MINE RECLAMATION BONDING

AND REGULATION

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

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IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF MASTER OF SCIENCE
IN MINING ENGINEERING

SEPTEMBER 2004

Approval of the Graduate School of Natural and Applied Sciences

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ABSTRACT

MINE RECLAMATION FINANCIAL BONDING AND REGULATION

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September 2004, 169 pages

Dereliction of land by mining activities within the broad range of dereliction caused by other industrial and human activities was examined. Special attention was paid to impacts, mitigation, and costs thereof. Mine reclamation was examined in detail with special reference to professional interpretations. Mine reclamation bonding was studied with reference to environmental management planning so as to contribute to a forthcoming regulation concerning exactly these matters by providing a detailed listing of mining operations to be geared toward mine reclamation in Turkey's conditions and by providing key concepts in the inception of a draft regulation concerning mine reclamation as part of the EU accession program.

Keywords: bonding; mine reclamation; land dereliction; environmental management; regulation

ÖZ

DOGAYA YENIDEN KAZANDIRMA TEMINATI VE YÖNETMELIGI

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Endüstriyel faaliyetler ve insan faaliyetleri arasindan madenciligin neden oldugu dogal bozulma incelenmistir. Etki, etki giderme ve bunlarin maliyetinin üzerinde durulmustur. Madencilik faaliyetleriyle bozulan arazilerin dogaya yeniden kazandirilmasi, profesyonel açidan bakisla ayrintili olarak incelenmistir. Dogaya yeniden kazandirma teminati, henüz taslak asamasinda olup bu konularla ilgili bir yönetmelige, AB'ye uyum saglama asamasinda olan Türkiye'nin kosullarinda dogaya yeniden kazandirma amacini güden faaliyetlerin arastirilmasiyla katkida bulunma amaci ile çevresel yönetim planlamasina özel ilgi gösterilerek incelenmistir.

Anahtar kelimeler: teminat; dogaya yeniden kazandirma; arazi bozulmasi; çevre yönetimi; yönetmelik

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CHAPTER I

INTRODUCTION

1.1. General Remarks

The production of ore, quarry stone, or coal requires vast amounts of overburden material removal, most of which cannot be replaced in many cases, resulting in the disturbance of landscape, ecosystems, and communities. To compensate for this disturbance, mine reclamation is carried out. Reclamation in its turn entails costs and has to be planned meticulously enough to be kept at minimal cost with optimal benefit to the scarred land. The practice in developed countries is to require financial assurances (bonds) from the enterprise to guarantee the reclamation of the site should the enterprise fail in restoring the land as agreed per the permit stipulations.

1.2. Statement of the Problem

At present in Turkey there exists no regulation directly in charge of the environmental aspect of mineral operations. A variety of regulations are employed on partial basis if at all applicable to address environmental concerns of mining operations with questionable success as there is a general lack of coordination and no memorandum of understanding which leads to conflicts. Often times, as they have in the past, mining operations cause environmental damage unbridled. Expertise is lacking, key concepts are unheard of, and there are no available guidelines or examples in Turkish.

1.3. Objectives of the Thesis

This thesis has the objective of documenting the study whose aim was to 1) reflect some of the most significant concepts used in mining and environmental by carrying out a comprehensive literature survey, 2) formulate mine reclamation cost estimation tables and 3) make contributions to a forthcoming regulation concerning mine reclamation.

Contributions were made to the draft of an upcoming regulation concerning mine reclamation by recommendation of key principles and concepts. Persuasion was necessary for the inclusion of primary items concerning mine reclamation financial bonds so as to attempt at bringing the legal statutes in Turkey to a condition on par with those of countries with exemplary track records.

1.4. Methodology of the Study

A detailed literature survey in a very broad perspective was carried out with the purpose of seeking acquaintance with land and mine reclamation as well as related environmental issues, such as mining and environment, impact of human activities, environmental impact assessment (EIA), mine reclamation, and environmental management in mining.

It was of paramount importance to become familiar with some of the operations of reclamation in mining. This was also to be true for general mining operations.

From the standardised ten steps of reclamation, those which entailed costs were singled out. These were further expanded with details, at times comprehensive, at times serving the purpose of guidance.

Data concerning reclamation costs taken from a certain company were distributed into this list in tables with appropriate rates and sums in order of year under each item in the list.

It was discovered that there was an upcoming regulation concerning mine reclamation being worked on. Through invitation of the Ministry of Environment and Forestry, it was possible to get involved in the regulation and share what had been studied so far.

1.5. Thesis Outline

Following the introduction in Chapter I, a literature survey covering very broad concepts of mining and mine reclamation-specific issues ensues in Chapter II.

Chapter III covers mine reclamation financial bonding. Current world practice, issues, alternatives, and the like are covered.

Chapter IV is the case study in question. Here are given the steps of this study which led to the formation of comprehensive listings of operations that would entail costs in mine reclamation practice. The process whereby the regulation was involved in is also described.

Chapter V concerns the Regulation for the Reclamation of Land Affected by Mines, Quarries, Pits, and Storage Facilities.

Finally, Chapter VI provides results and recommendations pertinent to this study. Additional information concerning specific aspects of environmental management planning and the like is provided in the Appendices included at the end of this thesis, not the least of which is Appendix A which provides additional literature review concerning the very broad concepts of environment, dereliction, and the like.

CHAPTER II

LITERATURE SURVEY

An extensive literature survey has been carried out. This has then been divided into two parts. The below is directly in correspondence with the topic. The auxiliary part has been included at the end of the thesis as Appendix A.

2.1. Environmental Impact Assessment

2.1.1. Introduction

"Project planners should undertake environmental impact assessment (EIA) with the goals of preventing degradation of the environment, restoring natural systems that previous economic activity has destroyed, ensuring the environmental-economic balance of future economic development, creating positive living conditions for people, and developing measures to reduce the level of environmental danger that the planned project poses. EIA should precede the making of a decision about the commencement of any particular project." (Maximenko, 1992)

Environmental impact assessment is viewed by some as the "expert and analytical process of examining the impact of a project on the environment" (Li *et al.*, 2000). In the event that a project poses very drastic impacts on the environment, an environmental impact statement (EIS) is required (Li *et al.*, 2000). The most crucial issues in environmental impact assessment are environmental impact analysis, prediction of pollutant effects, and assessment of mitigation measures (Li *et al.*, 2000). EIA can be implemented into all countries from a variety of political systems, is adaptable, can evolve, provides means for participation of affected populations, and spearheads the collection of environmental data sooner or later (Robinson, 1992).

EIA was devised in the U.S. in the 1960's and, by the time the European Economic Community (EEC) had begun considering environmental impact assessment as a vital tool in the enforcement of environmental standards preservation for the first time in the 1970's, and, a decade later, in 1985, the EEC Directive was born (Renfrew, 1988), it had already been in use in jurisdictions in Europe and there was already some experience in it (Robinson, 1992). None of these nations did so by way of international enforcement; they all adapted such by themselves, although in 1987 U.S. Secretary of State James Baker propositioned the sanctification of EIA by the World Bank (Robinson, 1992).

"Growth and development are essential for conservation, and conservation is essential for growth. Despite some assertions to the contrary, these concepts are not mutually exclusive. In fact, they should not necessarily be deemed mutually antagonistic. I am not saying that growth and development do not put new and difficult strains on the natural environment. The lessons of centuries is that they often do--and with tragic results, when men and women are careless . . . . I think we have to pursue, both in the United States and abroad, a philosophy of growth combined with conservation . . . . What [the United States] wants the World Bank and the other development banks to do is make environmental analysis, systematically and routinely, a central part of every loan proposal. We want the Bank to draw on the expertise of trained environmental analysts--both from its own staff and outside consultants--who know developing countries and can assess just what impacts any new project or policy will have on the ecology of those countries. It should then incorporate that analysis into its lending decisions and assistance from the very beginning of the lending process." (in Robinson, 1992)

While it may be considered a weak tool by some (Renfrew, 1988) and is today superseded by a more comprehensive prototype called Integrated Pollution Prevention and Control (IPPC) (EUROPA, 2004), the EEC Directive encouraged the prevention of impacts upon the environment and curing what is inevitably effected, rather than designating *carte blanche* and then curing (Nicholson, 1988).

The IPPC aims to achieve "a high level of protection of the environment taken as a whole by, in particular, preventing or, where that is not practicable, reducing emissions into the air, water, and land" (Defra, 2002).

The official definition of the IPPC is:

"Legal process, by which large industrial processes are licensed and regulated, refers specifically to the requirements of the European Commission's IPPC (integrated pollution prevention and control) Directive (96/61/EC)." (EEA, 2004)

Moreover,

"The system of Integrated Pollution Prevention and Control (IPPC) applies an integrated environmental approach to the regulation of certain industrial activities. This means that emissions to air, water (including discharges to sewer) and land, plus a range of other environmental effects, must be considered together. It also means that regulators must set permit conditions so as to achieve a high level of protection for the environment as a whole. These conditions are based on the use of the 'Best Available Techniques' (BAT), which balances the costs to the operator against the benefits to the environment. IPPC aims to prevent emissions and waste production and where that is not practicable, reduce them to acceptable levels. IPPC also takes the integrated approach beyond the initial task of permitting, through to the restoration of sites 1 when industrial activities cease." (Defra, 2004)

Ferreira et al. (2004) say, "In keeping with the precautionary principle, it is safer to err on the side of caution, and standards should be set closer to complete restoration." Preferring prevention to cure is also reasonable from a financial point of view. Indeed, if habitats can be used as indicators to the health of an environment, it would be beneficial to read McMahon (1994) who quotes:

“There should be no misunderstanding about the fact that re-created habitats are usually **second-best**, compared with the originals. It is seldom possible to restore ecosystems with the full richness of their former species complement” (emphasis added).

Nicholson (1988) also states that:

“The Brundtland Commission report notes that much environmental concern has concentrated on repairing the damage of past actions rather than anticipating and preventing future environmental damage.”

The Brundtland Commission is:

“The World Commission on Environment and Development chaired by Norwegian Prime Minister Gro Harlem Brundtland. The Commission's report, Our common future (1987), popularised the notion of sustainable development.” (EEA, 2004)

For Haigh (1993), too, prevention is the best cure and in fact he quotes a school of authors who go so far as to dismiss land restoration as a farce. In view of the necessity of mineral resources, this contention is not to be considered seriously or taken into account.

The EEC Directive has two “annexes” (“schedules” in the U.K.). These are provided in Appendix B. It is important to note, from these Annexes provided in Appendix B, what else the extractive industry, of which mining is a branch, is grouped with, for Annex I industries are those that require systematic assessment, whereas Annex II are those for which “assessment is discretionary” (Nicholson, 1988). This echoes how the mining industry was characterised in 1982 in Stockholm, namely as not as malignant as some others (Haigh, 1993).

The EIA process involves the following:

- screening the proposal;
- preparing an initial executive project summary;

- preparing Terms of Reference for an environmental assessment;
- preparing the assessment;
- reviewing the assessment and incorporating its findings into the project; and
- conducting post-project evaluation (Robinson, 1992).

So that to ensure the sustenance of human health and quality of life, biodiversity, and survival of ecosystems, environmental impact assessment ought to focus on the effects on human communities and their material assets and cultural heritage, wildlife, media (soil, water, and air), climate, and landscape and how the relation of all of these with one another will be changed (Nicholson, 1988). Perhaps one way of defining environmental impact assessment in a nutshell and laying out the rationale for its use would be to compare it with the days before it was brought forth and finally engrained into an EEC Directive. Nicholson maintains that the advantages of environmental impact assessment far outweigh the disadvantages. Table 2-1 was taken from Nicholson on how environmental impact assessment is a procedure more advantageous than the old practice where no assessment whatsoever was carried out.

Table 2-1 Advantages and disadvantages of EIA (Nicholson, 1988)

Advantages of EIA	Disadvantages of EIA
- has the potential to increase standardisation of analysis - because it is systematic and logical, it reduces delays in the planning process and makes possible faster and more efficient processes in decision-making - EIA necessitates the collection of data (never required before) which can be ready reference in other applications - under appropriate circumstances, EIA can aide the possibility of determining secondary and tertiary impacts on the environment - EIA is a guarantee in the hand of the developer that they have received approval from authorities under certain conditions and with certain understanding - a holistic view of baseline data and potential impacts is provided for - EIA marks a milestone by requiring public participation - EIA deems possible rigorous analyses versus cosmetic ones - EIA can determine potentially problematic issues and deems possible solutions to problems at an early phase	- Like any system being installed, EIA is bound to be laborious initially - EIA requires data that has not been collected previously - EIA means time and money - EIA sometimes puts developers in the difficult position of having to share what was previously considered commercial or confidential information - EIA in its own merit does not provide solutions to problems - EIA requires another circle of management

Regarding the effectiveness of the EIA process, Baker and McLelland (2003) outline seven basic principles (verbatim):

1) respect uncertainty;
2) adopt sustainability as the central objective;
3) set clear rules for application and implementation;
4) assess needs and alternatives;
5) ensure transparency and openness and public participation;
6) monitor the results and apply the lessons; and
7) be efficient.

Policy effectiveness is summarised in Figure 2-1.

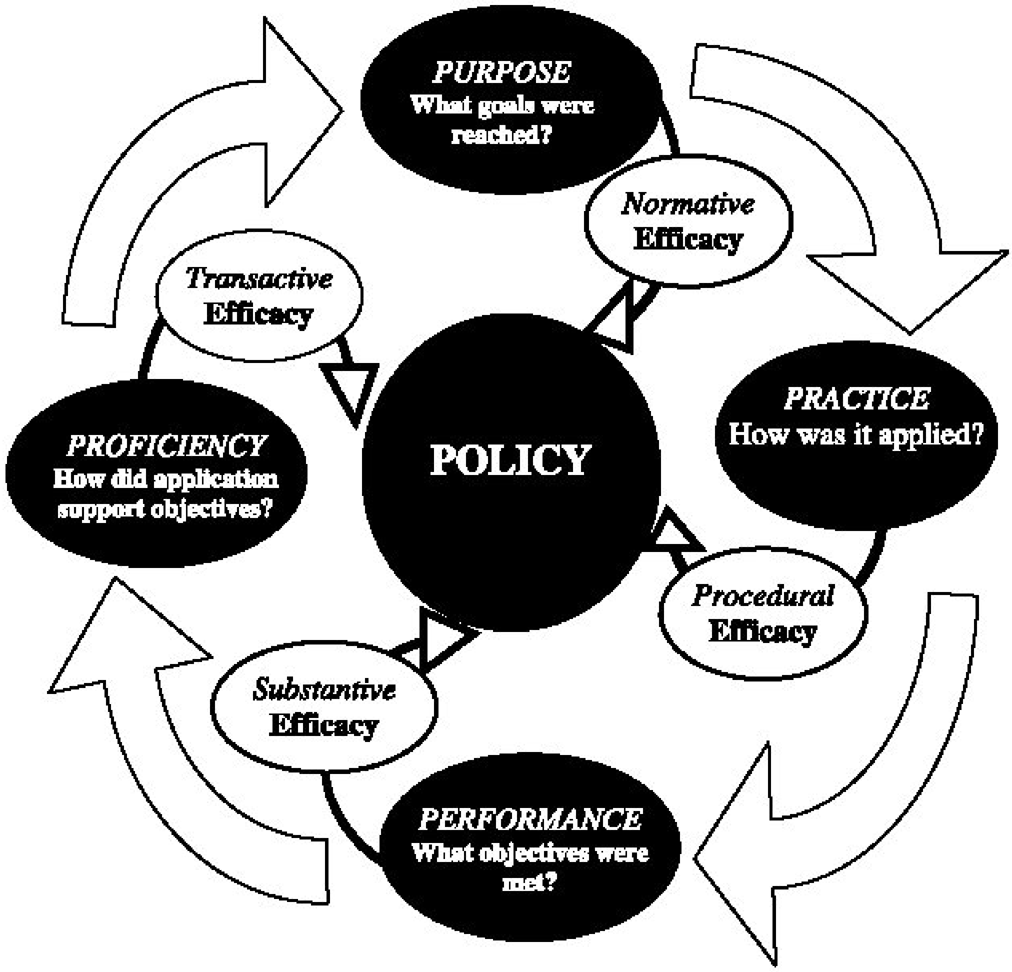

Figure 2-1 Components of policy effectiveness (Baker and McLelland, 2003).

Strategic Environmental Assessment

Also known as environmental appraisal, planning and programme development, integration of environmental assessment into policy-making, policy impact assessment, and programmatic environmental impact statements, among a number of other things, strategic environmental assessment (hereafter SEA), Lowe (1999) maintains, is a relative novelty whose roots lie in the United States of the 1970's, that "SEA is often described as an environmental impact assessment (EIA) of policies, plans and programmes (PPPs)." Attention is drawn to the fact that in the United States of America, SEA is not distinct from EIA, whereas in the countries of the European Union, SEA is being considered as a topic of importance, as originally it was going to have been engrained in the 1985 EIA Directive.

Lowe (1999) itemises six benefits or advantages of SEA

1. A view of the environment and projects from an outermost circle makes possible the deliberation of alternatives which might not be visible from the point of view at the project level.

2. The cumulative effects of concomitant projects are analysed.

3. SEA can operate on a broader scale and therefore aside from projects, it may analyse impacts of policies and programmes.

4. SEA can facilitate the EIA stage by doing away with certain considerations which may be deemed unnecessary and it may simplify, shorten, or even eliminate EIA.

5. SEA can go farther than EIA in determining problematic issues and dealing with them at early stages of projects.

6. SEA advocates a pro-active modus operandi in mitigating environmental impacts and this encourages and facilitates the achievement of sustainable development.

Because SEA is an issue on the level of the capacity of regulators (broad and peripheral), it will not be considered further.

2.1.2. EIA in the Mining Industry

EIA is viewed by many developers as "anti-development" (Pritchard, 1994). The responses of developing countries have differed from those of the developed; the former maintain that indeed EIA is anti-development; in developed countries, it has been seen as an inconvenience (Robinson, 1992). In the case of mining, it is a commonly accepted fact that all mineral workings will effect the environment, whether lightly or profoundly; hence, it follows that all prospective projects should be subject to the requisite of some manner of EIA (Pritchard, 1994).

In the context of the mineral industry, the aim of EIA is to predict potential impacts of surface mining to be able to evaluate the outcomes of the project (Haigh, 1993). Analysis of how impact, which depends on the location and size of the mine (population density, topography, climate, economic and social factors playing a role) (Kobus, 1992), the mineral being worked, the methods and equipment used, etc., affects whom and where this impact is inflicted (Coffey, 2000) is an integral part of EIA.

Although practice across the world differs, it is assumed to be best practice to require a scoping, or preliminary environmental impact assessment, report, where meticulous research is not a necessity. Depending on the discretion of whatever authority acting under and by whichever legislation, one of three things could be decided upon: 1) it could be decided that there would be no further need for a follow-up on EIA, 2) there could be a partial EIA requested as complement to what is already known (with possibly a government-sponsored SEA developed beforehand), or 3) there could be a full EIA requested of the developer. Pritchard (1994), however, says of mining activities, "During the EA screening state, it should be assumed that all mineral extraction proposals could entail significant environmental impacts, and therefore, all proposals will potentially require some sort of EA."

In Australia, for mining projects, there are three types of applications, depending on whether they would need EIA or not. These are (EPA/QPWS, 2003, verbatim):

- standard applications: for projects that have a low risk of serious environmental harm determined by its ability to meet a set of criteria and comply with standard environmental conditions in a code of environmental compliance (or achieve acceptably low risk of serious environmental harm as a result of the imposition of one or more additional conditions);

- non-standard applications: for projects that do not meet trigger criteria and/or have a medium to high risk of serious environmental harm; and

- non-standard applications with an EIS (environmental impact statement) requirement: for projects that have a high risk of environmental harm, considerable uncertainty regarding the potential environmental impacts, a high level of public interest, or State or national significance.

EPA/QPWS (2003) also states that "Applications consisting entirely of prospecting permits or mining claims are always assessed as standard applications." Their application decisions for EA are summarised in Figure 2-2:

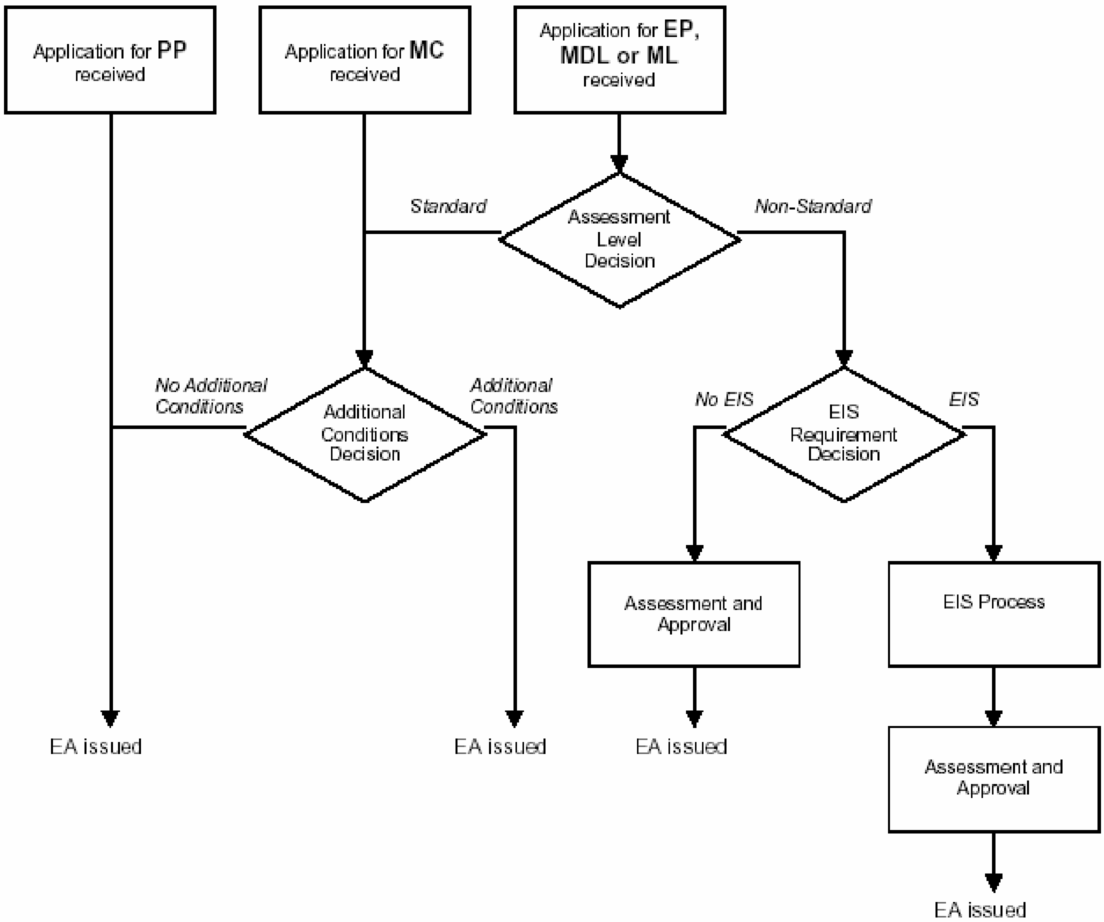

Figure 2-2 Summary of Application Decisions for EA (EPA/QPWS, 2003)

Identified areas of sensitivity and such differ from geography to geography. For example, although the EPA/QPWS of Australia identifies areas subject to treaty as the universal items of national parks, conservation parks, wilderness areas, marine parks, aquatic reserves, heritage/historic areas or items, national estates, UNESCO World Heritage Listing sites, areas of cultural significance, and scientific reserves, environmentally sensitive areas, such as dunes, in addition to wetlands, lakes, coastlines, islands, rivers, plateaus, alpine areas, and desert areas, may be more specific to Australia. Ecological systems such as uncommon, threatened, or endangered flora and fauna communities may also be counted alongside others such as mangroves, environmentally sensitive marine localities, saltmarshes, coral and seagrass meadows, rainforests and old-growth indigenous forests, desert communities, urban bushland, alpine meadows, remnant vegetation, wilderness, and wildlife corridors (EPA/QPWS, 2003).

Susceptibility to natural or induced hazards is also an issue; these are erosion, steep slopes, water catchments, surface water resources, earthquakes, bushfires, flood, cyclones, and salinisation (EPA/QPWS, 2003).

Touristy areas, areas of special aesthetic/scenic interest, areas of designated land use, and areas set aside for development, defence, or telecommunications purposes should be treated in depth (EPA/QPWS, 2003).

Whether human communities and renewable or non-renewable resources (especially agricultural land) are going to be impacted on by disturbance, whetherthese communities, natural or human, will be deprived of access to these resources, and whether the site is in an already-degraded area or is contaminated are to be taken into account. Physical factors, biological factors, land use, resource use, communities, infrastructure, heritage, aesthetics, and the like will determine how construction, operation, or decommissioning of the project will impact on the site. Where health and safety concerns are to be taken into account, air, water, wastes, hazards, noise, and the like should be taken into account. Where use of resources is concerned, it is important to assess that the environment will not be irreversibly damaged and will be able to regenerate and that land use at and/or around the site can be sustained, during or beyond the operational period (EP A/QPWS, 2003).

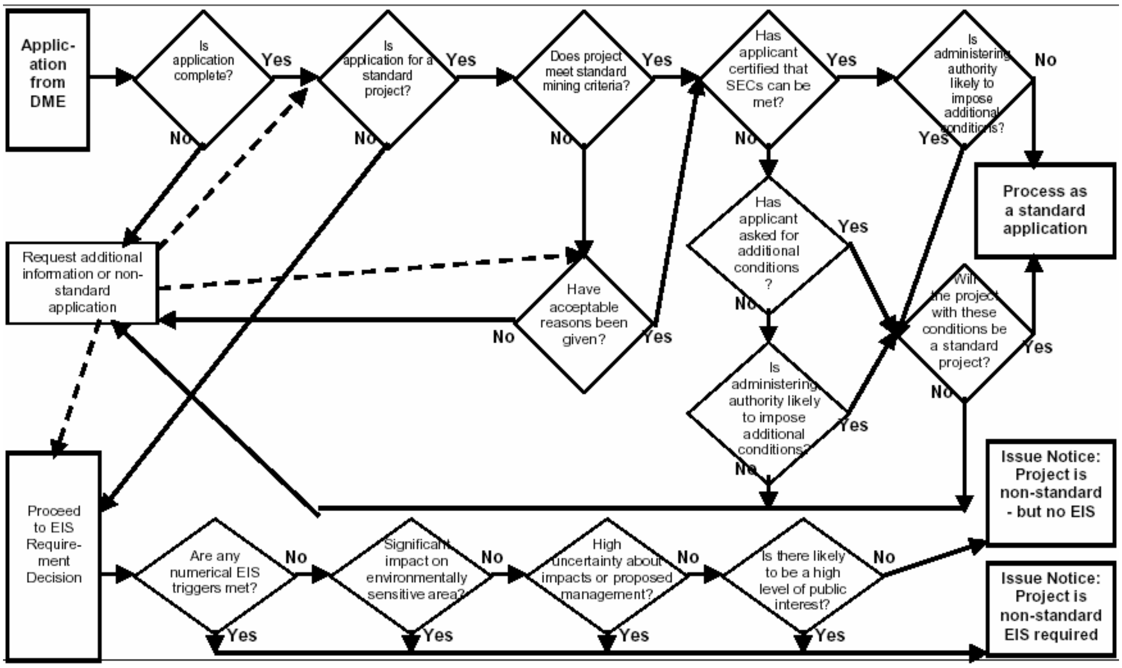

Figure 2-3 Flowchart for assessment level decision and EIS requirement decisions (EPA/QPWS, 2003)

Jay (1999) looks upon EIA in a novel way and notes that, more often than not, EIA is geared toward assessing environmental loss and/or damage and in fact endeavours to explore whether it can be applicable for projects that aim to reclaim, that is, take derelict land and improve on it for better ecological and/or economic conditions or endpoints. To this end he postulates two questions: 1) can EIA inform land reclamation and 2) can reclamation benefit from environmental assessment? According to Haigh (1993) this should be possible especially if the land being mined is of a particularly low quality to begin with.

Human Factor in EIA and Decision-Making

Project approval is dependent on the EIA and Kobus (1992) describes the rational and behavioural models of decision-making in the EIA process. It is suggested that a balance between the two be used in the application of the theory into practice. Table 2-2 summarises his research.

Table 2-2 Rational and behavioural components of decision-making process in selected stages of EIA (Kobus, 1992)

Selected EIA stage	Decision-making activity	Decision-maker	Elements of:	
			Rational model	**Behavioural model**
Project design and planning	Consideration of alternative location and production process	Developer or its consultant	Yes	Possible
Determining whether ES[§] is necessary *	Decision based on information provided by developer and criteria set by DOE	MA (or SOS)	Yes	Possible
Deciding on coverage of an ES (scoping)	Identification of possible impacts and their interactions during all phases of the project	Developer or its consultant	Yes	Yes
Preparation of an ES	Description of development and baseline environmental conditions	Developer or its consultant	Yes	Possible
	Assessment of the impact magnitude		Yes	Possible
	Assessment of impact significance		Yes	Yes
	Consideration of mitigation measures		Yes	Yes
Decision-making over planning permission	Reviewing the ES	MA (or SOS)	Yes	Yes
	Consultation		Yes	Yes
	Determination of the planning application		Yes	Yes
	Imposition of conditions **		Yes	Yes

§ ES: “environmental statement”

* Concerns schedule 2 (Annex II) projects.

** Concerns the approval of planning applications.

Of the above, the rational stages of EIA are project design and planning, determination of whether EIA is needed (this is in the case of Annex II projects), and assessment of two items with the EIA – the characterisation of the development and baseline environmental conditions and assessment of scale and extent of impact (Kobus, 1992).

The rationalist theory of decision-making, when applied to EIA, states the following (taken verbatim from Kobus, 1992):

1. Decision-makers are assumed to agree on the goals that govern a given decision.

2. Decision-makers identify all alternative courses of action that are relevant to their goals.

3. Decision-makers identify all relevant consequences of each alternative.

4. Using some appropriate calculus, decision-makers compare the sets of consequences and decide upon the optimum alternative.

The behavioural (also known as non-rational) decision-making model, on the other hand, concedes that understanding of an issue at hand is incomplete but that the first "satisfactory solution" that may be assumed appropriate on initiative could be taken up, whereby answering up to only specific aspects of any issue (Kobus, 1992).

The decision-making process can be affected by factors that would be both internal and external. An example to an internal factor is given as "professional constituency of the individuals involved." External factors can be economic prosperity, scientific progress, and party politics. Basically, with regard to economic prosperity, it can be said that for parties without the funds and/or economically dire times, the whole burden of preserving the environment could be looked upon as expensive and frivolous. On the other hand, scientific progress brings on advances in research, knowledge, and theory, making technology cheaper and more efficient; this is a net positive gain as it leads to the exertion of pressure on polluter and decision-maker to be stricter (Kobus, 1992).

Jay (1999) then takes the main steps of EIA and redescribes them. Scoping thus has to intend to determine areas of possible improvement and also those of possible undesirable effects. The environmental baseline has to be described as “a standard against which to measure the relative benefits of a project.” Designation of primary impacts is to focus on how effects relate to each other so that to understand the co-dependency of ameliorating factors. Forecasting impacts will involve not only the detrimental but also the possibly corrective. Public consultation and participation aims to interest groups for whom the after-use of the site is planned.

Description of the project and alternatives will focus on analysing the commensurate advantages of various reclamation options. Evaluation and assessment of substantial impacts will demonstrate the greatest accruing benefit of these effects. And, last but not least, to appraise possibilities for emending as well as mitigating measures, the identification of the same (Jay, 1999).

Environmental impact assessment in Turkey

Ahmad and Wood (2002) state that, while it has been approximately three decades since the introduction of the environmental impact assessment systems in the United States, the regions of the Middle East and North Africa have lagged behind some other regions of the third world countries in establishing their environmental impact assessment systems, with Oman, Turkey, and Tunisia spear-heading these steps in the 1980’s; they have examined Egypt, Turkey, and Tunisia, all three being more or less at the same level of development of the EIA systems on the criteria of legislative and administrative procedures for EIA; aspects of EIA such as screening scoping, EIA report review, mitigation, etc.; and measures undertaken to improve the effectiveness of EIA systems.

In Turkey, the legal provisions for EIA are provided by the Environment Act (No. 2872) of 1983, aided by the EIA Regulation 23/6/97, with temporary provisions (Ahmad and Wood, 2002). Provisions for appeal by the developer or the public against decisions do not exist as the opinion of the Ministry of the Environment and Forestry, the competent authority for EIA and environmental acceptablility, made in the Review and Assessment Commissions, where the Ministry of Environment and Forestry and other authorities with environmental responsibilities convene for review of environmental impact assessment reports, are final (Ahmad and Wood, 2002). Time limits for issuing decisions on EIA and for public review are stipulated in regulations (Ahmad and Wood, 2002). There are no formal provisions for strategic environmental assessment (SEA) (Ahmad and Wood, 2002). Ahmad and Wood's (2002) critique of the systems of the Turkish system is that the lack of review checklists or guidelines deem the review stage rather subjective; this lack is probably due to little contribution by "international donors on its EIA system" (Ahmad and Wood, 2002). It is stated that the influence of EIA on decision-making processes does not work on the rejection or withdrawal before project approval(Ahmad and Wood, 2002). A small note should be made, however, that while subjectivity usually is a negative connotation, sometimes it proves useful in the decision-making (Wilkins, 2003).

Public Participation

It has been wished to explore public participation because it is such a neglected aspect of EIA; it certainly was in Turkey (Ahmad and Wood, 2000) although the situation has improved (Utkucu, 2004). Public participation by affected populations in the EIA process is very important, as it is a tenet of the concept of participatory democracy and furthermore improves planning and decision-making and helps or prevents conflicts (Diduck, 1999) in an environment of openness, accountability, and a "plurality of interests," eventually tying up to the concept of sustainable development (Rosenberg and Korsmo, 2001). Rosenberg and Korsmo (2001) give an example (although not related to mining but municipal solid waste disposal) of how the input of the public and the facilitation of the processing of this input thereof enabled a last-minute manoeuvre which saved a substantial portion of an endemic dove's habitat in Grenada and plenty of lessons were learned about the effectiveness of employed processes and such, leaving room for improvement in the future, even though "Others questioned whether, endangered or not, protection of the Grenada Dove merited postponement of a much needed project."

Critical education is very important in public participation and has the objectives of enabling "critical consciousness and the development of appropriate skills and competencies related to social action (Diduck, 1999). Critical environmental assessment education should aim to enhance "instrumental and communicative competence" and "developing more functional frames of reference," where instrumental competence involves how we relate to our outside world, communicative competence aims to make possible the putting forth of the individuality of one's thoughts and appreciations rather than letting oneself come under the influence of the values and purposes of others, and frames of reference provide perspectives and schemes (Diduck, 1999). Appendix C provides a table of important conditions and their aspects with regards to success of panel processes (Fitzpatrick and Sinclair, 2003).

2.2. Mine Reclamation and Environmental Management

2.2.1. Mine Reclamation

Although a relatively recently formalised practice, mine reclamation is not an entire novelty. For example, an interesting fact is that the history of land, and in fact mine, reclamation in a country like Hungary goes back to the fifteenth century, when King Sigismund ordered that forest areas impacted on by mining be reforested (Haigh, 1993).

Mine reclamation aims to reclaim a site made derelict by mining activities to attain a status where it is economically and ecologically as proximately valuable as, if not more valuable than, the pre-mining condition whereby an equivalent or superior use or benefit may be attained (Ünal and Toprak, 2003). It is never possible to return the site to its original state. The steps of reclamation can be summarised as such (Ünal, 2000):

1. Base-line study.
2. Preparation of reclamation plans, post-mining land use plans, and mine closure plans, together with mining plans.
3. Participation of the public and non-government organisations in meetings.
4. Preparation of environmental management plan (EMP).
5. Realization of reclamation unit operations integrated with mining operations.
6. Providing physical and chemical stability to the land.
7. Landscaping activities.
8. Revegetation.
9. Mine closure and abandonment.
10. Monitoring, control, and maintenance (throughout steps 4-9).

This is best demonstrated by Smyth and Dearden's (1998) words: "In all jurisdictions [of the United States, Alberta, and British Columbia], temporary land use is implicit, and reclamation to an equivalent or 'higher' (anthropocentric) level of land use is a requirement … Equivalency is either reclamation-based, as in the Alberta system, or is restoration-based, as in the United States. The Alberta system involves 'equivalent capability' in the form of return to pre-disturbance landforms and soil productivity whereas the United States goes further in its biotic requirements…" Forsooth, the nuisances of blasting, dust, fears of toxicity, etc., however grave they may be, are temporary, whereas either of an abandoned mine or a reclaimed mine will be forever (Haigh, 1993), and it is the latter and not the former that should be endeavoured for. Although it was previously mentioned that there are abandoned mine workings (such as the Norfolk Broads in the U.K.) which are sites of special interest, this is not to say that mines should just be abandoned, for, as Hartland-Swann (1993) mentions in concluding words, "nature will not simply take over a workings and develop a high quality reserve," at least not within a few generations' memory.

Terminology where reclamation is concerned is abundant, including such words as restoration, rehabilitation, recultivation, and so on (Ünal, 2000). While often used interchangeably, they actually differ substantially. Restoration will bring about a situation where the land will host conditions pertaining to those of the pre-excavation phase (Nicholson, 1988), foreseeing the dismantling of all constructions, with after-treatment of the land to ensue (Hartland-Swann, 1993). Rehabilitation, on the other hand, introduces a totally new aspect, be it use or character (Nicholson, 1988), to the land. Reclamation, as a concept, can embody either or both of the above in differing proportions.

Still more concepts, such as after-treatment, aftercare, and after-use follow. According to Hartland-Swann (1993), the definitions are as follows:

"After-treament is the treatment of land following extraction and involves the filling, contouring, topsoiling, seeding and planting of the quarry site.

"Aftercare follows after-treatment and involves the treatment and management of the former quarry.

"After-use is the use to which the land will be put to after mineral working has ceased and redevelopment has occurred."

It should be noted that the terms used in the U.K. do not necessarily reflect the same meanings that may be in use elsewhere, much like the difference in meanings of "quarry" and "mine" in North America versus what they mean in the U.K.

Hourican's (1986) speaking of the china clay industry in Cornwall as that "most of the pits have not yet been bottomed and so the other seemingly logical solution of pushing the heaps of waste into adjacent pits is not acceptable" could possibly be one of the first mentions of backfilling.

After-use in Australia is preferred as reversion to natural ecosystems or rangeland (Osborne and Brearley, 2000). Important components of evaluation of reclamation are (verbatim, Smyth and Dearden, 1998):

1) selection of post-mining land use;
2) description of desirable reclaimed landscape characteristics;
3) standards for comparison; and
4) methods of evaluation.

Productivity, capability, and functional analysis could aid in evaluating performance standards (Smyth and Dearden, 1998). Soil productivity and vegetation productivity by use of novel equations are addressed for reclaiming surface mines by Burley and Thomsen (1990) and Burley (1990), respectively. It is possible to reclaim land that has been despoiled by industrial activity to a condition where it is superior to its previous condition, but permanent damage to cultivation of land and the landscape itself will often prove inevitable (Pritchard, 1994). Basically, the ideal is to reduce public health risks to a minimum whilst giving the land a chance to revive and once again nurture some use (Gerard, 2000).

Reclamation Costs

Obviously mine reclamation is not for free – for example, the U.K. Department of the Environment has estimated that for the years between 1978 and 1990, local authorities and mining companies had spent about £750 million to reclaim land in England alone in excess of 157,000 hectares, and in Montana in the U.S., mines of 500 acres and over tend to average above $20 million in posted bonds (Gerard, 2000), as can be seen from Table 2-3 – and is seen as an obstacle to profiting and as anti-development. While some companies may indeed conduct reclamation with goodwill, goodwill can go only so far. In the words of Hibbs (1999), “While it is possible to clean up any site completely by spending say £10 billion, to spend such an amount on the cleanup of one abandoned mine site is clearly unacceptable.” Some will argue that cleaning up is just about pointless because man cannot restore nature (per Haigh, 1993). While this last point, that man cannot restore nature, might be true, adding positive value to a landscape is altogether possible as shall be discussed further on.

Table 2-3 Bonded operations in Montana, January 1999 (Gerard, 2000)

Bonded acres	# of sites	Average acres bonded	Average bond amount ($)	Average $/acre
0-100	14	27	143,341	5309
101-500	9	277	3,414,425	12,326
>500	6	2048	21,447,009	10,472

Justifications

One of the idealised principles of mining and reclamation is that if, for whatever reason, including bankruptcy, a mined land cannot be reclaimed at the end of ceasing of mining activities, it is not to be mined. This was one of the principles by which Erten (1996) in her thesis stressed that stringent precautions be taken should the gold deposits of Artvin be mined. Indeed, McKone (1982) relates that Bradshaw and Chadwick quote "one American reclamation expert," in their work, The Restoration of Land (1980), as having said,

"If you can't put it back like it was before you got it out, then don't do it."

On the basis of this argument, it follows that "if it can be put back like it was before you got it out, then you can do it." The United Kingdom has examples of instances where mining was permitted even in national parks. Napier (1996) mentions that while in the U.K. the destruction to national parks sustained by mining is unrivalled by any other, ironically quite a few resources lie in national parks, deeming the continuation of the industry's endorsement by the government an understandable one. Hence, The Report of the National Parks Committee, dated 1947, is cited:

"Powers for the control of mining and quarrying by private undertakings are contained in the new Bill. We consider that they should be very strictly applied in

National Parks, where new mineral workings or considerable extensions of existing workings should be permitted only on grounds of proved national necessity."

This report also stipulates (taken verbatim from Napier, 1996) that:

- Park committees must draw up detailed plans while consulting owners and developers.
- Parks must define areas of new or extended mineral workings.
- When planning permission is granted for new or extended workings on National Park land, Park committees must impose conditions to deal with waste disposal, i.e. in a way to restore and preserve worked landscapes.

Thus the last item in particular is a crucial one. It comes to mean that as long as there is going to be a guarantee that land is not going to be left derelict and in fact amended in such sensitive areas, there may be few obstacles to mining as long as the basic condition of reclamation is met. Napier mentions a few issues that would need consideration, namely:

1) that the proposal is vital to the interests of the public;
2) that here exists no other suitable source of the resource to be utilised;
3) whether the nation's need of the resource outweighs the environmental impacts; and
4) whether there are sufficient effective methods to reduce impacts on the environment.

Indonesia has been faced with a dilemma centred around similar regarding her forests in designated areas (The Jakarta Post, 2003). The polemics are ongoing.

Common sense stipulates that, in the case of mining as a whole, a mineral can not be mined from a location other than that where it exists (Erten, 1996). And, in the event of reclamation, there need not be consideration as to whether the nation's need of the resource outweighs the environmental impacts, as neither will be a trade-off for the other and these impacts will be temporary. After all, as McKone (1982) points out, within the last half-century, there has been a greater understanding of the science of soil, and physical difficulties that were obstacles to mine reclamation have been dealt away with and now there exist earth-shifting and tree-moving machinery of great power and versatility, hence leaving little excuse for not continuing with reclamation if a project is well planned-out. It was this advance that led Pipkin (1994) to say, “Earthmoving was indeed unusual, but the emphasis was soon to shift decisively from forestry to civil engineering.” McKone (1982) continues to quote,

“Planners no longer stand intimidated beneath gigantic tips and scratch their heads.” (John Barr in Derelict Land,1969, in McKone, 1982)

There may however be policies of “saving for later,” as demonstrated for the case of fluorspar and limestone in Peak Park (Napier, 1996): “The Peak Park board feels it is of greater benefit to save and preserve fluorspar resources for use in years to come in Britain, instead of extraction by international companies for short term benefits.” This is certainly not something the prospective developer liked hearing, but it is an altogether legitimate policy.

How to Reclaim

As far as after-use of the land mined is concerned, basically anything is acceptable. In the U.K., for example, restorations were oriented by the Ministry of Agriculture, Fisheries, and Food. Hence, policies were toward increasing the production of food for the populations, therefore resulting in the encouragement of sites being reclaimed to agricultural land, pushing the aesthetics of the landscape to the backburner (Hartland-Swann, 1993). Winkley (1999) quotes from the Survey for Land for Minerals Workings in England in 1994 as estimating 66% of reclamation aiming for the establishment of agricultural land (which does not provide the benefit of habitat creation, hence not being ecologically enhancing but certainly economically beneficial), followed by amenity (27%) and forestry (8%).

In Kirklees in the U.K., additionally, the mineral planning authorities had provided their own policy geared toward orientation in which the operators would be encouraged to avoid restoration to agricultural land and to prefer afforestation (McMahon, 1994), which at times may simply serve as a means of habitat creation (Haigh, 1993). The author follows up by saying, "Clearly operators who are not the landowner have no long term interest in the land and the actual landowners usually desire the land as it was prior to operations."

Figures 2-4, 2-5, 2-6, and 2-7 provide examples of after-use schemes.

Figure 2-4 Mine site, before and after reclamation (Ünal, 2002).

Figure 2-5 Mine site, before and after reclamation (Ünal, 2002).

Figure 2-6 Open pit reutilised as recreational lake and wildlife area (Ünal, 2002).

Figure 2-7 Mine site after reclamation (Ünal, 2002).

One confusing aspect of reclamation is that it is conducted in synchrony with a number of other mining operations where possible, as this enables the success of the whole of the reclamation operations and is also economically more attractive. It is a common misconception among novices to the concept of reclamation that it is conducted starting at the end of cessation of mining activities. Nothing can be further from the truth, as long as circumstances permit. It should be borne in mind that when he says, “Furthermore, after-use plans may achieve a greater degree of success where reclamation is carried out progressively alongside quarry operations,” and, about the term “progressive reclamation,” “The term describes the process whereby quarry working proceeds in phases, such that when a phase is completed, reclamation can begin long before complete closure of the quarry,” Nicholson is writing in 1988, a decade and a half ago and only three years after the adoption of the EEC Directive. He also characterises “continuous reclamation” as one where "a repeated process of stripping, mining, and recovery is adopted." It being the case that surface mining is a "temporarily exclusive land use" (Smyth and Dearden, 1998), the sooner the after-use issues are settled, the better the success.

Bringing the landscape to a condition where the "approximate original contours" are approached is encouraged worldwide where possible, and this is in fact sought by the U.S. Bureau of Reclamation. Reclamation, taking into account the original conditions of the site, should focus on two very basic stages: landscape and soil reconstruction (abiotic issues) and long-term ecological stability (biotic issues) (Smyth and Dearden, 1998). In fact, any good permit should cover not only the reclamation plan and a posted bond but also items such as the reclamation of drill holes, open pits, processing facilities, and roads, as well as requirements for backfilling waste disposal, and revegetation (Gerard, 2000). However, contour design is the most expensive phase of most mine reclamation operations (Nicolau, 2003) as engineered slopes have to be made to last, as they may be stable initially but may deteriorate in time (Goh *et al.*, 1998). Coincidentally, the most important factors regarding restoration are wind erosion and "desertification" of soils, requiring that techniques of relief design be brushed up (Hartland-Swann, 1993). Mitigation of erosion is an urgent matter (Goh *et al.*, 1998). It was realised early on that backfilling is not always an option, for, in the words of Pritchard (1994), "There is usually insufficient waste spoil left behind to make full restoration to the original contours of the land a feasible proposition."

Landscape design may not always be or has not always been directed by concerns of ecology as much as by concerns of "visual amenity," referred to as cosmeticism (Selman, 1976, in Nicholson, 1988). Haigh (1993) also mentions cosmeticism when referring to land reclamation strategies, alongside sustainability and self-sustainability.

Over time, with the changing characteristics of landscapes affected by mining activities and upgrading desires for different post-mining land uses, gradually landscape architects have been started to be recruited and employed, albeit initially in the later stages of reclamation where their role was severely contained or constrained (Hartland-Swann, 1993). The Landscape Institute has a 1986 definition which says that the landscape designer "designs in the most fascinating of all mediums, the ever-changing environment … imagination and visual perception … and an interest in all aspects of ecology are essential" (in Nicholson, 1988). Also, in 1985, the same institute claims that "the landscape architect will identify and solve problems using design techniques based on a detailed knowledge of the functional and aesthetic characteristics of landscape materials" (in Nicholson, 1988).

Reclamation would be important in the recreation of habitats on the mine site. The creation of these habitats and their flourishing to a certain quality requires meticulous management (McMahon, 1994). McMahon (1994) in his interview with several operators in five districts in the U.K. found that hardly any would volunteer schemes involving habitat creation, opting for less costly alternatives.

An important role in mine reclamation is played by revegetation. Revegetation can take place naturally, or it may be carried out through pro-active intervention. That it can take place naturally may seem unlikely to some at first, but the fact that the mounds and tumuli one sees all across Anatolia may go unnoticed is because of the recolonisation of soil by vegetation.

Osborne (1999) says that long-term reclamation objectives seem to be very subjective just as what subjective would be is uncertain. He gives six questions (also to be read in Osborne and Brearley, 2000) which he says cannot be answered adequately:

1. What constitutes success in waste dump rehabilitation?
2. Is the vegetation likely to live to maturity?
3. Will the ecosystem regenerate and be sustainable?
4. What is an achievable objective for dumps in this region?
5. Is this dump heading towards success or towards failure?

6. How do we know whether there will be success or failure?

All reclamation practices, whether they be mining, riparian, or simply land reclamation, correspond to one another; therefore, there is much to be learned from the experiences of others in reclamation of different sites. For example, Webb and Erskine (2003) explore in depth the issues pertaining to the reconstruction of vegetation zones of bodies of flowing water (hereafter "riparian vegetation rehabilitation"), such as rivers, streams, and the like in Australia. While riparian revegetation, a rather intensive one of its kind, can be part and parcel of a mine reclamation scheme where restoration of a temporarily diverted watercourse could be an objective, it is of benefit to study the approaches of this system as, just like with the revegetation and rehabilitation of a whole landscape, it has to deal with species selection and a number of important factors and tools to be considered for the success of the scheme.

The role of vegetation in riparian systems is to regulate flow resistance, bank strength, sediment storage, bed stability, stream morphology, and aquatic ecosystem function, (Webb and Erskine, 2003), which can be held into account in habitat creation in mine reclamation. For what would correspond to reliance on baseline information in a mining project, during species selection, remnant vegetation surveys are carried out. Abandoned mines are a dreadful pre-legislation legacy (Ringe *et al.*, 1998a; Ringe *et al.*, 1998b) for a great many countries and this approach could possibly also be employed in the reclamation of. These surveys should be representative and valid for the actual site as sites may have undergone historical channel changes as well as changes due to climate, soil aspect, and hydrological characteristics. It is also encouraged to rely on historical and other records where possible. The authors caution that these records should be taken at face value and used only as assistance and not necessity, as they may be "qualitative, incomplete, or inexact," some requiring wise referral. On the other hand, within the scope of monitoring itself, Smyth and Dearden (1998) say that:

"The use of reference areas and their variants as a method of equivalency comparison for reclaimed land productivity levels is inflexible, expensive and precludes the creation and evaluation of mined-land ecosystems that are different from those present originally."

Webb and Erskine (2003) also refer to field trials as another tool in that they are underutilised due to their main disadvantage of requiring long periods of time to harvest results. However, once they are carried out and completed, they will be a treasure as they will provide cost-effectiveness in operations in the long run (Ringe et al., 1998a; Ringe et al., 1998b), just as the procedures of EIA provide an indirect means for the collection of much-needed yet neglected data. Monitoring once again comes into the picture and is encouraged to be carried out annually (Webb and Erskine, 2003). Mine reclamation can benefit from these insights.

Attention is drawn to the fact that endemic species should be used in riparian revegetation, just as they should be in mine reclamation. The authors maintain that the use of species not endemic to a country or even site (such as willows in Australia) is not consistent with preserving genetic integrity and biodiversity. Not only that, but the practice of such can prove disastrous, as the alien species may act as weed or sometimes bring forth low survival rates (Webb and Erskine, 2003). This latter point is reinforced by quoting the Western Australian Department of Minerals and Energy, "It is not possible to rehabilitate to self-perpetuating vegetation without reference to the surrounding ecosystem on which the constructed one will ultimately depend for stability" (Osborne 1999; Osborne and Brearley, 2000). In the issue of completion criteria for bond relinquishment, baseline studies of analogue communities and long term ecosystem studies of rehabilitation research trials will come in handy (Osborne and Brearley 2000; Smyth and Dearden, 1998). Hu *et al.* (1992) call for quantitative methods of assessment of reclamation so that to be able to determine soundly whether completion criteria are met.

Webb and Erskine (2003) outline a number of factors to be considered in revegetation. Chief among these are flood disturbance, vegetation zonation, species succession, substrate composition, corridor planting width, planting methods and techniques, native plant regeneration, large woody debris recruitment process, maintenance costs, and adaptive ecosystem management and post-project evaluation. Once again, many of these will ring true for any land reclamation operation, in particular mine reclamation.

Flood disturbance ought to be considered as it has to be aimed that grown plants should be able to cope with flooding and sediment deposition. While this is true most of the time, the same cannot be said for seedlings (Webb and Erskine, 2003). This issue should be born in mind for mine reclamation practices in regions such as the Black Sea coast in Turkey where periodic and very intensive rainfall is observed, usually in excess of 2,000 mm in the eastern parts (TSMS, 2003).

Vegetation zonation is an important aspect of revegetation, so much so that Webb and Erskine (2003) maintain that the closer the zonation to the original, the more successful the rehabilitation will be. Vegetation zonation is deemed to be a function of frequency, magnitude and duration of flooding and associated sediment deposition.

Substrate composition is about soil characteristics and material deposited on floodplain.

Corridor planting width aims to decrease streambank erosion, provide habitat for land animals and fight weed invasion and "edge-effects" (competition between weed and desirable vegetation) (Webb and Erskine, 2003).

For success and survival, planting methods should utilise the best practicable methods, taking into account climate, succession/weed, and depth of water table, etc., while decreasing labour costs, irrigation expenses, and weed-combat (Webb and Erskine, 2003).

The conditions which would encourage native plant regeneration should be prepared as this is favourable and would aid in the whole revegetation operation (Webb and Erskine, 2003) and cut down on costs of mine reclamation operations.

What is described as large woody debris recruitment process is perhaps only really applicable for riparian systems. Regardless, it should be mentioned that the authors count "tree mortality, episodic wind throw, bank erosion, landslides, undercutting of trees, transport from upstream areas" as reasons for accumulation of this material (Webb and Erskine, 2003).

Maintenance costs embody repairing fences, combating weed, replanting after flooding, vegetation/planting at different stages, etc. Adaptive ecosystem management and post-project evaluation entails monitoring to keep track of success and to ensure it succeeds it must be carried out with evaluation to follow done for future research into more effective and efficient practice in these types of programs (Webb and Erskine, 2003).

Climate, erosion rate, pile height, slope gradient, slope length, equipment, soil characteristics, legislation standards, and, last but not least, are some of the factors mentioned on the issue of spoil slope design (Goh *et al*., 1998). Refer to Figures 2-8 and 2-9. 84% of companies interviewed by Goh *et al.* (1998) observed spoil dump rehabilitation rates of less than 100 hectares/year. Important equipment consisted of draglines, truck/shovel systems and bucket wheel excavators with draglines. It was deemed important that during the rehabilitation stage, these equipment travel as little as possible to avoid compaction, as the uppermost layer compacted would become impermeable and eventually lead to sliding of the topsoil off the lower layers when saturated with water. Furthermore, popular methods of erosion mitigation employed the use of surface ripping, contour banks, sediment traps, diversion banks, runoff velocity control, lined waterways, grassed waterways and hydromulching (Goh *et al.*, 1998).

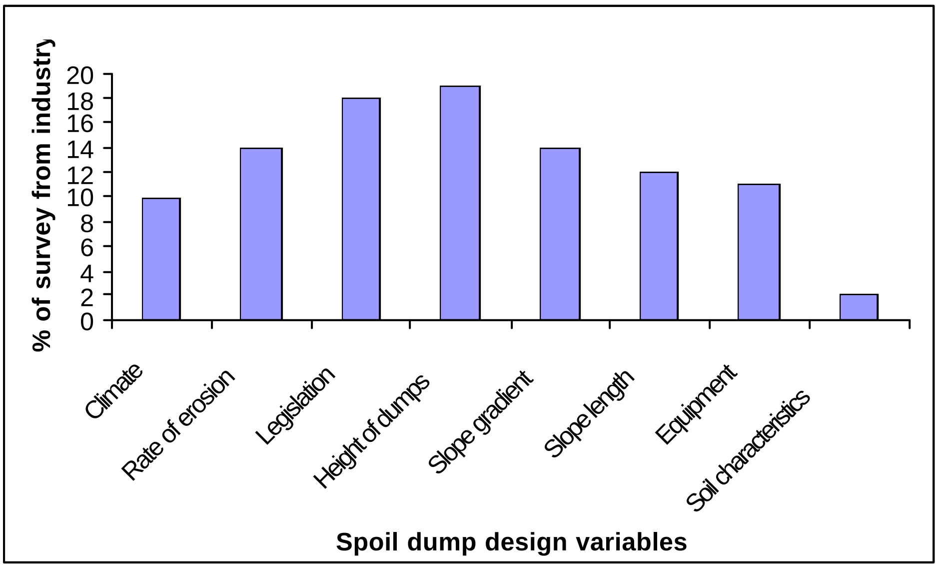

Figure 2-8 Industrial responses of variables used for spoil dump design (Goh *et al.*, 1998)

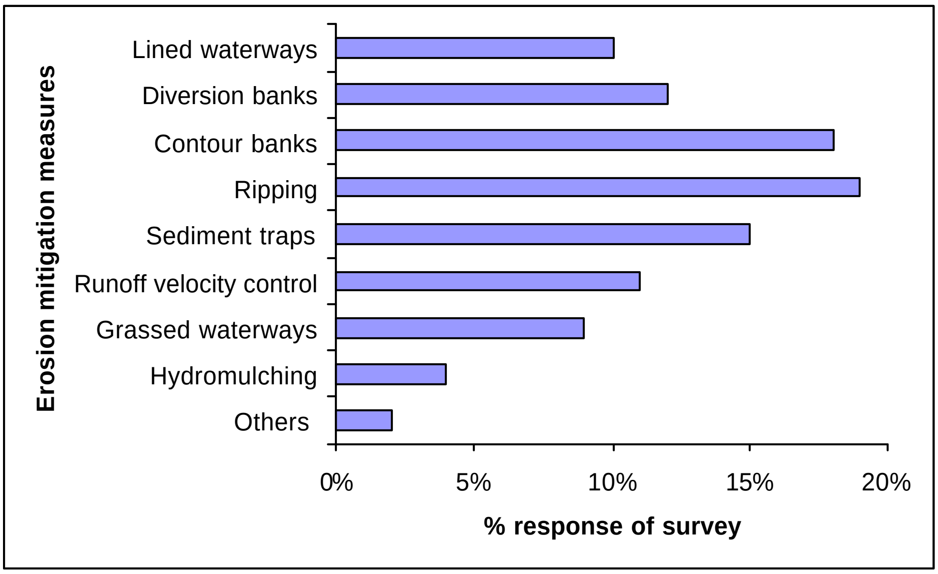

Figure 2-9 Industrial response on the application of erosion mitigation measures (Goh *et al.*, 1998)

2.2.2. Environmental Management in Mining

An environmental management plan, the purpose of which is "to propose environmental protection commitments to protect the environmental values affected by the proposed mining activities" (EPA/QPWS, 2003), "details the methods and procedures which an organisation will use to meet its objectives and targets" (DEH, 2004). These objectives and targets would be those of mitigating the impacts predicted in the environmental impact assessment stage. Furthermore, the company in question must substantiate for the viabilities of the operations onto meeting these objectives and targets by providing detailed studies of feasibility and cost effectiveness measures. Mitigation as well as prevention of further adverse impacts on the environment so that to minimise what is to be mitigated should also be included. Emergency and contingency plans for accidents for where and when deemed necessary are also in order (EPA Guyana, 2002).

Some of the most important items to be considered in an environmental management plan are water pollution, disposal of mine wastes, hazardous residues, and tailings and tailings dam management (UNEP, 1994).

EPA Guyana (2002) states the following to be included in environmental management plans (taken verbatim):

1. Environmental Policy of the company
2. Specific objectives of the plan.
3. Identification and description of the potential adverse impacts and environmental risks associated with implementation of the proposed/existing project.
4. Detailed description of the appropriate mitigation and compensatory measures together with designs, equipments description and operational procedures (as appropriate) to respond to these impacts or to avoid or reduce risks.
5. Determination of requirements for ensuring that responses to predicted impacts are made effectively and an implementation schedule (timing) for mitigation measures that must be carried out as part of the project.

6. Development of a programme to monitor the impacts arising out of the project operational activities and the effectiveness of the proposed mitigation measures. The monitoring plan should detail as a minimum, impact indicators, location and frequency of sampling, analytical methods to be used and criteria for evaluation. Such information enables the developer and the EPA to evaluate the success of mitigation and allows corrective actions to be taken when needed. This programme should also include regular audits of the implementation of the EMP.

7. Identification of persons within the company responsible for executing the EMP.

8. Identification of necessary funds (including budget) to implement mitigation measures.

9. Emergency Response Plan in cases where the project uses or produces substances know to have a deleterious effect on the environment.

The eighth item ("Identification of necessary funds [including budget] to implement mitigation measures") implicitly insinuates bonding, or financial assurances.

Mitigation can take place during operation, or it can take place after operation (Pritchard, 1994). "Mitigation after operation" is in fact what is already known as reclamation. The following paragraphs will briefly outline some of the daily operations necessary for mitigation of short-term and long-term impacts. They are just a few among a whole array of possible environmental management plans and the scenarios are very superficially provided.

Visual and landscape impacts of surface mines and quarries can sometimes be limited by "directional working" and by emulating the natural look of the surrounding landscape; "restoration blasting" may also be implemented (Pritchard, 1994), though the latter blasting is also used for slope stability concerns at times. For visual impacts on communities, trees and berms may be used as barriers to conceal ongoing development and production (Hartland-Swann, 1993). Monitoring water pollution, discolouration, and sedimentation and phasing development operations of mining to strip as small plots of land as possible at a time while restoration ameliorates what has been impacted are also recommended (Hartland-Swann, 1993).

Air impacts can be reduced by controlling dust and exhaust emissions. It is recommended that during dry seasons and periods of high wind, water-spraying (with the aid of chemical suppressants if necessary) to suppress dust be used in conjunction with proper maintenance of road infrastructure and appropriate speed restrictions on vehicles. Vegetation (pioneer or established) and covering with plastic sheets or canvas may provide consistent and constant suppression of dust (Hartland-Swann, 1993).

Noise impacts can be reduced or prevented altogether. Prevention would be possible where constructing facilities and infrastructure (processing plants, haul roads, etc.) at a distance away from communities could be an option that could be taken into consideration. Where this is not possible, restricting working hours so as to not be disruptive of day and night routines of communities is a must. This is especially true in the case of blasting operations. The volume of machinery can be toned down somewhat by fitting silencers or opting for electrical equipment versus those that function with diesel (Hartland-Swann, 1993).

Impacts on soils and geology may be compaction and cementation, steep slopes, wind erosion, sand-blasting effects, low nutrient status, and the lacking of essential micro-organisms in soil and are to be dealt with by segregated storage of topsoil and subsoil after removal of vegetation in piles small enough to minimise compaction. Potential for contamination must be nil. Erosion prevention and slope stability of these piles is a priority. A phased mining project is an advantage as this will mean that there will be as little desertification of the soil as possible (Hartland-Swann, 1993).

Hydrological impacts concern water quality, of both surface water and ground water, in the current and in the future. Water courses may be diverted to prevent them from interfering with mining operations as well as their getting contaminated. Likewise, run-on and run-off must be managed as appropriate with the use of drainage, collection, and diversion channels. Precipitation regimes may determine periods of operation during certain seasons of the year. Erosion-control not only prevents soil loss as mentioned above but it also prevents deterioration of water quality of receiving water bodies by sedimentation. Protection of water from pyritic waste rock and the like to prevent AMD and toxic discharges is of paramount importance (Hartland-Swann, 1993). The flow of ground water can be impacted on to cause aquifer contamination in cases where the formations are those that are highly permeable, such as limestone (Pritchard, 1994). Pumping out the water table to be able to continue operations may affect vegetation by depriving them of water and also areas within a 20 km radius (Haigh, 1993) and saline intrusion or introduction of toxic materials is feared (Haigh, 1993).

Ecological impacts are to be dealt with in a number of ways depending on possibilities. Areas of ecological importance (which may house rare species and habitats) should be preserved and maintained out of the scopes of prospecting and mining. Where applicable, rare and/or endangered species may be removed from the area prior to commencement of mining. During restoration, it is advisable, with reference to post-mining land use plans, to reintroduce endemic species. Habitats outside the area should be perturbed as little as possible. The circadian rhythms and breeding seasons of fauna should be taken into consideration when delegating working hours and phases of operation, respectively. Transplanting trees and rare species of plants is common practice (Hartland-Swann, 1993).

Whatever the empty spaces or pits are filled with, be they “inert waste” or “domestic refuse” (as in the case of landfills), land can be restored to an agricultural or amenity use (“soft” use) or for construction (“hard” use) (Pritchard, 1994). In the case of restoration to agricultural use, a number of issues do make themselves known (such as techniques for soil removal and replacement, compaction, differential settlement, etc.) (Sweigard, 1990).

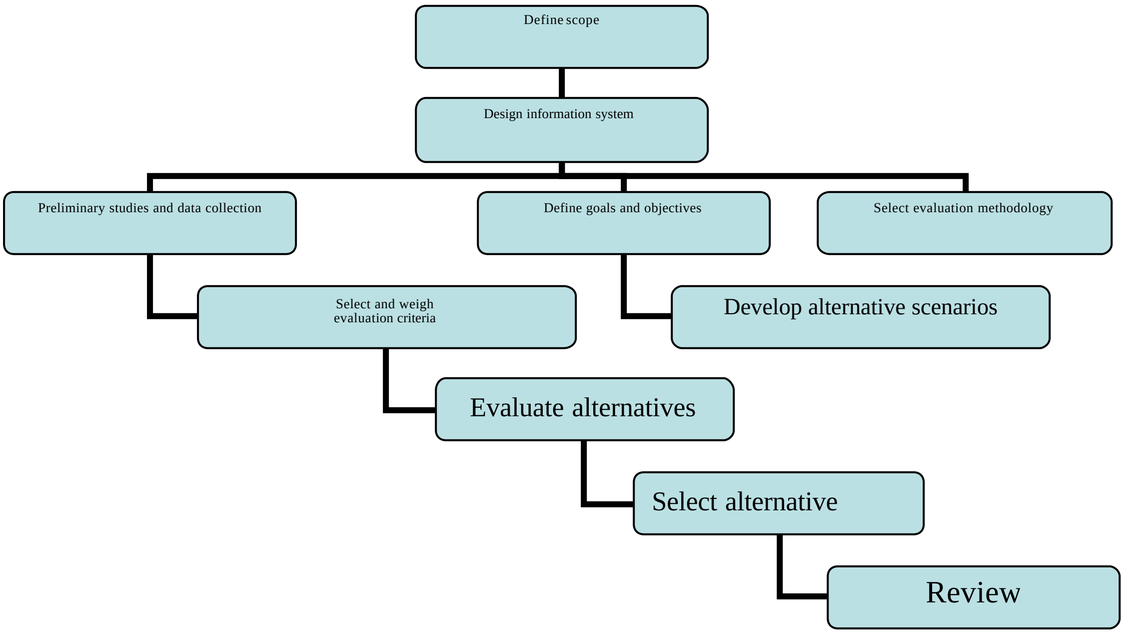

Figure 2-10 The site planning process as applied to post-mining land use (Sweigard, 1990).

There are a number of alternatives itemised for opencast coal mining provided in literature (Hartland-Swann, 1993), all of which can be applicable to surface mining in general. These are as follows.

Alternative mine locations can be selected. These locations would only be at the favour of the deposit's morphology (Hartland-Swann, 1993) and in fact the concept is in conflict with one of the constraints of feasibility in mining and there is little flexibility in this sphere (Erten, 1996).

Different mining methods could be opted for. It is known that although some of them can be graver, underground mining entails fewer, or at least less extant, impacts upon the environment than surface mining does (Hartland-Swann, 1993).

Optimising management so that to reassess favourability of current systems, techniques, and methods should be done periodically (Hartland-Swann, 1993).

Laying out the site and scheduling activities so as to minimise amount of surface covered at one time (with haul roads, buildings and other facilities, overburden, topsoil, or spoil heaps, etc.) or to get around a sensitive spot, permanently or seasonally, may also be considered at any time (Hartland-Swann, 1993).

Implementing noise and dust control techniques (Hartland-Swann, 1993) would reduce the discomfort for local communities.

The least favourite among alternatives in reducing environmental impact in continuing mines or prospective mine sites would be to put off or delay operations until supplementary studies are concluded, sometimes leading to even the rejection of a project (Hartland-Swann, 1993). This is the "do nothing" alternative Nicholson (1988) mentioned, as

"Many quarries have been abandoned in the past largely as a result of weak planning control. Some of the resulting quarries are now havens of wildlife interest, whilst others reek of dereliction and neglect. (…) Even in the light of the latter condition, it is nevertheless feasible to think of abandonment as a planned and thoroughly researched alternative 'after-use' for limestone quarries."

He goes further to say that a few concerns should nevertheless be held in perspective, namely, whether the abandonment option would actually be a net positive gain compared to the result that could have been attained through planning and management; what the abandoned landscape would be like; whether potential hazards and negative impacts ought to be taken into account; and, last but not least, what the rationale for abandoning the site versus actively reclaiming it would be (after Nicholson, 1988).

CHAPTER III

MINE RECLAMATION FINANCIAL BONDING

Mine reclamation financial bonding (hereafter "reclamation bonding") is in practice so that to avoid the possibility of actively working mines to be another tally mark on the abandoned mine legacy in place today all over the world (Gerard, 2000) where "safeguarding tax-payers against industry's environmental noncompliance costs is becoming a critical issue" (Ferreira *et al.*, 2004) and because "regulators are mainly concerned with the prospect of inheriting liabilities from lessees" (following "end-of-leasing operations" in the petroleum sector) (Ferreira *et al.*, 2004) and should not be confused as a price set on the ecosystems of a plot of land or some such. Here it would be of benefit to remind oneself of what Pani (2000) says regarding monetary value, that this has more to do with there being a finite source rather than any party being concerned with the actual value.

Bonds, also known as, or known to come in the form of, surety bonds, performance bonds, fidelity bonds, or letters of credit, comprise a mechanism for the enforcement of contractual and legal obligations, as financial assurance requirements (Gerard, 2000). They are basically an EIM (economic incentive mechanism) (Ferreira and Suslick, 2001). Intarapravich and Clark (1994) allude to this when they refer to CAC (command and control) and say, "Between implementing command and control regulations or establishing a bonding system, a bonding system is by far preferable for Thailand and other developing nations on the Asia-Pacific region." Ferreira *et al.* (2004) count fidelity bonds (guarantee honesty), fiduciary bonds (guarantee the proper management of assets), judicial bonds (guarantee the compliance with judicial decisions), and contractual bonds (guarantee the fulfilment of contractual obligations). It is from the last, contractual bonds, that they make the distinction onto performance bonds, among construction, bid, service and materials, advanced payment, retention, maintenance, transport, government regulatory, customs, financial, and licence and authorisation bonds. Ferreira *et al.* (2004) admit that the variety of names makes the recognition of different instruments quite confusing.

Bond amounts are to be calculated with the presumptions that:

- the mine project at hand is discontinued unexpectedly;
- the operator has carried out all reclamation requirements according to schedule up until the time of cessation; and
- the state will be the body responsible for subsequent reclamation operations.

3.1. Bonding Rates

Bonds may be considered among indirect costs, as demonstrated by BLM (2002): "Indirect costs are costs that are added to the direct costs and consist of overhead charges, insurance and bonding, general and administrative (G&A) rates, contractor profit and others."

The amounts of bonds posted for a site can be determined in two ways according to Gerard (2000): i) by area and ii) by reclamation cost. The latter has the potential to be profitable for a contractor or subcontractor where one is involved. The U.S. Bureau of Land Management practices the following: exploration projects are bonded at $1000 per acre; development projects at $2000 per acre; and cyanide-utilising projects or those that pose a potential for acid mine drainage at the whole reclamation project cost. Montana and Nevada are more demanding in this regard, for they demand bonds at expected reclamation cost from all developers (Gerard, 2000).

Rationale for and Mechanisms and Workings of Bonds

The reason why bonds as instruments are resorted to is because "the bond shifts the burden of proof of a legal dispute from the damaged party to the polluter," which means that this is different from liability in that the responsibility is direct and does not require a process whereby the "injured party" would have to "bring a suit and demonstrate harm." (Gerard, 2000) Bonds also take the risk of default from the public and the taxpayer and make the private sector face the consequences (Gerard, 2000). The dynamics of the bonding cycle are provided in the Figure 3-1.

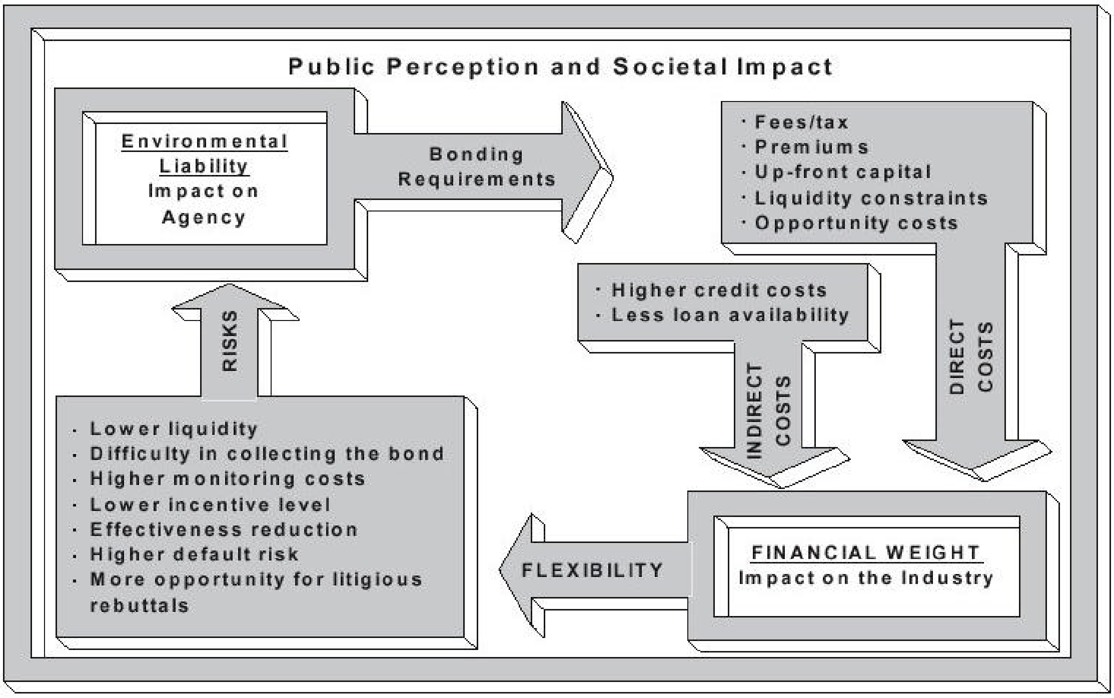

Figure 3-1 Public Perception and Societal Impact (OSM, 2000).

What are described as "third parties" are often surety providers. They are an advantage in that they augment the number of parties partaking in responsibility in the case of liability for cleanup and because they take on the responsibility of enforcement and they monitor both of the other two parties, the principal (authority) and the agent (firm), ensuring that the prospect of an unexpected but altogether possible faux-pas on the part of the regulator such as keeping the bonds whether or not reclamation is carried out so as to increase state or federal wealth, requiring that the agent have the means with which to challenge the principal, does not take place. Usually, when there arises a dispute where a firm challenges the regulator for not relinquishing the bond, there will be a likelihood that the court will find that the firm has in one way or another indeed been slack with compliance, as finding the least to object to is apparently not very difficult (Gerard, 2000).

While bonding is not something to long for, clean records are desirable on the part of firms as the advantages and positive effects on reputation will facilitate future applications with both regulators and surety providers; obedience is always a positive influence on future dealings, where surety providers may go so far as to charging higher premia or rejecting firms with poor records. At the same time, there is an issue as to why a solvent firm should even post a bond (Gerard, 2000). After all, as Gerard (2000) says,

"For a solvent firm the decision [of reclaiming] is independent of whether the firm or the surety posts the bond; if the firm fails to reclaim the site and the surety reimburses the regulator for the amount of the bond, the firm remains liable to the surety for the amount of the bond, and to the landowner for any cleanup expense over and above the amount of the bond."

Hence a solvent firm is not to be negligent, for this reason, confident of its assets and capacities, as negligence will cause it to get on the bad side of state authority, who might limit the categories of land (usually state) the firm could apply for.

Gerard (2000) also defines a "moral hazard" where the quality of the environment, restored or otherwise, is at stake and gives a best example, namely, "shirking," such as when a firm avoids, even if not altogether, operating a certain technology with the knowledge that the regulators do not have the capacity to monitor with sufficient frequency.

Such questions exist as to whether what regulations dictate should be the standards aspired to. Bonds ensure that firms lower reclamation costs and resort to prevention of damages because at the very least they will have a right to claim "the difference between the bond amount and the realised cleanup costs" (Gerard, 2000).

Bonding is mandatory in the United States of America through the Surface Mining Control and Reclamation Act; it is part of the permit application (OSM, 2000). The OSM prefers three bonding methods identified: according to entire permit area, incremental, and cumulative. These are up to the firm to choose but are subject to the approval of the regulator (OSM, 2000).

The distinction between the three is according to the area that the operator is allowed to disturb (what the working area is). Bonding according to the entire permit area is carried out when the permit area is the working area. When this is not the case, either one of the schemes, cumulative or incremental, is employed. That is, when the allowed working area is a fraction of the permit area, under the cumulative scheme, the entire permit area is bonded. Each year's bond amount, at a quantity sufficient for the worst-case scenario for that year, is added as the working progresses until the very end where the full reclamation cost has been posted as bonds. With the incremental method, on the other hand, "each bond applies only to a specific increment of the permit area" and usually the bond amounts for the increments are to be determined and the initial increment approved before the application is set in full force, although it may well be that all increments could be calculated at the same time in the beginning by the legal authorities as well (OSM, 2000).

Phase bonds are also defined by the OSM (2000) as those that may use either incremental or cumulative methods, on the basis of defined stages of reclamation, these stages being defined by almost infinite flexibility on the part of the operator.

Bonds may reduce liability risks by (verbatim from Ferreira *et al.*, 2004):

1. providing financial incentive for contractual compliance;

2. safeguarding government and taxpayers by attaining reasonable protection from default at a minimum increase in project costs; and

3. protecting the environment from potential harm resulting from failure to carry out proper closure operations in a timely fashion.

Bonds are used in both of the major two branches of extractive industries, that is, not only in mining but also in the petroleum sector (Ferreira *et al.*, 2004). Ferreira *et al.* (2004) count surety, paid-in and periodic-payment collateral accounts, letters of credit, self-guarantees, investment grade securities, real estate collaterals, insurance policies, pools, and special funds among these instruments and in fact they also do an analysis of which of these instruments were preferred. They also claim that it is altogether possible that although bonds would protect against ex post damages more than anything else, they could also be indirectly owed the protection of accidental and continuous damages; this would seem reasonable within the approach of "prevention is the best cure" also being economically viable.

Gerard (2000) maintains that the issue of bonding is not treated in depth. Just as it is still not certain if EIA is to be required of every polluter, it is not certain whether bonding would be required of every mine operator. The effectiveness of bonds as a deterrent to leaving a mine in a haphazard state instead of reclaiming it is also disputed. What the amount of bonds should be – geared toward meeting the whole reclamation cost, preparing for the worst-case scenario, or other – and what role the polluter's wealth should play in determination of these amounts and furthermore how these would be an threat to attractiveness to invest would still be of much concern. The OSM Reclamation Bond Calculation Handbook (2000) bases all calculations on the worst-case scenario whilst including the extra costs of employing a third-party contractor. On the other hand, all matters set aside, it is altogether conceivable that compliance can be encouraged, ensured, by designating the amount of bonds to a quantity less than the expected total reclamation cost(s) (Gerard, 2000), but that

"This, however, is not an unqualified endorsement for setting bonds below expected reclamation costs. There are well-known limitations of reliance on liability rules, as well as marked uncertainties concerning likely reclamation costs, especially at large-scale operations that have the potential to degrade water quality. Moreover, reputation effects only work in games with repeat players." (Gerard, 2000)

Ferreira *et al.* (2004) maintain that large and wealthy companies are often not to be intimidated by bonds, although they may be in situations where they are taking risky ("marginal") projects up, while it will be the small companies that will be affected most drastically, for bonds can "impose liquidity constraints on firms" (Gerard, 2000; Schaltegger and Synnestvedt, 2002). On the other hand, in time, with decreasing costs and increasing effectiveness of technology, what used to have been "prohibitively expensive" could become economically viable over the years (Ringe et al., 1998a; Ringe et al., 1998b), hence reflecting as less in the bond amounts. For now, it is for this reason that small-scale or weak companies are allowed to pay premia, and some states in the U.S. have bond pools for those who can not put aside more than $1 million for mine development and a quarter of that for the exploration stage, all the while the pros and cons of such practices are being discussed as time passes (Gerard, 2000). (Perhaps in this respect the practice does start to resemble insurance?) Gerard also likens mine reclamation bonds to those that are availed from people out on bail to make sure that they do turn up in court, to subcontractors and labourers that work on construction projects, for those projects which pose the possibility of hazard to public health and safety, and so on and so forth, and the very mechanism is not unlike that of deposits or the recycling system, even if these examples may not always be applicable outside the U.S.A. In countries such as the United States, United Kingdom, Canada, Australia, and Brazil, where the petroleum sector holds one manner or another of importance, bonds are in place to tackle the issue of the possibility of facing "ex post liabilities" (Ferreira *et al.,* 2004).

The procedures for issuing of bonds and their relinquishment in the petroleum sector where safe navigation and the environment are priority in protection is very similar to that of the mining sector. Just like in the mining sector, reclamation, abandonment, and decommissioning are carried out (Ferreira *et al.*, 2004).

The basic mechanism of bonds (Gerard, 2000) is that they are submitted to a regulator by a firm. From here, there are two scenarios. In the event that the reclamation is completed successfully, the regulator repays the bonds to the firm in question. Occasionally, when the firm fails to carry out reclamation (i.e. when the firm "defaults"), the bonds are kept by the regulator as funds and used by the same for the reclamation thence. Therefore, it would be ill-conceived to suggest that they are like insurance policies, although on the basis that they are instruments used merely for transferring risk, they might indeed be seen in this light.

Perhaps the reason for bonds' not being utilised more often is because of their limitations and the terms of scope of applicability and the effectiveness of their mechanisms. They certainly are endorsed by environmentalists for cases where future costs would be unknown (Gerard, 2000).

Ferreira *et al.* (2004) outline some of the advantages and disadvantages the petroleum sector has against the mining sector in the suitability of bonding mechanisms, as can be referred from Table 3-1.

Table 3-1 Advantages and disadvantages of the petroleum sector over the mining sector in the application of bonding mechanisms (Ferreira et al., 2004).

Advantages	Disadvantages
Petroleum exploration and production operations involve significantly smaller areas than other extractive activities. In most circumstances, because of the potential for significant government revenue earnings, oil projects are subjected to more scrutiny and more rigorous licensing processes. Currently, due to the costs involved in the licensing, exploration and development phases, in most cases, oil and gas projects attract fewer risky parties when compared to the mining sector. The potential for ex post environmental damages in petroleum projects is significantly small when compared to potential ex post damages in mining projects.	Decommissioning of large, fixed offshore installations: the industry does not have real experience in the decommissioning of large fixed platforms. Consequently, due to the technological uncertainties, estimating decommissioning costs is a very controversial issue. Decommissioning of pipelines: so far, regulators do not require the removal of pipelines. However this scenario may change, bringing significant environmental and financial uncertainties to the closure process. Cleanup of offshore sites: currently, there is significant discussion involving requirements for the removal and disposal of drill cuttings generated in offshore operations. As regulatory standards for offshore site cleanup toughen, uncertainties will be introduced into the cost estimation of ex post damages. Natural-occurring radioactive material (NORMs): the presence of NORMs in waste, fluids and gases brought to the surface from producing subsurface oil and gas formations has become a great concern for the oil industry. Long-overdue handling and disposal requirements for NORM-bearing waste and contaminated equipment will significantly impact ex post costs. Residual liability: the discussion on potential residual liability is also expected to add significant uncertainty to this debate: “when can a company walk away” or “when is liability over”.

The mechanism of bonding relies on a number of conditions for success: i) well-known damage valuation; ii) a high probability of detecting environmental damage; iii) a well-defined agreement; iv) few parties; v) a fixed time horizon; vi) a low bond value; and vii) no irreversible effects (Gerard, 2000).

When it comes to the accuracy of amounts of bonds to be posted, it is necessary to note that this is directly proportional to the amount of reclamation cost estimated. What the regulator should be concerned about should be not just trying to get around underestimating of costs on the part of the firm but also its own accuracy so as to avoid overestimating a cost, leading to disagreement and conflict; therefore, estimates should be within reasonable limits. In a situation where costs would be undercalculated, the amount of bonding would be short of what would truly reflect the necessary amount, and, in the case of default, this would require unfunded expenditures on the part of the regulator, and that at a cost higher than that with which the firm would have carried out its operations, for this time there most certainly would be contractors involved. Where costs would be ludicrously overcalculated on the part of the regulator or reasonable costs estimated by firms objected to, there would be the consequence of disincentive to invest posed. Firms in such situations would revise their options and in some situations opt not to work the project; in some situations, capital permitting, they might opt to work in countries with poorer environmental regulations or none at all (Ferreira *et al.*, 2004). Ferreira *et al.* (2004) stress that what is crucial is that standards and regulations be in place and that they be tried out and firm, as the rest ("the costs for achieving those standards") is pretty straightforward. It is, however, the responsibility of the regulator to ensure the bond amount is reasonable, taking into consideration (verbatim from OSM, 2000):

- The requirements of the approved permit and reclamation plan;
- The probable difficulty of completing reclamation, giving consideration to factors such as topography, geology, hydrology, and revegetation;

- The applicant's estimate of the cost of completing the reclamation plan, although the regulatory authority is not limited by this estimate.

The bond calculation procedures consist of five steps according to the OSM (2000). These require (taken mostly verbatim) i) the determination of the point of maximum reclamation cost liability, ii) the estimation of direct reclamation costs such as earthmoving, revegetation, and the removal and demolition of structures not to be retained as part of the post-mining land use, iii) adjustment and updating of direct costs for inflation, iv) estimation of indirect costs, including contractor and equipment mobilisation and demobilisation charges, contingency allowances, redesign expenses (including surveying, aerial photography, and monitoring in support of this effort), profit and overhead, and contract management fees, and, last but not least, v) calculation of the bond amount.

The Handbook for Calculation of Reclamation Bond Amounts (2000)by the U.S. Office of Surface Mining (OSM) gives the following for calculation of bond amounts:

- Direct reclamation costs – Calculated, using conditions which represent maximum reclamation cost.

- Indirect reclamation costs – Contract preparation and administration costs for staff time. Calculated by project staff and site specific.

- Mobilization – 1 to 5 percent of direct reclamation cost.

- Contingencies – Project uncertainties and unexpected natural events, 2 to 10 percent of direct cost.

- Engineering and design – Redesign to reflect current conditions, 2 to 10 percent of direct cost.

- Profit and overhead – Contractor profit and overhead not included in direct cost calculations, 3 to 14 percent of direct cost.
- Reclamation management – Project inspection and supervision, 2 to 7 percent of direct cost.

In order to determine where the point of maximum reclamation cost liability can be observed, one of the following must hold: the area of disturbance or the area designating final grading, topsoil placement, and revegetation at its greatest must be exacted; the backfill material and material required for the creation of post-mining approximate contours at greatest volume must be determined; longest travelling distances, such as whilst hauling between spoil and/or topsoil storage areas to the final destinations, must be determined; the greatest number of on-site structures must be accounted for; the point at which stock piles demand the greatest amount of cover material must be determined; and maximum disturbance areas that will demand special treatment, such as quality farmland, acidic or toxic materials, challenging topographic conditions, or underground mines that must be made safer (OSM, 2000). The actual costs are preferred to the extent possible (Utkucu, 2004).

According to OSM (2000), direct reclamation costs can be broadly grouped under three: structure demolition and disposal, earthmoving, and revegetation. Of these, earthmovingis further elaborated upon as such(OSM, 2000):

- Materials handling:
    - Material volume estimates
    - Haul distance estimates
    - Grade estimates
    - Equipment selection
        1. for spoil ridge reduction
        2. for final pit/highwall elimination
        3. for final grading

4. for topsoil redistribution
5. for removal of diversions and siltation structures
6. for covering exposed coal mine waste or other acid- or toxic-forming materials

- Equipment productivity

Adjusting direct costs to accommodate for inflation will be for the period prior to final bond release, be the method that for during the permit term or after the permit termination (expiration). The OSM (2000) gives two approaches: one that utilises an inflation factor to increase the initial bond amount to "reflect inflation for the full permit term," and the other does not consider inflation and instead readjusts the bond amounts periodically.

Indirect costs are itemised as those for:

- mobilisation and demobilisation
- contingency allowances
- engineering redesign costs
- profit and overhead
- project management fee

Ferreira *et al.* (2004) claim that for the petroleum sector, each 10% slice of reclamation costs more than the previous. Figure 3-2 is theirs:

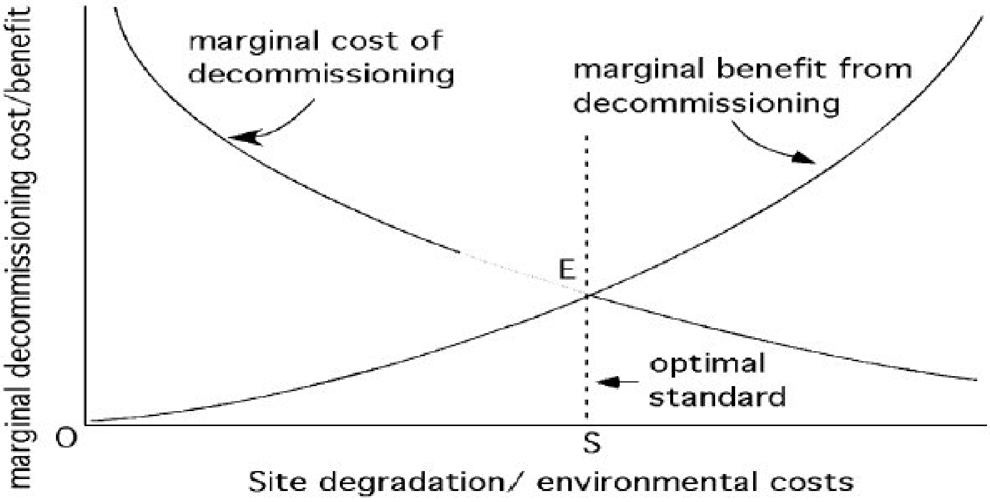

Figure 3-2 Marginal costs and benefits of decommissioning operations. E indicates the optimal point. The area A(OES) demonstrates a low efficiency scenario whereby costs outweigh the benefits of decommissioning (Ferreira et al., 2004).

It is for this reason that Hibbs (1999) has said, "While it is possible to clean up any site completely by spending say £10 billion, to spend such an amount on the cleanup of one abandoned mine site is clearly unacceptable." On the other hand, it is also stated elsewhere that an amount less than $10,000 is unacceptable (OSM, 2000). Furthermore, an agent's (firm's) assets are the upper bound on liability (Gerard, 2000).

OSM (2000) cites monitoring, evaluating, abating, and treating as main concerns of cost increase in the situation where there is acid mine drainage. This could be the reason why states such as Montana demand full reclamation cost as bond amount (Gerard, 2000).

Gerard (2000) mentions three parties where bonds are concerned: principal, agent, and third-party insurer. Ferreira *et al.* (2004), however, involve more, and count regulators, industry, society, project financing agents, and bonding agents/third party insurers as "stakeholders," as in Table 3-2.

Table 3-2: Main stakeholders involved in the bonding process (Ferreira et al., 2004)

Stakeholders	Main concerns
Regulators (government agencies)	Financial and environmental liabilities Investment flow within the sector
Industry (oil companies)	Profitability Corporate image
Society (public in general and interest groups)	Environmental protection
Project financing agents (investors, banks, international development institutions)	Development Investment returns
Financial assurance agents (insurance and surety companies, banks, etc.)	New business opportunities Risk reduction

In the petroleum sector, it is the financial bond (for where payment of a predetermined amount in situation where there is noncompliance by firm) and the performance bond (corresponding to performance of a contractual obligation) that are the most common (Ferreira *et al.*, 2004). Bonds therefore do not always cover just the environmental completion criteria. Areawide or blanket bonds are those that will cover the preliminary financial bonds of a number of sites held by the same company, these preliminary financial bonds covering regular payments of rents and royalties, civil penalties, fines, etc. (Ferreira *et al.*, 2004).

Bonds are to be kept until closure obligations (including, of course, reclamation) are satisfied. Ferreira *et al.* (2004) also mention the termination or transfer of leases. It is here that a mention of releases of bonds proportional to completed phase of reclamation is mentioned. The OSM (2000) specifies that

"[T]he regulatory authority must, upon receipt of a bond release application, inspect and evaluate the reclamation work, including an assessment of the degree of difficulty in completing any remaining reclamation. This evaluation must also determine whether pollution of surface and ground water is occurring, the probability of future occurrence, and the estimated cost of abating this pollution."

Without "well-designed and consistently implemented objective monitoring programs," bond relinquishment would be subjective and accountability questionable (Smyth and Dearden, 1998), as "The absence of a formalized description of monitoring requirements in British Columbia makes performance justification during the bond release period difficult." Certain practices specific to the United States, both federally and state-wise, are provided and not dwelt upon in this dissertation due to their nature very specific to that country.

Bonds may not be relinquished and instead forfeited in situations where the site is abandoned or the site has operations temporarily discontinued for whatever reason; this may also happen when reclamation does not proceed as planned (Ferreira *et al.*, 2004). It is recommended that partial relinquishment take place upon landscaping and soil reconstruction, with the full release upon results being deemed satisfactory on the part of the regulator at the end of the monitoring period (Smyth and Dearden, 1998).

According to OSM (2000), some principal sources need to be referred to in order to calculate bond amounts. These are i) the operation and reclamation plans in the permit or permit application thereof; ii) guidebooks and manuals so that to be informed of equipment productivity and performance and construction costs; and, last but not least, iii) contract and cost data from a variety of bureaus and offices within the state. The exact paragraph describing the first item is such:

"The reclamation and operation plans in the permit or permit application provide essential information on the type of mining to be conducted, the sequence of mining and reclamation activities within the permit area, spoil and topsoil hauling, haul distances, extent of areas to be disturbed, structures needed during the mining operations, final surface configuration, revegetation standards and techniques, and postmining land use considerations (such as retention of roads, ponds, and other structures)."

Gerard (2000) ponders on whether time will show bonding for other issues such as water quality, air quality, and other environmental performance standards as well. For now, the scope of bonding is limited because the mechanism of bonding relies on a number of conditions for success.

The whole of reclamation operations can be summarised in three phases according to Smyth and Dearden (1998), as demonstrated in Figure 3-3.

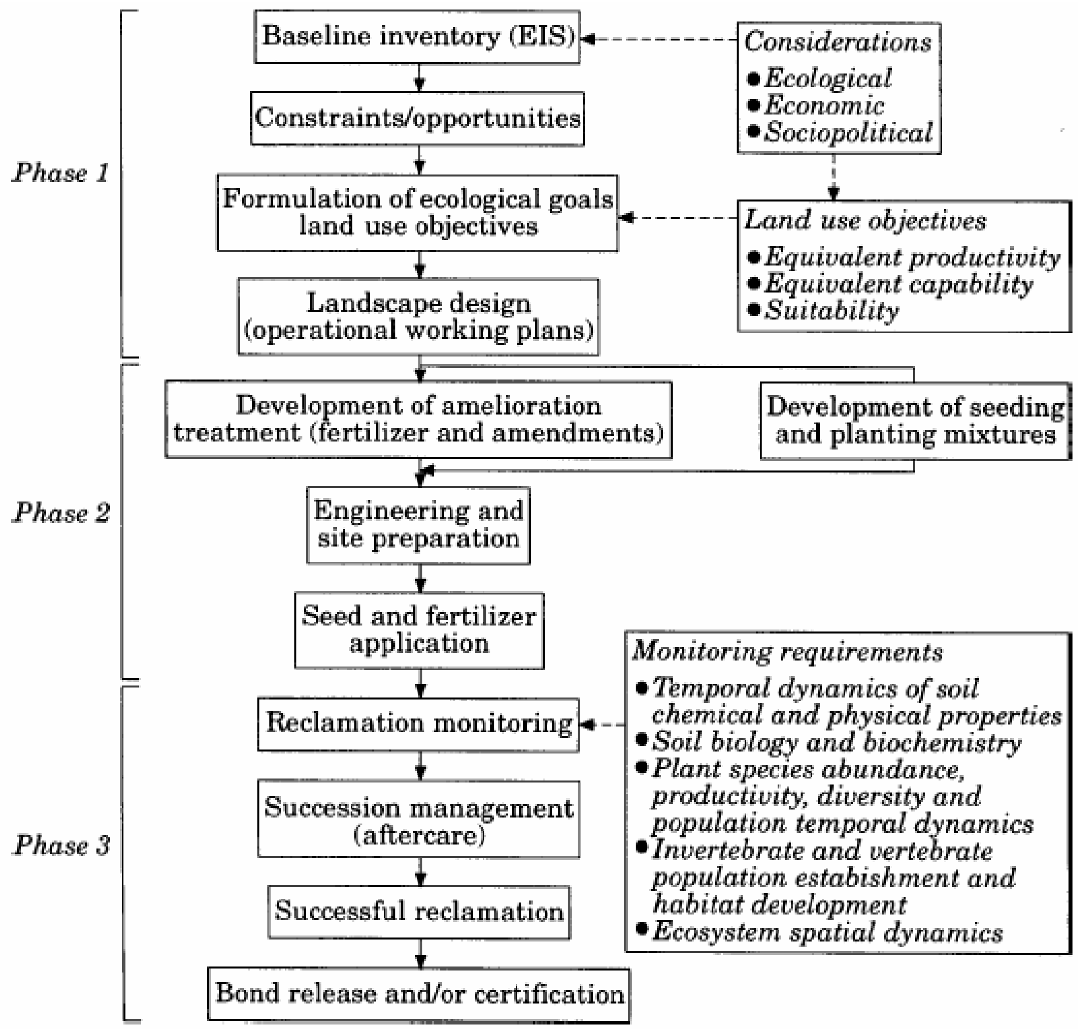

Figure 3-3 Reclamation planning, implementation, and performance monitoring up to the bond relinquishment stage (Smyth and Dearden, 1998).

Liability Insurance

Insurance amounts are estimated whereby the potential risk scenarios are considered in light of specific conditions, risk control measures (as proposed and undertaken by the operator),

Insurance is applicable where the relevant loss event satisfies the following:

- The event is accidental or unintentional.
- The event can only result in financial loss, never in gain.

- The loss is significant.
- The amount of loss can be determined.
- The insurer is capable of assuming the risk (Utkucu, 2004).

The insurance may cover

- the construction phase
- sudden and accidental pollution/discharges (operation phase)
- gradual pollution (environmental impairment) liability (operation phase) (Utkucu, 2004).

This estimation involves the scenarios which imply potential risk. Site-specific conditions, risk control measures as proposed and carried out by the operator, and the financial security for proposed reclamation and rehabilitation measures are considered.

CHAPTER IV

CASE STUDY: MINE RECLAMATION BONDING IN TURKEY

4.1. Necessity

The necessity for such a study arises from the lack of the necessary regulations and examples of practice in Turkey. The primary reason for the study was that a multinational mining company which wishes to apply to the World Bank or to apply the World Bank standards of environmental protection voluntarily was faced with a number of responsibilities. The World Bank, through its policy of support for environmentally and socially sustainable development, requires that those who seek credit or loans prove that their projects will not harm but in fact benefit the countries they work in economically, socially, and environmentally.

The said company had to prepare a reclamation report, an environmental management report, among other things, and to submit bonds to whichever appropriate authority. For this last item, a study had to be carried out. It was hoped that in the process there would be some learning for the parties involved.

4.2. Methods

In the quest for creating what would become a guideline for mine reclamation, environmental management planning, and mine reclamation bonding (also called “mine reclamation financial assurance”), steps were taken from the very basic to the very detailed. This process is detailed below in four steps:

Step 1: Category Formation

Step 2: Category Detailing

Step 3: Table Formation

Step 4: The Regulation

4.2.1. Step 1: Category Formation

Initially, the basic steps of reclamation were considered as outlined by Ünal (2004). These were:

Table 4--1 The Steps of Reclamation (Ünal, 2000).

STEPS OF RECLAMATION
1. Base-line study. 2. Preparation of reclamation plans, post-mining land use plans, and mine closure plans, together with mining plans. 3. Participation of the public and non-government organisations in meetings. 4. Preparation of environmental management plan (EMP). 5. Realization of reclamation unit operations integrated with mining operations. 6. Providing physical and chemical stability to the land. 7. Landscaping activities. 8. Revegetation. 9. Mine closure and abandonment. 10. Monitoring, control, and maintenance (throughout steps 4-9).

From these, the ones that would entail any costs to reclamation and environmental management projects were chosen to include the following:

Table 4-2 Steps of Reclamation That Entail Costs

Steps of Reclamation That Entail Costs
1. Land restoration. 2. Landscaping. 3. Revegetation. 4. Mine closure and abandonment. 5. Monitoring, control, and maintenance.

To these, a few more were added. Health and safety via the U.S. Bureau of Reclamation – Reclamation Health and Safety Standards (USBR-RSHS, 2002) was one of these. However, the sub-items taken were not from that source; it merely emphasised the importance of the issue of health and safety. Air and water management were decidedly better studied if a category on their own. Physical, chemical, and biological stability were also considered a category on their own. Finally, the concept of a baseline study was added to encompass the cost-entailing aspect of the EIA stage.

Thus the above table became such:

Table 4-3 Steps of Reclamation That Entail Costs - Extended

Steps of Reclamation That Entail Costs - Extended
1. Baseline study. 2. Health and safety. 3. Land restoration. 4. Air and water management. 5. Landscaping. 6. Physical, chemical, and biological stability. 7. Revegetation. 8. Mine closure and abandonment. 9. Monitoring, control, and maintenance.

A list of "provisions" was provided by the National Wildlife Federation (NWF, 2000: 305).

Table 4-4 Provisions provided by the National Wildlife Federation (NWF, 2000: 305).

A. Salvage, storage and replacement of topsoil or other acceptable growth medium.

B. Recontouring, stabilization and/or topsoil replacement of all disturbed areas.

C. Revegetation of all disturbed areas consistent with future use. Revegetation includes seedbed preparation, mulching, fertilizing, seeding and planting, and shall encourage the propagation of native species and selection. The plan must also include provisions for noxious weed control. At least three years, and up to 10 years, should be allowed for evaluation of revegetation prior to acceptance. Criteria with which to measure the success/failure of revegetation should be established.

D. Slope stability requirements, including maximum acceptable slope angles and achievement of erosion control, static and seismic stability.

E. Stream channel, stream bank and natural hydrologic flow restoration.

F. Measures to protect air and water resources by preventing discharges not meeting state and federal standards.

G. Requirements for geochemical modeling and AMD prediction and prevention.

H. Protection of public health and safety.

I. Protection of wildlife habitat and standards for habitat restoration.

J. Addressing aesthetic impacts, including visual impacts, on public, residential and natural (wilderness and other) areas.

These were redistributed among the categories previously itemised.

4.2.2. Step 2: Category Detailing

What operations these would include were detailed, in boxes x-y by use of the cited sources.

Table 4-5 Baseline study.

Baseline study
- flora and fauna: vegetation and wildlife (Marcus, 1997) - environmental risk assessment (Marcus, 1997) - land and geology: surface disturbance & topography (Marcus, 1997) - baseline ambient info: air, water, and soil (Marcus, 1997) - significant deterioration monitoring and/or prevention studies (Marcus, 1997) - socio-economics (Marcus, 1997) - cultural, historical, and archaeological assets/resources studies (Marcus, 1997) - noise (Marcus, 1997)

Table 4-6 Health and safety.

Health and safety - restricting public access - reclamation of tailings ponds - disposal of tailings pond sludge - reclamation of trenches, pits, and adits

Table 4-7 Land restoration.

Land restoration - topsoil handling (NWF, 2000: 305) - control of spoil heaps - backfilling - grading - recontouring, stabilization, and/or topsoil replacement - rehabilitation of pregnant, barren, intermediate solution, and storm ponds - protection of wildlife habitat and standards for habitat restoration

Table 4-8 Air and water management.

Air and water management
- stream channel, stream bank, and natural hydrologic flow restoration (NWF, 2000: 305) - preventing discharges not meeting state standards (NWF, 2000: 305)

Table 4-9 Physical, chemical, and biological stability.

Physical, chemical, and biological stability
- slope stability requirements - requirements for geochemical modeling - AMD prediction and prevention

Table 4-10 Revegetation

Revegetation - seedbed preparation - mulching - fertilizing - transplantation of plants - seeding and planting - irrigation

Table 4-11 Mine Closure and Abandonment

Mine Closure and Abandonment - site clearing - dismantling of buildings - ripping of roads - disposal of rubble - removal of fence marking overall project boundary - re-use of roads, some buildings, etc. (Utkucu, 2004)

The entirety of the items in reclamation cost estimation can be viewed as Appendices D and E.

4.2.3. Step 3: Table Formation

The compiled list of operations was spread onto a table. Each category had its sub-items cited individually. See Appendix E.

The sub-items were further detailed by year. A non-numerical example can be viewed as Appendix F.

The reason for the yearly details was because it was thought that it would be beneficial to see how reclamation costs peaked by year. Further down the road, however, it was reasoned that subjecting the Turkish developer under the economic circumstances of this country to the full cost of the risk of default would be extremely harsh (even if fair in other states) and certainly a disincentive to invest. A compromise had to be made so as to protect the environment whilst not making it impossible for the developer to invest and mine. Therefore, it was thought plausible to examine these graphs of yearly costs and draw the cost of the year with the highest corresponding reclamation cost to cover the reclamation cost of any year, including the costliest year. At the same time, to not compromise the environment in a situation where reclamation costs were seemingly homogeneously distributed by year, a minimum percentage was necessary. It has to be admitted that the percentage of the reclamation cost should be determined independently and that at this point it would be only arbitrarily chosen.

4.2.4. Step 4: The Regulation

The regulation has been covered in detail in the Chapter V.

CHAPTER V

REGULATION FOR THE RECLAMATION OF LAND AFFECTED BY MINES, QUARRIES, PITS, AND STORAGE FACILITIES

5.1. Introduction

In an unexpected turn of events, it was discovered that the Ministry of Environment and Forestry was seeking advice and consultation. The issue was a regulation concerning the reclamation of surface mines and other workings where soil removal was involved.

Prof. Ünal and the author were thus requested collaboration. A number of contributions were made during the review of the regulation. First and foremost, in the first article outlining the purpose of the regulation, the concept of a site being reclaimed to an economically and/or ecologically enhanced state was engrained. This concept is implicitly in line with that of sustainable development.

Some additional definitions, such as “reclamation” and “bonding” and the like, were supplied. The concept of environmental management was wholly newly introduced, as were the relationships between environmental management and the concepts of reclamation, bonding, and so on. There was some debate as to the ratios of the total reclamation cost to take as bond amount. Similarly, there was some contention as to whether the concept of a reclamation plan and/or report was encompassed under the umbrella of the environmental management plan or whether this should be taken separately. Whatever the eventual outcome is to be, whether the reclamation plan is considered one of a number of plans of environmental management (such as wildlife management plans; see Appendix G) or it is to be considered as a separate entity, whatever the regulators make of the concepts will be suited to their circumstances and their needs.

Finally, after some negotiation, it was decided that the permit to develop a mine be given after submission of a reclamation report and for the environmental management plan and corresponding bonds to be submitted in a year lest the developer run the risk of not having permits renewed.

5.2. The Regulation

The regulation at the time of writing comprises 23 articles in four sections. Some of the articles will be highlighted due to their significance and the contribution of Ünal and Toprak (2004).

Section I is concerned with the preamble: purpose, scope, and definitions.

> *Section I*
>
> *Purpose, Scope, and Definitions*
>
> *Purpose*
>
> *Article 1. The purpose of this regulation is to bring land despoiled by mining and quarrying, excavations done for the purpose of material and soil acquisition, and dumping and disposal of wastes to a state near, if not better than, pre-development, economically and/or ecologically; to provide for the appropriate restoration of the land during operational periods; to provide stability; to provide for suitable after-use planning; and to determine the managerial and technical principles and programs, monitoring methods, and legal provisions for the safe use of this land by humans and wildlife alike.*

The very definition of reclamation is inherent in **Article 1**, the statement of purpose; there is the aim to serve sustainable development by taking into account the rights of future generations.

> *Scope.*
>
> *Article 2. This regulation encompasses those activities whereby reclamation is carried out for the minimisation of adverse environmental impacts brought forth by underground and surface mining activities, quarries, and other large excavations made for the purpose of constructing other structures and the waste dumps thereof.*

It follows without saying that it is understood through **Article 2** that this regulation deals with not only mining activities but any other activity that might lead to scarification of the land.

Article 4 provided some definitions of such terms, most of which will be taking place in a regulation for the first time in Turkey's history:

Acid mine drainage
Bonding
Environmental impact assessment
Environmental management plan
Mine closure and abandonment
Mine reclamation
Monitoring
Public participation
Restoration
Revegetation

The above comprise the key definitions and concepts important in the matters of reclamation. "Bonding," "environmental management plan," "mine closure and abandonment," "monitoring," "restoration," and "revegetation" were the most important and novelty among these.

Article 5 capitalises on the responsibility of the developer to reclaim the site worked to a suitable after-use purpose. The last paragraph is of utmost importance in that it states:

> *Under no circumstances may the land's being arid, infertile, or other be demonstrated as a reason with which to excuse negligence in reclamation. All reclamation projects must aim to restore the land to a condition similar to or better than previous together with converging at approximate original contours.*

Although the ideal of approaching "approximate original contours" is more of an American practice than anything else (European standards are more flexible), it has been introduced a grain at a time into the regulation. Whether the principle will be embraced or not remains to be seen.

As for negligence in reclamation, it simply implies that walking away from a site is not to be tolerated. There are special situations where this can be accommodated for but these are rare cases.

Article 6 outlines the situations where reclamation is to take place. These are defined as those listed under Annex I of the EIA Regulation (corresponding to the EEC Directive) and those among Annex II industries to be screened and deemed appropriate for issuance of an environmental statement.

Article 9 lists the ten steps of reclamation. **Article 11** states that the submitted reclamation reports may not be altered; however, they may be revised as necessary due to changing conditions, etc. The same applies for environmental management plans, followed in **Article 12**.

Article 13 concerns bonding. Bonds are to be submitted prior to operations and as part of application. Initially, it was decided that the yearly amounts for reclamation would be considered individually and the highest amount for whichever year would be taken as the amount of bond to be submitted. This differs from international practices, of which there are many, where the method may be that the total reclamation cost amount can be taken. At times, the amount can be determined by acreage. It was later pondered on whether the practice of taking five-yearly amounts as bond amount would be fair and more appropriate upon revision of examples supplied by Utkucu (2004).

CHAPTER VI

Results, discussion, and recommendations

6.1. Results

1) The work and research carried out so far has gone beyond conducting a study for an M.Sc. Thesis and has culminated in input and contributions to a regulation in a country such as Turkey where many (certainly not all) concepts related to environmental protection are still in their inception.

2) In this study, efforts were made to establish the necessary processes, procedures, and mechanisms, emulating those of the more developed countries of the world to pave the way for a smooth implementation of the tools of environmental management and bonding.

3) The inclusion of environmental management planning in the said regulation is a first for Turkey within the scope of mining. This concept is in fact used in broader contexts outside of mining in the current.

4) Bonding cost items wrought for the case study and eventually also added to the draft regulation include those such as a baseline study, health and safety, land restoration, air and water management, landscaping, physical, chemical, and biological stability, revegetation, mine closure and abandonment, and monitoring, control, and maintenance.

5) The OSM (2000) has a procedure in bond calculation whereby direct reclamation costs are estimated along with indirect reclamation costs and adjustments for

inflation are made.Thus when reclamation bond calculation procedures were carried out within the scope of this study, direct reclamation costs and indirect reclamation costs were used. Indirect reclamation costs were added to the direct reclamation costs to bring the sum of the total reclamation cost by using a ratio of 25%. Indirect costs are usually taken between 15% to 30% “to internalise costs such as overhead and third-party costs” (Ferreira *et al.*, 2004); this study took the ratio at 25% to be “on the safe side.” This is yet another negotiable aspect of the study but only to the extent of changing the ratio of indirect, for unexpected costs will be paid by the taxpayer in the event the bonded amount is inadequate enough to accommodate default (NWF, 2000: 313).

6.2. Recommendations

1) At the time of writing, whether operations involving cyanide leaching or those operations that could potentially cause high amounts of acid mine drainage (AMD) should be given special provisions was being argued about. These would be such that if the common mine had to submit no less than, say, 35% of bonds, a mine which posed the abovementioned risks would be required to submit 50% of the expected reclamation cost. There exists practice where these types of operations are bonded at the full expected reclamation cost and not per acre (in Montana and Nevada; Gerard, 2000). It has been argued that measures of mitigation of circumstances which would bring about disasters involving cyanide or AMD are cheap to implement. The author is of the opinion that for the practice of requiring full reclamation cost in some states with reputations for disaster, there must be a history and plenty of experience for these decisions to have been made. The preference of full reclamation cost over acreage is an indicator that cost risks upon default posed by these sites can be greater than their acreage bonding. The issue would not be one of how cheap it would be to mitigate the effects but how expensive repairing damage would be for the taxpayer by the time the authorities were able to intervene in the event of default, especially if they were quite lacking of the necessary funds. At the very least, in principle, however small, there should be a different standard so that it is easier to adjust this standard in an amendment to

the regulation rather than struggling to bring it in at a later date if need for such arises with time and experience.

2) It is important for a country wishing to develop yet prove like other countries have that environmental protection is not a “luxury” (Yandle et al., 2004) (that only the wealthy states of the West would be able to afford) to establish the necessary processes, procedures, and mechanisms, emulating those of the more developed countries in the world, to pave the way for a smooth implementation of the tools of environmental management, bonding, and the like so that these processes are not viewed by developers as “anti-development” (Pritchard, 1994) and bureaucratic obstacles. Bonding mechanisms for industries that require them should also be established.

3) There is apprehension as to whether the mechanism of bonding is at all legal within the laws and regulations of the Turkish state. What concepts bonding might be adapted to have yet to be explored as it seems next to impossible to shift around statutes to accommodate for this practice. Because this issue is almost entirely bureaucratic, it has not been delved into in this dissertation. The necessary reforms should be speedily carried out as soon as possible. It is of paramount importance to solve the issue of statutes and obstacles that hinder the establishment of the bonding mechanism. This is bound to be a degree more difficult than merely passing a regulation.

4) Adjustment to inflation as suggested by OSM (2000) was not included. It would be recommended that these be included in future revisions and amendments to the regulation. It would facilitate matters to make the calculations with the use of a major foreign currency and to establish the inflation rates thereafter.

5) Gerard (2000) ponders on whether time will show bonding for other issues such as water quality, air quality, and other environmental performance standards as well. For now, the scope of bonding is limited because the mechanism of bonding relies on a number of conditions for success. These were discussed *infra* in Chapter 3. If speedy research regarding bonding so that to implement the principles in the

Turkish system of laws and regulations are carried out, it could be recommended that bonding for these issues be also researched. It could be possible to get ahead of other countries and present an example to the world if this momentum is made good use of.

6) One issue not kept in mind at the time was that some mines operate for very long periods of time. Some mines are reputed to work for many decades, such as the Bell Island metals mines in Canada and others. As such, it is difficult to project beyond a certain number of years what circumstances would change the initially conceived reclamation and environmental management plans, making bonding for, say, half a century cumbersome if not ludicrous and very burdensome on the company. Therefore, a limit should be agreed to so that at certain intervals the management plans would be updated.

7) The authorities and bodies in charge of reviewing the bonds should be determined, and not only of bonds but also all the other reports and plans. These could be carried out in a fashion similar to that of the Review and Assessment Commissions as with the EIA reports.

8) The whole model of reclamation and closure bonding must be defined with respect to responsible government bodies, exemptions to bonding, size limitations, bonding requirements (with special reference to operations involving cyanide, other toxic chemicals, etc.), accepted financial assurance forms, review periods for bonds and environmental management plans, and the like.

9) The option of leaving workings as-is as a reclamation scheme should not be ruled out, so long as this does not provide grounds for abuse of this flexibility. Mention of the suitability of such (abandoning without amelioration) in certain cases is mentioned in literature (Binks, 1987; Coffey, 2000; Hourican, 1986). Likewise, it should be expressly stated to what degree a site that is planned on being reworked is to be restored to with respect to its previous (i.e. in a situation where a mine abandoned in the pre-legislation days is going to be re-exploited due to renewed feasibility).

10) In the reclamation cost items and the corresponding table, labour cost, maintenance costs of equipment and the costs of running the equipment, etc., have not been explicitly itemised. It would be recommended that these factors be stated explicitly rather than being incorporated into costs of other items and categories.

11) In the greater scheme of things, such as the world platform, there could perhaps arise a situation where the costs of environmental responsibilities make surface mining less preferable than underground mining which entails less responsibilities and costs. Whether it is possible to postulate a mechanism whereby the necessary calculations could be conducted efficiently, at least for some categories of mines, could be looked into.

12) Along the lines that Erten (1996) suggested, the industry should cooperate, pro-actively, with the government, decision-makers, and public in the establishment of "equitable, cost-effective and realistic laws for the protection of the environment" (Erten, 1996).

13) The author in her turn would like to explore the possibility of suggesting a Ph.D. proposal of applying what Jay (1999) studied in his dissertation, The Application of Environmental Impact Assessment to Land Reclamation Practice, to a site being reclaimed in Turkey to assess whether this could successfully become an integral and very functional part of environmental management if not merely an aide to it. Alternately, a study of slope stability issues with the use of several models (such as RUSLE) in line with those carried out by Nicolau (2003) and Dabney *et al.* (1999).

14) Whatever the stage of abandonment of a mine by a defaulting developer, the closure costs, which cannot be belittled, will be there. That is, whether a mine is operated halfway or three quarters of its life, regardless of what reclamation has been carried out and what remains, the closure and abandonment costs of the reclamation process will remain static (Utkucu, 2004). Therefore, they should be considered for all years and added to calculation amounts as such to cover the

reclamation costs for not only the yearly (or five-yearly) program but also the ultimate closure and abandonment.

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Appendix A.

Additional Literature Review

A.1. Impact of Human Activities

A.1.1. The Concept of Environment

The Stockholm Conference of 1972 had issued a Declaration, of which Principle I said that humans have a “fundamental right to freedom, equality, and adequate conditions of life, in an environment of quality that permits a life of dignity and well-being, and [they] bear a solemn responsibility to protect and improve the environment for present and future generations” (Schofield, 1999).

According to the Encyclopaedia Britannica, the environment is “the complex of physical, chemical, and biotic factors that act upon an organism or an ecological community and ultimately determine its form and survival.” (Encyclopaedia Britannica, 15th edition, vol.4, p. 512:1a) Here, “ecology” includes the biosphere, geosphere, hydrosphere, and atmosphere (Nicholson, 1988).

The concept of environment, for practical purposes, can go beyond pristine wilderness and also embody cultural landscapes which through human activity have been significantly altered but are nevertheless seen as an integral part of the environment where human settlement exists. Examples to such can be open ditches and remnant biotopes in Denmark, hedgerows dividing farm borders in the UK, and the “bocage” in France (Dramstad *et al.*, 2002).

It is this intangibility and all-encompassing nature of what an environment is that makes it just about impossible to deal with environmental issues in the capacity of a regulator. In fact, this also means that a certain availability of uncertainty with reference to the environmental consequences of human actions makes it not an easy task to determine, for example, tax levels for a projected national environmental objective where there is one, all the while under pressure from the relevant sectors to not curb international competitiveness (Turner *et al.*, 1998). Some go further to claim that the environment is priceless, as Pani (2000) attests to: "Some people hold that the value of life, diversity of wildlife and beauty of landscape should not be measured in monetary terms." Kobus (1992) seconds this in the context of environmental impact assessment, where he capitalises on the fact that not everything (such as visual impact, damage to ecosystems, etc.) can be assigned a value for assessment and comparison. However, in the paragraph preceding those words, Pani also says, "Putting a monetary value on environmental damage is necessary, as the environment is not an infinite resource; this fact becomes important in the situation where projects are making substantial claims on the environment." Ferreira *et al.* (2004) consolidate this by stating that it is "not always possible to calculate the total monetary value of complex non-market goods such as ecosystem functions and services, though many methodologies currently exist to calculate partial values."

A.1.2. Impacts on Environment

All human activities, from hunting and fishing to construction and settlement to agriculture and mining to war and conflict have impacts on the environment. This in turn translates into biodiversity loss. Some activities result in some form of habitat conversion if not annihilation of living forms and this affects ecosystems profoundly. More important than the loss of this gene pool, and consequently genetic information, is the relationship between loss in biodiversity and the decline of ecosystem resilience (Batabyal, 2000) so that to tackle the issue soon enough. Ecologists and economists alike, in the hope of finding guidelines to cut down on this loss and preserve what currently exists of biodiversity, study the issue to valuate and measure biodiversity and determine the exact causes for this loss in biodiversity.

Due to the scope of this dissertation, it will be the impacts of human activities, specifically industry, and, even further, the mining industry that will be dwelt upon, and issues such as ecocide, eco-terror (environmental terrorism), and the like (Beltran, 2002; Schofield, 1999), which involve malice rather than consequence of everyday human industrial activities, will be left out, as will accidents, characterised by such examples as the Vajont dam failure, Aberfan disaster (1966) (Haigh, 1993), and Chernobyl nuclear power plant disaster in1986. Nevertheless, it is beneficial to initially get acquainted with the bigger picture.

Most of the impacts on the environment can be interpreted in one way or another as resource degradation. Without reference to any specific activity or industry, Batabyal (2000) cites Gadgil, that biodiversity loss is closely linked with "the ever-growing resource demands of [citizens of the First World and the Third World elite]… and their willingness to permit resource degradation in tracts outside their domain of concern." Regarding resource use, Diduck (1999) says,

"It is reasonable to expect fair-minded people to disagree on the nature of current patterns of resource use. As Orr (1994) commented, an economist will likely perceive different aspects of reality when observing the state of interactions between human and natural ecosystems. Placing faith in technological substitution, the economist (at least of the neoclassical variety) may see unlimited potential for economic growth. The ecologist, relying on systems thinking, knowledge of thermodynamics and a sense of place in the ecosystem, may see an entirely different picture, one of unsustainable resource exploitation, climate change, fragile ecosystems and alienation between humans and nature."

American President Theodore Roosevelt stated in a White House Conference on Conservation in 1908,

"We have become great in a material sense because of the lavish use of our resources, and we have just reason to be proud of our growth. But the time has come to inquire seriously what will happen when our forests are gone . . . when the soils shall have been further impoverished and washed into streams . . . . These questions do not relate only to the next century or to the next generation. One distinguishing characteristic of really civilized men is foresight . . . and if we do not exercise that foresight, dark will be the future." (In Robinson, 1992)

Environmental degradation is also being tried to be explained by what is called the Environmental Kuznets Curve (hereafter EKC). Although Kuznets had deceased in 1985, by the 1990's, his theories in economics were beginning to be adapted to studies in environmental degradation, most notably the trends exemplified in the Kuznets Curve which earned him a Nobel prize in economics in 1971. This curve was bell-shaped and postulated that in a country or community, low levels of per capita income brought about high levels of inequality, and with rising income came lower levels of inequality. The modified Kuznets Curve (Figure A-1) hypothesised that with lower levels of per capita income on the rise came greater levels of environmental degradation, until this trend of degradation peaked and finally began to subside as environmental protection was no longer considered a "luxury" but a common "good" (Yandle *et al.*, 2004). This of course deals entirely with the economics and has little to do with community awareness, another important factor in environmental protection.

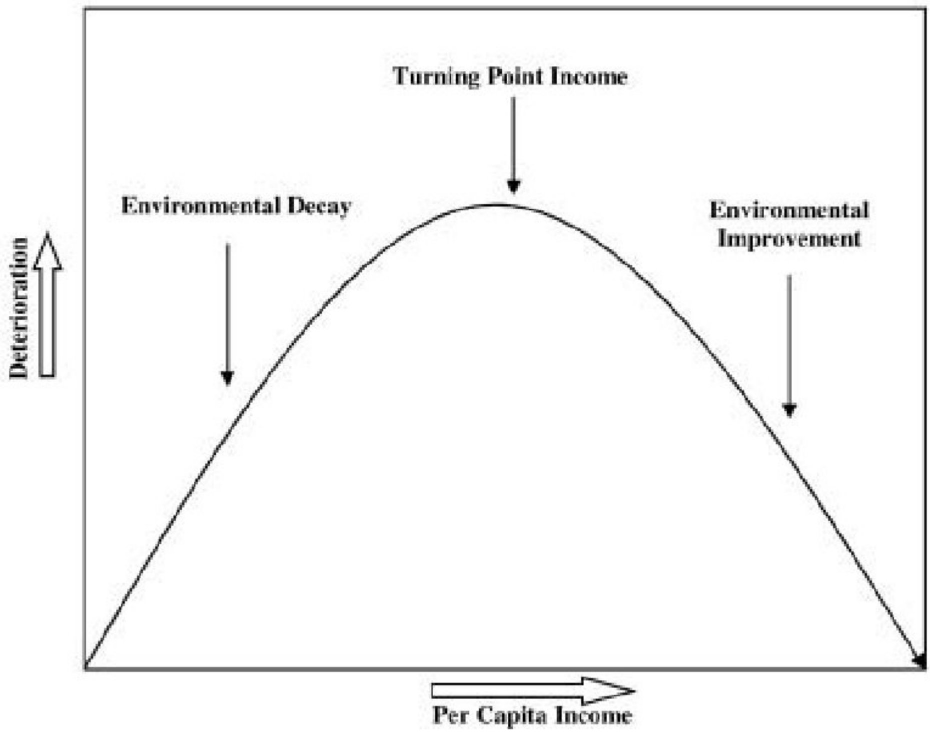

Figure A-1 The Environmental Kuznets Curve (Yandle et al., 2004).

In this light, one of the most popular topics among lay environmentalists and certainly of television broadcasts across the world is the plight of the tropical rainforests. Rainforests suffer from a number of human activities that "collectively result in the conversion of approximately 200,000 km^2 of primary forest every year." (Batabyal, 2000) While fuelwood gathering for local needs is one of them, it pales in comparison with commercial logging, some if not most of it carried out illegally for illegal exports of timber. The most well-known of these activities to hit headlines has been the illegal logging of mahogany for export across the world, especially to the U.S. (GreenPeace, 2001). Once again, although also for domestic use, cattle raising and forest farming take their toll, as soya (UBC, 2004) and cattle for fast-food restaurants in North America and Europe, take the lead in this aspect of rainforest conversion. Surprisingly it has recently been established that rainforest conversion in the Amazon (through forest burning to clear land for agriculture in particular) results in greater adverse effects via greenhouse gas emissions than the widely-believed benefits of being the "lungs of the world," putting Brazil among the top ten polluters in the world (Reuters, 2004). The forests of West Africa, the Greater Antilles, India, Madagascar, the Phillipines, and Atlantic Brazil today are, area-wise, less than 10% of what they used to cover, it being estimated that these forests will survive only another 35-40 years, leaving behind only the protected areas (national parks and such) because the process is not slowing down and in fact the rate of forest conversion is actually escalating (Batabyal, 2000). Lomborg (in Vaknin, 4 June, 2003) however claims the opposite regarding rate of tropical deforestation.

A totally random and equally unlikely to be considered example from Turkey (where it is erosion of Anatolia that catches the headlines) is the result of the Tea Law of 1940. What began as a government incentive to encourage terracing for growth and harvest of tea plants for the benefit and welfare of the population of the region has resulted over the years in a retreating of forests in to higher altitudes in the eastern Black Sea coast in northern Turkey and also much loss of life and property as a result of erosion, floods, landslides, and avalanches (Günay, 2003).

The pros and cons of all activities and industries have to be juggled and considered together, for, just as they are for our benefit, so is guardianship of a safe environment in which to live (Coffey, 2000). George Orwell, characterises a town of his times (in Binks, 1987),

“In a crowded dirty little county like ours, one takes defilement almost for granted. Slag heaps and chimneys seem a more normal, probable landscape than grass or trees.” The Road to Wigan Pier (1937)

For example, in the case of agriculture, it impacts on waterways, lakes, and aquifers (Önal *et al.*, 1998). Still, an agricultural landscape is a function of many factors, those including environmental, technological, economic, and socio-cultural factors, followed by scientific development, and state policies – agricultural or environmental – all of which “influence farm management choices.” An agricultural landscape, although it, too, is an alteration from natural wilderness, harbours high species diversity as an outcome of certain endemic, or environmental, factors, coupled with the way the land is managed, also concerning the "cultural and historic interest, and the scenic and recreational qualities of the cultural landscape." It follows that a change, whose variables are space and time, in the landscape is appreciated in these terms as well, being in content or in structure, acting upon fauna, flora, thermodynamics within the system, and the perception and accessibility to that landscape (Dramstad *et al.*, 2002). Dramstad *et al.* (2002) tell that in a developed country such as Norway, it being the case that changes in agricultural landscape concern large portions of the population, there may be effected problems upon planning and management.

This is not to say that agriculture as an industry should be abandoned, for it is a vital activity for the human species and, ironically, despite its impacts on the environment from one point of view, it has been determined to give allowance to some species in facilitating their comeback, as was observed with skylarks in the U.K., where populations increased after patches of uncultivated land in between plots were encouraged (ENN, 2004). This merely demonstrates that planning and design can create significant difference without compromising human interests.

Any activity or any project can have a number of impacts on the environment, in dimension, in stages, etc. Ferreira *et al.* (2004) itemise all forms of damage that can be inflicted to the environment by the petroleum sector, on land or on sea (on off-shore installations), as ex post, accidental, and continuous. Accidental damages are those that cannot be predicted, and risk levels are only so reliable as the applicable statistical data; continuous damages would be those that take place during operations, impacting on the media and on land, as well as on wildlife and human communities and which are expected; and ex post damages are the end result of the activities and it is these activities that will require mitigation, reclamation, etc. (Ferreira *et al.*, 2004). Figure A-2 exemplifies a common oil project in terms of its life, phases, and areas for environmental concern.

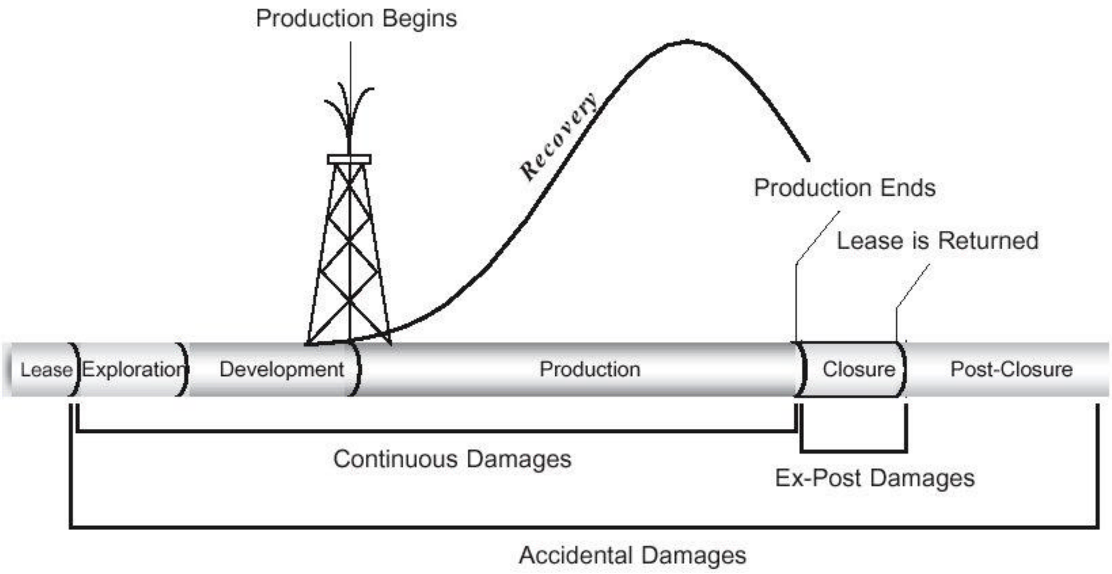

Figure A-2 An oil project in terms of its life, phases, and areas for environmental concern (Source: Ferreira et al., 2004).

A.1.3. Derelict Land

Graham Moss (in Binks, 1987) states that there are "five main forms of wasteland":

1. underused,
2. idle/dormant,
3. derelict,
4. despoiled, and
5. operational.

What concerns the scope of this thesis is land laid derelict by mining activities. The official approach of the U.K. government to the issue was that of derelict land being a "disincentive to invest" and not only that but that the dereliction could speed up emigration (Binks, 1987). The UK definition of derelict land came about in the 1940's, as:

"Land which has been so damaged by extractive or other industrial processes or by any form of urban development, that in default of special action it is unlikely to be used again within a reasonable time, and may well be a public nuisance in the meantime." (Baines, 1983, in Hourican, 1986)

This definition was revamped in the 1960's to say:

"Land so damaged by industrial and other development that it is incapable of beneficial use without further treatment." (Barr, 1969, in Hourican, 1986)

There is also a 1974 definition of dereliction by the Mineral Workings' "Survey of Derelict and Despoiled Land in England" (in McKone, 1982), namely where are itemised "operational land, abandoned spoil heaps, excavations and other land associated with these types of activities and including land so damaged by industrial or other development that it is incapable of beneficial use without treatment."

It was to be noted, however, that dereliction was a dynamic actuality inasmuch as much of what existed today was really a legacy from earlier years. This continuity is demonstrated:

"So we have inherited a legacy of dereliction to add to the dereliction we are devising at the moment, and the still greater dereliction we shall invent in the future." (Derelict Land Act, 1982, in Hourican, 1986)

It is also important to define dereliction satisfactorily, for if the definition is conducted too narrowly, it is possible that the official size (scale) of dereliction will be seemingly less. In the words of McKone (1982), "at the official level the definition has been used as a political football."

The main causes of dereliction can be listed as follows:

- Mineral extraction of all sorts (Binks, 1987);
- Industrial activity (Binks, 1987);
- Government policies (Binks, 1987);
- Planning authorities (Binks, 1987);

- Statutory undertakers (Binks, 1987);
- Property market (Binks, 1987);
- Dumping of solid waste by the industry (Hourican, 1986);
- Abandonment of industrial buildings which cannot be re-used for other purposes as they are mostly very narrowly focused in design, purpose, and construction (Hourican, 1986); and
- Military land (Binks, 1987; Hourican, 1986).

It would seem curious that radioactive waste dumps are not mentioned, for it is known that they can cover vast areas, such as 55 square kilometres in the Koskhar-Ata waste dump in Kazakhstan, which obviously not only threatens the health of nearby populations with the radioactive dust but also lays the land derelict (IRIN, 2003) or the millions of hectares of agricultural lands and forest areas in the Ukraine as a result of Chernobyl (Scherbak, 1992).

Although the data pertaining is over two decades old, the following Table A-1 is very explanatory:

Table A-1 Amount of reclamation, by category, 1974-1982 (England) (Derelict Land Survey, 1982, in Hourican, 1986)

Category of Dereliction	Hectares		
	Total Derelict Land 1974	Total Restored 1974 – 1982	Total Derelict Land 1982
Spoil heaps	9,084	6,124	13,340
Excavation and pits	6,596	2,806	8,578
Military dereliction	3,145	1,547	3,016
Derelict railway Land	6,412	1,996	8,210
Other forms of dereliction	7,831	4,479	12,539
Total for England	33,068	16,952	45,683

There can be several forms of derelict land. Solid waste can come in the form of spoil heaps, ranging from "low wide mounds" to heaps as high as 50 metres at times. The problem they pose is that they constitute visual conflict with the rest of the landscape, but, more importantly, they may pose potential hazards to health and safety due to physical, as well as biological and chemical, instability, which may reduce the land to one which is sterile and, in Binks' words, ecologically inhospitable (Binks, 1987). Former mineral workings, too, can entail physical instability, resulting in subsidence of underground mine workings whereby "flash lakes" (Binks, 1987) can be formed. Although they do not produce as much waste as some activities, quarries and surface mines will be very much in conflict with the rest of the landscape. Smelting facilities will produce large heaps of slag, sterile for any vegetation whatsoever (Binks, 1987). Although not visited and/or examined by the author, the slag heaps of decades of gold mining in Iliç in the province of Erzincan, Turkey, are reputed to still be visibly barren today per what was related in 2002.

Industrial activity can sometimes end in factory closures due to economic reasons as well as relocation by government incentive or other (Binks, 1987). This will mean that some structures will be abandoned for their total uselessness and will fall into disrepair.

Specific to the UK, likewise, with government incentive or not, there can be periods of decentralisation of cities, resulting in the collapse of downtown city centres. The same property market will get derelict land to be maintained as it is, as land that has to be cleaned and/or treated is seen as a blight and is not deemed attractive for development. Small urban sites, even those such as undeveloped plots of land sandwiched in between buildings (Binks, 1987) and other plots of specific purpose and cultural texture, will be difficult to make use of, and, even where purpose would be specified, it would be possible that getting permits would be a difficulty. There are also the cases where railway installations (since the 1960's) and docklands and canals (with the advent of containerised freight) are abandoned due to obsolescence (Binks, 1987; Hourican, 1986). Railway lines and canals are "linear" and this makes them difficult to reclaim (Binks, 1987).

In the case of dereliction as a result of mineral extraction, the distinction between past dereliction and current dereliction should be acknowledged (McKone, 1982). For dereliction from the past, one could count dereliction that is a legacy of pre-legislation times and perhaps also that which has occurred post-legislation when restoration by the operator was not accomplished for a number of reasons and which has effectively necessitated restoration by public effort (with donations, grants, etc.). Current dereliction by mining activities is that which will have taken place recently and that which can take place in the future (McKone, 1982). (These will in further sections explain the need for bonding mechanisms.) The benefits of exploiting a resource (in this case underground/mineral resources) have to be weighed against the environment that surrounds these resources and the damage that will be visited upon them (Coffey, 2000).

A.1.4. Regulations and Standards Concerning Environmental Protection

Public perception affects public participation and public roles in environmental protection or the calls for regulations and standards concerning such; thus, it should be encouraged rather than allowing for anti-technology mobilisation or smear campaigns to take place later, just as environmental impact assessment (to be covered later) lays the basis for such. The history of regulations concerning the environment date back about a century, but the key ones would be the 1951 Code of Restoration Practice in the U.K., 1958 Opencast Coal Act (U.K.), 1967 Pollution Control Act (Japan), 1969 National Environmental Policy Act (U.S.A.) and Environmental Protection Act (Sweden), and similar in 1974 in Australia, 1986 in the Netherlands, 1988 in the UK, and Federal Environmental Impact Assessment Act in Germany in 1990, to name a few (Haigh, 1993).

Environmentalism can be said to have been officially recognised in 1970, when the first Earth Day was held in the U.S.A. on April 22 (Beltran, 2002). Beltran (2002) states:

“As the environmental movement flourished, environmentalists began using litigation and lobbying techniques to promote the protection of the environment. The increased significance of litigation and lobbying to enforce environmental legislation spurred the growth of environmental organisations and their memberships.”

Although this was not as true in the case of the former USSR where it was not publicly revealed until the beginning of the 1990’s how drastic the environmental conditions of the union were (Goldman, 1992; Scherbak, 1992), concern is such in most ex-Soviet states that environmentalists coordinate international efforts, as pollution respects no boundaries and can essentially be trans-boundary (Goldman, 1992), affecting a whole geography of countries. As far as public awareness is concerned, there can be awareness of a problem only if there is some information about the situation at hand (Hourican, 1986). It certainly makes a difference, as Schofield (1999) argues that today transgressions against the environment have come to be viewed as a traditional crime by the layperson rather than the mere regulatory violation that they are.

It is important to keep things in perspective in that there has to be not just trust but rigour in approaches to problems. For example, on the issue of environmental taxes, Turner *et al.* (1998) say, “Consumer groups have recently become antagonistic towards, and suspicious of, Governments’ real intentions as more green taxes have been introduced. These groups seem to believe that revenue generation is the dominant motivation behind such policy switches and that consumers are unfairly being made to pay. They argue that such economic (market) instruments are not ‘proper alternatives to strong environmental regulations enforced by law and that they should only be imposed on firms, who are after all responsible for the design and production of materials and energy intensive products which eventually require costly disposal.’ There is a moral tone to this perspective which is supported by a perception that prices and markets somehow symbolise greed and exclusion.” The authors add hence the rigour in decreasing levels of taxes on “desired activities” (unobjectionable activities) whilst increasing those on “undesired activities” (such as those that cause pollution or depletion of a resource, renewable or nonrenewable) needs to be done wisely (in the words of the authors, should not be “ill-conceived”).

It is possible to go farther by pointing out that this mistrust on the part of the public leads to or stems from two misconceptions, namely that firms will make consumers pay for the extra cost of taxes (by heaving the burden onto them) and that economic instruments cannot replace regulation (Turner *et al.*, 1998). The authors continue to examine static cost minimisation benefits vs. dynamic incentive benefits.

Standards

Before looking into the broader range of regulations, it might be beneficial to look at standards, prime among which are the ISO 14000 family of standards. Environmental management plans can be carried out in line with environmental management systems such as ISO 14001 (ISO, 2002). The ISO 14000 Family of Standards is tabulated below in Table A-2:

Table A-2 ISO 14000 Family of Standards (Jensen, 2002; ISO, 2002).

ISO 14000 Family of Standards	
GROUP	STANDARDS
Environmental Management Systems	ISO 14001 ISO 14004 ISO/TR 14061 ISO 14063
Environmental Auditing	ISO 14010 ISO 14011 ISO 14012 ISO 14015 ISO 19011
Environmental labelling	ISO 14020 ISO 14021 ISO 14024 ISO/TR 14025
Environmental Performance Evaluation	ISO 14031 ISO/TR 14032
Life Cycle Assessment	ISO 14040 ISO 14041 ISO 14042 ISO 14043 ISO/TR 14047 ISO/TS 14048 ISO/TR 14049
Environmental Management Vocabulary	ISO 14050
Environmental Aspects in Product Standards	ISO/TR 14062 ISO 14064 ISO Guide 64

Kwon *et al.* (2002) say of the ISO 14001,

"The elements of the ISO 14001 are set within the context of 'continual improvement.' Such a system is not static,[sic] but must respond to meet changes in company operations and management strategies. The ISO 14001 model is built on the cycle of 'Plan-Do-Check-Act' to ensure that environmental issues are systematically identified, controlled, and monitored. This model has foundations in Total Quality Management principles since improving environmental management requires the company to focus on 'why' things happen in addition to 'what' happens. Thus, ISO 14001 is a 'process' standard, not a 'performance' standard. In other words, the standard does not tell companies what level of environmental performance they must achieve. Instead, it provides a framework that will help a company achieve its own objectives and targets over time. Another important concept is that better management leads to better environmental performance, which is an important objective."

The management system of the ISO 14001 standards is carried out in five stages: policy, planning, implementation and operation, inspection and corrective activities, and review by management (Kwon *et al*., 2002). This is very similar to the plan-do-check-act (PDCA) cycle, otherwise known as the Deming cycle in Total Quality Management. Environmental policy achieves this aim through objectives, targets, and environmental programs (Kwon *et al*., 2002). Planning analyses the environmental aspects of the organisation in terms of the processes, products, goods, and services in use by the organisation (Kwon *et al*., 2002). The implementation and organisation of processes aim to control and improve operational activities which would be crucial from an environmental perspective (Kwon *et al*., 2002). Checking so that to implement corrective action such as monitoring, measurement, recording of the characteristics and activities that have an important impact on the environment follows (Kwon *et al*., 2002). A final approval by the top layer of management ensues (Kwon *et al*., 2002).

Implementing ISO 14000 can be rewarding. Customer demand, national environmental regulations, demonstration of conformity to legislation, and reduced costs of implementing mandatory environmental standards are incentives to endeavour for industrial environmental certification (Kwon *et al*., 2002). In fact, Schaltegger and Synnestvedt (2002), while admitting that there is much controversy as to whether environmental protection is just costly for firms or whether this advantages them in the long run, claim that the latter (namely, there being long-term advantages) holds true most of the time, as there ought to be rewards for environmental protection and bad environmental performance brings about no gains. The issue is in the spotlight, so much so that environmental performance influences the economic success of a firm through costs and income (revenue) (Schaltegger and Synnestvedt, 2002). It has been observed that the ISO 14000 series advantages implementers with cost cuts (Szwilski, 2000). On the other hand it is also true that it is the wealthy that will be able to most generously afford being able to perk environmental performance (Schaltegger and Synnestvedt, 2002). Nevertheless, they continue to say:

"However, these direct links do not seem to exist in practice nor do they stand up to more thorough theoretical analysis. From a management perspective there is no natural or mechanical law automatically linking environmental with economic performance. One might argue that in some cases regulations might create obvious links between environmental and economic performance. This may hold true in specific cases where the regulatory tolls give strong economic incentives for continuous improvements in environmental performance. The question to what extent environmental protection activities result in an improvement of the economic success depends on a variety of factors such as consumers' willingness to pay for environmentally friendly goods in a given market, the kind of environmental and health regulations in a country, the stakeholder pressure in different industries, the level of technological development, etc. Furthermore, environmental issues must be of a certain, maybe even major, financial importance to have some impact on the company's economic performance. In addition, the company must face some degree of competition in the market because otherwise economically inefficient behaviour does not necessarily have a measurable impact on the profit."

In Figure A-3, at ES*, the optimal level of environmental performance may result in the greatest economic success at lowest costs. This is an idealised curve, as,

"In reality, the described functions may not be as smooth as shown in our model. Fixed costs of environmental protection, for example costs induced to establish and environmental management system would cause 'steps' in the cost function. The same may occur for the revenues, for example due to sudden shifts in demand when passing a threshold value for environmental performance (e.g. due to image gains, certification or product labels, etc.)." (Schaltegger and Synnestvedt, 2002)

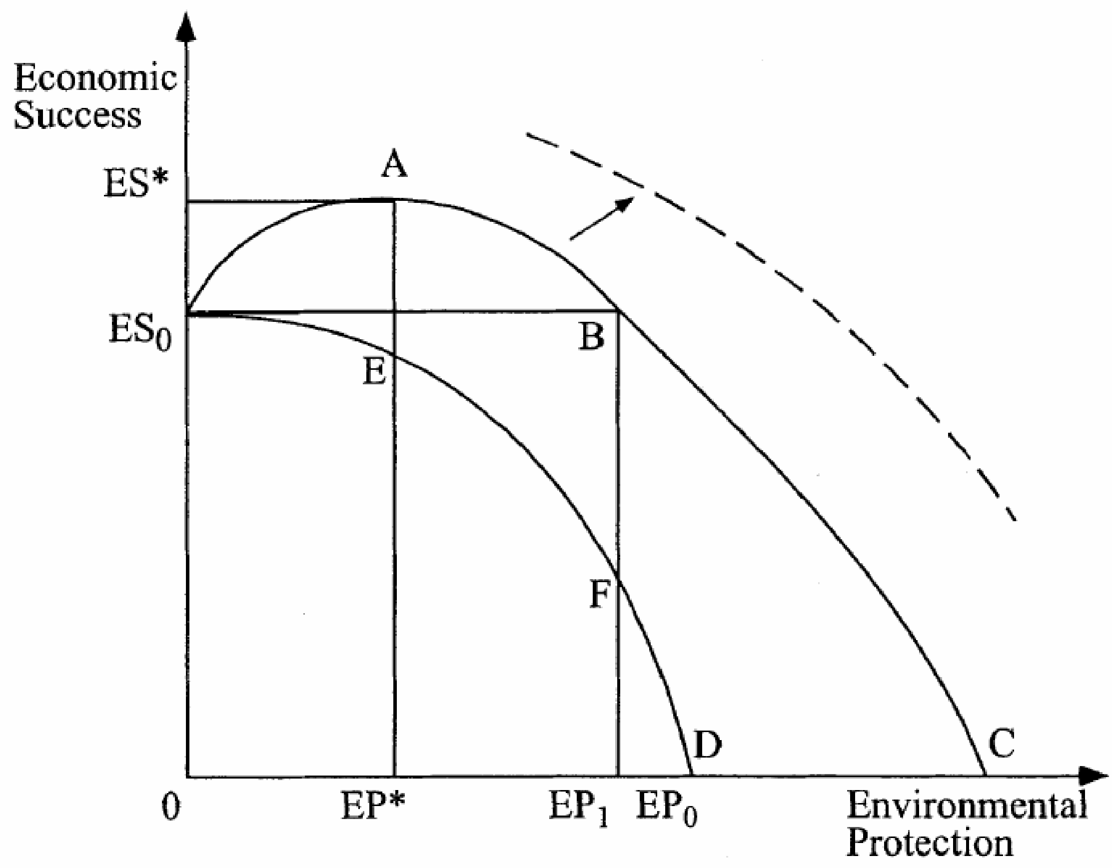

Figure A-3 Possible relations between corporate environmental protection and economic success (Schaltegger and Synnestvedt, 2002).

Moreover, the curve in the figure might approximate the dashed one, that is, shift to the right, when, with the advent of environmentally friendly technological developments, marginal costs of environmental protection may be reduced, the market gains of good environmental performance may be increased by changes in consumer preferences, good environmental performance may be rewarded by regulatory changes, etc. (Schaltegger and Synnestvedt, 2002).

Instruments

Ferreira *et al.* (2004) say of environmental regulations sporadically coming through in certain countries, "Owing to the evolution of social consciousness and pressure from interest groups, regulators are being compelled to establish stringent environmental policy requirements, including incentive mechanisms aimed at safeguarding society against environmental degradation and related financial liabilities." That is one aspect, whereas punishment is another. More often than not, environmental statutes, albeit equipped with provisions for criminal punishment, consider trespassing against the environment as offences rather than crimes (Schofield, 1999).

The United States has had experience with environmental protection since the nineteenth century and today is at the forefront in this area while international bodies have furthered the laws they feel necessary to protect the environment, an example of this initiative being the foundation of the United Nations Environmental Program (UNEP) on the principles outlined in the Stockholm Conference (1972), although, on a national level, many countries (especially developing countries) have yet to catch up (Schofield, 1999). Environmental regulations' onset has resulted, eventually, in changes in business culture of firms (Johnson, 1992) and has brought on the concept of "internal monitoring."

Combating environmental degradation can take on several forms. In the case of hapless habitat conversion, it need be not only regulations but also certain actions that should get ahead of environmental degradation. For example, the Corbett National Park (India), Pico da Neblina National Park (Brazil), and the Sierra Nevada National Park (Colombia) are prime examples of stopping habitat conversion. These are the outcomes of actions on the part of the social planner (Batabyal, 2000).

Combating pollution and resource degradation requires environmental policy. In the lives of the individual citizens, this is usually observed as duty differential between leaded and unleaded petrol, a recycling credit system, landfill tax, and such. In the E.U. and in North America, the combined use of fiscal instruments and regulations is utilized. The U.K., within the E.U., however, lags behind in this area somewhat (Turner *et al.*, 1998).

The individual Turkish citizen, despite the regulations aiming to increase recycling/re-use of materials and reduce solid-waste disposal, does not have access to or the benefit of solid waste management programs in at least 20% of 3215 municipalities across Turkey, and 1768 municipalities cannot comply with the Solid Waste Management Regulation and 942 municipalities are unaware of the regulation at all (DIE, 2001). On the other hand, in a First World country such as the U.S., there are instruments, both regulatory and economic, that aim to accomplish the same, this time in the form of subsidies (recycling), taxed aimed to discourage certain industries from using primary inputs in production, refunds (on metal and glass containers, batteries, and the like), minimum recycled content standards (especially for newsprint and packaging), investment tax credits (for the encouragement of purchase of recycled material or equipment), bans on certain packaging materials (which may or may not be in use in Turkey), and many more (Turner *et al.*, 1998). Turner *et al.* (1998) continue to discuss that many of the trepidations cited in the paper would not exist in a situation where there does not exist an environmental target but that environmental management costs would possibly exceed the predicted amount(s) and initially prove not as useful as the case with "direct regulation."

Direct regulation is also called "command and control" (CAC) and market alternatives are called "economic incentive mechanisms" (EIM) (Ferreira and Suslick, 2001). CAC certainly seems "old school" in that it is geared toward the determination of objectives, standards, etc., and instalment and enforcement of laws and regulations. EIM on the other hand is more flexible, more interactive and more innovative, giving dynamism to the application of new technology and practices, so long as basic objectives expected on the part of the regulator are met. This subject is briefly touched on by Ferreira and Suslick (2001), and they have this to say about regulations geared toward or in one way or another concerning oil companies, their expertise:

"Economic analysis indicates that present methods of environmental protection, mostly based on CAC strategies, are inefficient and often provide disincentives for directing resources toward abatement. The main causes are: (1) great uncertainties in calculating closure costs; (2) costly and lengthy litigious processes; (3) homogeneous treatment of oil companies (no record-based assessment); (4) great information burden on the regulatory agency (selecting the best technology and enforcing penalties for noncompliance); (5) little incentive for development of innovations that can result in improvements and cost reductions; (6) regulatory evasion rather than regulatory compliance; and (7) vague regulatory language allowing companies to build persuasive cases by showing that requirements are unachievable."

The U.S., although a market-based economy, has employed CAC for decades and has recently been making a shift to market-based incentives in her environmental policies (Stewart and Wiener, 1992).

The purpose of any regulation must be to bring about a benefit of the majority. That said, perhaps the principle outlined in Zaim and Taskin (2000) could be cited – that it should be aspired to catch the optimal point where output of human activity is maximum while the input and pollution for this same production are minimized. One method of approaching a solution would be to capitalise on the pollution aspect and assign a cost to this disposal so that it is no longer for free, providing for an incentive to reduce the production of undesirables, whether by installation of better technology or other. Lee *et al*. (2002) suggest a method which employs the concept of shadow price to estimate the "value of nonmarketed, undesirable outputs, or pollutants," whereby regulators would be in a better position to assigning penalty rates or amounts for the discharge or emission of different pollutants so that to protect tax-payers from paying for what Stewart and Wiener (1992) call "market failure." Hourican (1986) quotes the Department of Industry, 1984, regarding monetarily low-cost alternative for the industry, laying testament to the existence of the vicious circle,

"Unfortunately, the existence of derelict land frequently attracts illicit dumping of solid waste as a cheap alternative to properly controlled disposal."

It can be challenging to determine the best timing for a regulation or act. Perhaps the "theory of optimal stopping" mentioned by Batabyal (2000) can be of guidance. This tenet examines the connection between the social planner's optimal conservation policy (OCP) and the extent (or length) of the "planning horizon" as their efficiency in their duty will be dependent on time which brings the "accumulation of information." Accumulation of information is an issue as the time-frames need to be set long enough in order to be able to observe a series of disturbance regimes and "successional processes affecting the ecological communities" as unfortunately those time frames necessary for studying biological matters are more often than not far longer than traditional planning horizons, which usually relate to a social planner's or team's period in office (Batabyal, 2000).

Upon receipt of the information, the social planner does one of two things – he either goes about the necessary steps to stop conversion or he gives the information the benefit of doubt and maintains the status quo where conversion is taking place and waits for more information to be acquired so that to enable the process where potential hazard-causing agents are evaluated. In the latter action, the previous information, which has not been acted upon, becomes obsolete, but this avoids the making of mistakes (Batabyal, 2000).

Here there may arise a question as to why information should be given the benefit of doubt. This is because it would be preferred to have the social planner "ascertain areas of high biodiversity and conservation priority and to plan effective area networks," for the social planners optimal conservation policy (OCP) works on an all-or-none basis – to allow conversio n or not to allow it (Batabyal, 2000).

The sector itself and the regulator will see look upon a regulation or regulatory issue with very different outlooks, these being sometimes diametrically opposite that of the other. The regulator has to look at issues, assuming they are in the shoes of the industry, without compromising safety when flexibility is demanded (Ferreira *et al.*, 2004).

To demonstrate an example of social awareness, refer to the below figure for the bonding cycle and its dynamics. Due to public pressure, bonding requirements are adopted. Bonds cause direct and indirect economic impacts on the industry, which pressures for flexibility. Flexibility may increase liability risk, forcing regulators to review requirements.

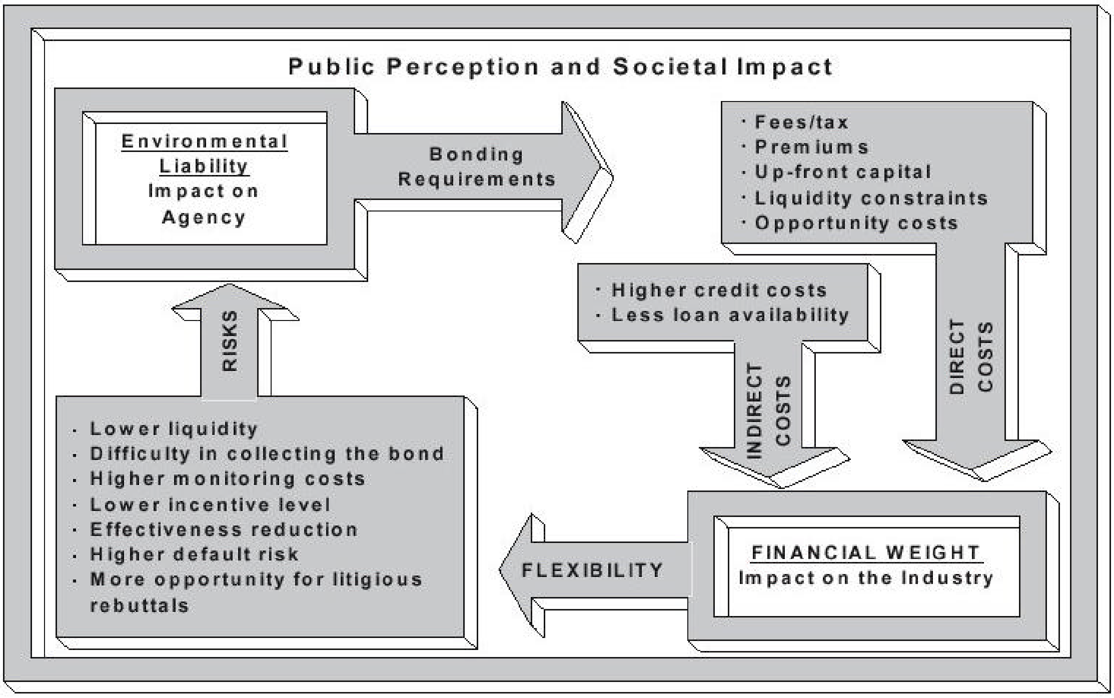

Figure A-4 The dynamics of the bonding cycle (OSM, 2000).

A.1.5. Regulations Regarding Mining

In the case of mining, about the federal statutes such as the Clean Water Act, Clean Air Act, National Environmental Act, Endangered Species Act, Superfund, and the like, Gerard (2000) says that "[t]hese laws are not specifically tailored to mining, but the federal land management agencies each have mining-specific surface management regulations."

Haigh (1993) views reclamation as a "bargaining tool" on the part of the developer (of the mining industry) to be able to "get on the good side of the regulator." On the other hand, the issue of the lack of the deterring factor in environmental regulations is a problem, so much so that polluters can face the penalties because not passing up the profits gained from infringing statutes shift the balance toward noncompliance (Schofield, 1999).

The Surface Mining Control and Reclamation Act (1977) aimed to create the necessary frameworks for protection of the environment before, during, and after mining (Ringe et al., 1998a; Ringe et al., 1998b). This began earlier in Canada, where Smyth and Dearden (1998) mention that Alberta was the first provincial jurisdiction to develop reclamation policies with the passing of the 1963 Surface Reclamation Act. On a brief note, as opposed to the systems of the Canadian provinces of Alberta or British Columbia, the U.S. system is more dependent on statute and regulation specifications (Smyth and Dearden, 1998).

Of the passage of the SMCRA Public Law, Smyth and Dearden (1998) say that it enabled more regularisation with reference to reclamation and bonding as well as making possible public involvement in permitting and legal enforcement. Things go so far as to mean that "In the United States, private individuals may file and request on-site visits at any time during the year" (Smyth and Dearden, 1998). Fitzpatrick and Sinclair (2003) and Diduck (1999) discuss this issue.

Laws and Regulations in Turkey

Environmental protection and management in Turkey is problematic as there are legal voids, lack of principles mutually agreed on by authority and developer, lack of expertise, lack of communication, lack of a central body that would coordinate activities, lack of constructivity of NGO's, the inexistence of a ministry to deal with the issues, lack of consistency in the EU adaptation process, and political interests (Ünal, 2002).

Mining in Turkey is governed by the recently revised Mine Law. There are presently no laws or regulations in Turkey that deal with the environmental aspect of mining activities one-on-one. Instead, the environmental aspects of mining are being tried to be handled by combinations of several regulations (such as those concerning water, soil, etc.) where applicable, sometimes leading to difficulties for the developer. It is hoped that with the eventual drafting of the suitable regulation, issues pertinent to this area will be adequately and efficiently addressed.

Environmental protection and issues, therefore, are governed by such laws as the Ports Law (1923), Law Concerning Water (1926), Public Health Act (1930), Law of Underground Waters (1960), the Forest Law (1961), Water Products Law (1971 and 1973), the Law of Conservation of Cultural and Natural Assets (1983), the Law of 1984, the Environmental Law of 1983, and, last but not least, the 1982 Constitution of the Republic of Turkey (Erten, 1996) whose Article 56 stipulates that, "Every person has the right to live in a health and stable environment. Developing and protecting the environment and preventing environmental pollution are the duty of the state and citizens" (Maritime Advocate, 2003). Regulations include the Regulation on the Fund for Pollution Prevention (1985), Regulation of Air Quality (1986), Regulation on Noise Control (1991), Regulation on Solid Waste Control (1991), Regulation on Hazardous Waste Control (1995), and the Environmental Impact Assessment Regulation (1993).

A.1.6. Reclamation and After-Use of Derelict Land

Restoration's capacity to bring land to an economically valuable form could be translated as "reintroducing the potential for revenue." Just as there are the regulations for reclaiming industrial sites in general, so too are there the actual benefits, from which regulations stem. Binks (1987) outlines some of the reasons why derelict land ought not to exist (taken verbatim):

1) The existence of a high proportion of dereliction in an area acts is a disincentive to potential investors.

2) Derelict land represents a waste of a valuable and limited resource. The location of dereliction may be able to cater for specific needs and prevent the unnecessary use of valuable agricultural land.

3) Environmental improvement is beneficial in itself to improve the environment of local people who live and work in the area.

4) Derelict sites may often be, or contain elements, of a dangerous nature.

Hence some reasons for reclamation (Hourican, 1986):

- restoring, maybe in fact improving, health and fecundity of the land
- providing opportunity of after-use so this resource (land) is not wasted and put into use
- maintaining a landscape that is not an eye-sore
- prevention of pollution, contamination, and danger to life

However, not all derelict land is undesirable (Hourican, 1986), at least not to some groups, for whom, as Binks (1987) states,

"[S]uch sites may not be derelict land, or weed patches. What is so often classed as 'waste' or 'unused' is actually important to and used by them"

and

"This indicates that derelict land reclamation needs to be done for the benefit of the community."

Coffey (2000) confirms this by stating that "to some quarry faces will seem entirely satisfactory landscape features, where as[sic] to others their industrial connection will make them forever unacceptable." It is also possible that abandoned mine features/workings (a legacy of two centuries; Davies, 1994) may prove to be niches which provide unusual opportunities for certain uncommon species of wildlife to flourish in, and, in fact, among a total of 3000 Sites of Special Scientific Interest mentioned in 1974 in the U.K., roughly 2.5% were mines, constituting such examples as the Norfolk Broads which go back to medieval times peat workings (Hourican, 1986). In this context, when he mentions the technique of restoration blasting, Pritchard (1994) says, "In the Derbyshire Peak District, the technique of restoration blasting has been used on abandoned quarry faces in order to replicate the natural limestone scenery in the area. These can then be left for nature to regenerate, often with interesting results. For example, some long-disused quarries have been found to harbour many rare flora and fauna, probably due to poor nutrient status and lack of human or agricultural interference. Such cases have proved difficult for those LPAs that tried to use old quarries for waste disposal and then found conservationists arguing for their preservation."

Hourican (1986) quotes two more sources which would touch upon the human factor in the regeneration of the site altogether where public participation should allow input into the decision-making process.

"… rarely appreciated that the deposition of industrial waste can also make a positive contribution to the landscape quality." (Oldham Borough Local Plan, written statement, 1983, in Hourican, 1986)

"There would appear to be considerable scope for modifying existing landscapes restoration techniques in order to capitalise on derelict industrial sites as areas of significance to wildlife conservation in Britain." (O.M.B.C., Environmental Improvement Programme 1984/85, in Hourican, 1986)

Thus, habitat management in mine reclamation can practice the options of non-intervention, limited intervention, and active management (Knipe, 1995). In this thesis, for the sake of simplicity, it will be assumed that reclamation with active management would be practiced throughout, as Ferreira et al. (2004) so eloquently state, "In keeping with the precautionary principle, it is safer to err on the side of caution, and standards should be set closer to complete restoration."

McKone (1982) says of legal action that "the correct course of action for the planning authority is to 'prevent' the dereliction occurring by forcing the operator to immediately restore." He goes on to itemise the culprits – "lack of Government[sic] initiative, public disinterest and irresponsible mineral operators" –

and adds that “the calls have been made for such nebulous things as ‘a national will,’ and ‘an ethic of responsibility toward the land,’” which he finds euphemistic.

Knipe (1995) also mentions non-intervention, control or reduction, encouragement and increase, introduction, and re-introduction within the scope of species management. The success of the rehabilitation can be studied by surveys of species to evaluate the success of techniques used, as Lacki *et al.* (1991) demonstrate. In the concluding words in his thesis, about the contention that high intensity restoration management will produce a landscape of lower environmental quality and hence value, Knipe (1995) says, “From the conclusions it is clear that this is not the case, as high intensity management will produce a more diverse range of habitats and therefore have a more diverse range of species. Without this management the former quarry sites will become fairly heterogeneous in terms of species type, and therefore have a lower environmental quality.” Likewise, Osborne and Brearley (2000) say, “The Western Australia Government Agencies controlling initial environmental bond assessment and land relinquishment after mine decommissioning advocate **proactive** environmental management approaches by the mining operator” (emphasis added).

Winkley (1999) says that for reclamation, “there is now a statutory obligation to agree [to] a restoration plan with the relevant minerals planning authority as part of any application…” and has the propensity to look upon restoration as a form of “intervention.” He cites (from Andrews and Kinsman, 1990) three main reasons for the change in attitude toward derelict land over the past decades whereby “intervention” has become necessary:

1. statutory obligations;
2. restoration’s being regarded as a “public relations exercise”; and
3. restoration’s capacity to bring land to an economically valuable form.

A popular form of reclamation is reforestation, oft practiced by TKI (Turkish Coal Enterprises) in Turkey. Winkley (1999) has researched facts about reforestation of derelict land and especially mine sites in the U.K. as an after-use scheme, where less than 10% of the area is covered in forest, a state which leaves it in demand of imports of timber from elsewhere whilst on the Continent, the average is around 25%. Winkley has ascertained that the Forestry Commission, Countryside Commission, and Chesire County Council would desire a doubling of England's forest area over the next half century. While the desires and strategies are there ("talking the talk"), the policies that need implementing in order to realise these strategies ("walking the walk") are not, and so far the author says that within his area of study, reforestation was conducted as an after-use scheme only in cases where the land was previously forest. The fact is that in the U.K., few, if any, sites in the 1980's were reclaimed with the sole aim of providing wildlife a habitat to take root in; however, opportunities for such were called to be seized if possible (Hourican, 1986). Knipe (1995) maintains that "woodland management is extremely important for the maintenance of a diverse wildlife population." Forestry does provide potential for habitat-formation and niches for fauna and flora, although among a number of after-use options for post-mining land use, amenity has been observed to be on the rise in the past years (Winkley, 1999). As Winkley (1999) states, "it must be recognised that mineral sites have endured massive disturbances and the establishment of trees on such sites can be problematic." This difficulty faced in after-use planning and implementation is true not only for post-mining land use for ceasing mines but also for landfills (some of which can be past mine pits viewed as desirable dumping sites for industrial or municipal waste, Haigh, 1993), where afforestation is actually not desirable, as it can be feared that tree roots might unbridle contaminants by boring into the landfill cap, although indeed there does exist a whole range of possibilities in degree of success with respect to tree growth on landfill sites, and Pipkin (1994) states that colliery spoil is not desirable material for revegetation efforts in after-use schemes, thus requiring not a generalisation but a recognition of the individuality of each case and that this necessitates meticulous studies, rather than a "one shoe fits all" solution, as it is usually various combinations of cons that will work against efforts toward successful reclamation. Hu (1993) has determined however that due to the presence of some organic matter, coal wastes may sometimes prove successful and in fact "Forestation with deep rooting tree species begins the process of re-establishing the biological conditions for natural soil formation" even as this process is slow and observed to entail a low success rate (Gentcheva-Kostadinova *et al.*, 1994). As far as pH of the medium of growth is concerned, 3.0 is sufficient for afforestation (Haigh, 1993).

A.1.7. Impact of Mining

The Importance of Mining

Mining of all sorts of minerals and materials takes place all over the world everyday. McKone (1982) quotes Sir Roger Stevens as having stated that

"It is difficult to exaggerate the importance of mineral to our way of life, our industry, and our economy"

and

"Britain's wealth and power are built, and to a large extent still rest on, the exploration and industrial use of her mineral resources."

This, of course, is true not just for Britain but for any country. This can be demonstrated by quoting Atatürk for the case of Turkey:

"Bir milletin tealisi yeralti zenginliklerinin islem ve degerlendirilmesine baglidir." (*A nation's progress is dependent on the valuation of her mineral riches.*)

Public Image and Public Relations

John Barr (1969, in McKone, 1982) is quoted as having uttered the following politically incorrect words, namely, that the mineral extraction industry is

"generally a rough and tumble old fashioned industry with more than its share of obsolete attitudes. The spokesmen for the industry are too often hostile and contemptuous of planning officers and civic groups whom they regard as amateurs."

Barr went further to state:

"The heap makers and the hole makers are sacrosanct… minerals are a measurable national wealth, a decent environment is not." (in McKone, 1982)

Mineral operators in their turn will attempt at portrayal of damage as exaggerated and accuse planning authority and procedures for imposing economic obstacles (the condition of reclamation is to be viewed as such) rather than mediate (McKone, 1982). A decade ago, even the relatively light task of assessing environmental impact was considered too much of a burden and obstacle, as Pritchard (1994) relates: "At present, many developers still perceive EA as 'anti-development.'" This indicates the difficulty of the situation the regulators finds themselves in – on the one hand the developers do not trust them and on the other hand the public is suspicious of them (Turner *et al.*, 1998).

Binks (1987) defines three periods of history in mineral extraction in the United Kingdom. Taken verbatim:

1) Pre-1800	Extraction small scale and manual. Overall incidence of dereliction was low, no long term problems. Many areas are now valued e.g. Norfolk Broads.
2) 1800-1920	
a) 1800-1870	Increased depth and size of mines, abandonment of former mining areas. Unmechanised and potential dereliction still not severe.
b) 1871-1920	Transition between primitive and fully mechanised industry.

3) 1921-1971

a) 1921-1947	Contraction of coal mining and other industries increased the amount of existing dereliction. Further spread of mineral operations increased the potential dereliction. Greater mechanisation allowed deeper mining. More extreme landscape e.g. deepened pits and heightened spoil tips.
b) 1948 onwards	Realisation of problem created much legislation. Closure of uneconomic workings and concentration on better placed workings.

This realisation resulted in the utterance of such words as “I believe that the coal industry has to be dragged kicking and screaming into this century of the environment and live up to its responsibilities,” by British Member of Parliament, Sir Hugh Ross in the Independent, 17th June, 1989 (Haigh, 1993).

The threshold for “realisation” may be another issue altogether, but knowledge of environmental impacts of mining is an old story even if problems have not been as acute. Centuries ago, in 1556, Georgius Agricola in his treatise of the mining industry (De Re Metallica – Encyclopaedia Britannica, 15th edition, vol. 8, p. 158:3a) wrote the following (in Nicholson, 1988):

“The strongest argument of the detractors is that the fields are devastated by mining operations … the woods and groves are cut down, for there is need of an endless amount of wood for timbers, and machines and the smelting of metals. And when the woods and groves are felled, then are exterminated the beasts and birds, very many of which furnish and pleasant and agreeable food for man. Further, when the ores are washed, the water which has been used poisons the brooks and streams, and either destroys the fish or drives them away … Thus it is said, it is clear to all that there is greater detriment from mining than the value of metals which the mining produces."

However, in principle, mining is no different from any other industry in that it entails an environmental impact. Just as every industry mentioned above comes with a cost, so does mining. Detriments, which can be generalised as "abandoned mineral workings, pocked with subsidence, quarries, disused plant and banks of dross and debris, spoil and slag" (in McKone, 1982), caused by mining in some cases can be worse than those of most activities (Kobus, 1992), but, if one is to keep matters in perspective, it would be fair to note that the 1982 Stockholm Environment Conference did not cite surface mining in its own right as among the most detrimental to the environment (Haigh, 1993). Binks (1987) said for his day that conical spoil heaps were a major recent cause of dereliction. Gerard (2000) states that for the U.S., "[t]he abandoned mines legacy is attributed both to a lack of concern about the potential hazards and an absence of regulation." In fact, in Montana and Arizona, which, sarcastically, are the crème de la crème of mine-inflicted dereliction, the results of surveys are pretty grim. In Montana, 350 of 3000 sites studied, based on their "environmental and safety characteristics," were listed as having to be dealt with urgently. Arizona had 5890 mine openings, shafts, adits, prospects, and quarried-out areas appraised and it was found out that of these, about 2% (118 sites) posed the possibility of environmental hazards while 11% (668 sites) were deemed dangerous to public safety. (Coincidentally, Montana has the harshest mine reclamation bonding terms in the U.S.; Gerard, 2000.)

Scenes such as these comprise some of the reasons why countries and governments all across the world are becoming increasingly intolerant of such degradation (Haigh, 1993). Haigh (1993) says:

"Legacies from decades of bad practice continue to haunt modern coaling agencies. Too many coal contractors have gone about their business for too long with too little regard for their neighbours and too little regad for the future of the lands they work. This has provided ammunition for an increasingly powerful lobby with ambitions to place ever greater restrictions on an industry ‘which cannot be trusted.’”

Anggraeni (2003) who contributes to the Jakarta Post says of miners, in reference to the stirs in Indonesia over the past year:

“Most of the polluters, it seems, are not setting out to pollute. They are, rather, just irresponsibly negligent. When they regard the costs of cleaner production as an added burden instead of part of running a company, the temptation to disregard that obligation will be hard to resist.”

Attempts at giving answers to these issues, and not just for mining but for the whole range of human activities, have been made. Robinson (1992) says:

“The key problem is: a critical line must be drawn to balance the relation between development and environment. The environmental problem caused by development must be restricted within the limit which human beings and other living things can accept (some people suggest a ‘bearable limit’ principle), so that the economy can develop continuously without degrading environmental quality. A suitable developmental pace should be found to meet environmental requirements and harmonize the environment/economy relationship. In doing so, the economy must be developed in a gradual and sound manner, and the environment must be protected and improved. We must do our best to integrate the benefits of environment, economy, and society.”

A.1.8. Sustainable Development

Sustainable development is an ideal around which international environmental policy rotates (Diduck, 1999). One of the most popular mantras of the anti-mining activists in particular is that mining in no way, shape or form can possibly reinforce sustainable development, the definition of which is

“Development that meets the needs of the present, without compromising the ability of future generations to meet their own needs” (The Mineral Planning Group, 1994).

They state the above confrontation on the sole premise that mining concerns a nonrenewable resource. Although the contention seems justified in this light, where mining is not like other forms of land-use or other where precaution is simply that “harvests” are not to be overdone so as to not thwart health and endanger future production, mining does impact on other natural resources such as arable land (which in its turn is a finite resource [Ghosh, 1991]) and such, and what is important is that these resources are to be back in place even if made unavailable temporarily. This is why reclamation of that site is so important, and not only reclamation but also minimisation of impacts upon the environment (Mineral Planning Group, 1994) over the course of projects (what would be called “continuous damages” by Ferreira *et al.*, 2004) so as to maintain environmental quality over a period of time with regard to the environment, society, and the individual (Haigh, 1993). The Mineral Planning Group (1994) have mentioned two steps in achieving sustainable development. They argue that, firstly, actual damages must be curbed, and, secondly, mineral riches must be utilised in more efficient ways. The latter would require the industry to practice selectivity during production of goods, as in using a lower amount of the mineral when producing that commodity rather than wasting it in input. Promotion of recycling by regulators would aid this course

In their case of Thailand, Intarapravich and Clark (1994) cite that “a combination of appropriate mineral policies, environmental policies, legislation, administration, enforcement and organization in order to achieve a balance between mineral development and environmental concerns” is necessary where the end is consummating sustainable development so that to orient the mine operator toward internalising environmental costs via the PPP (“polluter pays principle”). Ferreira et al. (2004) assert that “Even from the viewpoint of economics, efficient market outcomes require that producers pay all of the costs associated with their production." The "polluter pays principle" is also the principle whereby the Environmental Law of Turkey of 1983 which actually implies sustainable development (Erten, 1996).

A.1.9. Impacts

Chronically, mining indeed has a series of impacts on the environment, some of which would be visual impacts (Coffey, 2000), air and dust impacts, water impacts, noise impacts (McKone, 1982; Coffey, 2000), impacts on soils and geology, hydrological impacts, ecological impacts (Hartland-Swann, 1993), traffic, blasting, wastes, and impacts on residents (Kobus, 1992) to name the primary. Scarification of the landscape will also be enhanced by large vertical rock faces being left over from quarry workings (Pritchard, 1994).

The flow of ground water can be impacted on to cause aquifer contamination in cases where the formations are those that are highly permeable, such as limestone (Pritchard, 1994). Likewise, it is important that tailings impoundments, a very widely used method of waste disposal in mining operations (Hossein *et al.*, 1993), discharge as little contaminant as possible. It is not possible to not release discharges, however, for even the "zero liquid discharge" concept, which applies not only to the mineral processing industry but also to other industries, such as chemical plants, paper mills, refineries (Koppol *et al.*, 2004), etc., acknowledges a certain negligible limit.

As cut-off grades drop and ore which would previously be characterised as "poor grade" shall become economic and profitable to extract and process (in part also due to growing demand from the mushrooming economies of China and India, Jakarta Post, 2003), larger quantities of land than ever will be disturbed worldwide, conflicting with greater areas of arable land and amenities (McKone, 1982). Hourican (1986) mentions that in the Cornwall region of the UK, for every tonne of china clay that is produced, there are produced around 8 to 10 tonnes of waste. The metal mining industry where ores with grades in the order of several ppm's have become feasible to mine and process whereas a few decades ago grades were evaluated in percentages. Pritchard (1994) names a few of the types of mines with their respective characteristic impacts upon "land-take." While sand and gravel workings cover considerable amounts of land (at times conflicting with land of agricultural value) compared to quarries, the latter can inflict more impact upon the visual aspect of the land. With surface mining, it is possible to restore the landscape by way of progressive backfilling with overburden and/or process waste; however, more often than not soil quality and landscape and biological diversity will be slow to recover, if at all to recover by themselves.

The impact of mining, surface mining in particular, can be reduced by mitigation, alternatives, or aftercare. Reclamation certainly is an alternative to simply abandoning a site, in that it ameliorates a situation. Jay (1999) explores the true sense of reclamation adding benefit to a site in his thesis.

Some mining operations can lead to acid mine drainage (AMD). AMD is one of the most important issues that a metal mine can be confronted with (Hossein *et al.*, 1993) and is caused when pyrite is oxidised upon exposure to air (the important component being oxygen) and water, resulting in the formation of ferric oxides and sulfuric acid. Sulfuric acid is dangerous in that abundant quantities can dissolve iron precipitates and heavy metals in addition to contaminating the very surface and ground waters themselves (Soucek *et al.*, 2000). In underground mines, this can be spurred with the flow of underground water or rain runoff, for example to meet with pyritic or sulphide material to augment acidity. On the surface, surface water run-in or precipitation can cause this in pits; likewise, mining waste rock dumps can also contribute to this phenomenon (Sáinz *et al.*, 2002). AMD can be remedied by cutting off contact with oxygen or the application of limestone or power station fly ash to neutralise pH (Haigh, 1993). AMD is worth a chapter of its own and will not be broadly covered. Suffice to add at this point that while it is much-feared, AMD is in fact cheap to prevent and regardless has generated such research going so far as to cover such topics as tailings erosion and resuspension in tailings impoundments brought about by wind turbulence and how this would affect acid generation are being studied (Mian and Yanful, 2003). The OSMRE (2004) has released a third version of a program called AMDTreat.

A.2. Miscellaneous

A.2.1. An example of impact upon an archaeological site

As a demonstration of the need for environmental impact assessment of mining operations and the actual impacts that come about as a result of lack of planning, the author would like to demonstrate the case of the ruined city of Ani, a world-class heritage site in Kars, Turkey, on the border between Turkey and Armenia. The author has visited Ani several times in the past and has also consulted with a website documenting the situation at the archaeological site.

Beginning in the year 2000, quarrying of tuff for the purpose of dimension stone for facing of buildings began on the side of the gorge (whose river defines the border between Turkey and Armenia) that belongs to Armenia, upgrading to four actively working quarries in 2001 (VirtualAni, 2004).

Aside from causing scarification and despoilment across the landscape on the Armenian side of the border as a result of the quarrying operations, there have been impacts due to blasting, which was a peculiar method to employ for a company that wished to produce dimension stone. The blasting caused vibrations that brought down dust from the ceilings of the historical buildings and in fact caused a certain amount of structural damage to the Ani Cathedral: "In recent years, most probably due to the effects of the quarry blasting, the upper half of the west facade has started to lean noticeably out from its original vertical position and there is a real risk of the complete collapse of the whole west facade of the cathedral" (VirtualAni, 2004).

After much publicity and political football in newspapers such as Hürriyet, Turkish Daily News, Anadolu Agency, Agos, Interfax News Agency, L.A. Times, and the like, the blasting was discontinued. The scarified landscape is to remain as it is (VirtualAni, 2004).

A.2.2. Monitoring

Lack of monitoring or the lack of the requirement of monitoring have deemed the EIA process somewhat unsuccessful (Robinson, 1992).

Norway's monitoring program aims to assess whether environmental objectives are reached, to aid the development of new environmental objectives, evaluate the effectiveness of policy instruments and contribute to their improvement and compare developments in Norway with those in other countries (Dramstad *et al.*, 2002). This monitoring program has four points of concern: spatial structure of the landscape, biodiversity, cultural heritage, and accessibility.

Just as much as monitoring can be done nation-wide, it can be done in a specific region and especially within a specific site. Mining sites take their fair share in this, but theirs is internal monitoring combined with external monitoring. Gerard (2000) mentions that it is possible for mining companies to pass up some of their responsibilities due to the costs of monitoring where external monitoring is not strict or is infrequent; he also mentions that, more often than not, a firm cannot be bothered with issues of compliance to regulations if business is going downhill fast. This unreliability on the part of the body responsible for external monitoring can perhaps be demonstrated by his example of the U.S. Forest Service, whom he cites as having recalled the following as items of difficulty in maintaining a regular schedule:

1. budget constraints
2. lack of qualified personnel
3. remoteness of sites
4. higher priority work (Gerard, 2000)

It would be little wonder that a country such as Turkey would be complaining of the same difficulties, as ascertained in Ahmad and Wood (2002). Gerard (2000) also states that determination of avoidance of compliance more probable on the part of the principal if it is cheap to investigate or monitor, with monitoring costs depending on the frequency with which facilities are to be checked out and on how facile it is to ferret out and substantiate noncompliance. For the firm, though, at least for most, although variable, monitoring costs can be low enough within tolerable limits (Gerard, 2000).

Winkley (1999) recommends after-closure monitoring period as 10 years where forestry is concerned as young trees are susceptible to damage in freak or bad weather. This immediately reminds us of the guidelines given by Webb and Erskine (2003). Smyth and Dearden (1998) cite a period that is less than 20 years of "corporate responsibility," which is considered long enough but favourable for the public "particularly at higher elevation and higher latitudes." One sole instance of mention of 30 years for monitoring in reclamation is by Yazicigil (in Reinart, 2003).

Generally speaking, the jurisdictions of Alberta, British Columbia, and United States as reviewed by Smyth and Dearden (1998) reflect a static understanding of ecosystems rather than a dynamic one.

A.2.3. Land stability

Runoff transports soil that has been eroded and, with it, nutrients, pesticides, and possibly pathogens (Önal *et al.*, 1998).

The models used by Nicolau have also been used by Dabney *et al.* (1999), who concluded that both RUSLE and WEPP overestimated rates of erosion due to the fact that these models do not take into account the effects of backwater and slope modification.

The balance of land must be kept very carefully as Önal *et al.* (1998), who explore the possibilities of developing a "methodological framework that offers the capability to integrate economic and environmental objectives while incorporating equity among participants," warn that limiting runoff can elevate levels of contamination indirectly. They demonstrate the case of Lake Pittsfield, where levels of atrazine were increased due to this practice, causing an encouragement of weed propagation, thus making it necessary for more extensive use of or reliance on more herbicides, throwing the whole system into a vicious circle.

On the quest for information about cost-estimation of environmental damage and of environmental remediation, one of the concepts stumbled upon was that of "marginal willingness to pay."(Pani)

Batabyal (2000) states that from a "demand curve for native genetic resources," it is possible to infer marginal willingness to pay "for the marginal species and the marginal hectare of threatened habitat."

Wales has large amounts of land which are listed as restored but still in rather sordid condition (Haigh, 1992).

Draining of water table can lead to degradation of surrounding lands as well (Ghosh and Ghosh, 1993).

Reclamation of abandoned mines from the past goes on in several countries of the West, chief among them North America and the U.K. Davies (1994) has examined a possibility of coal retrieval from spoils funding the reclamation efforts.

The U.K. has had its fair share of dereliction, so much so that former coalfields constitute some of the most degraded land in Europe (Haigh, 1993).

The author has visited a few abandoned brick-making factories in the Imrahor Valley just outside Ankara (April, 2004). These facilities could be put into use.

Appendix B

EEC Directive Annexes I and II

Annex I:

1. Crude-oil refineries (excluding undertakings manufacturing only lubricants from crude oil) and installations for the gasification and liquefaction of 500 tonnes or more of coal or bituminous shale per day.
2. Thermal power stations and other combustion installations with a heat output of 300 megawatts or more and nuclear power stations and other nuclear reactors (except research installations for the production and conversion of fissionable and fertile materials, whose maximum power does not exceed I kilowatt continuous thermal load).
3. Installations solely designed for the permanent storage or final disposal of radioactive waste.
4. Integrated works for the initial melting of cast-iron and steel.
5. Installations for the extraction of asbestos and for the processing and transformation of asbestos and products containing asbestos: for asbestos-cement products, with an annual production of more than 20 000 tonnes of finished products, for friction material, with an annual production of more than 50 tonnes of finished products, and for other uses of asbestos, utilization of more than 200 tonnes per year.
6. Integrated chemical installations.
7. Construction of motorways, express roads (1) and lines for long-distance railway traffic and of airports(2) with a basic runway length of 2 100 m or more.
8. Trading ports and also inland waterways and ports for inland-waterway traffic which permit the passage of vessels of over 1 350 tonnes.

9. Waste-disposal installations for the incineration, chemical treatment or land fill of toxic and dangerous wastes.

Annex II:

1. Agriculture
2. Extractive industry
3. Energy industry
4. Processing of metals
5. Manufacture of glass
6. Chemical industry
7. Food industry
8. Textile, leather, wood and paper industries
9. Rubber industry
10. Infrastructure projects
11. Other projects
12. Modifications to development projects included in Annex I and projects in Annex I undertaken exclusively or mainly for the development and testing of new methods or products and not used for more than one year.

Appendix C

Table A-3: Conditions through which critical education can develop as part of the panel process, and associated conceptual and operational definitions.

Criteria and conceptual definition	Operational definition
Participatory Learners have a voice in education **Situated** Material reflects learners’ thoughts and language **Democratic** Educators and learners work together to develop the learning agenda **Dialogic** Learning methods emphasise discussion **Desocialisation** Education encourage[sic] active participation in education	Did the learners participate in developing the scope of the environmental assessment? Were the participants encouraged to participate in the conformity analysis? Was the EA documentation presented in plain language? Were the hearings conducted in a way encourage[sic] participation? Were steps taken to modify the hearings process to level power relations? Was all material presented given equal consideration (as opposed to discounted beause[sic] of process or methodology)? Were participants encouraged to dialogue outside the formal process? Did the process encourage dialogue about potential solutions to outstanding issues? Were steps taken to encourage inactive publics[sic] to participate? Was[sic] he[sic] hearings open to all people who wanted to participate?

Table (cont'd): Conditions through which critical education can develop as part of the panel process, and associated conceptual and operational definitions (Fitzpatrick and Sinclair, 2003).

Multicultural Curriculum acknowledges cultural diversity	Was the public able to become part of the panel's EA decision? Were efforts made to engage people from diverse cultural backgrounds in the hearings?
Research-oriented The teacher studies the identity of student; and students research problems posed in class	Did the process reflect the needs of participants (translation, location, process, etc.)? Did the panel encourage independent research by participants?
Activist The classroom is both active and interactive	Did the panel investigate he[sic] participants and tailor the materials to reflect their needs? Did the panel investigate the participants and tailor the materials to reflect their needs?
Critical The dialogue promotes self-reflection and social analysis	Did the material presented during the panel contribute to future research initiatives? Did the hearings process encourage participants to engage in experiential learning?
Affective Discussion interested in broad feelings	Were participants given an opportunity to critically reflect on the written documentation before the commencement of the hearings? Was there aaaan[sic] opportunity for participants to critically reflect on the material presented during the hearings before being required to respond? What relationships developed among participants as the result of participation in the process[sic]

Appendix D

Items of Reclamation

STEPS OF RECLAMATION

1. Preparation of reclamation plans, post-mining land use plans, and mine closure plans, together with mining plans.

2. Base-line study.

3. Preparation of environmental management plan (EMP).

4. Public meetings.

5. Realization of reclamation unit operations integrated with mining operations.
   - salvage, storage, and replacement of topsoil or other acceptable growth medium (site clearing; stripping, loading, transportation, and unloading of topsoil)
   - control of spoil heaps
   - backfilling (covering of lots/phases with oxide rock)
   - grading (preliminary, fine, coarse, final, etc.)
   - recontouring, stabilization, and/or topsoil replacement of all disturbed areas (laying of aggregate for berms and topsoil in storage area, sowing of seed and on irrigation and fertilization of stripped and stored and/or replaced topsoil)
   - stream channel, stream bank, and natural hydrologic flow restoration
   - measures to protect air and water resources by preventing discharges not meeting state standards
   - rehabilitation of pregnant, barren, intermediate solution, and two storm ponds
   - protection of public health and safety
   - protection of wildlife habitat and standards for habitat restoration

6. Providing physical and chemical stability to the land; respectively:
   - slope stability requirements, including maximum acceptable slope angles

and achievement of erosion control and static and seismic stability (pit wall stabilization at certain intervals of elevations)
- requirements for geochemical modeling and AMD prediction and prevention (ARD testing)

7. Landscaping activities: addressing aesthetic (including but not limited to visual) impacts on public, residential, and natural (wilderness and other) areas.

8. Revegetation (cultivation) of all disturbed areas consistent with future use (with the purpose of encouraging propagation of native species and selection).
   - seedbed preparation
   - mulching
   - fertilizing
   - transplantation of plants
   - seeding and planting
   - afforestation
   - provisions for noxious weed control

   At least three, and up to ten, years should be allowed for evaluation of revegetation prior to approval/acceptance. Criteria with which to measure success/failure of revegetation should be established.

9. Mine closure and abandonment.
   - site clearing (construction areas and disturbed lands)
   - dismantling of buildings (crushers, ADR, other)
   - ripping of roads
   - disposal of rubble (crushers, ADR, other buildings, roads, etc.)
   - removal of fence marking overall project boundary,

   etc.

10. Monitoring, control, and maintenance (throughout steps 4-9).

Appendix E

Reclamation Cost Estimation Table

The compiled list of operations was spread onto a table. Each category had its sub-items cited individually.

Reclamation Cost Estimation Table

Item #	Unit Operation	Amount	Unit	Unit Cost	Cost
A.	Baseline Study				
A1.	flora and fauna: vegetation and wildlife				
				A1. Subtotal	
A2.	environmental risk assessment				
				A2. Subtotal	
A3.	land and geology: surface disturbance & topography				
				A3. Subtotal	
A4.	baseline ambient info: air, water, and soil				
				A4. Subtotal	
A5.	significant deterioration monitoring and/or prevention studies				
				A5. Subtotal	
A6.	socio-economics				
				A6. Subtotal	
A7.	cultural, historical, and archaeological assets/resources studies				
				A7. Subtotal	
A8.	noise				
				A8. Subtotal	
				A. subtotal	
B.	Health and Safety				

B 1.	restricting public access				
				B1. Subtotal	
B 2.	reclamation of tailings ponds				
				B2. Subtotal	
B 3.	disposal of tailings pond sludge				
				B3. Subtotal	
B 4.	reclamation of trenches, pits, and adits				
				B4. Subtotal	
				B. subtotal	
C .	Land Restoration				
C 1.	topsoil handling				
				C1. Subtotal	
C 2.	control of spoil heaps				
				C2. Subtotal	
C 3.	backfilling				
				C3. Subtotal	
C 4.	grading				
				C4. Subtotal	
C 5.	recontouring, stabilization, and/or topsoil replacement				
				C5. Subtotal	
C 6.	rehabilitation of pregnant, barren, intermediate solution, and storm ponds				
				C6. Subtotal	
C	protection of wildlife habitat and standards for habitat restoration				

7.					
				C7. Subtotal	
				C. subtotal	
D.	Air and Water Management				
D 1.	stream channel, stream bank, and natural hydrologic flow restoration				
				D1. Subtotal	
D 2.	preventing discharges not meeting state standards				
				D2. Subtotal	
				D. subtotal	
E.	Landscaping				
				E. subtotal	
F.	Physical, Chemical, and Biological Stability				
F 1.	slope stability requirements				
				F1. subtotal	
F 2.	requirements for geochemical modeling				
				F2. subtotal	
F 3.	AMD prediction and prevention				
				F3. Subtotal	
				F. subtotal	

G.	Revegetation				
G1.	seedbed preparation				
				G1. Subtotal	
G2.	mulching				
				G2. Subtotal	
G3.	fertilizing				
				G3. Subtotal	
G4.	transplantation of plants				
				G4. Subtotal	
G5.	seeding and planting				
				G5. Subtotal	
G6.	irrigation				
				G6. Subtotal	
				G. subtotal	
H.	Mine Closure and Abandonment				
H1.	site clearing				
				H1. Subtotal	
H2.	dismantling of buildings				
				H2. Subtotal	
H3.	ripping of roads				
				H3. Subtotal	

H 4.	disposal of rubble				
				H4. Subtotal	
H 5.	removal of fence marking overall project boundary				
				H5. Subtotal	
				H. subtotal	
I.	Monitoring, control, and maintenance				
				I. Subtotal	

Appendix F

Example of a Worked Reclamation Cost Estimation Table

The compiled list of operations was spread onto a table. Each category had its sub-items cited individually. This is a non-numerical example to serve as guideline.

Reclamation Cost Estimation Table

Item #	Unit Operation	Amount	Unit	Unit Cost	Cost
A.	**Baseline Study**				
A1.	**flora and fauna: vegetation and wildlife**				
	Year 1				
	flora and fauna: vegetation and wildlife 1				
	flora and fauna: vegetation and wildlife 2				
	flora and fauna: vegetation and wildlife 3				
				Year 1 subtotal	
	Year 2				
	flora and fauna: vegetation and wildlife 4				
	flora and fauna: vegetation and wildlife 5				
				Year 2 subtotal	
	(…)				
	Year N				
	flora and fauna: vegetation and wildlife x				
	flora and fauna: vegetation and wildlife y				
	flora and fauna: vegetation and wildlife z				
				Year N subtotal	
				A1. Subtotal	**Years 1+2+...+N**
A2.	**environmental risk assessment**				
	Year 1				
	environmental risk assessment 1				

	environmental risk assessment 2				
				Year 1 subtotal	
	Year 2				
	environmental risk assessment 3				
				Year 2 subtotal	
	(…)				
	Year N				
	environmental risk assessment x				
				Year N subtotal	
				A2. Subtotal	**Years 1+2+...+N**
A 3.	**land and geology: surface disturbance & topography**				
	Year 1				
	Operation 1				
				Year 1 subtotal	
	Year 2				
	Operation 2				
				Year 2 subtotal	
	(…)				
	Year N				
	Operation x				
				Year N subtotal	
				A3. Subtotal	**Years 1+2+...+N**
A 4.	**baseline ambient info: air, water, and soil**				
	Year 1				
	Operation 1				

				Year 1 subtotal	
	Year 2				
	Operation 2				
				Year 2 subtotal	
	(…)				
	Year N				
	Operation x				
				Year N subtotal	
				A4. Subtotal	**Years 1+2+...+N**
A 5.	**significant deterioration monitoring and/or prevention studies**				
	Year 1				
	Operation 1				
				Year 1 subtotal	
	Year 2				
	Operation 2				
				Year 2 subtotal	
	(…)				
	Year N				
	Operation x				
				Year N subtotal	
				A5. Subtotal	**Years 1+2+...+N**
A 6.	**socio-economics**				
	Year 1				
	Operation 1				
				Year 1 subtotal	

	Year 2				
	Operation 2				
				Year 2 subtotal	
	(…)				
	Year N				
	Operation x				
				Year N subtotal	
				A6. Subtotal	**Years 1+2+...+N**
A 7.	**cultural, historical, and archaeological assets/resources studies**				
	Year 1				
	Operation 1				
				Year 1 subtotal	
	Year 2				
	Operation 2				
				Year 2 subtotal	
	(…)				
	Year N				
	Operation x				
				Year N subtotal	
				A7. Subtotal	**Years 1+2+...+N**
A 8.	**noise**				
	Year 1				
	Operation 1				
				Year 1 subtotal	
	Year 2				

	Operation 2				
				Year 2 subtotal	
	(…)				
	Year N				
	Operation x				
				Year N subtotal	
				A8. Subtotal	**Years 1+2+...+N**
				A. subtotal	**A1+A2+A3+…+A8**
B.	**Health and Safety**				
B1.	**restricting public access**				
	Year 1				
	Operation 1				
				Year 1 subtotal	
	Year 2				
	Operation 2				
				Year 2 subtotal	
	(…)				
	Year N				
	Operation x				
				Year N subtotal	
				B2. Subtotal	**Years 1+2+...+N**
B	**disposal of tailings pond sludge**				

3.					
	Year 1				
	Operation 1				
				Year 1 subtotal	
	Year 2				
	Operation 2				
				Year 2 subtotal	
	(…)				
	Year N				
	Operation x				
				Year N subtotal	
				B3. Subtotal	**Years 1+2+...+N**
B 4.	**reclamation of trenches, pits, and adits**				
	Year 1				
	Operation 1				
				Year 1 subtotal	
	Year 2				
	Operation 2				
				Year 2 subtotal	
	(…)				
	Year N				
	Operation x				
				Year N subtotal	
				B4. Subtotal	**Years 1+2+...+N**

				B. subtotal	**B1+B2+B3+B4**
C.	**Land Restoration**				
C1.	**topsoil handling**				
	Year 1				
	Operation 1				
				Year 1 subtotal	
	Year 2				
	Operation 2				
				Year 2 subtotal	
	(…)				
	Year N				
	Operation x				
				Year N subtotal	
				C1. Subtotal	**Years 1+2+...+N**
C2.	**control of spoil heaps**				
	Year 1				
	Operation 1				
				Year 1 subtotal	
	Year 2				
	Operation 2				
				Year 2 subtotal	
	(…)				
	Year N				

	Operation x				
				Year N subtotal	
				C2. Subtotal	**Years 1+2+...+N**
C 3.	**backfilling**				
	Year 1				
	Operation 1				
				Year 1 subtotal	
	Year 2				
	Operation 2				
				Year 2 subtotal	
	(…)				
	Year N				
	Operation x				
				Year N subtotal	
				C3. Subtotal	**Years 1+2+...+N**
C 4.	**grading**				
	Year 1				
	Operation 1				
				Year 1 subtotal	
	Year 2				
	Operation 2				
				Year 2 subtotal	
	(…)				
	Year N				
	Operation x				

				Year N subtotal	
				C4. Subtotal	Years 1+2+...+N
C 5.	**recontouring, stabilization, and/or topsoil replacement**				
	Year 1				
	Operation 1				
				Year 1 subtotal	
	Year 2				
	Operation 2				
				Year 2 subtotal	
	(…)				
	Year N				
	Operation x				
				Year N subtotal	
				C5. Subtotal	**Years 1+2+...+N**
C 6.	**rehabilitation of pregnant, barren, intermediate solution, and storm ponds**				
	Year 1				
	Operation 1				
				Year 1 subtotal	
	Year 2				
	Operation 2				
				Year 2 subtotal	
	(…)				
	Year N				
	Operation x				
				Year N subtotal	

				C6. Subtotal	Years 1+2+...+N
C 7.	protection of wildlife habitat and standards for habitat restoration				
	Year 1				
	Operation 1				
				Year 1 subtotal	
	Year 2				
	Operation 2				
				Year 2 subtotal	
	(…)				
	Year N				
	Operation x				
				Year N subtotal	
				C7. Subtotal	Years 1+2+...+N
				C. subtotal	C1+C2+…+C7
D .	Air and Water Management				
D 1.	stream channel, stream bank, and natural hydrologic flow restoration				
	Year 1				
	Operation 1				
				Year 1 subtotal	
	Year 2				
	Operation 2				
				Year 2 subtotal	

	(…)				
	Year N				
	Operation x				
				Year N subtotal	
				D1. Subtotal	**Years 1+2+...+N**
D 2.	**preventing discharges not meeting state standards**				
	Year 1				
	Operation 1				
				Year 1 subtotal	
	Year 2				
	Operation 2				
				Year 2 subtotal	
	(…)				
	Year N				
	Operation x				
				Year N subtotal	
				D2. Subtotal	**Years 1+2+...+N**
				D. subtotal	**D1+D2**
E .	**Landscaping**				
	Year 1				
	Operation 1				
				Year 1 subtotal	
	Year 2				

	Operation 2				
				Year 2 subtotal	
	(…)				
	Year N				
	Operation x				
				Year N subtotal	
				E. subtotal	**Years 1+2+...+N**
F.	**Physical, Chemical, and Biological Stability**				
F 1.	**slope stability requirements**				
	Year 1				
	Operation 1				
				Year 1 subtotal	
	Year 2				
	Operation 2				
				Year 2 subtotal	
	(…)				
	Year N				
	Operation x				
				Year N subtotal	
				F1. subtotal	**Years 1+2+...+N**
F 2.	**requirements for geochemical modeling**				
	Year 1				

	Operation 1				
				Year 1 subtotal	
	Year 2				
	Operation 2				
				Year 2 subtotal	
	(…)				
	Year N				
	Operation x				
				Year N subtotal	
				F2. subtotal	**Years 1+2+...+N**
F 3.	**AMD prediction and prevention**				
	Year 1				
	Operation 1				
				Year 1 subtotal	
	Year 2				
	Operation 2				
				Year 2 subtotal	
	(…)				
	Year N				
	Operation x				
				Year N subtotal	
				F3. Subtotal	**Years 1+2+...+N**
				F. subtotal	**F1+F2+F3**

G.	**Revegetation**				
G1.	**seedbed preparation**				
	Year 1				
	Operation 1				
				Year 1 subtotal	
	Year 2				
	Operation 2				
				Year 2 subtotal	
	(…)				
	Year N				
	Operation x				
				Year N subtotal	
				G1. Subtotal	**Years 1+2+...+N**
G2.	**mulching**				
	Year 1				
	Operation 1				
				Year 1 subtotal	
	Year 2				
	Operation 2				
				Year 2 subtotal	
	(…)				
	Year N				
	Operation x				
				Year N subtotal	

				G2. Subtotal	**Years 1+2+...+N**
G 3.	**fertilizing**				
	Year 1				
	Operation 1				
				Year 1 subtotal	
	Year 2				
	Operation 2				
				Year 2 subtotal	
	(…)				
	Year N				
	Operation x				
				Year N subtotal	
				G3. Subtotal	**Years 1+2+...+N**
G 4.	**transplantation of plants**				
	Year 1				
	Operation 1				
				Year 1 subtotal	
	Year 2				
	Operation 2				
				Year 2 subtotal	
	(…)				
	Year N				
	Operation x				
				Year N subtotal	

				G4. Subtotal	Years 1+2+...+N
G 5.	seeding and planting				
	Year 1				
	Operation 1				
				Year 1 subtotal	
	Year 2				
	Operation 2				
				Year 2 subtotal	
	(…)				
	Year N				
	Operation x				
				Year N subtotal	
				G5. Subtotal	Years 1+2+...+N
G 6.	irrigation				
	Year 1				
	Operation 1				
				Year 1 subtotal	
	Year 2				
	Operation 2				
				Year 2 subtotal	
	(…)				
	Year N				
	Operation x				
				Year N subtotal	
				G6. Subtotal	Years 1+2+...+N

					G. subtotal	**G1+G2+…+G6**
H.	**Mine Closure and Abandonment**					
H1.	**site clearing**					
	Year 1					
	Operation 1					
					Year 1 subtotal	
	Year 2					
	Operation 2					
					Year 2 subtotal	
	(…)					
	Year N					
	Operation x					
					Year N subtotal	
					H1. Subtotal	**Years 1+2+...+N**
H2.	**dismantling of buildings**					
	Year 1					
	Operation 1					
					Year 1 subtotal	
	Year 2					
	Operation 2					
					Year 2 subtotal	
	(…)					

	Year N				
	Operation x				
				Year N subtotal	
				H2. Subtotal	**Years 1+2+...+N**
H 3.	**ripping of roads**				
	Year 1				
	Operation 1				
				Year 1 subtotal	
	Year 2				
	Operation 2				
				Year 2 subtotal	
	(…)				
	Year N				
	Operation x				
				Year N subtotal	
				H3. Subtotal	**Years 1+2+...+N**
H 4.	**disposal of rubble**				
	Year 1				
	Operation 1				
				Year 1 subtotal	
	Year 2				
	Operation 2				
				Year 2 subtotal	
	(…)				
	Year N				

	Operation x				
				Year N subtotal	
				H4. Subtotal	Years 1+2+...+N
H 5.	**removal of fence marking overall project boundary**				
	Year 1				
	Operation 1				
				Year 1 subtotal	
	Year 2				
	Operation 2				
				Year 2 subtotal	
	(…)				
	Year N				
	Operation x				
				Year N subtotal	
				H5. Subtotal	**Years 1+2+...+N**
				H. subtotal	**H1+H2+…+H5**
I.	**Monitoring, control, and maintenance**				
	Year 1				
	Operation 1				
				Year 1 subtotal	
	Year 2				
	Operation 2				
				Year 2 subtotal	
	(…)				

	Year N				
	Operation x				
				Year N subtotal	
				I. Subtotal	**Years 1+2+...+N**

Cumulatives by year

Year 1

Year 2

(…)

Year N

Grand total

Cumulatives by category

A.	**Baseline Study**
B.	**Health and Safety**
C.	**Land Restoration**
D.	**Air and Water Management**
E.	**Landscaping**
F.	**Physical, Chemical, and Biological Stability**
G.	**Revegetation**

H.	**Mine Closure and Abandonment**
I.	**Monitoring, control, and maintenance**
	Grand total

Appendix G.

Some examples of environmental management plans

i. Baseline studies management plan

ii. Public participation management plan

iii. Restoration management plan

iv. Stockpile and waste piles management plan

v. Physical stability management plan

vi. Erosion and sedimentation management plan

vii. Chemical stability management plan

viii. Biological stability management plan

ix. Wildlife management plan

x. Waste water management plan

xi. Landscape management plan

xii. Revegetation management plan

xiii. Mine closure and abandonment plan

xiv. After-use plan

xv. Monitoring plan

xvi. Health and safety plan

xvii. Emergency and contingency planning