' fund (MT), provides a post mining sustainable land use, which can be maintained under the management of an 'authority' (the successor custodian or their management appointee). This process needs to be achieved regionally (for mining districts such as Sudbury, or possibly Province, State or Country) and locally and stakeholder input must be provided for in all the steps.



Mining 'districts' are a particular concern. It is the writers' anticipation that, ultimately, the diversity of stakeholder interest together with the economic importance of the resources, as well as regional and international concerns about the cumulative and combined environmental impacts on regions, will result in the emergence or creation of a more formalized resource and area specific 'Regional Planning Groups' (RG's). Each mine in such a region will undertake its individual closure planning using its own resources (e.g. - Post Mining Land-use Plan for Company A). The Regional Planning Group (RG) will have to ensure that the plans from all mines are compatible and satisfy some global regional plan and objectives. Clearly the 'Regional Plan' (RP) must include input from each of the Mine Plans as well as Stakeholders. Such regional planning groups are well established in other sectors (Greater Vancouver Regional Planning; Tennessee Valley Planning Authority; etc.)

<u>Region</u>		<u>Mine Areas</u>			<u>Stakeholders</u>	
Regional Plan	=	Company A Plan	+ Company B Plan	+ ... + Forestry Input	First Nations Input	+ Environment Canada Input

It is also the writers' anticipation that once the concept of region planning is formalized, that the logical next step would be the rationalization of the 'Trust' funds and the establishment of a Regional Management Authority (RA). Such an authority would serve to co-ordinate and manage the regional (post-mining) land use, development and maintenance.

The Regional (Sustainable Use) Plan (RP) must comprise the individual Mine Plans (MP). The Regional (Sustainable Use) Trust (RT) must comprise the individual Mine Trusts (MT).

Finally, following successful implementation and acceptance of the Lease Plans and Trusts the individual mine developers can request release from any further obligations or responsibilities regarding their sites. The succeeding custodian [Regional (Sustainable Use) Authority (RA)] must continue to interact with the long-term stakeholders.

	Region	Mining Region					Stakeholders				
		Company A		Company B	etc		Forestry	First Nations		Environment Canada	etc
Group	RG* =	MG	◆	+	◆	+	0	+	0	+	0
	↓										
Plan	RP =	MP	◆	+	◆	+	0		0		0
	↓										
Trust	RT =	MT	◆	+	◆	+	0		0		0
	↓										
Authority	RA =	REGIONAL POST MINING LAND USE PLAN					0	+	0	+	0

*** Definitions**

RG*	Regional (Sustainable Use) Planning Group	◆	Mine groups and products
MG	Mine (Closure) Planning Group		
RP	Regional (Sustainable Use) Plan	0	Contributing stakeholders
MP	Mine (Closure) Plan		
RT	Regional (Sustainable Use) Trust		
MT	Mine (Closure) Trust		
RA	Regional (Sustainable Use) Authority		

Figure 4. Matrix of main elements needed to achieve regional mined land reclamation and long term (post mining) sustainable use.

The RA will manage the region post closure. The RA will be part of the RG and likely the ultimate authority that will approve Regional Plans and Trusts and hence determine closure costs. Their mandate and practice will substantially determine the success of the individual Mine Plans and the adequacy of the individual Trusts.

In Canada and the USA the current RA's may be Provincial, State or Federal agencies. The disparity of interests, capability and resources of RA's has resulted in a fragmented and uncoordinated development

of closure requirements and processes. Here again there is opportunity for the mining industry to motivate and provide leadership in the development of a more rationalized consistent and effective structure.

FRAMEWORK FOR SUSTAINABLE USE PLAN DEVELOPMENT

The framework for post mining sustainable use planning (closure plan) development is illustrated in Figure 4. This framework recognizes that the period of interest of stakeholders is much greater than that of the mine owners. Also that the long term management and maintenance of each mine site must be provided for in a regional plan, and may require the establishment of endowment or 'trust funds' which, under the careful management of the succeeding custodian, provides for a regional post mining sustainable land use. The Regional Authority is required to maintain oversight and administrative control all succeeding custodians managing Post Mining Land-use Plans which require passive or active care.

The Mining Company's Part

Operating mining companies control the elements shaded in gray on Figure 4. Mining companies should play a leading role in stimulating and guiding stakeholder and regulatory input to post mining land-use plan development. The largest uncertainty that companies face in setting objectives for post mining land-use (or closure) planning is the relevance of these objectives to the objectives and criteria that will finally emerge from the Regional Authority at the time of ultimate closure. The risk associated with this uncertainty is that companies plan for inappropriate closure objectives and may implement development or reclamation, which will have to be modified when the final RA objectives are defined. While this risk cannot be avoided it can be minimized by companies taking active participation in the establishment of the RA and their setting of interim, and later, final closure objectives and criteria.