SECTION 2

APPENDICES FOR GUIDELINES FOR MINING AND SUSTAINABLE DEVELOPMENT

Mining and Environment Guidelines Adopted at the International Round Table on Mining and the Environment

Berlin, 25-28 June 1991

A full set of the papers presented at the meeting in Berlin, as well as a summary of the discussions is published in Mining and the Environment: The Berlin Guidelines*, which is available from Mining Journal Books, 60 Worship St, London EC2A 2HD, UK.*

Environmental Management Guidelines for Mining

Worldwide long-term economic development can best be achieved through the pursuit of sustainable development policies comprising a balance of economic, sociocultural and environmental protection measures. While taking into account global environmental concerns, each country should apply this concept to meet the needs of their environmental and economic circumstances.

Sustainable mining activities require good environmental stewardship in all activities, from exploration and processing to decommissioning and reclamation. It acknowledges the importance of integrating environmental and economic considerations in the decision-making process and the fact that the mineral deposits are unique in their occurrence. It recognizes the importance of mining to the social, economic and material needs of society, in particular for developing countries, and that minerals, notably metals, offer great potential for the use of future generations through increased recycling programs.

Sustainable mining under appropriate environmental guidelines is based on interaction between industry, governments, non-governmental organizations and the public, directed towards optimizing economic development while minimizing environmental degradation. The need for such guidelines is recognized by industry, governments and international agencies. It is also recognized that the political will of governments, together with the commitment of industry management and of the community, are the essential conditions needed to enforce environmental legislation, and more importantly, to ensure compliance with all applicable laws for the protection of the environment, employees and the public.

Environmental Guidelines for Action Addressed to the Mineral Sector

Governments, mining companies and the minerals industries should as a minimum:

1. Recognize environmental management as a high priority, notably during the licencing process and through the development and implementation of environmental management systems. These should include early and comprehensive environmental impact assessments, pollution control and other preventative and mitigative measures, monitoring and auditing activities, and emergency response procedures.
2. Establish environmental accountability in industry and government at the highest management and policy-making levels.
3. Encourage employers at all levels to recognize their responsibility for environmental management and ensure that adequate resources, staff, and requisite training is available to implement environmental plans.
4. Ensure the participation and dialogue with the affected community and other directly interested parties on the environmental aspects of all phases of mining activities.
5. Adopt best practices to minimize environmental degradation, notably in the absence of specific environmental regulations.
6. Adopt environmentally sound technologies in all phases of mining activities and increase the emphasis on the transfer of appropriate technologies that mitigate environmental impacts, including those from small-scale mining operations.
7. Seek to provide additional funds and innovative financial arrangements to improve environmental performance of existing mining operations.
8. Adopt risk analysis and risk management in the development of regulation and in the design, operation and decommissioning of mining activities, including the handling and disposal of hazardous mining and other wastes.
9. Reinforce the infrastructure, information systems service, training and skills in environmental management in relation to mining activities.
10. Avoid the use of such environmental regulations that act as unnecessary barriers to trade and investment.
11. Recognize the linkages between ecology, sociocultural conditions and human health and safety, both within the workplace and the natural environment.
12. Evaluate and adopt, wherever appropriate, economic and administrative instruments such as tax incentive policies to encourage the reduction of pollutant emissions and the introduction of innovative technology.
13. Explore the feasibility of reciprocal agreements to reduce transboundary pollution.
14. Encourage long term mining investment by having clear environmental standards with stable and predictable environmental criteria and procedures.

Environmental Guidelines for Action Addressed to Development Assistance Agencies

Multilateral and bilateral assistance agencies have an essential role to play in furthering environmental management, particularly in developing nations, and in assisting these nations in programs to protect their environment, both nationally and as part of the global environmental system. Accordingly, they should:

1. Accord high priority to the mitigation of environmental degradation associated with mining in developing countries to achieve high environmental performance.
2. Initiate, as an integral part of any exploration and mining project, environmental institutional building programs. Special support should be given to countries actively working to improve their environmental capabilities.
3. Require that all mining projects supported shall contain a training component that will include specific training on environmental awareness and its application to the mining sector.
4. Support increased research regarding the development of new processes with fewer environmental impacts, including recycling.
5. Support the development of activities that would mitigate adverse effects on the sociocultural fabric and the ecosystem. To achieve this objective, international agencies should give priority to education and training that increase awareness of these issues and allow the affected communities to participate in decision-making.
6. In supporting mining projects, agencies should also take into account the following:
    - rehabilitation of displaced as a result of proposed project activity;
    - environmental history of the country;
    - large-scale impact on sociocultural patterns of the affected population;
    - the overall economic balance of the project vis-à-vis its total environmental impact;
    - the impact on other natural resources and fragile, ecologically sensitive areas, e.g. protected forest lands, mangroves, wildlife parks, neighbouring waterbodies, including seas.
7. Promote conferences and policy research on environmental management practices and technologies, and ensure the dissemination of this information.
8. Support and promote regional cooperative programs to achieve sustainable development of mineral resources.
9. Adopt environmentally safe methods of mining and processing to existing projects.
10. Increase and coordinate their assistance to developing nations in the field of environmental policies management.

Guideline for Establishing an Environmental Management System

Based on the ISO 14000 Series of Environmental Management System (EMS) Standards.

The ISO 14000 series, launched in 1993, is a project of the International Organization for Standardization (ISO) and is a collection of voluntary consensus standards that have been developed to assist organizations to achieve environmental and economic gains through the implementation of effective environmental management systems.

A properly implemented EMS can also contribute to the achievement of a number of other objectives, e.g.:

- compliance with environmental regulations;
- meet internal standards and targets;
- improve investor and/or customer satisfaction;
- improve the company's public image;
- improve relations with regulatory authorities;
- ease permitting process;
- decrease short- and long-term liabilities.

The ISO 14001 standard is the key standard for an organization to effectively implement its environmental practices, while the other ISO 14000 standards can support this development and implementation by providing tools, methods, techniques and guidelines for management system auditing and environmental performance evaluations.

The Definition Standard of environmental terms is an important tool for understanding and interpreting the ISO 14000 series, while the ISO 14004 standard, General Guidelines on environmental principles, systems and supporting techniques, provide specific guidance and helpful hints for design and development of ISO 14001.

The relevant family of ISO standards is briefly described in Table 1.

Table 1: Description of ISO Standards (based on ISO definitions)

STANDARD	TITLE	SCOPE AND APPLICATION
ISO 14001 1996	Environmental management systems — specification with guidance for use.	This Standard specifies requirements for an EMS, to enable an organization to formulate a policy and objectives taking into account legislative requirements and information about significant environmental impacts. It applies to those environmental aspects, which the organization can control and over which it can be expected to have an influence. It does not itself state specific environmental performance criteria. This International Standard is applicable to any organization that wishes to: • implement, maintain and improve an environmental management system; • assure itself of its conformance with its stated environmental policy; • demonstrate such conformance to others; • seek certification/registration of its environmental management system by an external organization; • make a self-determination and self-declaration of conformance with this International Standard.
ISO 14004 1996	Environmental management systems — General Guidelines on principles, systems and supporting techniques.	This International Standard provides guidance on the development and implementation of environmental management systems and principles, and their coordination with other management systems. The Guidelines are applicable to any organization, regardless of size, type, or level of maturity, which is interested in developing, implementing and/or improving an environmental management system. The Guidelines are intended for use as a voluntary, internal management tool and are not intended for use by EMS certification/registration bodies as a specification standard.
ISO 14010 1996	Guidelines for environmental auditing — General principles.	This Standard provides the general principles of environmental auditing that are applicable to all types of environmental audits. Any activity defined as an environmental audit in accordance with this International Standard should satisfy the recommendations given in this International Standard.

STANDARD	TITLE	SCOPE AND APPLICATION
ISO 14011 1996	Guidelines for environmental auditing—Audit procedures—Part 1: Auditing of environmental management systems.	ISO 14011 establishes audit procedures that provide for the planning and performance of an audit of an EMS to determine conformance with EMS audit criteria.
ISO 14012 1996	Guidelines for environmental auditing—Qualification criteria for environmental auditors.	This International Standard provides guidance on qualification criteria for environmental auditors and lead auditors. This International Standard is applicable to both internal and external auditors. Criteria for the selection and composition of audit teams are not included; reference should be made to ISO 14011 for further information on these subjects.
ISO 14031 1999	Environmental Management—Environmental Performance Evaluation Guidelines .	ISO 14031 supports ISO 14001. Environmental Performance Evaluation (EPE) is an internal process and tool designed to provide management with reliable and verifiable information on an ongoing basis to determine if an organization's environmental performance is meeting the criteria set by the organization's management. EPE can be applied where an EMS exists to evaluate environmental performance against environmental policy, objectives, targets and other environmental criteria. In the absence of an EMS, EPE can be used to assist in the identification of a company's environmental aspects, determining which it will treat as significant and setting criteria for its environmental performance. The purpose of EPE is to identify areas for improvement and can be used for current evaluation of performance and temporal trends.

The Guideline outlined below specifies the elements of an environmental management system, which can apply to all types and sizes of organizations. The purpose of a system of this kind is to enable an organization to establish procedures to set an environmental policy and objectives, achieve compliance with them, ensure continuous improvement through regular updating of knowledge and demonstrate such competence to others.

It contains a specification for an environmental management system for ensuring and demonstrating compliance with stated environmental policies and objectives. It also provides guidance on the implementation of the specification within the overall management system of an organization.

Based on the Environment Australia's Best Practice Guidelines (see reference in Appendix 11, under Ameef), the components of a full EMS designed for the mining industry include the following elements:

1. organizational commitment;
2. corporate environmental policy;
3. environmental impact assessment (not always standard for an EMS, but typically included for a mining EMS);
4. community consultation and involvement;
5. corporate performance indicators;
6. environmental management programme;
7. documentation and records;
8. operational and emergency procedures;
9. responsibility and reporting structure;
10. training, awareness and competence;
11. environmental impact, regulatory and legal compliance and environmental performance review audits;
12. emission and performance monitoring and measurement.

To be fully effective, an EMS must be fully integrated into the everyday operation of the site. An EMS requires periodic internal and external review to refine and optimize its operation. Therefore, environmental management audits and environmental management reviews are inherent but separate parts of the system. Audits assess both the environmental management system and the achievements of the environmental objectives. Reviews check the continuing relevance of the environmental policy, update the evaluation of the environmental effects, and check the efficacy of the audits and follow-up actions.

1. Scope

The EMS should be applicable to any organization that wishes to:

a) assure itself of compliance with a stated environmental policy;

b) demonstrate such compliance to others;

c) seek certification of its EMS by an external organization.

2. Environmental Management System Requirements

2.1 Environmental Management System

The system must provide for the preparation and implementation of documented system procedures and instructions.

A programme for achieving environmental objectives and targets needs to be established and maintained. This, in part, is achieved through the definition of corporate environmental policy.

2.2 Environmental Policy

Definition and documentation of an organization's environmental policy. The policy should be in the form of a public statement of the company's intentions with respect to the environment. It should also inform the company's own employees with regard to environmental goals and the level of performance the company intends to maintain.

2.3 Organization and Personnel

2.3.1 Responsibility, Authority and Resources

Definition and documentation of the responsibility, authority and interrelations of key personnel, who manage, perform and verify work affecting the environment.

2.3.2 Verification Resources and Personnel

Identification of in-house verification requirements and procedures, provision of adequate resources and assignment of trained personnel for verification activities.

2.3.3 Management Representative

Appointment of a management representative who has defined authority and responsibility for ensuring that the requirements of the environmental standard are implemented and maintained. This appointment should normally take place at a senior level.

2.3.4 Personnel, Communication and Training

Establishment and maintenance of procedures to ensure that employees are aware of:

- the importance of compliance with environmental policy and objectives;
- the potential environmental effects of their work activities and the benefits of improved environmental performance;
- their roles and responsibilities in achieving compliance with the environmental policy and objectives;
- the potential consequences of departure from agreed operating procedures.

2.4 Environmental Effects

2.4.1 Register of Legislative, Regulatory and Other Policy Requirements

Establishment and maintenance procedures to record all legislative regulatory and other policy requirements relating to the environmental aspects of the organization's activities, products and services.

2.4.2 Communications

Establishment and maintenance of procedures for receiving, documenting and responding to communications from relevant interested parties concerning its environmental effects and management (e.g. complaints).

2.4.3 Environmental Impact Assessment

Establishment and maintenance of procedures for examining and assessing the environmental effects, both direct and indirect, of activities, products and services the production of an environmental impact assessment (EIA). The EIA is an essential component of company strategy with respect to minimizing environmental impacts arising from its operations.

2.5 Environmental Objectives and Targets

The objectives and targets should be consistent with the environmental policy and should quantify, wherever practicable, the commitment to continual improvement in environmental performance over defined time scales, relative to data collected during the EIA and associated audits.

Definitions:

a) ***Environmental objectives:*** The goals, in terms of environmental performance, which an organization sets itself to achieve and which should be quantified wherever practicable, e.g.:

- performance levels specified in the EIA;
- compliance with regulatory limits;
- reduction of environmental impacts;
- public satisfaction with company responses to complaints or inquiries.

b) ***Environmental targets:*** Detailed performance requirements, quantified wherever practicable, applicable to the organization or parts thereof, which arise from the environmental objectives and which need to be met in order to achieve those objectives, e.g.:

- compliance with recommendations from site audit or regular checklist inspections;
- internal waste reduction;
- internal savings targets.

2.6 Environment Management Plan

The Environment Management Plan should be designed to illustrate how the company will achieve its objectives and targets. It should also set out the environmental performance indicators that will be used to measure progress. Environmental performance indicators are defined by the International Standards Organization as "[...] a type of environmental indicator used in relation to the organization's management and operations".

2.7 Environmental Management Manual and Documentation

2.7.1 Manual

Establish and maintain a manual to:

- collate the environmental policy, objectives, targets and programme;
- document the key roles and responsibilities of personnel;
- describe the interactions of system elements;
- provide direction to related documentation and describe other aspects of the management system, where appropriate.

2.7.2 Documentation Control

Establish and maintain procedures for controlling all environmentally related documents.

2.7.3 Environmental Management Records

Establish and maintain a system of records in order to demonstrate compliance with the requirements of the environmental management system.

2.8 Operational Control

2.8.1 General (management responsibilities)

Management responsibilities should be defined.

2.8.2 Control

Identify functions, activities and processes that affect, or have the potential to affect, the environment. These functions and activities should be planned to ensure that they are carried out under properly controlled conditions.

2.8.3 Verification, Measurement and Testing

Establish and maintain procedures for verification of compliance with specified requirements and for establishing and maintaining records.

2.8.4 Non-compliance and Corrective Action

The responsibility and authority for initiating investigation and taking corrective action in the event of non-compliance with specified requirements shall be defined.

2.9 Environmental Management Audits

2.9.1 General

Establish and maintain procedures for audits to be carried out in order to determine:

- whether or not the environmental management activities conform to the environmental management programme and are implemented effectively;
- the effectiveness of the environmental management system in fulfilling the organization's environmental policy.

For this purpose, an audit plan should be established and maintained.

2.9.2 Audit Plan

The audit plan should deal with the following points:

- the specific activities and areas to be audited;
- the frequency of auditing of each activity area based on the nature and environmental importance of the activity concerned, and the results of the previous audit;
- who has the responsibility for auditing each activity area;
- personnel requirements;
- the protocol for conducting the audits, which may involve the use of questionnaires, checklists, interviews, measurements and direct observations, depending on the nature of the function being audited;
- the procedures for reporting audit findings to those responsible for the activity area audited and who shall take action on reported deficiencies;
- the procedures for publishing audit findings if the organization has undertaken such a commitment.

2.10 Environmental Management Reviews

At appropriate intervals the environmental management system adopted needs to be reviewed to ensure it satisfies the organization's requirements and to ensure its continuing effectiveness. Management reviews should include an assessment of the results of environmental management audits, which are a systematic, documented and objective evaluation of the performance of the organization, environmental management and control systems currently in place with the aim of protecting the environment.

Contact Details

ISO members offer information and customer services with regard not only to international standards and standardizing activities, but also to national and regional standards, regulations, certification and related activities, which do not fall within ISO's sphere of activity. Therefore the first point of contact should always be the ISO member in your country.

International Organization
for Standardization
1, rue de Varembé
Case postale 56
CH-1211 Genève 20
Switzerland
Tel: 41 22 749 01 11
Fax: 41 22 733 34 30
Email: central@iso.ch
Web: http://www.iso.ch

International Council on Metals and the Environment: Environmental Charter 1998

The International Council on Metals and the Environment (ICME) brings together major non-ferrous and precious metal mining and primary metal companies on a worldwide basis. Its purpose is to promote sound environmental and related health policies and practices to ensure the safe production, use and recycling and disposal of metals.

To this end, ICME develops and continuously reviews criteria for responsible policies and practices in relation to the environment and health. ICME emphasizes the importance of sound science and technical and economic analyses to support its position and to improve environmental and health standards internationally.

Preamble

Everywhere in the world, the progress and prosperity of individuals, communities and societies depend on the economic production and availability of a broad range of metals. In coming years, population growth and expectations of improvement in the quality of life, notably in developing countries, will necessitate additional assured supplies of metals. ICME members have the capacity not only to meet these increasing requirements, but also to add to human progress and scientific knowledge. They recognize that this will require environmentally acceptable economic development.

ICME members are determined to achieve and demonstrate progress in environmental performance consistent with the improving standards people everywhere expect in today's world. Neither their operations nor their products should present unacceptable risks to employees, customers, the general public or the environment. Members of ICME accept the importance of responsibly managing their operations and products. They will adopt appropriate measures and implement enhanced risk management strategies, in current and future activities, to foster environmentally sustainable economic development.

On behalf of its members, ICME will participate in the international debate and contribute to international understanding, thus helping to determine the way in which the world moves into the next century and will be guided by the principles set out below.

Product Stewardship Principles

- Develop or promote metal products, systems and technologies that minimize the risk of accidental or harmful discharges into the environment.
- Advance the understanding of the properties of metals and their effects on human health and the environment.
- Inform employees, customers and other relevant parties concerning metal-related health or environmental hazards and recommend improved risk management measures.
- Conduct or support research and promote the application of new technologies to further the safe use of metals.
- Encourage product design and uses that promote the recyclability and the recycling of metal products.
- Work with government agencies, downstream users and others in the development of sound, scientifically based legislation, regulations and product standards that protect and benefit employees, the community and the environment.

Environmental Stewardship Principles

- Meet all applicable environmental laws and regulations and, in jurisdictions where these are absent or inadequate, apply cost-effective management practices to advance environmental protection and to minimize environmental risks.
- Make environmental management a high corporate priority, and the integration of environmental policies, programs and practices an essential element of management.
- Provide adequate resources, staff and requisite training so that employees at all levels are able to fulfil their environmental responsibilities.
- Review and take account of the environmental effects of each activity, whether exploration, mining or processing, and plan and conduct the design, development, operation, and closure of any facility in a manner that optimizes the economic use of resources while reducing adverse environmental effects.
- Employ risk management strategies in design, operation and decommissioning, including the handling and disposal of waste.
- Conduct regular environmental reviews or assessments and act on the results.
- Develop, maintain and test emergency procedures in conjunction with the providers of emergency services, relevant authorities and local communities.
- Work with governments and other relevant parties in developing scientifically sound, economic and equitable environmental standards and procedures, based on reliable and predictable criteria.

- Acknowledge that certain areas may have particular ecological or cultural values alongside development potential. In such instances, consider these values along with the economic, social and other benefits resulting from development.
- Support research to expand scientific knowledge and develop improved technologies to protect the environment, promote the international transfer of technologies that mitigate adverse environmental effects, and use technologies and practices that take due account of local cultures and customs and economic and environmental needs.

In support of the above Environmental Charter, in communicating ICME policies and principles and in promoting better understanding, ICME will seek to:

- provide a free flow of information on international environmental and developmental issues affecting the industry;
- listen and respond to the public about metals and the environment;
- develop and implement programs that communicate the benefits of a balanced consideration of environmental, economic and social factors;
- present products, processes or services as being environmentally sound only when supported by well-founded contemporary data; and
- ensure information provided is candid, accurate and based on sound, technical, economic and scientific data.

Statement of Community Principles

Preamble

In response to the world's growing need for metals, the mining industry seeks high quality ore bodies in all parts of the globe. The discovery of deposits and their subsequent development provides the mining industry with an opportunity to foster sustainable improvements in health, education and prosperity. The following principles offer guidance to ICME members on how to relate to their local communities during the exploration, development, operation and closure of mining and related activities.

Core Principles

1. Respect the cultures, customs and values of individuals and groups whose livelihood may be affected by exploration, mining and processing.
2. Recognize local communities as stakeholders and engage with them in an effective process of consultation and communication.
3. Contribute to and participate in the social, economic and institutional development of the communities where operations are located and mitigate adverse effects in these communities to the greatest practical extent.
4. Respect the authority of national and regional governments and integrate activities with their development objectives.

Contact Details

International Council on Metals and the Environment, 1998
http:// 206.191.21.210/icme/envchar.htm

International Council on Metals and the Environment
294 Albert Street, Suite 506
Ottawa, Ontario K1P 6E6
Canada
Tel: 613-235-4263
Fax: 613-235-2865
Email: info@icme.com

The Mining Association of Canada: Environmental Policy 1995

Member companies of The Mining Association of Canada are committed to sustainable development, which embodies protection of human health, the natural environment and a prosperous economy. In all jurisdictions, in addition to complying with legislative requirements, member companies will diligently apply technically proven and economically feasible measures to advance protection of the environment throughout exploration, mining, processing, manufacturing and closure. The member companies of The Mining Association of Canada will:

Corporate Priority. Recognize environmental management as an important corporate priority and establish policies, programmes and practices for conducting business in an environmentally sound manner.

Integrative Management. Integrate environmental policies, programmes and practices into all activities of the organization.

Environmental Management. Monitor the performance of environmental programmes and management systems to ensure compliance with company and legislative requirements and this policy.

Continual Improvement. Establish an ongoing programme of review and improvement of environmental performance, taking into account technical and economic developments, scientific understanding and environmental effects of operations.

Efficiency. Develop, design and operate facilities based upon the efficient use of energy, resources and materials.

Risk Management. Identify, assess and manage environmental risks.

Incident Management. Develop, maintain and test emergency preparedness plans to ensure protection of the environment, workers and the public.

Research. Support research to advance understanding of industry's impact on the environment and to reduce harmful effects through improved practices and technologies.

Technology Transfer. Contribute to the dissemination of environmentally sound technology and management methods.

Public Policy. Work with government and the public to develop effective, efficient, and equitable measures to protect the environment based on sound science.

Contractors and Suppliers. Require contractors to comply with corporate environmental requirements and work cooperatively with suppliers to identify opportunities to improve environmental performance.

Communications. Encourage dialogue on environmental issues with employees and the public and be responsive to concerns.

Employees. Ensure that all employees understand and are able to fulfil their environmental responsibilities.

Closure. Reclaim sites in accordance with site-specific criteria in a planned and timely manner.

Contact Details

The Mining Association of Canada, 1995
http://www.mining.ca/english/publications/policy.html

The Mining Association of Canada
350 Sparks Street, Suite 1105
Ottawa, Ontario K1R 7S8
Canada
Tel: 613-233-9391
Fax: 613-233-8897

The Australian Minerals Industry Code for Environmental Management

Code for Environmental Management

More than in any other way, the community judges the minerals industry by its environmental performance. Recognizing the need to achieve environmental excellence and to be open and accountable to the community, Australia's minerals industry has developed a Code for Environmental Management. The Code has been strengthened by contributions from government and non-government organizations.

The Code is the centrepiece of a new commitment to respond to community concerns through consultation, demonstrated environmental performance, continual improvement and public reporting.

Adoption of the Code is voluntary and open to all minerals companies. Signatories will be required to demonstrate their commitment to environmental excellence and provide leadership to the minerals industry for the broad adoption of the Code. Irrespective of whether a company becomes a signatory, the Code provides a basis for improving environmental performance through progressive implementation of the Code's principles.

Effective environmental management within the minerals industry must take into account the physical, environmental, statutory, economic and social parameters relevant to each operation. Therefore, the Code provides a comprehensive framework for the development of effective systems and processes for each operation. It does not prescribe specific practices, standards or any particular local requirements, as they cannot provide effective environmental management across diverse operations.

The Code does not set entry standards but requires signatories' commitment to continual improvement and public reporting of Code implementation and environmental performance. Signatories will progressively implement the Code's principles by putting in place systems and processes to achieve full implementation over time.

Signatories will apply the Code wherever they operate. The principles will guide signatories through each phase of mineral development, from exploration, through design and construction to mining, minerals processing, rehabilitation and decommissioning.

Signatories to the Code will:

- observe the policies, and respect the aspirations of State, Territory and sovereign governments relevant to mineral developments;
- facilitate community partnerships on environmental matters;
- report publicly on environmental performance and implementation of the Code.

The industry recognizes that community, government and industry needs and expectations will change over time. The Code will continue to evolve with ongoing input from all stakeholders.

Statement of Principles

Signatories to the Code are committed to excellence in environmental management through:

Sustainable Development. Managing activities in a manner consistent with the principles of sustainable development such that economic, environmental and social considerations are integrated into decision making and management.

Environmentally Responsible Culture. Developing an environmentally responsible culture by demonstrating management commitment, implementing management systems, and providing the time and resources to educate and train employees and contractors.

Community Partnership. Consulting the community on its concerns, aspirations and values regarding development and operational aspects of mineral projects, recognizing that there are links between environmental, economic, social and cultural issues.

Risk Management. Applying risk management techniques on a site-specific basis to achieve desirable environmental outcomes.

Integrated Environmental Management. Recognizing environmental management as a corporate priority and integrating environmental management into all operations from exploration, through design and construction to mining, minerals processing, rehabilitation and decommissioning.

Performance Targets. Setting environmental performance targets not necessarily limited to legislation, licence and permit requirements.

Continual Improvement. Implementing management strategies to meet current and anticipated performance standards and regularly reviewing objectives in the light of changing needs and expectations.

Rehabilitation and Decommissioning. Ensuring decommissioned sites are rehabilitated and left in a safe and stable condition, after taking into account beneficial uses of the site and surrounding land.

Reporting. Demonstrating commitment to the Code's principles by reporting the company's implementation of the Code and environmental performance to governments, the community and within the company.

Systems and Processes

The systems and processes relevant to each Principle are:

Sustainable Development

Managing activities in a manner consistent with the principles of sustainable development such that economic, environmental and social considerations are integrated into decision making and management.

- Support activities to improve knowledge of the short- and long-term availability and use of mineral resources.
- Promote reuse and recycling of mineral products and by-products to maximize their utility to current and future generations.
- Pursue cleaner production through research, technological innovation, operational efficiencies and waste minimization.
- Recognize the maintenance of ecological and cultural heritage values as an important consideration in sustainable development.

Environmentally Responsible Culture

Developing an environmentally responsible culture by demonstrating management commitment, implementing management systems, and providing the time and resources to educate and train employees and contractors.

- Develop, implement and communicate an environmental policy consistent with the Code.
- Demonstrate management commitment through application of environmental management practices consistent with the Code.
- Implement effective environmental education and training programmes for all employees and contractors.
- Ensure that employees and contractors are provided with necessary company policies, goals, procedures, guidelines and practices for environmental and heritage protection.
- Require employees and site contractors to comply with company practices and procedures.
- Facilitate community education about the minerals industry and its environmental management.

Community Partnership

Consulting the community on its concerns, aspirations and values regarding development and operational aspects of mineral projects, recognizing that there are links between environmental, economic, social and cultural issues.

- Identify directly and indirectly affected stakeholders, and their concerns.
- Foster openness and dialogue with employees and the community, promote cross-cultural awareness, and specifically address concerns about environmental and social impacts.
- Provide to the community technical information about potential effects of operations, products, waste and rehabilitation practices.
- Establish community consultation relevant to each stage of operations.

Risk Management

Applying risk management techniques on a site-specific basis to achieve desirable environmental outcomes.

- Utilize environmental baseline studies as the basis for risk management.
- Evaluate the risks of alternative project concepts, weighing the positive and negative consequences of the outcomes and provide opportunities for stakeholder participation.
- Implement management strategies to mitigate environmental impacts of the preferred development option.
- Adopt a proactive and cautious approach to reasonably foreseeable environmental risks.
- Develop and implement contingency plans to address incidents and abnormal operating and environmental conditions.

Integrated Environmental Management

Recognizing environmental management as a corporate priority and integrating environmental management into all operations from exploration, through design and construction to mining, minerals processing, rehabilitation and decommissioning.

- Establish a management system that allocates management and employee responsibilities relevant to the organization's activities and applicable legal requirements.
- Address within an environmental management system:
    - applicable legal and regulatory requirements;
    - requirements under this Code and any other codes to which the company is a signatory;
    - company environmental policies, objectives and targets;
    - environmental management plans and procedures;
    - environmental monitoring procedures;

- setting and testing of contingency and emergency response plans;
- regular auditing of the environmental management system and environmental performance;
- reporting procedures.

- Periodically review the environmental management system to ensure that it remains effective and relevant to the company's evolving needs and changing community values and expectations.

Performance Targets

Setting environmental performance targets not necessarily limited to legislation, licence and permit requirements.

- Identify legal and other requirements applicable to the environmental aspects of the organization's activities, products or services.
- Set internal performance targets and periodically assess achievements to reinforce policy commitments and to enable demonstration of continual improvement.
- Ensure that legal requirements and internal performance targets are effectively communicated to the employees who are accountable for the relevant activities.

Continual Improvement

Implementing management strategies to meet current and anticipated performance standards and regularly reviewing objectives in the light of changing needs and expectations.

- Regularly review and update corporate policies, programmes, and environmental performance to correct any deficiencies.
- Assess and rank environmental issues in order to concentrate efforts in priority areas and where maximum gains are achievable.
- Undertake, participate in, or support research on priority issues and facilitate transfer of information on technical developments, scientific understanding, consumer needs and community expectations.

Rehabilitation and Decommissioning

Ensuring decommissioned sites are rehabilitated and left in a safe and stable condition, after taking into account beneficial uses of the site and surrounding land.

- Incorporate rehabilitation and decommissioning options in the conceptual design of operations at the feasibility stage.
- Develop clearly defined rehabilitation plans, monitor and review rehabilitation performance and progressively refine such plans.
- Determine and account for rehabilitation and decommissioning costs and periodically review their adequacy during the life of the operation.
- Establish a programme of progressive rehabilitation commensurate with the nature of the operation and the rate of disturbance.
- Periodically review the rehabilitation and decommissioning strategies over the life of the operation to incorporate changing legislative requirements, public expectations and environmental and cultural heritage information.
- Address issues and programmes related to long-term responsibility for land management in the final decommissioning plan.

Reporting

Demonstrating commitment to the Code's principles by reporting the company's implementation of the Code and environmental performance to governments, the community and within the company.

- Implement regular reporting of environmental performance to all stakeholders, including the Board of Directors, shareholders, employees, authorities and the community.
- Provide an annual public environmental report.
- Reports should describe the company's processes for:
    - communicating environmental policy;
    - communicating environmental performance;
    - community consultation and responding to concerns;
    - code implementation.
- Reports should also include, but not be limited to:
    - organization profile, environmental policies and objectives;
    - environmental management processes;
    - establishment of benchmarks against which continual improvement can be measured;
    - opportunities/progress in improvements;
    - prosecutions and associated significant environmental incidents;
    - performance in relation to regulatory requirements and internal targets;
    - environmental and heritage issues to be addressed and strategies to implement them.

Code Implementation

Companies committing to the Code will be listed on a register maintained by the Code Secretariat. Initially, the Secretariat will be provided by the Minerals Council of Australia.

Eligibility

All mining and minerals processing companies are eligible to become Code signatories, provided they commit to its implementation. Membership of an industry association is not a prerequisite to becoming a signatory. Similarly, being a signatory is not a prerequisite for association membership. State Minerals Councils, Chambers of Mines and other minerals industry associations may associate with the Code.

Signatory companies will use all reasonable endeavours to have the Code Principles applied to operations in which they hold a non-controlling interest.

Registration

Companies wishing to commit to the Code will advise the Code Secretariat by letter. Eligible companies will be added to the register, which will be published and available for public inspection. Individual companies may choose to publicize their registration.

Performance Review

Implementation of the Code will be evaluated by qualified, externally accredited auditors from within the signatory company, or by accredited external auditors appointed by the company at least every three years.

Reporting

Signatories to the Code will produce annual public environmental reports in accordance with the Code's Reporting Principle. The first report is to be prepared within two years of registration.

The reports are expected to demonstrate the company's commitment to, and implementation of the Code and describe its performance in relation to the key Principles.

Companies are to make their annual environmental reports available to the public through their corporate and regional offices. Copies of each report, for public review, are to be lodged with the Code secretariat and in major libraries in jurisdictions within which the company operates.

Code Review

The Code will be a living document and will continue to be refined and developed. Consultation with stakeholders will continue. The Code will be formally reviewed in 1999, when signatories will be invited to recommit to the Code.

The Code will provide a rigorous framework to guide mining companies towards effective environmental management strategies for each phase of mine development.

Contact Details

Web: http://www.minerals.org.au/

Secretariat:
Minerals Council of Australia
P O Box 363
Dickson ACT 2602
Australia
Tel: 61 26 279 36 00
Fax: 61 26 279 36 99

Environmental Management Programme for Exploration

This appendix has been drafted by UN staff members and consultants over several years.

The primary environmental objective of an exploration programme should be to minimize disruption to landholders, the ecology, waterways, livestock and land. An environmental management plan (EMP) should be prepared for areas subject to advanced exploration, which is defined as meaning "the excavation of exploratory shafts, adits or declines, the digging of test pits and trenches, and the associated removal of material for bulk testing from an exploration or mining licence area, the installation of a portable pilot plant or other temporary facility for ore and rock testing purposes, or any other significant ground disturbance conducted to determine the existence of a commercially exploitable mineral deposit".

The more intensive the exploration programme, the more rigorous should be the EMP.

An EMP for an exploration programme should address some or all of the following (other factors may also need to be taken into consideration at certain sites):

Broad Issues

- Define project team, chain of command, responsibility, etc;
- Place environmental conditions on the exploration licence;
- Current land use of the locality;
- Documentation of pre-exploration environmental baseline (qualitative and quantitative);
- Current land tenure, landholder and land-user details;
- Conservation value of the land, presence of rare or endangered flora or fauna species;
- Significant features of the locality (e.g. waterways, wetlands, cliff lines, heritage sites, important food producing areas);
- Significant seasonal variations in climate;
- Access, presence of existing tracks and roads;
- Any particular diseases in the human, animal or vegetation populations;
- Presence of noxious weeds or feral animals;
- Fire precautions or other emergency provisions required;
- Siting of temporary campsite away from environmentally sensitive areas;
- Communications and community relations.

Management Details

- Minimize noise and dust when working near residential areas.
- Avoid unnecessary disturbance to livestock.
- Keep site clean and tidy and remove all rubbish.
- Identify any rare or endangered species and ensure their protection. Avoid spreading any plant or animal disease or noxious weeds.
- Use existing tracks wherever possible and keep clearing to an absolute minimum.
- Design new tracks to go around significant trees and roll vegetation, where necessary, so as to maintain topsoil and root systems.
- Avoid environmentally sensitive locations such as creek banks and areas subject to erosion.
- All fuel, sewage and chemicals should be stored properly to avoid contamination of water or land.
- Drill holes should be capped or filled in, excavations back filled or fenced if they are to be left open and markers removed.
- Avoid unnecessary disturbance to soil surface to prevent erosion and retain as much vegetation as possible.
- Minimize risk of fire.
- Where vegetation has to be cleared, stockpile the topsoil (separately from the subsoil) and replace on disturbed areas (seeded or fertilized, if required).
- Ensure saline or contaminated water and drill fluids are not discharged into the surrounding environment via sumps, controlled drainage, etc.
- Disturbed areas should be ripped to facilitate revegetation. The uneven surface will retain moisture from rainfall and windblown plant seed.
- Remove all equipment and litter from the site.
- Cap drill holes.
- Clear and backfil sumps.
- Make arrangements for periodic monitoring and assessment of remedial action.

Parameters to be Included in an Environmental Impact Statement

This appendix has been drafted by UN staff members and consultants over several years.

In addition to the details of the proposed mining development the following environmental data should be collected in detail:

Land Ownership

Details of land ownership, tenure and existing land use are an important basis of the EIS. It is important that the ownership of traditional land by indigenous people and archaeological sites of significance be reviewed as soon as an area is identified for mineral exploration.

Projects planned and implemented in cooperation with indigenous people can result in fewer adverse social impacts and can be expected to provide equitable benefits to local communities. There is a greater likelihood that mining projects will be permitted to proceed without costly delays and interruptions when all parties are encouraged to negotiate in a constructive and positive role. Such cooperation can increase both the returns to mining companies and the long-term enhancement of the social well-being of traditional people.

Two areas which will require particular identification and investigation are:

i) anthropological land ownership regions.

ii) archaeological sites of significance.

Climactic Data

A climactic profile for the locality should be constructed by collecting the following data:

- rainfall (data collected at 9:00 a.m. and 3:00 p.m. daily);
- evaporation (data collected at 9:00 a.m. and 3:00 p.m. daily);
- wind speed and direction (continuous collection of data);
- relative humidity (data collected at 9:00 a.m. and 3:00 p.m. daily);
- temperature maximum/minimum (data collected at 9:00 a.m. daily);
- barometric pressure (data collected at 9:00 a.m. and 3:00 p.m. daily).

Flora (Vegetation)

A comprehensive flora study should include:

- an inventory of terrestrial and aquatic flora;
- population and density data for vegetation species;
- identification of valued populations (e.g. where vegetation/trees are scarce);
- identification of any rare or endangered species.

Fauna (Animals)

A comprehensive fauna study should include:

- an inventory of terrestrial, aquatic and avifauna and bats;
- population and density of animal species;
- permanent/migratory populations (with identification of trans-migratory routes);
- habitat;
- identification of any rare or endangered species.

Terrain Analysis

This study should address:

- geology;
- geomorphology;
- drainage;
- hydrogeology;
- soil classification;
- erosion potential.

Air Quality

Air quality studies draw on climactic data coupled with projected emission data from the mining or mineral processing activity to forecast expected levels of:

- total background particulate;
- dusts containing biologically-significant silica/silicates;
- noxious fumes;
- sulphur dioxide concentration;
- other gases.

Water Quality

Water quality studies draw on hydrology/receiving water and hydrogeology information coupled with projected discharge data from the mining or mineral processing operation to develop profiles for:

- surface water quality;
- groundwater quality.

Waste Disposal and Chemical Safety

Identification of anticipated chemicals that will be used on the site, a possible inventory, proposed storage and handling procedures, emergency planning procedures, and waste disposal arrangements should be considered from an early stage.

Parameters to be Included in a Socio-Economic Impact Assessment

This document was prepared by. Meredith Sassoon,
Mining Environmental Management Consultant, January 2001

A Socio-Economic Impact Assessment (SEIA) is concerned with identifying, predicting and evaluating the foreseeable socio-economic impacts, both beneficial and adverse, with a view to eliminating or minimizing the negative impacts while optimizing the positive impacts. The SEIA should be carried out during the feasibility stage of the proposed project and should contribute to project formulation and design. The findings of the Socio-Economic Impact Assessment should be summarized in the Environmental Impact Statement and the study attached as an appendix. The Environmental Impact Statement should be submitted for approval at the same time as the draft Feasibility Study.

Objectives

The specific objectives of the Socio-Economic Impact Assessment are to:

- define the local community or communities whose socio-economic or socio-cultural environments will be most immediately and directly affected by the project;
- establish the areas or zones of social, economic and cultural impact both in the immediate project area and in the wider context;
- describe the existing social, economic and cultural features and status of these zones;
- define the direct and indirect impacts of the proposed project;
- establish mitigation measures for minimizing negative impacts;
- propose methods and procedures for enhancing positive impacts;
- improve the level of communication between the proponent and the community;
- minimize the risk of conflict between the proponent and the community;
- demonstrate the proponent's capacity to optimize local participation in the project.;
- establish the proponent's contribution to the long-term development of the region;
- show that the proposed project is consistent with National, Provincial and Local Governments constitutional imperatives;
- develop a social and economic monitoring programme;
- ensure that the socio-economic status of the region is sustainable following closure.

Scope

As well as looking at the socio-economic aspects, the Assessment should take in to consideration the physical relationship between the community and the natural environment including land use, water, air and other natural features and resources in relation to the overall social environment of the potential impact area. The scope of the assessment should include:

- social structures;
- cultural profile;
- existing land use;
- resource utilization;
- economic basis;
- demography;
- infrastructure and services;
- health;
- education;
- law and order;
- historical, archaeological and cultural issues.

Potential Issues

The potential impacts should be assessed for all stages of the project including construction, operation, decommissioning and closure. The potential impacts should include:

- magnitude and significance of effects;
- beneficial and adverse impacts;
- direct and indirect impacts;
- short-, medium- and long-term impacts;
- reversible and irreversible impacts;
- cumulative impacts.

Monitoring

The SEIA should identify the methods and procedures for monitoring the positive and negative impacts of the project and establish a monitoring programme as part of the Environmental Management Programme. The monitoring programme should take into consideration any compensation agreements and Memorandums of Understanding. It is essential that this monitoring programme involve the local community and the National, Provincial and Local Governments.

Suggested Table of Contents of an Environmental Impact Statement (EIS) for a Mine Development Programme

The following table of contents for an EIS for a mine development programme is a very detailed guide to the headings and sub-headings that may be relevant to a new mining operation. It is based on the table of contents for an EIS that was produced by Epps & Associates (now EMC International) that won an award from the Royal Australian Planning Institute. The EIS was for the Camberwell Coal Project, New South Wales, Australia. The table has been generalized to accommodate metalliferous mining.

For this generic Table of Contents major impacts and issues that could arise at some stage of the project have been shown. In practice, the specific characteristics of the project will determine which items may be actual risk elements that should be addressed by the EIS and which items are irrelevant. In some circumstances additional elements may be required.

The list is not intended to be definitive. It is a guide only.

2. Geology

2.1 PREVIOUS EXPLORATION AND MINING

2.2 GEOLOGICAL SETTING

2.3 OVERBURDEN/INTERBURDEN

2.4 STRUCTURE

2.5 ORE RESOURCE

2.6 ORE RESERVES

3. Project Description

3.1 PROJECT CONCEPT

- 3.1.1 Outline
- 3.1.2 Site Constraints
- 3.1.3 Work Practice Implications

3.2 PRODUCTION RATES

3.3 PROJECTED PRODUCT SALES

3.4 OVERBURDEN AND INTERBURDEN REMOVAL

3.5 THE MINING PLAN

3.6 GEOTECHNICAL CONSIDERATIONS

3.7 TRANSPORT

- 3.7.1 Ore, Wastes, Concentrates
- 3.7.2 Chemicals

3.8 INFRASTRUCTURE

- 3.8.1 Construction Facilities
- 3.8.2 Site Access
- 3.8.3 Site Development and Earthworks
- 3.8.4 Site Facilities
- 3.8.5 Power
- 3.8.6 Fuel Storage
- 3.8.7 Maintenance and Repair Workshops
    - Laboratories
    - Temporary or Semi-permanent Accommodation

4.4 ALTERNATIVES

4.4.1 Siting of Processing Plant

4.4.2 Ore Handling Technology

4.4.3 Train/Truck Loading

5. Water Management

5.1 WATER MANAGEMENT STRATEGY

5.2 AVAILABLE WATER RESOURCES

5.2.1 Surface Waters

5.2.2 Groundwater

- Site Water Sources
- Local, Regional and National Significance of Water Resources

5.3 WATER CONSUMPTION REQUIREMENTS

5.3.1 Nature of Water Requirements

5.3.2 Processing Plant

5.3.3 Dust Suppression

5.3.4 Bathhouse and Industrial Uses

5.4 THE WATER CONTROL SYSTEM

5.4.1 Water Management Controls Strategy

- Rainfall Runoff
- Groundwater
- Potable Water Supply
- Domestic and Process Waste Waters

5.4.2 Water Control Network

5.5 PERFORMANCE UNDER VARYING CONDITIONS

5.5.1 Extreme Flow Rates

5.5.2 Normal Flow Rates

5.6 WATER BALANCE MODELING

5.6.1 Methodology

5.6.2 Model Inputs

5.6.3 Results

5.7 ALTERNATIVES

5.8 HYDROLOGICAL AND GEOCHEMICAL CONSIDERATIONS

5.8.1 Hydrological Considerations

5.8.2 Geochemical Considerations

- Acid Producing Potential
- Element Solubility
- Salinity Status

6. Rehabilitation

6.1 LEGISLATIVE REQUIREMENTS

6.2 POST-MINING LAND USE

6.2.1 Alternatives

6.2.2 Preferred Post Mining Land use

6.3 LANDFORM DESIGN

6.3.1 Design Criteria

6.3.2 Interim and Final Landforms

- Pit and Out-of-Pit Overburden Emplacements
- Post Mining Land Capability

6.4 REVEGETATION PROCEDURES.

6.4.1 Guidelines

- Clearing Topsoil Stripping
- Suitability of Overburden and Interburden
- Final Shaping
- Surface Preparation
- Seeding
- Tree Planting

6.4.2 Field Trials and Monitoring of Rehabilitation

6.4.3 Land Management Plan

7. Existing Environment and Environmental Impact Assessment

7.1 PHYSIOGRAPHY

7.2 SOILS

7.2.1 Soil Survey

7.2.2 Soil Profile Descriptions

- General Soil Characteristics
- Analytical Results
- Non-anthropogenic Soil Contamination
- Phyto- and Bio-availability of Natural Contamination

7.2.3 Suitability of Soils for Stripping, Stockpiling and Topdressing

7.2.4 Erosion Status

- Extent
- Erodibility of Soils
- Erosion Hazard
- Inventory of Emissions to Soils
    - Waste Rock
    - Overburden
    - Tailings
    - Slimes
    - Slags
    - Concentrates
    - Dusts
    - Fumes
    - Hydrocarbons
    - Other Process-related Wastes
- Nature of Emissions to Soils
    - Concentration and Bioavailability of Metals
    - Concentration and Bioavailability of Hydrocarbons
    - Concentration and Bioavailability of Other Contaminants
    - Potential for Acid Generation
- Soil Quality Impact Prediction
    - Long-term
    - Short-term
- Impact Assessment — Soil Quality

7.2.5 Environmental Management of Soils

- Chemical Management
- Proposed Stripping Practice
- Reduction of Erosion Hazard

7.3 HYDROLOGY AND WATER QUALITY

7.3.1 Hydrology

- Historic Flood Levels
- Basis of Calculations

7.3.2 Surface Water

- Usage
- Water Quality
- Monitoring Programme
- Results

7.3.3 Groundwater

- Groundwater Study
- Aquifer Characteristics
- Groundwater Monitoring Programme
- Existing Registered Groundwater Bores
    - Emissions Inventory
    - Nature of Emissions

7.3.4 Long- and Short-term Impact Assessment — Hydrology and Water Quality

- Surface Waters, Run-off and Springs
- Abstraction from Rivers
- Groundwater

7.4 CLIMATE AND AIR QUALITY

7.4.1 Climate

- Data Sources
- Wind
- Extreme Wind Gusts
- Rainfall
- Evaporation
- Temperature and Humidity
- Frost

7.4.2 Air Quality Assessment

- The Study
- Local Setting
- Aspects of the Project Influencing the Assessment
- Method of Assessing Impact

7.4.3 Dispersion Meteorology

- Introduction
- Wind Data
- Mixing Height and Stability Class

7.4.4 Air Quality Criteria

- Short-term Criteria
- Concentration
- Deposition
- Long-term Criteria
- Concentration
- Deposition

7.4.5 Existing Air Quality

- Emissions Inventory

    Inert Fugitive Dusts

    Fugitive Dusts containing Biologically-significant Silica/Silicates

    Vents from Process Plant

    Dust Blow from Surface Wastes

    Mineralized Dust from Ore and Solids Handling

    Process-related gases (e.g.: CO_2, NO_x, CO, etc.)

    Noxious fumes (e.g.: As_2O_3)

7.4.6 Air Quality Impact Prediction

- Modeling
- Long-term Impacts
- Short-term Impacts

7.4.7 Health Criteria

7.4.8 Impact Assessment — Air Quality

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7.5.1 Existing Acoustic Environment

7.5.2 Major Noise Sources from the Project

7.5.3 Evaluation of Noise Emission Levels

- Mineral Processing/Surface Handling and Mobile Equipment
- Product Transport

7.5.4 Noise Impact Assessment Procedures

- General Objectives
- Design Goals for Rural Areas
- Rail/Truck Traffic Noise

7.5.5 Predicted Noise Impact

7.5.6 Noise Mitigation

7.5.7 Blasting

- Material to be Blasted
- Predicted Levels of Blast Emission
- Blasting Impact

7.5.8 Impact Assessment

- Acoustics
- Blasting

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- Diversity
- Endangered, Rare or Threatened Species

7.6.2 Open Woodland and Wholly Cleared Land

7.6.3 Vegetation along Waterways

- Populations
- Density
- Valued Populations of Species

7.6.4 Impact Assessment — Vegetation, Biodiversity

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- Populations
- Migratory Characteristics
- Habitat
- Endangered, Rare or Threatened Species

7.7.2 Birds, Bats

7.7.3 Mammals

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7.7.5 Impact Assessment — Fauna, Biodiversity

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- Cropping
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Aide-mémoire for the Preparation of Environmental Management Programme Reports for Prospecting and Mining

Prepared by the South African Department of Mineral & Energy Affairs (now the Department of Minerals and Energy) in conjunction with the country's mining industry and the South African Agricultural Union.

Note: At the time of its printing in August 1992, the Aide-Mémoire was under review. It is expected that a new version will be available soon.

Preface

The holder of the right to any mineral in respect of land has the right to enter upon such land and to disturb the surface thereof in order to search for and win his mineral and so to establish a mine on the land concerned. While such right must in all respects be exercized in a responsible manner, the mining entrepreneur has a grave responsibility to manage the effects of the mining activity on the environment in such a way as to mitigate the negative impact whilst maximizing the positive features.

In order to enforce this responsibility the Minerals Act, l991, requires the owner of every mine to submit and obtain approval for an environmental management programme before mining operations may commence.

Various Government Departments have an interest, under different laws, in protecting the environment affected by mining. In an effort to simplify compliance with the legal provisions, these departments have adopted a holistic, co-coordinated approach in order to achieve a common goal.

This Aide-mémoire is the result of negotiations, cooperation and consensus between the departments in question, the mining industry and organized agriculture. It is intended to assist and guide entrepreneurs and mine owners to compile environmental management programmes in accordance with procedures and norms acceptable to all concerned with a view to leaving a useful heritage to future generations after the mineral resources have been extracted.

It is trusted that the Aide-mémoire will provide simple, practical guide-lines for compiling environmental management programmes, promote the speedy and effective evaluation of such programmes, enhance dedicated management strategies following mining-related effects on the environment and state clearly the responsibilities of all concerned.

Dr. P.J. Hugo
Director General
Mineral and Energy Affairs

Acknowledgements

This Aide-mémoire is the result of a team effort by representatives of the under mentioned institutions involving many hours of hard work by the participants on the steering committees and various project committees. Their valuable assistance and contributions are sincerely appreciated.

Chamber of Mines of South Africa
Aggregate and Sand Producers' Association of SA
South African Agricultural Union
Department of Water Affairs and Forestry
Department of Environment Affairs
Department of National Health and Population Development
Department of Finance

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AIDE-MÉMOIRE FOR ENVIRONMENTAL MANAGEMENT PROGRAMME REPORTS FOR PROPOSED PROSPECTING AND MINING

Introduction

Purpose of the Aide-mémoire

The Aide-mémoire has been compiled to assist applicants for, and holders of, prospecting permits or mining authorizations to draw up environmental management programme reports in accordance within an established approach which is acceptable to all the regulating authorities concerned and to secure the approval thereof.

What is an Environmental Management Programme Report (or EMPR)?

It is a document that aims to achieve the following overall objectives:

- to meet the environmental requirements and directives under the Minerals Act, No. 50 of 1991, and its regulations;
- to provide a single document that will satisfy the various authorities concerned with the regulation of the environmental impacts of mining;
- to give reasons for the need for, and the overall benefits of, the proposed project;
- to describe the relevant baseline environmental conditions at and around the proposed site;
- to describe briefly the prospecting or mining method and associated activities so that an assessment can be made of the significant impacts that the project is likely to have on the environment during and after mining;
- to describe how the negative environmental impacts will be managed and how the positive impacts will be maximized;
- to set out the environmental management criteria that will be used during the life of the project so that the stated and agreed land capability and closure objectives can be achieved and a closure certificate can be issued;
- to indicate that resources will be made available to implement the environmental management programme set out in Part 6 of this document.

The EMPR document is not intended to be an exhaustive description of the project. Rather, it is a document containing sufficient information to make the reader aware of the overall character of the site and its surroundings, the mining method, the likely impacts and how these are to be managed. Back-up reports should be kept on file by the mine for inspection should they be required.

The document should be as simple, yet as comprehensive as possible in order to accommodate a prospecting or mining operation of any size or complexity; flexible, so that the environmental management programme can be tailored to the site-specific mine and environmental conditions; and, finally, adaptable, so that with judicious pruning it can be used for the smallest and simplest prospecting or mining operation.

An EMPR is prepared on the strength of facts pertaining at the time of preparation. It must, however, be seen as a dynamic document that may require updating during the life of the project. In appropriate circumstances, e.g. where the programme as set out in Part 6 is altered, application for approval for updating the programme should be made to the Regional Director.

It should be noted that the environmental management programme outlined in Part 6 would result in site-specific legal obligations on the part of the proponent. Once approval of the programme outlined in Part 6 has been granted, the programme is binding and therefore if it is adhered to, closure will be granted.

Apart from Part 6, the remaining sections of the document do not constitute part of the environmental management programme envisaged in section 39 and in the other provisions of the Minerals Act and will accordingly not give rise to legally binding obligations on the part of the developer.

Where changes that may have a significant impact on the environment are initiated by a third party, consultations between the mine management, the third party and the relevant Government authorities should, where appropriate, be initiated through the Regional Director, to ensure that mining and the validity of the approved programme as outlined in Part 6 of this document are not prejudiced. Should this occur, the programme may be revised with the approval of the Regional Director.

It is likely that the proponent may wish to keep portions of the EMPR confidential. These portions should be identified and the confidential matter extracted and located in a separate section of the EMPR to facilitate distribution of the non-confidential portion. In this regard it must be emphasized that confidentiality relates only to information on proposals or decisions having an impact on the business and financial affairs or the technical processes of the proponent.

In terms of the Minerals Act, the Regional Director may, on receipt of an application in writing and subject to such conditions as he may determine, exempt the applicant for, or holder of, any prospecting permit or mining authorization from the obligation to submit an EMPR.

How to Use this Aide-mémoire

The Aide-mémoire provides a **list of items to be considered** when drawing up an EMPR. All items should be considered and **if a particular item does not apply to the project, that item should be marked "Not Applicable" in the EMPR document** and where practicable a brief reason should be given as to why it is not applicable.

If an item has been considered, **but its impact is insignificant, that item should be marked "No Significant Impact" in Part 5 of the EMPR** and where practicable a brief reason should be given as to why there is no significant impact. Consequently, the item need not be considered further in Part 6.

It is advisable to consult with the Regional Director concerned before starting to compile the EMPR so as to examine with him which items listed in the Aide-mémoire need to be completed and in what format. Since he will understand the requirements of the other authorities, this pre-planning briefing can assist in avoiding unnecessary work.

The items that are applicable should be written up as concisely as possible so that non-specialists can understand the nature of the EMPR.

New Projects

For proposed prospecting projects, it is necessary to address only the environmental issues that may be affected by the exploration activities themselves, not issues that may be affected by any subsequent mining projects.

Much of the information required to describe the pre-mining environment in Part 2 is available from Government departments and local authorities.

The plans required for the EMPR must be on scales appropriate to show the level of detail required for the particular project or aspect described. As a guide, 1:50 000 scale plans would be suitable for regional and catchment descriptions and 1:10 000 scale plans would be suitable, if available, for surface infrastructure layouts, mining layouts, pre-mining environmental conditions, water and waste management facilities and the plans for the environmental management programme. However, larger-scale plans (at a scale of 1:2 000 or even 1:1 000) may be needed to show the details of river diversion and water reticulation aspects such as pollution control dams, return water dams, seepage collection and clean water diversion works and evaporation facilities.

Operating mines

For operating mines the emphasis changed from an assessment of the potential impacts of a project on the pre-mining environment to establishing the actual impacts of an operating mine on an environment in which development has already taken place.

It should be noted that baseline information relating to a pre-mining environment may be difficult or impossible to obtain.

Rehabilitation plans approved under the Mines and Works Act of 1956 will be accepted in lieu of an EMP (Environmental Management Plan) for existing mines, subject to amendment where required.

EMPs for operating mines may be drawn up by using the Aide-mémoire in the following ways:

1. Complete the Executive Summary.
2. Complete Part 1, changing paragraph 1.6 to describe the mine and its actual operating parameters.
3. Complete Part 2. Describe the existing environment. Exclude paragraph 2.17, as no new parties will be affected.
4. Exclude Part 3.
5. Complete the relevant paragraph of Part 4 for an operating mine.
6. Complete the relevant sections of Part 5 with a description of actual impact and with due consideration to the information contained in Part 2, if available and applicable.
7. Complete all the remaining Parts of the Aide-mémoire where applicable.

Glossary of Terms

BATNEEC Best (Proven) Available Technology Not Entailing Excessive Cost

The term implies that the technology being proposed is proven by practical application, which is appropriate to the particular problem and is cost-effective and is established and generally acceptable nationally at the time that the proposal is made.

Closure

Closure, in the case of mining operations discontinued or abandoned prior to the coming into force of the Minerals Act, 1991, means where a closure certificate has been issued in terms of Regulation 2.11 under the Mines and Works Act, 1956; or in any other case where a closure certificate has been issued in terms of section 12 of the Minerals Act, 1991 or in terms of Regulation 2.11 thereunder, and where a closure certificate provided for in section 32 (2) of the Atmospheric Pollution Prevention Act, 1965, has been issued.

Decommissioning

The activity or process that begins after cessation of prospecting activities or mineral production (including metallurgical plant production) and ends with closure. It involves, *inter alia*, the removal of unwanted infrastructure, the making safe of dangerous excavations and surface rehabilitation with a view to minimizing the adverse environmental impacts of mining activities remaining after cessation of mineral production. It includes the after-care or maintenance that may be needed until closure.

Partial closure

The closure of a part, section or portion of a mine. The environmental management issues that need to be addressed for partial closure are the same as those required for closure of the whole mine.

Significant impact

An impact can be deemed significant if consultation with the relevant authorities and other interested and affected parties on the context and intensity of its effects provides reasonable grounds for mitigating measures to be included in the environmental management report.

The onus shall be on the proponent to include the relevant authorities and other interested and affected parties in the consultation process. Present and potential future, cumulative and synergistic effects should all be taken into account.

THE AIDE-MEMOIRE

A. Executive Summary of the EMPR

The Executive Summary should summarize the overall benefits of the project, highlight the major environmental findings and how these will be managed to prevent, reduce or rehabilitate adverse impacts. The overall closure and post-mining land capability objectives should be stated clearly.

B. Table of Contents of the EMPR

Part 1: Brief Project Description

1.1 **Name, address, telephone and fax numbers of mine, mine owner and mine manager/responsible person.**

1.2 **Name and address of the mineral rights holder.**

1.3 **Name, address, telephone and fax numbers of the applicant for, or holder of, the prospecting permit or mining authorization.**

1.4 **Name and address of the owner of the land and the title deed description.**

1.5 **Regional setting** (plan or aerial photograph required).

1.5.1 Magisterial district and relevant Regional Services Council authority.

1.5.2 Direction of and distance to neighbouring towns.

1.5.3 Surface infrastructure (such as roads, railway lines and power lines in the vicinity).

1.5.4 Presence of servitudes.

1.5.5 Land tenure and use of immediately adjacent land (Plan required. Provide a list of names and addresses of these landowners where available.).

1.5.6 The name of the river catchment in which the mine is situated.

1.6 **Description of the proposed project**.

A very brief description of the proposed project is required.

1.6.1 Mineral deposit.

1.6.2 Mine products (s) or prospecting target mineral (s).

1.6.3 Estimated reserves or extent of target area.

1.6.4 Proposed prospecting or mining method (s) (e.g. opencast, underground, longwall, extensions to existing mine, etc.).

1.6.5 Planned production rate.

1.6.6 Planned life of mine or duration of prospecting.

Part 2: Description of the Pre-mining Environment

2.1 Geology

For prospecting, give an indication only of what is known of the geology.

2.1.1 Geology. (Include where appropriate representative borehole logs, a section through the ore body and surface mapping. Identify and characterize overburden material that will be disturbed and that, once disturbed, may give rise to a deterioration in water quality.)

2.1.2 Presence of dykes, sills and faults that extend beyond the property boundary. (Plan required.)

2.2. Climate

2.2.1 A brief description of the regional climate.

2.2.2 Mean monthly and annual rainfall for the site and number of days per month with measurable precipitation.

2.2.3 Maximum rainfall intensities per month — 60 min, 24 hrs, 24 hrs/50 yr and 24 hrs/100 yr storm events.

2.2.4 Mean monthly maximum and minimum temperatures.

2.2.5 Mean monthly wind direction and speed — where appropriate (such as in urban areas and if such information is freely available). The hourly wind direction and speed, with the maximum one-minute speed in each hour, may be required.

2.2.6 Mean monthly evaporation.

2.2.7 Incidence of extreme weather conditions — frost, hail, drought, high winds. Since it is unusual to have a weather station on a proposed mine site, data for the site may have to be deduced from Stations around the site.

2.3 Topography (plan required)

The topographical plan is the base plan on an appropriate scale with surface contours at appropriate intervals which, for areas in which significant topographical disturbance is expected, will give a clear indication of the topography.

2.4 Soil (plan required)

A description of the soil types to be disturbed, their fertility, erodibility and depth should be provided and the soil should be mapped according to a recognized soil classification system. The dryland production potential and the irrigation potential of these soils should also de described.

2.5 Pre-mining land capability (plan required)

The land to be disturbed should be classified and mapped into the following pre-mining land capability classes according to the definitions of these classes in the Chamber of Mines Rehabilitation Guidelines:

- Arable land;
- Grazing land;
- Wetland;
- Wilderness land.

A table should be presented with the area and percentage of each land capability class that will be disturbed by mining and its associated infrastructure.

2.6 **Land use** (plan required)

2.6.1 Pre-mining land use.

2.6.2 Historical agricultural production.

2.6.3 Evidence of misuse.

2.6.4 Existing structures.

2.7 **Natural vegetation/plant life**

2.7.1 Dominant species.

2.7.2 Endangered or rare species.

2.7.3 Invader or exotic species.

Note: In an undisturbed area, a vegetation map should be prepared.

2.8 **Animal life**

2.8.1 Commonly occurring species.

2.8.2 Endangered or rare species.

2.9 **Surface water** (plan required)

The presence of watercourses, streams, rivers, dams and pans should be indicated (on a plan) in blue. The position of the estimated maximum flood-line for the 1:50-year flood event should be indicated in red lines on the plan.

2.9.1 Surface water quantity.

The catchment in which the mine is to be located should be described up to the point where the affected catchment discharges into the receiving water body. This description should include the following information:

2.9.1.1 A map on an appropriate scale indicating the catchment boundaries, the boundaries of the subcatchment occupied by the mine and the watercourse which would be followed by water emanating from the mine (the affected watercourse).

2.9.1.2 The mean annual run-off from the catchment upstream of the point of discharge to the receiving water body and from the subcatchment upstream of the mine.

2.9.1.3 Normal dry weather flow in the affected watercourse.

2.9.1.4 Flood peaks and volumes for recurrence intervals of 1:20, 1:50 and 1:100 years and the regional maximum flood.

2.9.1.5 For river diversions only. An estimate of the contribution of the mean annual run-off normally entering the river over the affected section and the total mean annual run-off entering upstream of the proposed diversion.

2.9.2 Surface water quality.

An analysis of surface water samples in sufficient detail to characterize the water quality in the affected watercourse (s).

2.9.3 Drainage density of areas to be disturbed.

Record as kilometres of drainage path per square kilometre of land area.

2.9.4 Surface water use.

Identify, where possible, who uses the surface water along the route of the affected watercourse (s) down to the receiving water body, for what purpose and how much in cubic metres per day.

2.9.5 Water authority.

Identify the authority concerned, if any.

2.9.6 Wetlands.

Location of wetlands on the property, the extent thereof and an indication of the significance and the biological diversity of the wetland.

2.10 Groundwater

2.10.1 Depth of water table (s).

2.10.2 Presence of water boreholes and springs and their estimated yields (plan required).

2.10.3 Groundwater quality.

Analyze water in boreholes and springs in the affected zone so as to characterize the water quality.

2.10.4 Groundwater use.

Identify, where possible, groundwater and spring-water users in the study area and the quantity used.

2.10.5 Groundwater zone.

The groundwater zone that is likely to be affected by the mining operation (the affected zone) should be identified. Its importance as regional resource should be described. If available, maps on appropriate scales should be provided indicating the groundwater zone boundaries. Stratigraphic sections, in sufficient detail to indicate the conceptual groundwater model, the nature and location of significant aquifers and aquicludes and relevant physical properties, should be provided.

Note: These sections may not be required for deep mines.

2.10.6 For river diversions only.

An estimate of the contribution of the stream or river to groundwater recharge and an estimate of the contribution of groundwater to surface water over the diverted section should be made.

2.11 Air quality

A survey should be made of the air quality and existing sources of air pollution in the area, including fallout dust, suspended dust and gaseous emissions (only if the project includes a schedules process, as defined in the Atmospheric Pollution Prevention Act of l965). Potential impact sites should be identified (within 3 km from the mine boundary for fallout dust and as far as the ambient air quality may deteriorate for suspended dust and gas, if appropriate to the project).

2.12 Noise

Existing noise levels on and around the property should be identified, as should potential noise impact sites. If the potential impacts warrant it, pre-mining noise monitoring may be required.

2.13 **Sites of archaeological and cultural interest** (plan required)

Sites of recognized archaeological and cultural interest should be noted.

2.14 **Sensitive landscapes**

If especially sensitive landscapes under statutory protection occur on the site, they should be described and shown on the plan.

2.15 **Visual aspects**

Describe the visibility of the project site from scenic views, tourist routes and existing residential areas. This should include the visibility of dust and other atmospheric pollution currently generated.

2.16 **Regional socio-economic structure** (does not apply to prospecting)

Local, provincial or national regions may be considered, depending on the nature of the project.

2.16.1 Population density, growth and location.

2.16.2 Major economic activities and sources of employment.

2.16.3 Unemployment estimate for the area.

2.16.4 Housing — demand, availability.

2.16.5 Social infrastructure — schools, hospitals, sports and recreation facilities, shops, police, civil administration.

2.16.6 Water supply.

2.16.7 Power supply.

2.17 **Interested and affected parties**

Identify and list known bodies representing interested and affected parties. This may be done in consultation with the relevant authorities.

Part 3 Motivation for the Proposed Project

3.1 **Benefits of the project**

A brief indication of the following is required for the project:

3.1.1 Where it is intended that the product(s) will be sold.

3.1.2 An estimate of the expenditure required to bring the project into production.

3.1.3 An estimate of the total annual expenditure at full production.

3.1.4 An estimate of the labour force at full production.

3.1.5 An estimate of the multiplier effect on the local, regional and national economy.

Note: Since some of the benefits will be unknown before prospecting, only items 3.1.2, 3.1.3 and 3.1.5 may be relevant for a prospecting EMPR.

3.2 Consideration of project alternatives

The major project alternatives and their impact on the environment, which were considered prior to the compilation of the EMPR should be recorded. Such alternatives may include the following:

3.2.1 Mining method.

3.2.2 Mineral processing method.

3.2.3 Transport, power and water supply routes.

3.2.4 Sources of water.

3.2.5 Mine infrastructure sites.

3.2.6 Mine residue disposal sites.

3.2.7 Domestic and industrial waste disposal sites.

3.2.8 Housing sites.

3.2.9 Land use options after rehabilitation.

3.2.10 Alternatives to river diversions.

3.2.11 The "No project" option.

Part 4 Detailed Description of the Proposed Project

4.1 Surface infrastructure (plan required)

The proposed major surface infrastructure required for the mine should be described briefly and shown on a topographical plan. This should include the following:

4.1.1 Roads, railways and power lines.

4.1.2 Solid waste management facilities.

4.1.2.1 Industrial and domestic waste disposal sites.

4.1.2.2 Mine residue disposal sites. State or show on the plan, the type of residue, final extent of the dumps, construction method and water reticulation layout.

4.1.3 Water pollution management facilities.

4.1.3.1 Sewage plant location, its design capacity and the process to be used.

4.1.3.2 Pollution control dams, paddocks and evaporation dams.

Indicate whether these are to be lined or not.

4.1.3.3 Polluted water treatment facility, its design capacity and the process to be used.

4.1.4 Potable water plant location, its design capacity and the process to be used.

4.1.5 Process water supply system, its design capacity and the process to be used.

4.1.6 Mineral processing plant.

4.1.7 Workshops, administration and other buildings.

4.1.8 Housing, recreation and other employee facilities.

4.1.9 Transport.

4.1.10 Water balance diagram

A schematic diagram linking up the flow of water to and from the facilities described in 4.1.2 to 4.1.9 above and the mine is required. The diagram should also show the water supply source(s), the water discharge point(s), the evaporation areas and potential seepage points. Each step in the diagram should indicate the estimated flow, in m3/day, into and out of the facility, whether it is pumped or gravity fed, piped or an open channel flow, clean or dirty water and, where appropriate; e.g. in the case of dams, the storage capacity.

4.1.11 Disturbances of watercourses.

Give details of any of the facilities described in to 4.1.9 and mining layouts that are proposed within or beneath an area defined by the 1:50-year flood lines for any watercourse—unless the facility or mine layout is unlikely to disturb the natural flow or alignment of the watercourse in any (e.g. deep level mining).

4.1.12 Storm water.

Indicate on the plan the storm water diversion measures designed to separate clean from contaminated water. The items described above may require more than one plan.

4.2 Construction phase

A brief description of the activities during this period is required, including a plan if necessary.

4.3 Operational phase

4.3.1 Soil utilization guide (plan, if necessary).

Based on the soil map, this should show the depths of usable soil in disturbed areas that will be utilized mining. It should also show soil stockpile positions.

4.3.2 The proposed mine surface layout (plan required).

This section requires a brief, illustrated description of the items below. Using the topographical plan as a base, this should give the following:

4.3.2.1 Access to the workings (vertical and inclined shaft positions or adits, ramps and haul roads). For working sites should be indicated if possible.

4.3.2.2 All structures that may be affected by blasting vibrations.

4.3.2.3 Expected location, extent and depth of surface subsidence.

4.3.2.4 All structures and drainage paths that may be affected by surface subsidence.

Note: The above points apply to all mines.

4.3.2.5 The mining plan, box cut and final void positions.

Note: This point applies to opencast and shallow underground mines.

4.3.3 Mineral processing

A brief description of the mineral processing method is required. This description should highlight areas in the plant that could generate air, water and noise pollution.

4.3.4 Plant residue disposal.

A brief description of the disposal method(s) giving tons disposed of per day at full production for each type of residue.

4.3.5 Transport.

A brief description of how the raw material and final products will be transported (to their point of sale inland or port of export) is required.

4.3.6 Proposed river diversions.

A Water Act Section 20 permit to alter the course of a public stream may be required before the environmental management programme is approved.

Depending on the importance and timing of the diversion and its potential impact on the environment, the following information may be requested. This information must relate to the final situation upon closure since approval for temporary diversions, not showing the final situation, will not be given.

4.3.6.1 Topographical plans covering the original alignment, the new alignment and sufficient of the areas upstream and downstream of the proposed diversion so as to extend beyond the area of influence of the diversion.

4.3.6.2 Plans, cross-sections and long-sections showing the full scheme and nearby infrastructure.

4.3.6.3 Details of any linings, armouring or erosion control measures.

4.3.6.4 Details of any linings, armouring or erosion control measures.

4.3.6.5 Details of hydraulic structures forming part of the diversion.

4.3.6.6 Details of the beginning and end of the diversion showing the transition to the original natural watercourse.

4.3.6.7 Details of points where storm water is expected to enter the diversion and the associated erosion control measures.

4.3.6.8 A detailed description, including plans at the same level of detail as for the final diversion, of any intermediate or temporary steps which may be necessary to achieve the final aim.

4.3.6.9 Measures for maintaining the long-term alignment (such as may be required where a diversion is located on unstable ground).

4.3.6.10 Stratigraphic sections and engineering properties of the materials through which the diversion is to be constructed.

4.3.6.11 Flood lines for recurrence intervals of 1:20, 1:50, 1:100 years and the regional maximum flood for both the pre-diversion and the post-diversion situation.

Part 5 Environmental Impact Assessment

The mining proponent will be expected to demonstrate that he has considered and understood the potential or expected impacts of the project on the environmental components described in Part 2. Therefore, an estimate of the nature of these impacts should be given for the construction, operational and decommissioning phases. When describing the impacts, an estimate of magnitude, timing and duration of the impacts is required, e.g. very significant, immediate, temporary impact; and low probability, delayed, long-term impact.

5.1 Construction phase

Describe the impacts on the environment to be expected during the construction phase, using the checklist of items set out in 5.2.1 to 5.2.16 for the operational phase. It is not necessary to given details of any particular point if it is to be set out fully under the operational phase. For prospecting projects, site establishment may be considered as the construction phase.

5.2 Operational phase

Describe the environmental impact of the project on items 5.2.1 to 5.2.16 during the phase when the mine is producing (or prospecting is under way) up until when decommissioning activities begin.

5.2.1 Geology.

5.2.2 Topography.

5.2.3 Soils.

5.2.4 Land capability.

5.2.5 Land use — include an assessment of likely impact on existing structures.

5.2.6 Natural vegetation/plant life — for river diversions, emphasize impacts on aquatic vegetation.

5.2.7 Animal life — for river diversions, emphasize impacts on aquatic wildlife.

5.2.8 Surface water — when assessing surface water and groundwater impacts, two overriding questions must be asked: Will the project significantly change either the catchment yield or the water quality in the catchment? If the answer to one of the questions or both is yes, an effort must be made to determine the magnitude and nature of the impact.

5.2.8.1 Include an estimate of all dewatering volumes and discharges of polluted water and the impact of these on the receiving body of water.

5.2.8.2 Describe the consequences on the mine and associated works of floods exceeding the design flood in magnitude, and in particular, the consequences of the regional maximum flood.

5.2.8.3 For river diversions only.

Estimate the long- and short-term watertightness and structural stability of, and the quality and quantity of water seeping into and out of the diversion and the consequences of failure particularly where the proponent intends to mine, or has already mined, under the diversion or where the diversion is to be constructed on unstable ground and/or where the water table is likely to change its position after the closure of the mine.

5.2.9 Groundwater — include an assessment of the impacts of mining activities on groundwater in the affected zone the impact on boreholes and the impact on groundwater users.

5.2.10 Air quality — assess the likelihood of air pollution from the plant, dumps, materials handling facilities, vehicles or blasting and the effects this could have on the potential impact sites described in 2.11.

5.2.11 Noise — the noise that the project may potentially generate should be assessed against existing noise levels at possible noise impact sites.

5.2.12 Sites of archaeological and cultural interest.

5.2.13 Sensitive landscapes.

5.2.14 Visual aspects — describe the impact the project will have when viewed from scenic views, tourist routes and existing residential areas.

5.2.15 Regional socio-economic structure.

5.2.16 Interested and affected parties.

5.3 Decommissioning phase

When a mine, or part of a mine, ceases production (or prospecting activities cease) decommissioning activities start. This phase continues until closure. If the environmental management programme for the construction and operational phases, described in Part 6 has been implemented successfully, there should be only a few outstanding impacts left to manage. The possible nature of these impacts should be assessed and the potentially significant impacts should be described, using the list of headings in 4.1 and 4.3 and the environmental impacts described in 5.2 to assist in their identification.

5.3.1 Partial closure — if the intention is to apply for a closure certificate in respect of a portion, part or section of a mine, the environmental impact assessment should describe the impacts associated with only that portion, part or section of the mine likely to be the subject of such an application. Furthermore, the assessment should concentrate on those matters that may have significant impacts on, or be affected by, the remainder of the mine, so that measures to mitigate such impacts can be identified and described in Part 6.

Note: The Department of Water Affairs and Forestry will consider closure of part of a mine only if it can be demonstrated that parts separate form the remainder of the mine, with respect to water.

5.4 Residual impacts after closure

There may be some significant residual impacts resulting from the construction, operational or decommissioning phases that persist after these activities have ceased and a closure certificate has been issued. Where possible, these impacts should be identified at least qualitatively so that they can be accommodated when the closure objectives are being defined and when the environmental management programme, described in Part 6, is being devised. The environmental impact assessments done in accordance with paragraphs 5.1 to 5.3 of Part 5 will have highlighted the major issues on which to focus. However, the potential impacts resulting from the closed operation, listed below, should be considered in any event. It is nevertheless recognized that quantification of these impacts could be imprecise, or even unfeasible.

5.4.1 The potential for acid mine drainage or poor quality leachates emanating from the mine or residue deposits.

5.4.2 The long-term impacts on groundwater.

5.4.3 The long-term stability of rehabilitated ground and residue deposits.

5.4.4 The long-term impacts arising from river diversions.

Part 6: Environmental Management Programme

Whenever a significant impact has been identified in Part 5, the proponent must describe how the impact will be managed.

Once approved, the environmental management programme set out in this Part will be legally binding in terms of the Minerals Act and its Regulations. Once the approved programme has been complied with a closure certificate will be issued.

The impact management activities described in this Part should, in general, be based on the concept of Best (Proven) Available Technology Not Entailing Excessive Cost (BATNEEC)

6.1 Construction Phase

Using the checklist of items set out in paragraphs 6.2.1 to 6.2.17, describe how each significant impact identified in paragraph 5.1 will be managed. It is not necessary to detail any particular point if it is to be detailed fully under the operational phase. For prospecting projects, the management of impacts during site establishment should be considered here.

6.2 Operational phase

6.2.1 Geology.

6.2.2 Topography — plan required of expected post-mining topography. Include what slopes will be created during rehabilitation and dump construction.

6.2.3 Soils — include depths of soil that will be used and how fertility and erosion will be managed.

6.2.4 Land capability — plan required of expected post-mining land capability.

6.2.5 Land use — include what type of land use is planned.

6.2.6 Natural vegetation/plant life — for river diversions emphasize aquatic plant life. If possible, include a description of the plant life that will be used during rehabilitation and how the vegetation will be managed.

6.2.7 Animal life — for river diversions, emphasize aquatic animal life.

6.2.8 Surface water — indicate the strategies for managing the following:

6.2.8.1 The water balance described in 4.1.10.

6.2.8.2 Storm water.

6.2.8.3 Surface rehabilitation (in so far as this affects surface water).

6.2.8.4 The legitimate requirement of surface water users on the affected watercourse.

6.2.8.5 For river diversions only — indicate how the significant impacts identified in 5.2.8.3 will be managed, paying particular attention to erosion control, structural stability and surface drainage into and out of the diverted section.

6.2.9 Groundwater — indicate the strategies for the following:

6.2.9.1 Optimizing surface rehabilitation in order to minimize adverse groundwater impacts.

6.2.9.2 Meeting the requirements of legitimate groundwater users in the affected zone.

6.2.9.3 For river diversions only — the control of seepage into and out of the diverted section of the river.

6.2.10 Air quality — include an air pollution control plan if the assessment reveals significant potential impacts on air quality at potential impact sites.

6.2.11 Noise — include an air pollution control plan if the assessment reveals significant potential impacts on air quality at potential impact sites.

6.2.12 Sensitive landscapes.

6.2.13 Visual aspects.

6.2.14 Regional socio-economic structure.

6.2.15 Interested and affected parties.

6.2.16 Submission of information — the proponent will have to establish the extent to which information on measurements, taken to comply with statutory requirements, requires to be submitted.

6.2.17 Maintenance — some of the measure described in this Part will require maintenance after they have been implemented until the time decommissioning activities begin. Again, this will be site-specific, but the proponent should consider, where appropriate, the maintenance of at least the following:

6.2.17.1 Rehabilitated land.

6.2.17.2 Water pollution control structures.

6.2.17.3 Rehabilitated residue deposits.

6.3 Decommissioning phase and closure

Every effort should be made during the life of the project to minimize the cost and amount of the work required for this phase. This Part should describe briefly how the project will be decommissioned and closed. It should address the management of the potentially significant impacts identified in paragraph 5.3 and 5.4 of Part 5, the conceptual outline of the planned decommissioning strategy and the closure objectives.

6.3.1 Closure objectives.

6.3.2 Infrastructure areas — demolition or disposal of structures and buildings, removal of foundations and debris and rehabilitation of the surface subject to section 40 of the Minerals Act.

6.3.3 Mine residue deposits.

6.3.3.1 Disposal facilities (pipes, solution trenches, return water dams, etc.).

6.3.3.2 Ongoing seepage, control of rainwater.

6.3.3.3 Long-term stability.

6.3.3.4 Final rehabilitation in respect of erosion and dust control.

6.3.4 Sealing of underground workings and rehabilitation of dangerous excavations.

6.3.5 Final rehabilitation of open cast mine haul ramps and roads and final voids.

6.3.6 Submission of information — the proponent's obligation in this regard, for the period after decommissioning activities have ceased, until the time closure is approved, is described in paragraph 6.2.16.

6.3.7 Maintenance — if aspects of the decommissioned site required maintenance until the time that closure is approved, these should be described. The aspects to consider are those listed in 6.2.17.1 to 6.2.17.3

6.4 Proposed timetable, duration and sequence

These dates are estimates and are dependent on the economic conditions pertaining from time to time during the life of the project.

6.4.1 Prospecting projects.

6.4.1.1 Submission of prospecting EMP, where appropriate, and prospecting application.

6.4.1.2 Proposed starting, duration and completion dates for prospecting.

6.4.1.3 Proposed rehabilitation programme and rehabilitation completion date.

6.4.2 Mining projects.

6.4.2.1 Submission of mining EMPR and applications for mining permissions.

6.4.2.2 Start and duration of construction period.

6.4.2.3 Proposed start of mining, full production and cessation of production dates.

6.4.2.4 Proposed rehabilitation programme.

6.4.2.5 Proposed dates for progressive or partial closure applications.

6.4.2.6 Proposed decommissioning and aftercare programme.

6.4.2.7 Proposed date for closure application.

6.5 Financial provision

Particulars should be given of the proponent's ability to make the necessary financial provision to implement the measures described in Part 6.

Part 7: Conclusion

Assuming that the closure objectives are met, give the general overall net impact of the project on the environment.

Part 8: Statutory Requirements

A list of permissions already granted under other statutes concerning the environment should be provided, indicating the permit or registration number, date and place of issue. If applications have been made but not yet granted, these should be included.

Part 9: Amendments to EMPR

This part is intended to accommodate amendments to the document so that it remains dynamic and complete.

Part 10: References and Supporting Documentation

References to back-up information/reports.

Part 11: Confidential Material

Should the proponent wish to keep certain business (including technical innovations and/or processes) or financial information confidential and to exclude this from the EMPR document, reference to this should be made in this Part

Contact Details

Further information is available from:

Department of Minerals and Energy
Private Bag X59
Pretoria 0001
South Africa
Tel: 27 12 317 90 00
Fax: 27 12 322 34 16
Web: http://www.dme.gov.za/

New South Wales Environmental Management Plans and Guidelines for Annual Reporting for Coal Leases

Prepared by the New South Wales Department of Mineral Resources, Australia, January 1994.

1. Introduction

1.1 The community of New South Wales has an enhanced awareness of the environment and has developed a keen expectation for the environmental performance of its industries.

1.2 A range of environmental legislation is applicable to coal mining in New South Wales. In this context, Government is obliged to provide consistent direction and to reduce duplication of effort as far as possible to achieve the desired goals.

1.3 It is the Department's mission to promote the responsible development of the State's mineral and coal resources for the community's benefit. The Department therefore is concerned to ensure that any adverse effects of mining and processing are minimized, and that a consistent high standard of environmental protection, pollution control and rehabilitation is practised at each mine site in the State. Mining companies are expected to give adequate consideration to the environment from the design stage, through the operational phase, to mine closure.

1.4 Consideration of environmental factors in the planning and management of a mining programme is an essential procedure for preventing adverse effects and reducing rehabilitation costs. Much can be done in pre-development design to prevent impacts that can bring the industry into disrepute, and that would cost more money to rectify than if pollution controls or rehabilitation had been cost-effectively planned from the outset.

1.5 The Department of Mineral Resources is empowered by Sections 238 and 239 of the Mining Act 1992 to include in a lease appropriate conditions for protection of the environment and rehabilitation of areas disturbed by mining.

1.6 All leaseholders are required, as a condition of lease, to report annually to the Department of Mineral Resources against an environmental management plan. All future granted leases will similarly contain such a condition to achieve appropriate mining, rehabilitation and environmental management reporting.

2. The Environmental Management Plan

2.1 Activities within the majority of coal leases in NSW (New South Wales) have been carried out under a system of prescribed environmental and rehabilitation control procedures. These procedures may have been variously prescribed according to the conditions of:

- the Coal Lease (and Open Cut Approval for open cut mines);
- a Pollution Control Approval (through licences under the Clean Air, Clean Waters, Noise Control Acts);
- a Development Consent.

These statutory approvals therefore form the basis for the environmental management plan of a coal mining operation.

2.2 Since the implementation of the coal lease consolidation process, all coal leaseholders in NSW are now required to submit an Annual Environmental Management Report on performance against the plan. This thereby provides:

1. a management tool for the entire operation within the coal lease;
2. a means of identifying and concentrating on the significant mining, rehabilitation and environmental aspects of the operation; and
3. a basis for more efficient and systematic interaction with government, which can then form a basis for agreement on the objectives over time, and irrespective of personnel changes.

2.3 The Department of Mineral Resources will be responsible for overseeing the environmental management plan under the coal lease and for ensuring the rehabilitation and environmental performance is in accordance with the lease conditions.

2.4 These guidelines are provided to assist in the preparation of the Annual Environmental Management Report. The overall aim is to provide a format that:

i) is consistent for all coal mining operations in NSW (which may involve open cut and/or underground mining within the coal lease area), and

ii) facilitates a single system of reporting to all levels of government separately but using the same basic report and applicable to an agreed annual reporting date for each particular coal mining operation, and

iii) is comprehensive in scope to address the range of environmental reporting requirements of government, yet

iv) is sufficiently flexible to accommodate to varying scale of operations and the resources available to prepare such a report.

3. The Review Process

3.1 It is expected that rehabilitation and environmental management at each mine site will be subject to annual review by means of:

i) the Annual Environmental Management Report submitted by the Company which will be reviewed by relevant government authorities; and

ii) an environmental inspection at least annually of the operation by Inspectors of the Department of Mineral Resources.

3.2 The report and inspection will provide a means of measuring progress and the attainment of environmental objectives. The report should also specify the environmental and rehabilitation targets to be achieved in the following 12-month period.

3.3 Modification or amendment of mining development or operation procedures may be required to take into account a range of circumstances including changed mining conditions and external circumstances, such as operational requirements, or impacts on the surrounding community. Changes to approvals or licenses undertaken during the preceding 12 months or forecast for the following 12 months are to be addressed in the annual report.

3.4 The Annual Environmental Management Report will provide an opportunity to consolidate into one document all annual government reporting requirements that pertain to environmental management. Separate appendices would accompany the annual report. Such appendices would facilitate reporting separately to specific government authorities any environmental information or data that pertains to an established approval format. In the case of Open Cut Coal Mines, the Department's standard Annual Rehabilitation Report would remain in its existing format, as an Appendix. The annual reporting of environmental monitoring data pursuant to the EPA's Pollution Control Approval and Licence(s) shall also appear as a separate Appendix.

3.5 The rehabilitation and environmental management of a coal mine is dynamic. Where the operation's environmental management plan is amended by statutory approval (development consent, coal lease, EPA licence) within the reporting period, such changes are to appear in the proceeding Annual Environmental Management Report.

4. A Suggested Model for Annual Environmental Management Reporting

4.1 All matters to be addressed should be discussed in relation to the government requirements, standards and conditions that have been applied to the operations within the Coal Lease.

The Annual Environmental Management Report for operations within a Coal Lease shall, unless otherwise previously agreed to by the Department's District Inspector, be prepared according to the model in Appendix 1 of this guideline.

In general terms, reporting should be presented under the following section headings:

SECTION 1: Introduction and General Objectives

Summarizes the status of leases, licences and approvals for the operation; identifies principal modifications and amendments within the reporting period; introduces the mining company and mine personnel responsible for ongoing environmental management and rehabilitation; outlines the employment status and any relevant socio-economic aspects.

SECTION 2: Summary of Operations

Outlines the status of mining constraints, ROM coal production, coal washing, coal handling and transport; identifies a mine development programme; provides a review of operations infrastructure and equipment and any construction works within the reporting period.

SECTION 3: Environmental Management

Addresses the controls used for protection of the environment with respect to water, air, noise and blast; reviews trends in environmental and meteorological monitoring data; addresses waste management procedures; and addresses any other environmental reporting requirements of the operation.

SECTION 4: Rehabilitation

Describes land use management within the coal lease area including land use objectives, treatment of final voids, landscaping and visual screening of operations; presents a review of progressive rehabilitation performance for mining areas, infrastructure areas, coal washery rejects emplacements.

Plans

i) Site Plan — surface facilities and current mine development.

ii) A Synoptic Rehabilitation Plan.

iii) A Surface Water Management Plan.

iv) A Plan of Environmental Monitoring Sites.

(All plans are to be "synoptic" in presentation to show an overview at A4 or A3 size and contained within the text of the document.)

v) Colour aerial photograph (optional).

Appendices

I. Compilation of Approvals and Licence Conditions. (granted during the annual reporting period.)

II. Environmental Monitoring Data. (Submitted to EPA only, pursuant to licence reporting.)

III. Annual Rehabilitation Report For Open Cut Mines. (Submitted to Department of Mineral Resources only, pursuant to Open Cut Mining Approval.)

IV. (Any specific report requirements to other government authorities only.)

Contact Details

New South Wales Department of Mineral Resources
PO Box 536
St Leonards
NSW 1590
Australia
Tel: 61 2 99 01 88 88
Fax: 61 2 99 01 87 77
Web: http://www.slnsw.gov.au/

General Guidelines for an Environmental Monitoring Programme

This guideline was compiled by Barry Middleton, now retired, while he was a consultant to the UN DDSMS.

Introduction

The following environmental monitoring schedule is a guide only and should be adjusted for the characteristics of individual mine sites.

It will be necessary to draw up recording sheets for each environmental parameter monitored. Dependent upon the site location, access to equipment, technical expertise and availability of finance, these recording sheets will record data by handwritten entry or computer entry.

In order to properly design an effective and efficient monitoring programme, the principle parameters to be measured must be identified during the environmental impact assessment and subsequent investigations and relate to commitments made in the environmental management plan. Parameters will normally include aspects of:

- land;
- climate;
- biological systems;
- water;
- air;
- noise;
- process effluents and wastes;
- community issues.

Equally important are the concepts of what to measure, where and when to measure it, how to measure it and which evaluation methods should be used subsequent to data collection. Sample collection, sample analysis and data handling must all be carried out using standard

procedures. Therefore, where appropriate, one of the first steps in the environmental monitoring programme will be a review of internal and external capacity to collect and analyze samples and evaluation the analytical data. This may include some of the following elements:

- Assessment of sampling and laboratory manuals, including:
  - clarity;
  - availability;
  - comparison with standard manuals;
  - adaptations for site-specific sampling and analytical requirements.
- Assessment of in-house and external training facilities.
- Assessment of sampling and laboratory practice, including:
  - choice of sample sites and sampling technique;
  - responsibility for sample collection;
  - sample collection staff experience, training and qualifications;
  - type and size of sample taken;
  - sample labelling;
  - pre-analysis sample storage;
  - assessment of analytical facilities;
  - analytical staff experience, training and qualifications;
  - use of control, repeat and standard samples;
  - responsibility for data interpretation;
  - validity of data interpretation (including computer modelling where applicable);
  - data interpretation staff experience, training and qualifications;
  - data storage;
  - response to data interpretation;
  - data reporting;
  - distribution of data and associated reports.
- Assessment of factors hindering efficient sample collection and analysis:
  - sampling equipment downtime;
  - analytical equipment downtime;
  - equipment shortages;
  - absence of power supplies in remote locations;
  - other non-operational sampling sites.

Where a shortfall in capacity exists, training, recruitment or the use of external sources of expertise can be used for rectification prior to continuing with development of the environmental monitoring programme.

Parameters to be Monitored and Monitoring Period

1. Land

1.1 Traditional Land Ownership Issues

- Anthropological — Land Ownership/Yearly
- Archaeological — Sites of Significance/6 Monthly

1.2 Physical, Chemical and Biological Characteristics

- Erosion/6 Monthly
- Topsoil stockpiles/6 Monthly
- Weed control/6 Monthly (autumn & spring)
- Nutrient Status/2 Yearly

1.3 Terrain Analysis/Monthly

Terrain analysis is undertaken to gauge the wind and water erosion potential of soils as a result of land surfaces that have been exposed by mining operations. Simple techniques such as sand traps and surveyed marker gauges can provide useful information relating tonnages of surface soil loss or movement.

2. Meteorological — Climate/Daily at 9 A.M. and 3 P.M.

All parameters including wind, rain, evaporation, humidity, temperature and barometric pressure.

3. Biological Systems

3.1 Flora — Vegetation/6 Monthly

To include terrestrial and aquatic vegetation. Species population and density to be counted on fixed and surveyed grid points. Photo-point analysis of terrestrial vegetation; markers to be completely surveyed at least once per year. Soil and plant pathogens should also be monitored if appropriate.

3.2 Fauna/3 Monthly

- *Native Avifauna*. Actual sight recordings and mist nets of birds and bats.
- *Terrestrial Native Fauna.* Actual sight recordings of large mammals and amphibians. Pitfall trapping of small mammals and amphibians.
- *Aquatic Native Fauna.* Net sampling of fish and benthic (bottom dwelling) communities.
- *Feral Animals*, e.g.: cats, foxes, etc.
- *Health Risk Vectors*, e.g.: mosquitoes.

4. Water

4.1 Quality/Monthly (or more frequently as required)

All surface and ground waters should be regularly sampled from the same sampling point each month and analyzed for total suspended solids, heavy metals and other relevant parameters.

4.2 Quantity/Monthly

- Groundwater
- Record groundwater height from standard height datum using lead weight plumb and measuring tape.
- Surface Water

To determine stream height and stream flow use a fixed standard gauge on stream bank. To determine stream flow use a "V" notch wire gauge or direct velocity stream gauge in litres per second.

5. Air Quality

5.1 Inert and Biologically Active Fugitive Dusts/Weekly

This analysis can be obtained using a high volume air sampler to give total particulates in grams per cubic metre of air. These particulates may then be analyzed for individual major elements, particle size distribution, respirable dust fraction, presence of crystalline silica and concentration and distribution of heavy metals.

5.2 Sulphur Dioxide/Continuous

Where it is believed sulphur dioxide emissions from smelting or mining operations are a risk to health or the environment, a sulphur dioxide monitor should be installed. Early detection of plume grounding should be an inherent component of the sampling and monitoring design.

5.3 Environmental Radiation

- Radon Gas/Continuous
- Instrumentation required is a Radon Gas Monitor
- Radon Daughters/Continuous
- Gamma Radiation/Daily

6. Noise

6.1 Blast Over-pressure and Vibration/Each blast

6.2 Other Process-Related Noise/3 Monthly

7. Process Effluence and Wastes/Monthly; Weekly; Continuous—Depending on Nature of Waste Stream

Process effluents and wastes such as waste rock, overburden, tailings, slimes, slags, other solid wastes, treatment water, bleed water, slimes dam seepage, mill discharge and run-off and seepage from the process plant area, slag dumps and stockpiles should be monitored for metal content, bio-availability of metals, the potential for acid generation, pH, etc.

8. Community Issues

A two-way communication must be established with communities directly and indirectly impacted by the mining operation. Critical groups and special areas of land or interest to these groups must be identified at the earliest possible opportunity.

Environmental Aspects of Mine Closure

Meredith Sassoon,
Mining Environmental Management Consultant

Mining, by its very nature, cannot be classified as a form of sustainable development. However, if sustainable development is defined as a balance between social, economic and environmental considerations (McPhail and Davy, 1998), then a mining project that is developed, operated and closed in an environmentally and socially acceptable manner could be seen as promoting sustainable development. Critical to this goal is ensuring that the full benefits of the project, including revenues and expertise, are employed to develop the region in a way that will survive after the closure of the mine. To achieve this ideal, a mine closure plan, incorporating both physical rehabilitation and socio-economic stability, should be an integral part of the project life cycle and designed to ensure that:

- future public health and safety are not compromised;
- environmental resources are not subject to physical and chemical deterioration;
- the after-use of the site is beneficial and sustainable in the long term;
- any adverse socio-economic impacts are minimized;
- all socio-economic benefits are maximized.

At the time of mine decommissioning and closure not only should physical environmental rehabilitation be completed in a satisfactory manner but also the community should have been developed to maintain a sustainable existence.

1. Physical Rehabilitation

Mining is usually a relatively short-term land use that can, if not managed properly, have an adverse or even devastating impact on the surrounding environment. Therefore, an important aspect of mine planning is the rehabilitation of disturbed lands to a stable and productive post-mining landform, which is suitable and/or acceptable to the community. The physical rehabilitation programme should be an integral part of the mine plan.

Before starting any mine site rehabilitation, closure objectives and a detailed plan of action need to be established. The essential goal of site rehabilitation is to return all affected areas, as near as possible, to their optimum economic value. This does not always involve returning a site to its original state or use. The main aims of site rehabilitation are to reduce the risk of pollution, to restore the land and landscape, to improve the aesthetics of the area and to prevent further degradation. Through consultation with relevant interest groups, including the regulatory authority, traditional owners and private owners, the mine operator can establish the required future land use for the different physical components of the project (i.e.: the underground workings, open pits, waste rock dumps, spent ore piles, tailings impoundments, water management facilities, ore stockpiles and any surface facilities and infrastructure).

Mine closure and rehabilitation have three main stages though the boundaries between these stages are often difficult to distinguish and in some cases "active care" may need to continue for several decades or even in perpetuity. The three stages are:

- *The Planning Stage* — a rehabilitation plan should be established and integrated into the mine plan and environmental management plan or system at the earliest possible opportunity and regularly updated during the operating life of the project.
- *The Active Care Stage* — the active care programme immediately follows the cessation of activity in a specific area, i.e.: the closure of a waste rock dump, or the total cessation of mining.
- *The Passive Care Programme* — the passive care programme is a period of sampling and monitoring designed to demonstrate that the active care programme has been successful and the "walk-away" state has been achieved.

Site rehabilitation should be progressive so that, wherever possible, the rate of restoration is similar to the rate of mining. Mining is a temporary land use that should be integrated with, or followed by, other forms of land use where appropriate. For all the components of a mine site, physical stability, chemical stability and future land use must be considered. An outline of the components that need to be considered in a site rehabilitation plan are as follows, with a tabulated summary of the issues, objectives and methods of control.

1.1 Underground Mine Workings

The main environmental problems that are encountered when closing an underground mine are the release of contaminated water into the natural hydrological regime, the release of methane gas to the atmosphere and surface subsidence. In addition, all openings to the surface need to be properly sealed to prevent access and ensure the future safety of people and animals. However, it is interesting to note that some disused mine shafts in Australia are now being sealed with specially constructed gates to allow bats to continue to roost in them (Thomson, 1999). Prior to the closure of an underground mine all equipment and fixed plant that can be removed should be extracted, in particular those items that have the potential of future contamination. There are mines in eastern Europe where the water discharged is highly contaminated by iron due to rusting machinery that has been left in the flooded workings.

The majority of underground mines extend below the natural water table and have to be pumped during the operations. Once pumping stops these mines are liable to fill with water, both from ground and surface sources, and may eventually discharge to the surface. As this water has been in contact with the exposed faces of the orebody it is often acidic and may contain elevated levels of heavy metals and sometimes suspended solids. It is necessary to treat this discharge prior to releasing it into the natural environment. This treatment can be done in a water treatment plant, where lime is added to increase the pH and the solids are allowed to settle out, or by the use of an engineered wetland.

Methane gas is commonly encountered during coal mining operations and previously it was vented to the atmosphere. However, recent concern about global warming and greenhouse gases has meant that this practice is no longer acceptable. A number of operations have now installed collection units and the gas is used for power generation.

Often underground mining, especially coal extraction, leaves an extensive network of voids. If the roof materials cave in this can cause the collapse of the overlying rock strata resulting in subsidence on the surface. In some instances it is sufficient to leave the site alone until the subsidence has ceased and then level and rehabilitated the affected area. In severe cases subsidence may threaten existing surface structures and it is necessary to backfill the underground workings with waste and/or grouting.

Table 1.1: Underground Mine Workings

ISSUES	OBJECTIVES	CONTROL
Physical Stability • shafts • adits • declines • subsidence	• prevent access • seal • safety • stabilization	• backfill • plug openings • vent water and gas • infill underground and surface spaces • re-contour surface
Chemical Stability • mineral leaching • acid drainage • contaminants • methane	• clean water • meet water • quality regulations • prevent release	• flood workings • plug openings • remove contaminants • treat water discharge • collect and use gas
Land Use • productivity • aesthetics • drainage	• restore to original or accepted alternative use • re-establish drainage patterns	• backfill disrupted areas • contour surfaces • flood workings

1.2 Open Pit Mine Workings

Open pit mining, by its very nature, leaves a substantial void that can present a safety hazard to people and animals and may result in the discharge of contaminated water. In an ideal world the best solution would be for the mining company to backfill these voids. However, the costs associated with backfilling make it an uneconomic alternative. Some countries have allowed old open pits to be used for rubbish disposal but, if not properly engineered, this can create problems with contamination of the natural groundwater. More often the voids are left with minimal rehabilitation. This is the case in western Australia where legislation requires that an open pit be left fenced or bunded to prevent human access.

The nature of every open pit is unique and depends on the type of ore, the configuration of the ore body, the strength of the host rock, the topography and the ground water table. All these features are then relevant to rehabilitation, as they will govern the final configuration of the pit and, in turn, its end use. To ensure that open pits do not create a safety hazard all

unstable surfaces need to be recontoured, preferably during operations, and an easy access or exit route to the bottom of the pit installed. Fences and bunds tend to be a short-term solution to the problem of safety unless someone takes on the responsibility of maintaining them after the mining company has left.

In situations where the mineral that has been extracted is benign it is common practice to allow the open pit to flood with water as a man-made lake. Many gravel pits in the UK have been allowed to flood and are now used for recreational or conservational purposes. However, sulphide mineralization that has been exposed to the atmosphere presents the risk of the production of acid rock drainage. The present solution of handling this potential problem is to allow the pit to flood with water, thereby preventing any further acid generation. The success of this method of rehabilitation is still being questioned by many but the industry has yet to come up with a more acceptable idea.

Table 1.2: Open Pit Mine Workings

ISSUES	OBJECTIVES	CONTROL
Physical Stability • steep slopes • unstable faces • erosion • hydrology • safety	• stable surfaces • remove hazards • control erosion • clean water	• re-contour • establish vegetation • fence and erect signs • bunding • install drainage
Chemical Stability • metal leaching • acid drainage	• clean water • meet water • quality regulations	• seal surfaces • flood pit • control hydrology • treat discharge
Land Use • productivity • visual impacts • drainage	• restore to original or accepted alternative use • re-establish drainage patterns	• backfill pit • re-contour slopes • establish vegetation • flood

1.3 Waste Rock and Spent Ore

The removal and storage of waste rock and the utilization of heap or dump leaching methods for metal recovery results in the presence of large, barren, and often unsightly and unstable features. These have the potential to produce large quantities of contaminants, particularly acid drainage and heavy metals, elevated levels of suspended solids, dust and, in the case of a heap leach operation, residual process chemicals. For this reason it is essential to carefully plan the waste rock dump configuration with adequate drainage, a contoured and/or sealed surface to minimize water penetration and the placement of potentially acid forming material sealed by inactive waste that has a buffering capacity.

The design of waste rock dumps is critical to the success of the rehabilitation programme. All too often mining companies have in the past dumped the waste first and thought about rehabilitation afterwards. This can result in massive costs for the company, particularly if they have to re-handle the waste or install retrospective drainage features. The nature of the waste, whether it is reactive or not, the surrounding topography, the natural drainage, the seismicity of the region and the required end use for the area are all critical in the design of a dump. If a waste rock dump has been properly designed and constructed, taking into account all these aspects, then rehabilitation will most probably be limited to the revegetation of the surfaces.

The most serious environmental impact associated with waste rock dumps is acid rock drainage. Most sulphidic wastes are reactive and, when exposed to air and water, oxidize producing an acidic solution that percolates through the dump and dissolves any available heavy metals. This contaminated stream then flows into the natural drainage. If potentially acid-producing waste is isolated in dumps by inert, non-acid producing material, with adequate drainage, then the problem can be removed or minimized. If the reactive waste has not been properly isolated then it may be necessary to cap the dump with a layer of clay that is then compacted to prevent water penetration. It may be necessary for any discharges from the dump to be treated, by a water treatment plant or wetland, before being released into the natural environment.

Rehabilitation of the waste dumps may also involve measures to reduce surface erosion, both by water and dust, and the visual impact of the feature. Amelioration measures include control of the natural drainage away from the dump, recontouring the surface of the dump, softening the slopes and the addition of topsoil and revegetation.

Table 1.3: Waste Rock and Spent Ore

ISSUES	OBJECTIVES	CONTROL
Physical Stability • steep slopes • unstable faces • erosion • drainage • dust	• stable surfaces • avoid failures, slumps and sediment release	• site selection • internal drains • gentle slopes • contour surfaces • cap • water ditches • settling ponds • establish vegetation • monitor
Chemical Stability • metal leaching • acid drainage • mill reagents • contaminants	• clean water	• dump design • isolation of reactive material • cap and re-vegetate • control drainage • collect and treat effluent • monitor
Land Use • productivity • visual impacts • drainage	• restore to original or accepted alternative use • establish new drainage patterns	• re-contour • establish vegetation

1.4 Tailings Impoundments

The spent ore, or tailings, from a mine plant are usually disposed of by sub-aqueous or sub-aerial deposition of a thickened slurry to a surface impoundment. The dams for these impoundments are often constructed of a rock or earth fill and the tailings discharged onto beaches along the dam walls. The excess water is then decanted and discharged to the environment or recycled back to the plant. Surface drainage is usually directed around the impoundment. A tailings impoundment should be designed and decommissioned to be physically and chemically stable.

Although there are a number of different methods for constructing and operating a tailings impoundment, the problems associated with the rehabilitation of the feature tend to be similar. Tailings have a very fine grain size and complete dewatering is impossible even in the most arid climates. In some situations mining companies have opted to store saturated tailings with a permanent pond on the surface. This means that the stability of the impoundment is imperative, even after the site has been rehabilitated. Any collapse of a tailings impoundment is likely to have significant impacts.

Waste rock is sometimes used to construct the dam walls and the nature of the material and its acid forming potential must be established. If reactive waste has been used it may be necessary to cap the dam wall slopes in the same way as the waste dumps. All tailings impoundments leak, even if lined, and the amount and nature of the seepage dictate the method of rehabilitation. If the tailings have the potential to be acid producing then any effluent will need to be treated prior to discharge into the natural environment. Treatment can be by a water treatment plant or wetlands.

The surface of the tailings, when dry, has the potential to produce large quantities of dust that may contain residual heavy metals. The surface of the tailings should be contoured to control drainage and minimize penetration, covered with topsoil and revegetated. The dam walls should also be reconfigured, to lessen erosion and dust and reduce the risk of failure, and revegetated.

Table 1.4: Tailings Impoundments

ISSUES	OBJECTIVES	CONTROL
Physical Stability • dust • erosion • dam wall • drainage	• stable surfaces • avoid failures and slumps • control sediment	• site selection • dam design • tailings disposal method • cap and re-vegetate • control drainage
Chemical Stability • metal leaching • acid drainage • mill reagents • dam structure	• clean water by: ◦ control reactions ◦ control migration ◦ collect and treat	• use chemically stable material in dam wall construction • pre-treatment of tailings • cover to control reactions • form wetland • divert run-off • collect and treat effluent • monitor
Land Use • productivity • visual impacts	• restore to appropriate land use	• re-contour, cap and establish vegetation • flood and form wetland

1.5 Water Management

Water is an integral component of all mining operations. The construction, operation and closure of a mine will almost always cause changes in the natural ground and surface water. During the construction of a mine, surface water should be diverted around the main features of the operation such as the open pit, the waste dumps and the tailings impoundment. As has already been discussed, the rehabilitation of these features should then include the control of the natural and imposed drainage to minimize pollution. In order to predict and manage the impacts of a mining operation and its closure on the natural water it is imperative to have a full understanding of the hydrological and climatological regime.

During closure it may be necessary to direct all site run-off to sediment settling ponds to prevent high levels of suspended solids from entering the natural drainage. It may also be necessary to monitor the groundwater to ensure that surface features are not contaminating it. In extreme cases of groundwater contamination grout curtains can be installed to contain the natural flow.

Table 1.5: Water Management

ISSUES	OBJECTIVES	CONTROL
Physical Stability • dam walls • structures • pipelines • ditches • settling ponds • culverts • erosion	• long term • stability • safety of • structures • flood capacity • prevent blockage • prevent erosion • free passage of water	• breach dam • remove structures • plug intakes and decants • upgrade flood design • remove pipes • fill in ditches • provide for • long-term • maintenance • monitor
Chemical Stability • contamination of surface and/or ground water	• clean water	• remove or prevent contamination • drain, treat and discharge • install barriers • establish vegetation • monitor
Land Use • interruption of water supply • productivity of land drainage	• restore drainage patterns or establish alternative • return to appropriate land use	• stabilize and maintain dam or breach and establish erosion-resistant drainage • establish vegetation

1.6 Infrastructure

Depending on the end-use decided for the site, buildings, roads, airstrips and services and other infrastructure may be required to be left in situ. However, usually plant equipment and all other facilities directly associated with processing will have to be removed and the area cleaned where required and rehabilitated. In cases where spillages from the plant or chemical or fuel stores have seeped into the ground, it may be necessary to treated the contaminated material in situ or to excavate it and dispose of it in the waste dumps.

Table 1.6: Infrastructure

ISSUES	OBJECTIVES	CONTROL
Physical Stability • buildings • equipment • roads • airstrips • services	• make area safe • control access	• disassemble and remove all buildings, equipment and other services • excavate buried tanks and backfill • restore drainage • re-vegetate
Chemical Stability • fuel and chemical storage areas • PCB's and insulation • explosives • fuel or oil spills	• make secure and safe • clean water	• remove all unwanted materials • treat contaminated soil or dispose of in an approved site • control and treat drainage
Land Use • alternative uses • productivity • visual impact	• return to appropriate land use	• remove foundations and re-contour • restore natural drainage • re-vegetate

2. Socio-economic Mitigation

In many countries the development of a mining project is an unknown quantity, of which local communities, and to a lesser extent governments, will have little or no concept. The introduction of a cash economy, contributed to by employment, compensation, royalties and spin-off businesses, can upset the local balance, and ultimately culture, of the region. Often the mine is the only source of direct employment in the area and also supports the local economy and indirect employment. The closure of a mining project, if not carefully planned, is extremely likely to have a severe negative impact on the socio-economic status of the community by the sudden removal of this major financial provider with nothing to take its place. Mine-reliant communities can be devastated by the closure of a mine.

The socio-economic aspects of closing a mine should take into consideration the workforce, the community that has become established because of the mine and the local community who were in the area before the advent of the mine. To try to lessen the blow, the mining company needs to work with the local community and government to establish strategies for supporting these communities from the conception of the project. Consultation should be aimed at establishing a development plan for the region that takes into account the continuation of essential services, such as medical care, schools, etc., and the identification of self-sufficient industry that needs to survive after the mining company has left.

Table 2: Socio-economic Mitigation

ISSUES	OBJECTIVES	CONTROL
• workforce	• re-employment • relocation	• assistance with looking for other work
• local communities storage areas • PCB's and insulation • explosives • fuel or oil spills	• stable economy • good health • education facilities	• regional development plan • develop local self-sustainable enterprises • establish foundation or trust fund for essential services • relocate in-migrants

3. Financial Considerations

The regulatory authority is usually ultimately responsible for the environmental effects created by the closure or abandonment of a mine site. As a result, it is becoming common practice for some form of financial surety to be in place before a project is granted approval. This is designed to cover both the technical and/or financial failure of an operator to meet its full obligations at the time of closure, or in the event of an unplanned closure (Sassoon, 1996). There are a number of options available for establishing financial surety, including:

- *Irrevocable Letter of Credit:* an agreement between a company and a bank, whereby the bank will provide cash funds to the authorities if the company defaults;
- *Performance bond:* a surety bond issued by an insurance company in which the insurer is responsible for all claims up to an agreed limit;
- *Trust Fund:* a fund with regular contributions being invested by a fund manager;
- *Insurance Policy:* a special form of performance bond;
- *Parent-Company Guarantee:* the parent company guarantees to indemnify the government in the event of company default;
- *Pledging of Assets:* the company assets are pledged to the government.

For some operations the amount of financial surety is established during project negotiations and is based on the information contained in the Environmental Impact Assessment and a break down of rehabilitation costs. Another method is for the mine operator to be charged a levy on every tonne of rock/ore mined/processed or every tonne of concentrate/metal produced. The financial surety should be available to either the mine operator or the relevant regulatory authority, to pay for rehabilitation. If the mine operator defaults, the money remains in the hands of the regulatory authority.

Once all stages of rehabilitation have been completed, including the passive care programme, which might have to continue for hundreds of years, the remaining funds may be returned to the mine operator. Whichever method is used to establish a financial surety, it is essential that it be regularly assessed, as part of the Environmental Management System, and increased or decreased as necessary. This assessment would be part of the Review section of the Environmental Management System and would be included in the consultation process with the regulatory authority.

4. Conclusions

Mine site rehabilitation should be aimed towards a clearly defined future land use, whether active or passive, for the area. This land use should be determined in consultation with local communities and the government. Successful rehabilitation to a low maintenance land use, which is sustainable in the long term, requires an understanding of landforms, soil development, plant succession and species diversity.

For all the components of a mine site, physical stability, chemical stability and future land use need to be considered. The main aims of restoration and rehabilitation are to reduce the risk of pollution, to restore the land and landscape, to improve the aesthetics of the area and to prevent further degradation so that the resulting conditions pose minimal risk to people and the environment both in the short and long term. If this state is achieved then the mine operator can literally "walk-away" with the knowledge that there will be no future liabilities.

Before any rehabilitation work takes place the issues, objectives and methods should be clearly defined for each stage and a detailed rehabilitation plan established. Because all mine sites are unique, and the regions and countries that they are situated in have their own often differing requirements, it is essential that these plans be drawn up separately for each individual project. The issues and objectives for restoration and rehabilitation should be determined through consultation with the relevant regulatory authority and local community. During this consultation process the potential or required end-use will be established, whether it is agriculture, building or amenity development, forestry, nature reserve or a heritage site. The mine operator can then outline the methods for achieving these objectives, which are then also approved via consultation.

The socio-economic implications of the decommissioning of a mining project should also be included in the closure and rehabilitation plans, both for the workforce and impacted communities. Often a mine is the only source of direct employment in an area, as well as contributing to the local economy and indirect employment. In addition, it is not uncommon for a mining project to create compensation dependent communities. The removal of these sources of income can have a severe impact to the workforce, the government and the community. To try to lessen this blow mine operators should work with their employees to find alternative sources of employment and/or re-location. The company should also work with the regulatory authority to establish strategies for supporting the community from the conception of the project and promoting the investment of money in non-mine related enterprises.

If the mining industry is honestly going to embrace the concept of sustainable development then the successful closure of the project should be as important as the profitable operation of the mine. This involves a commitment to care for the environment, coupled with the social and economic development of the region, throughout mine life. By integrating closure plans into the project life cycle as early as possible it is possible to achieve this ideal.

5. Sustainable Development in Action

On the Kenya coast the Bamburi Portland Cement Company has been extracting Pleistocene coral limestone and Jurassic shale as the raw materials for making cement since 1954. During the process, vast tracts of land have been strip-mined and laid to waste. In 1970 the company, alarmed by the size of its growing quarries, embarked on a rehabilitation project and employed Dr. René Haller to run it. The project is now a financially independent operation with Dr. Haller as the managing director.

The Bamburi cement factory, located 12 km north of Mombasa Island, produces 1.2 Mt/y and for each tonne of cement approximately 1.5 t of raw materials have to be extracted. Over the last 40 years 25 Mt of limestone have been removed leaving behind an area of 2 km^2 of sterile wasteland. The substrate of coral limestone is relatively inhospitable and forms a hard crust when exposed to the air and sun. In addition, the proximity of the sea means that the water table, at a depth of 50 cm, is brackish.

5.1 Revegetation

Rehabilitation started with the planting of the tall casuarina tree or "whistling pine" (*Casuarina equisetifolia*) interspersed with conocarpus (*Conocarpus lancifolius*) and the coconut palm (*Cocos nucifera*). Three thousand trees were first planted as an "island" in the quarry to form a nucleus for the project. Many species of insects, spiders, reptiles, birds and mammals were introduced into the young forest to aid the development of a healthy ecosystem. All quarry areas not immediately available for re-vegetation were sown with pioneer grass species, such as *Rhyncholythrum* repens, and used for game farming.

After five years, 45 ha of the barren quarry floor had been planted with trees and the casuarinas had started to self-seed and were colonizing the surrounding quarry. After 20 years many of the older casuarinas, which were now 30 m tall, started to fall over because they had been unable to extend a tap-root system into the limestone, leaving space for a second generation of plant growth. In total, there are now estimated to be over 250 different plant species in the quarry, which support an increasingly diverse fauna.

5.2 Aquaculture

The presence of an abundance of underlying, unpolluted ground water suggested that the development of an aquaculture project could be feasible, both for rehabilitation purposes and as an economic venture. This started with the introduction of fish tanks for the breeding of tilapia and now includes a crocodile farm, a rice paddy and a Nile cabbage (*Pistia stratiotes*) pond that supports two hippopotami. The phosphate and nitrogen bearing waste water from the fish and crocodile tanks is pumped into the rice paddy, which traps the nutrient-rich sediment. From here the water passes through the Nile cabbage pond, where the plants extract the dissolved waste compounds such as ammonia, nitrate and phosphate, and back to the fish and crocodile tanks. The Nile cabbage is harvested on a regular basis and is used as compost for plants that are not sensitive to salinity.

5.3 Baobab Farm

In addition to the aquaculture system, the Baobab Farm also includes a banana and fruit tree plantation, herds of sheep, goats and antelope, poultry and bees that produce honey. The banana and fruit tree plantations, which contain oil palm, mango, breadfruit, passion fruit and tropical spices, are fertilized with farmyard manure. Nile cabbage harvested from the aquaculture bio-filter ponds is used as compost for plants. Potassium-rich dust from the filters of the cement factory is used to strengthen the defence of the bananas against fungal diseases. Honey is gathered from 60 beehives placed amongst the fruit trees and in the surrounding forest.

In the open quarry areas grass seed was sown in a few "nucleus" spots during the rainy season and over the last ten to 15 years primary grassland has become well established. This grass is used for grazing game animals such as eland and oryx, which are farmed for meat. At present there are 60 eland in four herds and 110 oryx in three herds. Culling is usually of the order of six to eight eland and ten to 12 oryx each year and the main markets for the meat are the numerous tourist hotels and restaurants.

5.4 Nature Trail

The creation of new habitats and the ever-expanding food sources have provided a refuge for a wide range of animals, birds and insects. The development of this green haven became a focal point for the area and created a lot of local interest resulting in the establishment of a "Nature Trail", which was open to the public in 1984. More than 100,000 tourists and locals now visit this Nature Trail every year and, because of its popularity, a second system of forest trails has recently been opened in a sector of the North Quarry.

5.5 Economics

As well as being an ecological success, the Bamburi rehabilitation project has also become an autonomous, economically viable unit and, over the last several years, has had a higher profit margin than the cement factory. The existing and potential sources of income are as follows:

- Well over 1.5 million casuarina trees have been planted and many of these are felled after five to seven years to be sold as building poles to substitute for the over-exploited mangroves. Wood that is unsuitable for the building trade is sold as firewood and charcoal.
- 30–35 t of market size tilapia can now be produced every year.
- Up to 300 crocodile skins are sold every year and there is currently the capacity to produce 500 skins/year.
- There is a potential rice production capacity of 2.5–3 t/year.
- In 1995 1,576 kg of antelope meat, 362 kg of ostrich meat, 3,600 kg of crocodile meat, 11,732 quails and 3,446 guinea fowl were sold.
- Bananas are sold from the banana plantation.
- Ornamental plants are grown and sold in a nursery.
- A shop sells indigenous handicraft.
- Visitors to the Nature Trail and Forest Trails pay an entrance fee.

To date a total of 300 ha of limestone quarry floor has been rehabilitated and the work is continuing as areas become available. Future plans for the area currently being mined to the north include a Wildlife Sanctuary, a recreation lake, a country club and golf course, an open-air amphitheatre, a butterfly pavilion, a 50 t tilapia farm integrated with crocodiles and rice, and an area of habitation.

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Environmental Management Tools

Contact Details

Industry and Environment, Vol 18, No. 2-3, 1995, is available from:

SMI (Distribution Services) Limited
P.O Box 119
Stevenage
Hertfordshire SG1 4TP
UK
Tel: 44 1438 74 81 11
Fax: 44 1438 74 88 44
Email: Enquire@SMIBooks.com

UNEP may be contacted at:

UNEP
Tour Mirabeau, 39-43 quai André Citröen
75739 Paris cedex 15
France
Tel: 33 1 44 37 14 50
Fax: 33 1 44 37 14 74
Email: uneptie@unep.fr
Web: http://www.uneptie.org

The Whitehorse Mining Initiative: Leadership Council Accord

The following is an excerpt from the Whitehorse Mining Initiative.

Introduction

The Canadian mining industry is facing major challenges as it prepares to enter the 21st century.

Mining helps to make Canada one of the most favoured societies of the world. We are resolved that it should help lead us into an equally bright future.

This Accord forges a key to that future. It is a summons to change, framed within the context of a commitment to social and environmental goals. What we seek is a sustainable mining industry within the framework of an evolving and sustainable Canadian society.

The specific challenges facing mining in Canada are complex. Some are outside Canada's control. We cannot escape the reality of the nature of global competition. Numerous mineral rich countries have liberalized their economic and political systems to attract investment. Many of the challenges, however, do come under our control and can be addressed through the cooperation of different sectors within Canada.

Against this background, the mining industry concluded that it needed support, assistance and advice within a non-adversarial framework, to help it develop a new strategic vision and to create solutions for the 21st century.

The Mining Association of Canada, on behalf of the mining industry, took a suggestion for a multi-stakeholder process to the mines ministers of all senior governments at their annual conference in Whitehorse in September 1992. The ministers agreed to become co-sponsors and trustees of the process and named it the Whitehorse Mining Initiative. Representatives of five sectors of society agreed to participate. They were the mining industry, senior governments, labour unions, Aboriginal peoples, and the environmental community.

Full-scale discussions began in February 1993 and, 18 months later, culminated in this Accord.

The Accord adopts a strategic vision for a healthy mining industry in the context of maintaining healthy and diverse ecosystems in Canada, and for sharing opportunities with Aboriginal peoples. It calls for improving the investment climate for investors, streamlining and harmonizing regulatory and tax regimes, ensuring the participation of Aboriginal peoples in all aspects of mining; adopting sound environmental practices; establishing an ecologically

based system of protected areas; providing workers with healthy and safe environments and a continued high standard of living; recognition and respect for Aboriginal treaty rights; settling Aboriginal land claims; guaranteeing stakeholder participation where the public interest is affected; and creating a climate for innovative and effective responses to change.

Contact Details

The full document is available online at:
http://www.nrcan.gc.ca/mms/mining-e.htm

The Mining Association of Canada is an alternative contact:
The Mining Association of Canada
1105–50 Sparks Street
Ottawa, Ontario K1R 7S8
Canada
Tel: 613-233-9391
Fax: 613-233-8897

Guidelines to Help You Get Environmental Approval for Mining Projects in Western Australia

Contact Details

The Western Australian Environmental Guidelines for Mining may be downloaded from:
http://www.dme.wa.gov.au/news/approval.html

Alternatively, you may contact the Department of Minerals and Energy of Western Australia.

Department of Minerals and Energy Mineral House
100 Plain Street (cnr Adelaide Terrace)
East Perth WA 6004
Australia
Tel: 61 89 222 33 33
Fax: 61 89 222 34 30

WHO Selected Water Quality Guidelines

Parameter (mg/L	Ghana 1997[1]	PNG 1998[2]	PNG 1998[3]	Zambia 1993[4]	World Bank 1999[5]	WHO 1996[6]
pH	6-9	6.5-9	<+/-0.2	6-9	6-9	6.5-8.5
Temp (↑C above ambient)	<3	<2	<2	40	–	–
Conductivity (µS/cm)	750	<+/-10%	–	4-300	–	–
Colour (TCU)	200	–	–	20 Hazen	–	15
Total dissolved solids	50	–	–	3000	–	1000
Total suspended solids	50	<+10%	<+10%	100	50	–
Turbidity (NTU)	75	<+/-10%	<+/-10%	15	–	5
Sulphide	1.0	–	–	0.1	–	–
Phenol	0.5	–	–	0.2	–	–
Oil and Grease	10	–	–	5	10	–
BOD	50	–	–	50	–	–
COD	250	–	–	90	150	–
Total Phosohorous	2.0	–	–	1.0	–	–
Nitrate	0.1	–	–	50	–	50
Total Coliforms	400	–	–	25000	–	–
Arsenic (total)	1.0	0.05	0.05	0.05	0.1	0.01
Arsenic (soluble)	0.1	–	–	–	–	–
Chromium (total)	0.5	–	–	–	–	–
Cr (hexavalent)	0.1	0.01	0.05	0.1	0.1	0.05
Cadmium	0.1	0.002	0.002	0.5	0.1	0.003
Copper	1.0	0.002	0.005	1.5	0.5	2.0
Iron (total)	2.0	1.0	–	2.0	3.5	0.3
Mercury	0.01	0.0001	0.0001	0.002	0.01	0.001
Nickle	–	–	0.015	0.5	0.5	0.02
Lead	0.1	0.001	0.004	0.5	0.2	0.01
Zinc	2.0	0.05	0.05	10.0	2.0	3.0
Cyanide (total)	–	–	–	0.2	1.0	-
Cyanide (free)	0.1	0.005	0.005	–	0.1	0.07
Cyanide WAD	0.5	0.1	0.1	–	0.5	–

[1] Proposed guidelines for discharges to water.
[2] Papua, New Guinea, water quality standards for fresh water.
[3] Papua, New Guinea, water quality standards for marine water.
[4] Zambia effluent standards.
[5] Effluent level guidelines.
[6] Drinking water quality.

Air Quality Standards: Discharges to Air

PARAMETER	MAXIMUM DISCHARGE (µg/m3)
Sulphur Dioxide	
Annual Arithmetic Mean	75.00
24 hour concentration	260.00
3 hour concentration	665.00
1 hour concentration	900.00
Antimony (Sb)	0.50
Arsenic (As)	1.00
Beryllium (Be)	0.10
Cadmium (Cd)	0.30
Chromium (Cr)	0.10
Copper (Cu)	2.50
Fluorine (F)	2.00
Lead (Pb)	2.50
Mercury (Hg)	1.00
Molybdenum (Mo)	2.50
Nickel (Ni)	0.10
Selenium (Se)	0.50
Uranium (U)	6.00
Vanadium (V)	1.00
Zinc (Zn)	2.50

Source: Ministry of Environment, British Columbia, Canada, 1989.

Tentative Netherlands Soil Quality Criteria

	Soil Quality Criteria		
	Concentration (mg/kg dry weight)		
Parameter	A[1]	B[2]	C[3]
Arsenic	20	30	50
Barium	200	400	2000
Cadmium	1	5	20
Chromium	100	250	800
Cobalt	20	50	300
Copper	50	100	500
Lead	50	150	600
Mercury	0.5	2	10
Molybdenum	10	40	200
Nickel	50	100	500
Tin	20	50	300
Zinc	200	500	3000

Source: VROM, 1983. Leidrand Bodemsanering, *Guidelines for Soil Clean Up*, Netherlands Ministry of Housing, Planning and Environment, Soil, Water and Chemical Substances Department, The Hague, Netherlands.

1 Reference value for "good" soil quality.

2 Limiting value for soil quality having potential for harmful effects on human health or the environment and requiring further investigation.

3 Limiting value for heavily polluted soil requiring remedial investigations and cleanup.

Reference to the World Bank Guidelines for Base Metals and Iron Ore Mining

Contact Details

Web: http://publications.worldbank.org/ecommerce/catalog/product?item_id=202374

Pollution Prevention and Abatement Handbook 1998: Toward Cleaner Production
English; 472 pages
Price: $ 125.00

Published March 1999 by World Bank ISBN: 0-8213-3638-X SKU: 13638

Model Provisions for the Right to Access Information

1.1 Citizen's Right to Access Information

Citizens and communities affected by mining activities are entitled to obtain full and timely information from the authorities if such information is relevant to the environmental impact of the mining activities.

Such information comprises, not exclusively, all written or graphic data, or data contained in other means of storage, regarding:

a) the state of waters, the air, the land, creatures and plants;

b) mining activities affecting the environment or the health of the community;

c) activities of the authorities and mine operators for the protection of the environment and limitation of adverse effects.

1.2 Duty to Disclose Specific Information to the Authorities

Notwithstanding other obligations, all mining operators have a duty to disclose to the competent authorities the following information:

a) At all stages:

- potential major accident hazards;
- hazardous substances involved in the mining activity;
- existing safety measures and procedures.

b) At the exploration stage:

- details about noise and air pollution involved;
- interference, if any, with community access to public roads, highways and easements, particularly those resulting from the construction of access paths and roads needed for exploration.

c) At the ore processing stage:

- environmental aspects of such operational activities, with particular emphasis on information regarding release of hazardous substances, pollutants, tailings and acid mine drainage.

d) At the stage of transportation of the processed minerals:

- aspects concerning the transport of hazardous substances;
- aspects relating to interference with normal community movements on the roads and highways used for such transportation.

e) At the stage of phasing out and winding up:

- workers and the community at large must be informed of job retrenchment plans and projections;
- advanced retirement plans offered to the operator's executive staff but not offered to others.

f) At the closure, abandonment or rehabilitation stages:

- details regarding the operator's obligations and plans on the process involved.

1.3 Exclusion of Access to Information

The right to access information can be excluded for serious and substantial reasons of public safety, public security, or the protection of recognized commercial secrets and intellectual property.

1.4 Costs

Access to information is free except for the costs arising from transmitting the information, such as photocopying and postage.

1.5 Judicial Review

The decision to refuse access to information, including the grounds for such refusal, should be subject to judicial review.

2. Capacity-building

The government should facilitate community participation through information campaigns regarding their rights, education programmes in environmental awareness and other suitable measures.

3. Goodwill Agreements

Besides the possibility of legal obligations, industry and affected communities should establish mutual trust by entering into agreements or other voluntary measures such as exchange of information or permitting access to sensitive areas of mining sites for inspection.

4. Worker's Participation in Safety Management

In every mine where hazardous substances are used or handled, the operator should set up a safety committee consisting of an equal number of representatives of workers and management to promote cooperation between the workers and the management in maintaining proper safety and health at the work place and to review periodically the measures taken in this respect.

Awareness and Preparedness for Emergencies at the Local Level—UNEP's APELL Programme

Adapted from an article in Environmental Management and Health, *Vol. 9 No. 3, pp. 124-129 (1998).*

Introduction

Awareness and Preparedness for Emergencies at Local Level (APELL) is a tool developed by the United Nations Environment Programme's Industry and Environment centre (UNEP IE), in conjunction with governments and industry. Its purpose is to minimize the occurrence and harmful effects of technological accidents and emergencies, particularly, though not exclusively, in developing countries. APELL was launched in 1988, following various industrial accidents that had adverse impacts on health and the environment — Bhopal in 1984 and the Sandoz warehouse fire near Basel in 1986, which resulted in extensive contamination of the Rhine, are obvious examples. This paper describes the APELL process and some of the tools that have been developed to implement it, especially the *APELL Handbook*. Some of the activities of UNEP's APELL programme are also described and examples of APELL implementation are given. Finally the future of APELL is considered. It is suggested that APELL is useful in any situation that requires joint planning for disasters by several parties, e.g. government, industry and local communities. Being aware and prepared means having workable, realistic plans in the event that an accident does occur. It also means creating a better understanding of local hazards, which in turn should lead to actions designed to prevent accidents from happening at all.

The APELL Process

Why APELL?

It is now universally acknowledged that every disaster, whatever the cause, may have an environmental impact. While some major industrial accidents can be contained within the boundaries of the plant, in other cases there are impacts on the surrounding neighbourhood, with adverse short- or long-term consequences affecting life, life-support systems, the social fabric or property. This is even more true of accidents arising from transport of dangerous goods, e.g. by road, rail or pipeline, through or close to populated areas, since by definition there is no boundary fence in these cases. The extent of the losses so caused depends to a large extent on the actions of the first responders to an emergency, at the scene of the accident and within the community around it.

Clearly, adequate response to such situations calls for cooperation between various institutions and individuals. This can be achieved only if there is awareness within the community of possible risks and of the need for joint preparedness to cope with their consequences. The *APELL Handbook* describes a process for improving community awareness and emergency preparedness and achieving cooperation between the various parties involved.

What is APELL?

APELL consists of two parts:

1. Provision of information to the community, referred to as "community awareness".
2. Formulation of a plan to protect people, property and the environment, referred to as "community awareness".

APELL addresses all emergencies with potential for fire, explosion, spills or releases of hazardous materials. The possibility of "combination accidents" should be noted at this point; for example, an earthquake that triggers an emergency in a chemical factory. The determination of which potential hazards should be covered by the APELL process is in principle the result of a risk assessment. In most cases, however, common sense will be sufficient to identify the facilities or areas that present a risk of a major accident. The criteria (lists of substances and threshold levels) given in international or national regulations or recommendations may also provide guidance.

APELL is flexible. Countries differ in culture, value systems, legal and regulatory requirements, community infrastructure and response capabilities and resources. Their industries present different potential dangers. However, they have one common need — the need to cope with a major technological accident affecting a local community. The *APELL Handbook* provides the basic concepts for the development of action plans that can be adapted to local conditions. No legislation or regulation is needed. Since the containment of health and environmental impacts depends on the speed and scope of the initial local response, emphasis is placed on local participation. However, it is recognized that national governments and the chief executive officers of industries have a fundamental role in promoting and supporting these local efforts. Industry associations also have an important part to play in encouraging industry participation.

The APELL process consists of ten steps, as follows:

1. Identify the emergency response participants and establish their roles, resources and concerns.
2. Evaluate the hazards and risks that may result in emergency situations in the community.
3 . Have participants review their own emergency response plans for adequacy relative to a coordinated response.
4. Identify the required response tasks not covered by existing plans.
5. Match these tasks to the resources available from the identified participants.
6. Make the changes necessary to improve existing plans, integrate them into an overall community plan and gain agreement.
7. Commit the integrated community plan to writing and obtain approval from local governments.
8. Educate participating groups about the integrated plan and ensure that all emergency responders are trained.
9. Establish procedures for periodic testing, review and updating of the plan.
10. Educate the general community about the integrated plan.

The *APELL Handbook* describes the content of each step and provides a checklist for completing it.

Who are the APELL Partners? What are Their Responsibilities?

At the local level there are three very important partners who must be involved if APELL is to succeed:

1. ***Local authorities***. These may include provincial, district, city or town officials, either elected or appointed, who are responsible for safety, public health and environmental protection in their area.

2. ***Industry.*** Industrial plant managers from either state-owned or private companies are responsible for safety and accident prevention in their operations. They prepare specific emergency measures within the plant and review their application. But their responsibilities do not stop at the boundary fence. As leaders of industrial growth and development, they are in the best position to interact with leaders of local authorities and community groups, in order to create awareness of how the industrial facility operates and how it could affect its environment and to help prepare appropriate community response plans in the event of an emergency. The involvement and active participation of the workforce is also very important.

3. ***Local community and interest groups.*** Such as environmental, health, social care, media and religious organizations and leaders in the educational and business sectors, who represent the concerns and views of their members or constituents in the community.

There are other partners, e.g. non-governmental organizations (NGOs). The APELL process is designed to harmonize with other initiatives to reduce risks and their consequences, not to replace them.

How Can an APELL Project be Started?

The APELL process may be initiated by any member of the three involved groups: industry managers, local authorities or community leaders. However, there must then be direct and close interaction between the representatives of the three partners. A "bridge" is created by means of the "APELL Coordinating Group". This is the mainspring of the process. The group does not itself have any operational role during an emergency but exists to prepare the various partners to be ready and to know their tasks if an accident does occur. Members must be able to command the respect of their various constituencies and be willing to work together in the interests of local safety, well-being and property security. In particular, local plant managers need to be active participants and local authority and community leaders need to know that they are acting with the blessing and full authority of the most senior managers in their companies. Ideally, the leader of the coordinating group should be able to ensure the motivation and cooperation of all segments of local society, regardless of cultural, economic, educational and other dissimilarities, and this needs to be borne in mind when choosing the leader.

The APELL process is designed to build on any and all existing emergency plans to create a coordinated single local plan. There may be national government emergency plans in place, but there is always the need for an effective structure at local level. Industrial facilities should already have on-site emergency plans. Local authorities and rescue services should have plans to deal with the consequences of major emergencies. Local hospitals should certainly have their own "major accident plans" for dealing with large numbers of seriously injured people. The APELL process ensures that all existing plans contribute to the overall integrated, cooperative plan.

How Can Community Awareness be Created?

Citizens want to know if potentially hazardous materials are being produced, stored, used or transported in their communities. In addition they need to be informed about potential risks in order to understand why an emergency plan has been established, how it works and what action they are expected to take in an emergency. There is really nothing mysterious about a community awareness programme. A fenced-in industrial plant can look threatening to the public, but much of the mystery disappears when people know what the plant uses and manufactures and know that it has a good safety record and that an effective emergency plan exists. No one can prescribe the activities necessary for a local awareness programme that will fit every community. However, the following points should be considered:

- Define the local community concerned.
- List existing local community contacts.
- Contact other industrial facilities to coordinate community activities.
- Plan an initial meeting of the APELL Coordinating Group.
- Develop fact sheets or kits on each industrial operation.
- Develop fact sheets on community preparedness.
- Assign responsibility for communications tasks.
- Look for communication opportunities.
- Select methods of communication suitable for local circumstances.
- Get outside help.
- Inform employees.

In preparing and building community awareness the following should be borne in mind:

- All parties active in the APELL process have a duty to keep the public informed about progress and to ensure that the public does not receive conflicting messages.
- Developing relationships with the media requires time and effort from everybody concerned.
- Media relations efforts, like local cooperation programmes, cannot be started after trouble has already arisen.

How Can Preparedness for Emergencies be Achieved?

Among the first steps in the planning process are the gathering of information and the assessment of the current situation. Therefore, one of the first tasks faced by the APELL Coordinating Group is the collection of basic data. This can be done by personal contacts or by more formal surveys, in order to:

- identify local agencies making up the community's potential awareness and preparedness network;
- identify the risks that may lead to an emergency;
- establish the current status of community planning and coordination and ensure that potential overlaps are avoided;
- identify the specific community points of contact and their responsibilities in an emergency;
- list the kind of equipment and materials for emergency response, which are available locally;
- identify the organizational structure for handling emergencies;
- check if the community has specialized emergency teams to respond to releases of hazardous materials;
- define the community emergency transport network;
- establish the community procedures for protecting citizens during emergencies;
- set up a mechanism that enables responders to exchange information or ideas with other parties during an emergency. These are only some of the major issues that will have to be resolved within or by the coordinating group. More details can be found in the *APELL Handbook*.

The main APELL tools and publications developed by UNEP IE are:

The APELL Handbook

Since its launch in 1988, more than 10,000 copies have been distributed worldwide in English, French and Spanish. The handbook has also been translated into 17 other languages: Arabic, Chinese, Croatian, Czech, Estonian, Hindi, Hungarian, Indonesian, Italian, Korean, Latvian, Lithuanian, Polish, Portuguese, Russian, Thai and Turkish. The *Handbook* is designed to help people start putting APELL into practice themselves.

The APELL Newsletter

The *Newsletter* appears twice a year in English, French, Spanish and Chinese. The *Newsletter* keeps readers informed of current APELL or APELL-related activities, as well as national and regional programmes and APELL-related events.

Computer–assisted Management of Emergency Operations (CAMEO)

The United States Environmental Protection Agency (US EPA) has adapted its CAMEO software for international applications by APELL users worldwide. Efforts are being made to make CAMEO available in Spanish.

APELL–related Publications

1. UNEP IE Technical Report Series:

    - *3, Storage of Hazardous Materials*;
    - *8, International Directory of Emergency Response Centres* (joint publication with OECD, currently under revision);
    - *12, Hazard Identification and Evaluation in a Local Community* (with the support of the Swedish government);
    - *19, Health Aspects of Chemical Accidents* (joint publication with OECD, WHO and IPCS);
    - *21, APELL Annotated Bibliography* (with the support of the Canadian government);
    - *28, Safety, Health and Environmental Management Systems*;
    - *35, "TransAPELL"* (APELL for accidents arising from the transport of dangerous goods).

2. *APELL for Port Areas* (joint publication with IMO).

3. *APELL World-wide* — a set of 12 national overviews of APELL implementation, in: Brazil, China, India, Mexico, Colombia, the Philippines, Thailand, Tunisia, The Czech Republic, Hungary, Latvia and the Russian Federation.

UNEP IE also distributes the OECD's *Guiding Principles for Chemical Accident Prevention, Preparedness and Response* and associated publications.

Contact Details

UNEP IE
Tour Mirabeau, 39-43 quai André Citröen
75739 Paris Cedex 15
France
Tel: 33 1 44 37 14 50
Fax 33 1 44 37 14 74
Email: unepie@unep.fr
Web: http://www.unepie.org

Supporting Reference Documents

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   - Community consultation and involvement (June 1995)
   - Environmental auditing (June 1996)
   - Environmental impact assessment (June 1995)
   - Environmental management systems (June 1995)
   - Environmental monitoring and performance
   - Hazardous materials management, storage and disposal (May 1997)
   - Managing sulphidic mine wastes and acid drainage (May 1997)
   - Mine planning for environment protection (June 1995)
   - Onshore minerals and petroleum exploration (June 1996)
   - Overview of best practice environmental management in mining (June 1995)
   - Planning a workforce environmental awareness training program (June 1995)
   - Rehabilitation and revegetation (June 1995)
   - Tailings containment (June 1995)

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Useful Web Sites

IDRC

Gender and Biodiversity Research Guidelines
http://www.idrc.ca/biodiversity/tools/gender1_e.cfm

ICME

Environmental Charter
http://www.icme.com/envchar.html

The Mining Association of Canada

Environmental Policy
http://www.mining.ca/english/publications/policy.html

Minerals Council of Australia

http://www.minerals.org.au

Code for Environmental Management
http://www.enviro-code.minerals.org.au

Department of Minerals and Energy of Western Australia

Environmental Approval Guidelines
http://www.dme.wa.gov.au/news/noi.pdf

Australian Minerals and Energy Environment Foundation (Ameef)

Groundwork magazine and *Best Practice Environmental Management in Mining* booklets
http://www.ameef.com.au
or
http://www.ea.gov.au/industry/sustainable/mining/bpem.html

World Bank

The World Bank Participation Sourcebook
http://www.worldbank.org/wbi/sourcebook

New Ideas in Pollution Regulation (NIPR)
http://www.worldbank.org/nipr

Consultative Group on Artisanal and Small Scale Mining Development
http://www.worldbank.org/html/fpd/mining/index.htm

Global Reporting Initiative

Sustainability Reporting Guidelines
http://www.globalreporting.org

European Community

EMAS
http://www.europa.eu.int/comm/environment/emas

International Organization for Standardization

ISO 14001
http://www.iso.ch

International Council on Metals and the Environment (ICME)

http://www.icme.com

Vereniging Milieudefensie (Friends of the Earth Netherlands)
http://www.milieudefensie.nl

World Mine Ministries Forum

http://www.miningmillennium.org