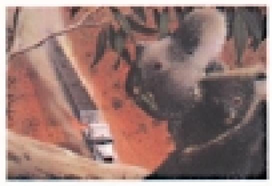

BEST PRACTICE ENVIRONMENTAL MANAGEMENT IN MINING

Mine Planning for Environment Protection

AUSTRALIA

EPA

Environment Protection Agency

2. MINE PLANNING STAGES

As the mining project process moves from the planning and concept design stages through to operation and decommissioning, proper planning can reduce environmental impacts, result in good environmental performance and enhance the public perception of the industry as able to operate in an ecologically sustainable way.

This chapter addresses the issues that need to be considered and planned for over the life of the mine.

2.1 MINE LOCATION

When reviewing any mineable deposit, it is useful to consider its general environmental constraints. Typical questions could include the following.

Location in drainage basin

Will it flood? Is there a substantial upstream catchment that would need diverting around the mine? What is the classification of receiving watercourses? Who uses water downstream and what do they use it for? What are the ecological needs of aquatic and terrestrial flora and fauna? Will there be enough water to operate the mine?

Proximity to utility infrastructure

Where are the nearest main roads, railways, water supply, sewerage, electricity, telecommunications, ports, etc. ? Do they have sufficient capacity and will their intensified use cause environmental impacts? Can they be supplemented or modified to satisfy the needs of the mine?

Surrounding land use

How is land surrounding the site currently used and what is its zoning for future development? Are there sensitive land uses that need to be accommodated?

Labour market

Is there an adequate local labour market, or will employees immigrate? If the latter, are there sufficient housing stock and community facilities to serve an expanded population? Should employees be flown in and out or should a viable community be established? How acceptable will construction camps be? Will there be potential for conflict between wealthy mine workers and traditional land owners?

Visual exposure

Is the deposit in a visually prominent area? If it is, does this matter to the local community? What can be done via screen planning or facilities location to minimise future impacts?

Cumulative impacts

Is there a potential for the impacts of the proposal to add to those from other mining or industrial operations? Will there be competition for water, transport services or employees? Will air quality, noise or water quality be cumulatively satisfactory?

2.2 PRE-MINING INVESTIGATIONS

Adequate baseline information is necessary before mines can be planned in an environmentally responsible way. An essential prerequisite is proper definition of the deposit itself. It is in the interests of the community and the mining company to have efficient and economically viable mines. If the resource is found to be inadequate after capital is committed, considerable environmental damage can be sustained in re-configuring the mine. Initial excavations may have to be abandoned and, in the worst situation, it might not be possible to sustain operating losses and the mine would have to be closed. In such cases orderly decommissioning and rehabilitation can be difficult to achieve. These problems can be avoided by effective pre-mining investigation and adequate baseline information.

The other key requirement is an adequate understanding of baseline environmental conditions. This would normally be obtained by an integrated monitoring program that established pre-mining conditions in meteorology, flora and fauna, water quality, noise and air quality, transport and other characteristics of the site and surrounding area. Conventionally, this should be collected over at least 12 months to account for seasonal variations. If the mine is a major development, or the surrounding environment is particularly sensitive, it is highly desirable to collect data for as long as possible, extending over at least three years.

This baseline data is essential to enable the mine planners and environment scientists to understand the environmental issues that will need to be addressed.

2.3 CONSTRUCTION

Some of the more significant environmental impacts associated with projects can occur during their construction. During this phase work force numbers often peak, placing strains on local temporary accommodation. Construction workers can be transient and therefore not subject to the same social controls, and may not have the same concern for the local environment, as workers from the

> THE UNDERLYING PRINCIPLE FOR EFFECTIVE POLLUTION PREVENTION AND CONTROL IS TO CONTAIN CONTAMINANTS ON THE SITE ITSELF

permanent population. Shipment of construction materials and mining equipment can be more significant than transport operations during mining.

Building environmental safeguards during the construction phase can themselves be intrusive. For example, building an earthen bund 10 to 15 metres high and several kilometres long for acoustic attenuation is a major earth-moving operation in its own right. By definition, it is not possible to acoustically screen the construction of noise bunds. As discussed in Section 1.2, higher noise levels may be permitted during construction but they can be difficult to explain to local communities. This is particularly the case because the first experience of noise-related impacts will be felt during construction. Adequate consultation with the community is needed about what can and cannot be achieved during construction and how local concerns will be addressed.

Facilities built during the construction phase can remain operational for more than 20 years in a large mine. Therefore it is appropriate to use low maintenance materials and to properly stabilise and rehabilitate earthworks.

Pollution controls during construction are sometimes designed to very low standards because they do not form part of the ongoing mine. However, there is little point building elaborate controls for the operational phase of mining if the environment they are supposed to protect has been destroyed during construction. It also undermines the environmental integrity of the mine managers, who may have gone to considerable lengths to reassure local communities about the potential for impacts and their commitment to responsible environmental performance.

Best Practice is the use of exactly the same range of environmental safeguards during construction and operations, including careful topsoil management, suitable dust suppression with tankers, wind shields etc. and well maintained equipment mufflers. What conclusion would a neighbour draw about future acoustic impacts of 240 tonne haul trucks, if 35 tonne 'toy' trucks used during construction cause intolerable noise from faulty or non-existent mufflers?

Prior to commissioning a mine, an issue that sometimes arises is the need to transport bulk samples or trial shipments of mine products before the final transport infrastructure is in place. This usually involves truck transport on existing roads that have not been upgraded to cope with the demands of a new facility. If it is possible to bring forward road improvements, it is highly desirable to do so. If not, the local council and road authority should be closely consulted and any commitments given honoured. Information to and consultation with the community may allay many concerns at this stage. It may be tempting to try to start mining prematurely under the guise of bulk sampling, but arrangements made in bad faith will do little to reassure regulatory authorities, politicians or their constituents of the company's commitment to doing the right thing.

2.4 POLLUTION PREVENTION AND CONTROLS

Pollution prevention and controls are routinely incorporated during the design phase of operations. Air quality controls include the use of water tankers for dust suppression, water sprays on conveyors and product stockpiles, controls on blasting during adverse weather conditions, and limits on freefall distances when stockpiling ore, overburden and products. The design and maintenance of haul roads is also an important consideration in dust control.

The underlying principle for effective pollution prevention and control is to contain contaminants on the site itself. This can include covering reagent tanks and chemical stockpiles, bunding chemical and fuel storages to guard against fires and prevent accidental releases, avoiding unplanned equipment maintenance without pollution safeguards, and considering pollution consequences from plant emergencies.

If the mine has an on-site ore concentrator, beneficiation plant or smelter, mine planners must also consider the potential environmental impacts associated with major pollutants. Such plants can process liquids and slurries, where containment and recycling for pollution control are essential. Plant designs should have a graded floor and allow for sumps and pumps to fully cater for all liquids in the event of a plant failure. Thickeners should have adequate dump ponds so that if it becomes necessary to empty the thickener, the operator can reasonably manage the situation.

Controls to reduce noise at source include acoustics specifications for mining equipment, locating major haul roads so they are shielded by bunds or mine workings, limiting night-time activities on acoustically exposed benches and efficient blasting design to limit blast overpressure, noise and vibration.

Water pollution prevention and control measures include separating clean water from contaminated runoff, using poorest quality water as a first priority, recycling and reuse of site runoff to minimise site releases, and treating excess water and effluent so it can be safely released to the environment if necessary.

One of the critical factors in successful pollution prevention and control is thorough workforce training. As pointed out in the module on environmental awareness training, no matter how sound the plant design or committed the mine management, ultimately environment protection can only be achieved with the understanding and commitment of every person on site. An untrained or thoughtless bulldozer driver can cause significant harm and expose a company to serious legal liabilities. In many Australian States, pollution is a criminal as well as a civil offence and liability applies to individuals as well as the offending company.

2.5 BIOPHYSICAL IMPACTS

Design safeguards can minimise the effects of the biophysical impacts discussed in Chapter 1. Soil erosion can be minimised by a proper understanding of soil structure, conservative landform design, utilising complex drainage networks, incorporating runoff silt traps and dry detention ponds in the rehabilitated landform. A dry detention pond is designed to hold water over a short period and allow its later controlled release. Careful use of topsoil can promote vegetation cover if the topsoil material is structurally appropriate and contains propagules of native vegetation. Selection of native floral species can be desirable in promoting a stable and robust vegetation cover. Where possible, species endemic to the area should be used, preferably those from the site itself.

Using freshly stripped topsoil and replacing the native vegetation can also assist in minimising impacts on fauna. Mining can create vegetation islands which are too small to ensure the long term ecological viability of resident fauna populations. Linking these areas by planted or planned natural corridors, fauna culverts and other protective measures can enhance breeding opportunities for the local fauna and give better protection against bushfires and predators.

2.6 SOCIO-ECONOMIC ISSUES

Measures are available to promote positive aspects of mining while recognising and addressing potentially adverse side effects. This applies to community infrastructure, employment, archaeological and heritage items and land use planning. One of the most sensitive social issues is what policies should be adopted for property acquisition. Land owners can also be more apprehensive about reduction of their property values than other impacts from mining.

Acquisition programs that are most likely to succeed are ones that are transparent, equitable, respond to the needs of individuals and are developed and communicated in close liaison with affected members of the public. As discussed in the module on community consultation, it may not be always possible to accommodate all the aspirations of nearby property owners. Nevertheless, close and frequent discussions can usually lead to better outcomes. The example of the Hunter Valley Mine, given in Case Study No. 2, shows the advantage of active cooperation with neighbours resulting in mutually beneficial outcomes.

2.7 ENVIRONMENTAL MONITORING

Ongoing operational environmental monitoring provides factual information to test environmental performance, demonstrate compliance with environmental legislation, refine operational practices and safeguard the interests of both the mining company and the surrounding community. A well conceived program must give attention to what is being measured, the way it is being measured and the ultimate use of the data. Monitoring within the mine site can be useful in checking source emissions, but it gives little information on the environmental effects on surrounding communities and the region.

Environmental monitoring, including physical, chemical and biological elements, needs to be extended to areas that may be affected around the mine site.

Monitoring results can provide useful input to ongoing liaison between miners and the surrounding community. This can be through informal arrangements but may be more effective through a formal community monitoring committee. More details on the value and approaches of environmental monitoring are provided in the module on environmental monitoring and performance.

2.8 DECOMMISSIONING

Ideally mine decommissioning should be planned at the commencement of operations. Where this is not possible because the mine is already long established, there is greater potential for proper decommissioning if it is integrated with the final years of mine operation.

One issue is long term water management. With surface mines, should stormwater runoff be directed to or away from final voids? Should these be interconnected with rivers to provide off-stream storage and flushing? If the mine is an underground operation, how should the workings best be sealed and should they be deliberately flooded to minimise acid mine drainage and spontaneous combustion?

Final rehabilitation should be influenced by the long term post-mining land use and environmental condition of the site determined in partnership with the local community . Mine sites often have established transport links, heavy workshops and other infrastructure that can be put to a range of post-mining uses. Where this is not the case or where restoration to pre-mining condition is required, haul roads and buildings should be removed and the site rehabilitated and revegetated.

One of the longer-term challenges is to ensure the safety and environmental appropriateness of final mining voids. These can be a valuable access point to further extraction of underground resources. Sometimes it is possible to use the void of one mine to dispose of surplus reject or overburden from an adjoining mine, or to provide make-up water and additional sedimentation capacity to other operations. A coordinated and planned approach to the issue of final voids for adjacent mines can significantly reduce environmental impacts.

CONCLUSION

Environmental considerations should be fully integrated into the planning of each stage of a mining project. This module sets out the issues that mining companies need to address to achieve economically worthwhile projects, while meeting community expectations and minimising environmental impacts.

Before mine planning can commence, planners need an adequate understanding of the resource deposit. This includes its extent, its quality, geological constraints and whether it is contaminated with dykes or volcanic intrusions. Planners need to understand the surrounding environment through programs of base-line environmental monitoring and data collection in order to identify particular features, attributes and constraints that need to be considered in mine planning.

The third building block for best practice mine planning is an understanding of community expectations. To achieve this, mine planners need to understand surrounding land uses, regional and town planning requirements and community aspirations. A constructive community dialogue commenced early in the project can be invaluable in testing project alternatives and obtaining feedback on biophysical and socio-economic issues.

Once the mineral deposit is evaluated and a proper appreciation obtained of the environmental and social context of the mine, extraction alternatives can be developed. These will include the rate and direction of mining, alternative process designs, optimal facility layouts and the location of supporting services and infrastructure.

Each option should be assessed for:

- economic feasibility;
- resource utilisation;
- community acceptability; and
- residual environmental impact.

Once a mine plan and design is developed, it will be tested and possibly modified during the environmental impact assessment (EIA) phase of the project. The EIA phase will examine the likely impacts of the planned project upon ambient air and water qualities, impacts upon flora, fauna, neighbours, archaeological and heritage sites, and how the wastes and potential hazards will be managed for the mine plan and design proposed by the developer. Fundamental to this evaluation will be consideration of the final rehabilitated landform for the site.

It is essential that the developer has an excellent understanding of all the environmental issues and constraints so that they can be considered at the start of the project's planning in order to produce the best outcome in terms of economic feasibility, resource utilisation, community acceptance and minimal environment impact.

All the environmental and planning work then needs to be complemented by its implementation through all phases of a project, ranging from construction to operations to closure. Implementation of a comprehensive plan requires workforce training and awareness, and environmental monitoring and compliance audits, all of which are integral components of an Environmental Management System.

While each mineral deposit is unique, the application of integrated environmental planning procedures is a fundamental component of Best Practice Environmental Management in Mining.

ENVIRONMENTAL CONSIDERATIONS SHOULD BE FIRMLY INTEGRATED INTO THE PLANNING OF EACH STAGE OF A MINING PROJECT

FURTHER READING

There is a surprising lack of detailed published information on the environmental aspects of mine planning. The following is a suggested list for further reading.

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The series illustration of the Koalas by Christer Erikson was commissioned by BHP Transport in 1988. Reproduced courtesy of BHP Transport.

Cover Photo: Sound bunds (3.5km long and up to 20m high) around the Northparkes Mines, Parkes, New South wales, minimise the noise impacts on neighbouring farms. Waste dumps were developed on the inside of the noise bunds. Potential for noise was raised during the EIA process and solutions incorporated in the environmental management plan. A ‘Do it once and do it right approach’ taken by Northparkes Mines. Photo: Julian Malnic

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Mine Planning for Environment Protection

One module in a series on

BEST PRACTICE
ENVIRONMENTAL
MANAGEMENT
IN MINING

Environment Protection Agency

June 1995

FURTHER MODULES PLANNED FOR THIS SERIES INCLUDE

Overview of best practice environmental management in mining
Environmental impact assessment
Community consultation and involvement
Tailings containment
Rehabilitation and revegetation
Onshore exploration for minerals
Onshore exploration and development for oil and gas
Planning a workforce environmental awareness training program
Prevention and control of acid mine drainage
Environmental management systems
Environmental auditing
Water management
Environmental incident and emergency/contingency procedures
Offshore oil and gas exploration and development
Decommissioning and planning for mine closure
Post-mining and land use management
Contaminated site clean up
Use of artificial wetlands for treatment of contaminated water
Noise, vibration, dust control, atmospheric emissions and air quality
Waste management through cleaner production
Landform design and construction

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FOREWORD

Environment protection is a significant priority for our society. For government a major role is setting environment standards and ensuring individuals and organisations meet them. Also, government, industry and community organisations are working increasingly as partners in protecting our environment for present and future generations.

Representatives of the mining industry in Australia and the Environment Protection Agency, an agency of the Australian Department of the Environment, have worked together to collect and present information on a variety of topics that illustrate and explain best practice environmental management in Australia's mining industry. This publication is one of a series of modules aimed at assisting all sectors of the mining industry — minerals, coal, oil and gas — to protect the environment and to reduce the impacts of mining by following the principles of ecologically sustainable development.

These modules include examples of current best practice in environmental management in mining from some of the recognised leaders in the Australian industry. They are practical, cost-effective approaches to environment protection that exceed the requirements set by regulation.

Australia's better-performing mining companies have achieved environment protection of world standard for effectiveness and efficiency — a standard we want to encourage throughout the industry in Australia and internationally.

These best practice modules integrate environmental issues and community concerns through all phases of mining from exploration through construction, operation and eventual closure. The concept of best practice is simply the best way of doing things.

The case studies included in these modules demonstrate how best practice can be applied in diverse environments across Australia, while allowing flexibility for specific sites. They achieve this through including practical techniques, recommendations, guidance and advice from Australia's leading mining practitioners.

I encourage mine managers and environmental officers to take up the challenge to lift performance in environment protection and resource management and to apply the principles in these modules to their mines.

Barry Carbon

Executive Director,
Environment Protection Agency,
and Supervising Scientist

EXECUTIVE SUMMARY

Mineral extraction industries have been active in Australia for more than 200 years. Only a few early operations were planned in ways that would now be regarded as environmentally appropriate, as environmental issues were not considered as important factors in mine design and layout. However, more recently the mining industry has developed environmental management expertise to ensure environment protection in planning and operating resource development projects. This expertise has been built up across a wide variety of different climatic and geographic conditions in Australia and overseas. The Australian industry includes almost the full range of extractive and mineral products, including iron ore, coal, base and precious metals, building materials and gemstones. Operations range from small scale mining through to some of the largest earth moving operations in the world.

This module examines one crucial part of the process — how mine planning for environment protection can help in developing projects that meet community expectations for minimal environmental impacts. It outlines the considerations that shape mining methods and the design of environmental safeguards. These considerations include air, water and noise quality, transport, biological resources, socio-economic factors, surrounding land uses, and heritage places and artefacts.

Successful mine planning for environment protection avoids or minimises potentially adverse environmental impacts over the life of the mine and into the future by carefully considering the layout and design of the various components of a mine. The process must integrate community expectations and concerns, government requirements and profitability of the mining project, while minimising environmental impacts. To ensure its effectiveness mine planning is updated and applied continually throughout a project's life. It is part of the environmental impact assessment (EIA) process, which protects the environment by examining the likely environmental impacts of mining proposals and minimises those adverse impacts identified through the phases of project planning, construction, operation and decommissioning. A separate module covers the EIA process.

Best practice in mine planning for environment protection is the application of this continual process of testing and evaluating different options to produce a mine design containing the optimal balance of community expectations, government requirements, engineering and cost considerations, and minimised environmental impacts.

Case studies are presented to show how proper mine planning can deliver ecologically sustainable development. The examples are drawn from coal mining, mineral sands production and a hard rock quarry, where an older operation had to adjust to meet changed circumstances and community expectations.

A key theme of the module is the need to integrate mine planning with active community consultation and to conduct environmental monitoring, operator training and compliance auditing within the framework of a comprehensive environmental management system. Other modules in this series provide detailed information on these topics.

CONTENTS

INTRODUCTION

AUSTRALIAN MINES ARE FOUND IN A WIDE VARIETY OF CLIMATES AND INCLUDE A BROAD RANGE OF LAYOUTS AND PRODUCTS

This module describes how environment protection can form a part of the planning and design of contemporary Australian mines with benefits to both the company and the community. Community standards have evolved to the point where principles of ecologically sustainable development, such as protecting endangered wildlife, rehabilitating all disturbed land, preserving the quality of rivers and minimising air pollution and air-borne dust, must underpin acceptable mining practice. Development must be accompanied by a commitment from the project developers to minimise environmental impacts and to operate in accordance with public undertakings on the environment.

In the past, communities often saw that the only choice available was whether a deposit should be mined or not. However, it has been shown that the manner in which a mine is planned can have a major influence on the magnitude and duration of impacts over the life of the development and following its closure.

This module demonstrates how environmental safeguards can be introduced to mines to make them acceptable to local communities, so they can co-exist with other land uses. The module outlines a range of environmental issues that are relevant to the planning of a modern mine. These include pollution prevention, waste minimisation controls, aspects of the biophysical environment and socio-economic issues.

These issues must be considered at all stages of a mine's development, from pre-investigation, construction, commissioning and operation, to ultimate rehabilitation. Case studies are presented of operations that demonstrate how mine planning has contributed to environmentally sound resource development projects and application of best practice.

No single element of mining can, by itself, minimise environmental impacts. While mine planning is important, it must be integrated with well thought out community consultation processes, accurate environmental impact assessment and thorough operator training. The results of pollution monitoring programs and environmental audits should be drawn together in comprehensive environmental management systems. Companion modules in this series point to such best practice approaches as part of a contemporary environmental strategy for resource developments.

Australian mines are found in a wide variety of climates and include a broad range of layouts and products. These extend over wet climates with average annual rainfall of more than 4 000 mm at Mt. Lyell in Queenstown, Tasmania, through to arid areas with annual rainfall of less than 250 mm.

Various mining methods are used, ranging from major open cut and strip mines to underground long wall and hard rock ore mines, to dredging operations, soil and gravel extraction, to hand excavation of gemstones.

Australian mining products include:

- precious metals such as gold, silver and platinum;
- base metals of copper, lead, zinc, aluminium and nickel;
- other metals such as iron, magnesium, manganese, chromium and vanadium;
- coal and peat;
- uranium;
- mineral sands including zircon, rutile and titanium;
- gemstones; and
- sand, soil and gravel.

Given this variety of mining operations and products, mining techniques to minimise environmental impacts cannot be standardised.

Each deposit is unique in its combination of physical, social and resource opportunities and constraints. Nevertheless, the use of consistently appropriate mine planning is the most effective way to harmonise mining with the environment. Exploitation of economic reserves using a well thought out mine plan will benefit local, State and Federal economies. Conversely, if a poor layout is adopted, the operation may result in continued environmentally damaging extraction because the cost of altering the mine cannot be sustained. The difference between a good and an indifferent mine plan can be initially evaluated through an honest, rigorous and public environmental impact assessment process. It is no accident that best practice mines in Australia and overseas pass through complex processes of environmental scrutiny, with inputs from regulators, interest groups and the general public.

As well as the method and rate of mining, some of the issues to be considered during mine planning for environment protection include the location of the mine infrastructure such as:

- haul roads;
- ventilation shafts;
- surface facilities, ie offices, workshops, carparks, warehouses, hardstands, power station;
- tailings and waste disposal areas and methods;
- transport and service corridors, ie railway lines, roads, pipelines, conveyors, helipads, airstrips, port facilities, power, water and gas corridors;
- product stockpiles;
- ore processing facilities;
- chemical and fuel storage; and
- township and housing location.

1. WHAT ARE THE ENVIRONMENTAL ISSUES?

NOISE CAN BE AN ISSUE BECAUSE MINES NORMALLY OPERATE 24 HOURS A DAY AND SOUND LEVELS CAN FLUCTUATE WIDELY

The first step in planning is to recognise the environmental issues that need to be faced in designing a feasible mine layout. This chapter suggests a checklist of matters which planners should use to analyse and help choose the optimal mine layout.

The scale and nature of contemporary mines mean that they are almost always visible and they almost always change surrounding air quality, noise and water quality. However, it is often possible to reduce these impacts so that mining is sufficiently compatible with surrounding land uses and preserves acceptable long term uses of the site itself. Determining acceptability of impacts is a complex and evolving process that includes careful consideration of, and sometimes trade-offs between, community expectations, government requirements, financial constraints and technological and engineering feasibility. Of these, community expectations in relation to environmental preferences are the most difficult to quantify and the hardest to determine at the planning stage of a project.

However, this is not just a task for engineers/planners alone. Assistance in identifying the environmental issues requires professional assistance from people with expertise in air, noise, water quality, hydrology, soils, archaeology, flora and fauna, rehabilitation and waste management, as well as input from the community with its wealth of local knowledge.

Typical issues that should be considered by mine planners in conjunction with specialist scientists, engineers, planners, consultants and the community for the development of a mine and its associated infrastructure are discussed below.

1.1 AIR QUALITY

The main air quality issue with mining is dust particles. Large amounts or concentrations of dust can be a health hazard, exacerbating respiratory disorders such as asthma and irritating the lungs and bronchial passages. However, people invariably feel a loss of environmental amenity, due to dust deposits or dust concentration, before their health is affected.

Dust deposition is measured with deposition gauges and reported in units of g/m^2 per month of dust fallout. Pre-mining background levels and total amounts of deposited dust are the usual measures against which limits are set. It has been found that in populated regions of Australia an average increase of 2 g/m^2/month in dust deposition due to mining will lead to a noticeable decrease in environmental amenity[1]. A similarly noticeable decrease in amenity will also occur if the combination of background dust and contribution from a project exceeds an average of 4 g/m^2/month of dust.

Dust concentrations are monitored with mechanical, high volume samplers and limits are placed on average and peak hourly values. Primary dust concentration standards are set to protect the health of sensitive members of the community. They include peak hourly total suspended particulate concentrations and the percentage of inhalable material finer than 10 micrometres in diameter. The National Health and Medical Research Council has set an hourly annual average total dust concentration limit of 90 mg/m^3. There are no national standards for short term dust concentration, though reference is often made to United States Environmental Protection

1 SPCC/NSW Coal Association

Agency primary and secondary standards. Primary standards to protect human health are set at 260 mg/m^3, while secondary standards to safeguard environmental amenity are reduced to 150 mg/m^3. Both these standards apply to 24 hour average readings. The US Environmental Protection Agency specifies that the primary standard should not be exceeded more than once per year.

Visible dust plumes, especially from blasting, are classed as an aesthetic impact. While milk production, fine wools, livestock, horticulture and vineyards have all been considered as possible victims of dust from mining operations, nearby residences usually seem to be the most important factor in determining the effects of dust on the environment.

External air quality is rarely a planning issue for underground mines except for air quality impacts from product transport and storage and the management of slimes and tailings ponds. However, open-cut mining can create dust nuisance if improperly planned. Control measures include minimising the area of pre-stripping, properly constructed haul roads, minimising overburden haulage distances and rehabilitating mined areas as soon as possible. At least fifty per cent of transport related dust can be eliminated by carefully watering haul roads. In some cases best practice involves the use of additional measures on haul road surfaces and ore stock-piles with the use of environmentally benign agglomerating or binding agents.

1.2 NOISE AND VIBRATION

Noise can be an issue because mines normally operate 24 hours a day and sound levels can fluctuate widely. Surface mines mainly generate noise from overburden excavation and transport, while the major noise sources from underground mines are ventilation fans, the surface facilities and product transport. Noise levels generally must be controlled so that they reflect the most stringent requirements during evening hours when nearby land holders wish to relax or sleep.

Noise is measured on a logarithmic scale and expressed in units of decibels. This complicates the understanding of noise impacts when noise sources are added. For example, if two identical noise sources of 50dB are placed together the increased overall noise is 3 decibels higher, ie 53dB. In view of the response to noise by the human ear, the decibel scale is adjusted to an 'A' weighted scale to give the best correlation between perceived and measured noise levels. All measurements recorded in this mode are known as dB(A). A noise perceived as being twice as loud would be about 8dB(A)-10dB(A) higher than the initial noise level.

Typical peak noise levels from an operation, which exceed 1% (L_1) and 10% (L_{10}) of the time, are usually limited to 5 to 10 dB(A) respectively above background noise levels. The background is usually expressed as the L_{90}, or noise level exceeded 90 per cent of the time. Depending on the location of the mine, higher levels, up to 20 dB(A) above background, are permitted during construction, because the duration of impacts are not long term. This includes the construction of protective bunds or screens to minimise operational noise. The case studies of the mineral sands mining below (Case Study 1) and the Albion Park quarry in New South Wales (Case Study 3) show how combinations of source noise control, bunding and operational planning together with appropriate land use zoning can reduce noise impacts on surrounding areas.

Peak noise is used to assess rail movements, overpressure from blasting and acoustics specifications for plant and equipment. Planners limit blasting noise in the same way as dust, by distinguishing between values that would cause physical damage or injure human health from those that people find intrusive and annoying. A damage/health limit might be 130 dBL (a linear, not a weighted scale), while an amenity limit might be set at 115 to 118 dBL.

Blast designs can reduce noise by limiting the Maximum Instantaneous Charge detonated simultaneously, by using good quality stemming in drill holes and by eliminating surface detonation chord between adjacent charges.

Blast planning must also limit ground vibration to avoid damage to building structures and annoyance to people living in the area. Vibration limits set for environmental amenity are significantly lower than for structural damage. Industrial structures can often withstand up to 50 mm/sec ground vibration without structural damage. However, to preserve amenity, the peak particle velocity may be limited to 10 mm/sec. Also particular attention should be paid to unusual structures and items of heritage value in the surrounding area. They may be affected by a much lower peak particle velocity of between 2 and 5 mm/sec.

For transport noise, L_{eq} or average noise exposure is adopted. In many parts of Australia it is also necessary to allow for noise enhancement caused by atmospheric thermal inversions at night. This can increase noise some distance from a mine by up to 10 dB(A).

CASE STUDY 1

Mineral Sand Mining

In 1991, RZM Pty Ltd submitted an application to mine titanium minerals from a sand plain adjacent to Big Swan Bay, Port Stephens, along the northern fringe of the regionally significant Tomago Sandbeds, from which high quality groundwater is extracted for domestic and industrial use. This area was previously mined in the early 1970s and the operation had left residual mineral deposits which had passed through the separation process. More efficient dredging and separation techniques and favourable market conditions meant that up to $30 million of titanium minerals could now be recovered.

Major constraints to the proposal included:

- residential areas as close as 100 m to the mine which could be affected by noise emissions and visual intrusion;
- incomplete revegetation of past mining areas;
- presence of koalas and other native species;
- presence of environmentally significant wetlands; and
- proximity to groundwater resources used for town water supplies.

CASE STUDY 1

To gain development approval, the company needed to plan around these constraints. Noise emissions from the mining and separation operations were predicted at nearby residences. Calculated noise was initially above the 35 dB(A) and 45 dB(A) night and day design goals. To limit noise, operations were staged to avoid high noise operations during night time. These included some of the noisiest activities, such as dozer operations, clearing, rehabilitation and dry mining. Structural solutions such as improved engine exhaust silencers and bund walls were also integrated into the overall mine plan. These operational and structural modifications brought predicted noise emissions to within the design goals.

Temporary bunds to reduce noise also shielded views of the mining operation from nearby residential areas. Endangered fauna such as the koala and other native species required an integrated revegetation plan which reconnected islands of native vegetation to larger tracts of adjacent forest and heathland. Extended corridors were particularly important for the long term viability of koalas in the Port Stephens area.

Coastal wetlands are protected under a State Government environmental planning policy. There are three such wetlands within the deposit, but they were excluded from mining. To recover mineral sands next to the wetland, dry mining with surface machinery was proposed rather than a dredge and pond.

Due to the high permeability of sandy soils and subsoils in the area, these Tomago sand beds are potentially prone to contamination. Strict operating controls at the mine ensure that contamination risks to both the groundwater resource and fishery habitat in Big Swan Bay are minimised. One of these controls requires a standoff from the shoreline that also minimises koala habitat disturbance.

RZM obtained development consent for the Big Swan Bay mining proposal in 1992, and operations are currently well advanced. Ongoing monitoring at residences confirmed that noise predictions were accurate and that abatement procedures formulated during mine planning effectively control noise emissions. Ground and water monitoring and monitoring of impacts upon koalas are to monitor the success of the overall mine plan and its environmental objectives.

1.3 WATER MANAGEMENT

AN ESSENTIAL PART OF MINE PLANNING IS THE DEVELOPMENT OF A WATER MANAGEMENT STRATEGY

Mine planners must consider how their facilities will cope with floods. Extreme floods can inundate surface workings, affecting mining equipment, worker safety and the continued operation of the mine. They can also grossly contaminate surface run-off and permanently divert rivers. Planners have conventionally used a one per cent probability flood, or the so-called 1 in 100 year event, as a design parameter for floods. Except for very short term mines, this can expose the workings to a risk of failure by flooding. It is prudent to consider more extreme flood events up to the Probable Maximum Flood, to see how substantial levees need to be. While it would usually be impractical to design for very rare floods, the consequences of failure, including impact on the environment, may encourage planners to raise flood diversion works.

The reliability of water supplies should be tested in wet weather and drought. Extended wet weather will exceed the capacity of normal water pollution controls, such as retention ponds, requiring the discharge of surface runoff. In droughts, a lack of water can reduce the effectiveness of dust suppression and can ultimately disrupt ore processing. The most useful way to test mine performance is to model water balances using computer simulations based on long term meteorological data. This can enable planners to quantify the statistical probability that the mine will run out of water or be forced to discharge surplus runoff.

Harvesting water for mines can conflict with other water users, especially surrounding farms and environmental requirements for water. Whether make-up water is drawn from local rivers and/or harvested from site runoff, there is often the need to consider other downstream water users and uses. Major on-site water supply dams could be easily replenished by off-peak pumping to minimise conflicts with other water users.

Mines can de-water groundwater aquifers some distance from shafts or open pits, which can make nearby wells or groundwater bores run dry. Where this is unavoidable, the mine planner may provide alternative water supplies or offer to compensate for shortfalls. As described in the module on community consultation, the satisfactory resolution of potential conflicts over water between the local community and the mine developer is essential to obtaining community acceptance for mine development.

1.4 WATER QUALITY

Mines can affect surface runoff and groundwater quality through contamination with dissolved and suspended material. Perhaps the commonest surface water contaminant is sediment or suspended solids. Sediment can smother the beds of receiving streams, affecting fish and benthic organisms. Planners can most simply minimise suspended solids by passing runoff and discharged water through sedimentation ponds. These are highly effective for sand and silt particles, but can be ineffective for fine clays. This is particularly the case for colloidal clays from soils with a high sodium adsorption ratio. Although each pond should be individually designed, they are often sized to provide between 200 and 600 m^3 of detention capacity per hectare of catchment disturbed.

Apart from runoff from overburden emplacements and stockpiles, stormwater can be contaminated from process plants, workshops and vehicle wash-down pads. These are usually controlled by grit and oil arresters with associated oil separators.

Acidic waters are a further mine planning issue. Drainage from oxidisation of sulphur or sulphidic ores is highly acidic and can contain dissolved heavy metals. These are toxic to aquatic life and impact on the surrounding environment. Control measures can include neutralisation with lime or limestone. However, best practice is the identification of potential acid generating materials and its selective mining, burial and isolation with a clay cover to prevent the entry of air and water. A separate module on acid mine drainage addresses this subject in detail.

Salinity control is a significant issue in mine development in many parts of Australia, as mining can disrupt saline aquifers or allow salt to be leached from freshly shattered overburden.

Mine designers must also guard against the release of chemically or radiologically contaminated water. Contaminants can include cyanide and acids from leaching solutions, hydrocarbons from fuels and lubricants, sewage from employee ablutions, acid waste water from boiler cleaning, excess fertiliser from rehabilitated areas, and chemicals used to separate different ores and to flocculate suspensions.

An essential part of mine planning is the development of a water management strategy. Best practice water management separates the different classes of water and prioritises consumption so that the poorest quality water is used first. Uncontaminated water should be diverted around disturbed areas, while all runoff from bare areas should be collected and drained to control systems such as sedimentation dams for subsequent reuse, if appropriate. Refer to Case Study 2.

Dry weather release of water from mines into rivers or streams is generally environmentally unacceptable and the water management program for the mine site should take this into account. However, if water quality is acceptable, off-stream storages may be useful to any nearby farmers. Where water quality in on-site storages is unsafe for wildlife and people, special fencing and/or netting is often used.

1.5 SOIL CONSERVATION

Topsoil management should be planned to conserve available soils for use in rehabilitation. Topsoil resources on a mine site can vary in depth from more than a metre in alluvial deposits to just a few centimetres in marginal grazing country. Moving topsoil with the equipment available in surface mines is relatively simple, although the careful handling, storage and use of topsoil to avoid erosion and promote rehabilitation is a significant planning task. Details on soil handling are outlined in the module on Rehabilitation and Revegetation.

Topsoil can promote regrowth by preserving plant propagules that naturally regenerate. The soil also contains nutrients, fungi and other organisms that greatly assist in the rehabilitation of the mine site.

1.6 FLORA AND FAUNA

An accepted part of pre-mining investigations is a survey of existing flora and fauna. Cataloguing individual species and grouping these into floral habitats are the first tasks. However, apart from identifying rare and endangered plants and animals, planners must consider the ecological integrity of an area and what role it plays as a part of a regional environment. Relevant questions include how well species and habitats are protected in parks and conservation areas, and the role of the site as a part of a habitat corridor.

Climate, soils and the rehabilitation strategy are important considerations in minimising impacts on native flora and fauna. In some areas native plant regrowth is extremely slow, so that animals and insects are displaced for considerable periods unless effective safeguards are adopted, such as linking of habitat areas, and measures to reduce extraneous pressures from feral pests.

Given the importance attached by the community to the conservation of our indigenous flora and fauna, the EIA process for any new project focusses heavily on minimising impacts of mines on flora and fauna through their layout and design.

1.7 ARCHAEOLOGY AND HERITAGE PROTECTION

Sites are surveyed for archaeological and heritage importance because it is common to find evidence of prehistoric human occupation extending over thousands of years. Artefacts can have considerable scientific importance, or may have spiritual significance to present-day Aboriginal communities. Likewise, sites may be historically important in their own right or be part of a regional context of early European settlement. As with flora and fauna, a key consideration for the project development team is to devise a means of allowing the project to proceed while minimising disturbance to, or taking steps to conserve, archaeological and/or heritage sites. The local community are invaluable in identifying these sites and finding mutually satisfactory solutions to their conservation.

1.8 TRANSPORT

Mine planners seek to use regional transport links to build the mine, to haul raw materials and products, and to provide access for the mine's workforce. Where suppliers and customers are concentrated, private or public railways can be attractive. An example is the iron ore railways in the Pilbara region of Western Australia. However, most mines use public roads for part or all of their transport needs. Relevant environmental issues include whether mine vehicles will increase traffic noise and congestion, reduce road safety and contribute to pavement wear.

Planning options include whether to upgrade and use existing roads or to construct new dedicated facilities, the environmental impact of which would need to be assessed. While the latter can improve safety and reduce impact noise on residents, it may be of no lasting benefit to the community once mining is finished.

In some cases a simple approach of staggering shift times with surrounding industries can alleviate potential road congestion.

1.9 SUBSIDENCE

Excavation of underground coal or minerals can disturb the surface of the land. Where there are valuable surface assets, these can be damaged by tilting or lowering structures or causing them structural distress through tensile or compressive forces. Natural features can be modified by making land more flood prone or waterlogging soils. In some cases, a trade-off must be made between the cost of surface damage and the potential cost of not being able to mine the resource.

Mine planners can sometimes modify extraction methods and sequences to keep damage within acceptable limits. This includes varying extraction panel widths and altering transmission lines and buildings before subsidence. Other measures are to modify surface improvements before subsidence occurs so they can better accommodate sediment or tilting. The bearings of bridges can be progressively raised to keep the superstructure trafficable. Bracing on industrial buildings can be unfastened so steel members are not overstressed from surface strains. Cables can be loosened from insulators on electricity transmission lines so that towers and poles can tilt without interrupting electricity services.

The magnitude of surface strains, ground movement and slope change can be predicted with empirical models or with finite element computer simulations. Where an area has been declared a mine subsidence district, subsidence planning will be simplified because many buildings will have been constructed to withstand subsidence.

1.10 REHABILITATION

While mining is often a short term land use, an important aspect of mine planning is the rehabilitation of disturbed lands to a stable and productive post-mining landform which is suitable or acceptable to the community.

The rehabilitation plan should be an integral part of the mine plan and a clear objective must be defined for rehabilitation. It should take into account an appropriate and agreed final land use for the area and the level of management that will be required to maintain the land use. The post-mining land use for the area should be defined in consultation with relevant interest groups including government departments, local government councils, traditional owners and private landholders.

TOPSOIL MANAGEMENT SHOULD SHOU BE PLANNED TO CONSERVE AVAILABLE SO FOR USE IN REHABILITATI

Rehabilitation normally comprises the following:

- developing designs for appropriate landforms for the minesite;
- creating landforms that will behave and evolve in a predictable manner, according to the design principles established; and
- establishing appropriate, sustainable ecosystems.

A separate module on Rehabilitation and Revegetation provides a detailed outline on the principles and practices of mine rehabilitation.

Apart from being a cornerstone of ecologically sustainable development, rehabilitation is a fundamental community expectation from environmentally sound mining. The case study of Hunter Valley No 1 Mine given below shows what can be achieved if rehabilitation is part of the original planning of a mine.

1.11 VISUAL IMPACTS

The scale of modern mines leads to the potential for significant visual impacts. Mining can remove vegetation cover, modify landforms, create colour contrasts and impose man made objects into natural vistas. It is often impractical to completely hide a mine, yet they can be made much less obtrusive. Although some would wish to emphasise and celebrate the built forms of mines as an interesting and aesthetically appropriate visual experience, this is generally not accepted as best practice in Australia. Planners can consider the visual catchment of each development, the nature and location of viewing points and the quality of the visual resource. Where visual safeguards such as tree screens are considered, their timing and practicality must be assessed. Planning visual safeguards could include pre-mine plantings, community forestation projects, suitable colour selection for plant and equipment, and site perimeter screening with bunds or vegetation.

1.12 HAZARD AND RISK ASSESSMENT

Prudent hazard and risk assessment is an essential part of mine planning. Deposit geology imposes certain risks of high- and low-wall failure, roof and floor instability, surface subsidence impacts and mine water inflows. Mines can be inundated by flooding and disturbed by other natural disasters such as bush fires and earthquakes. Operational hazards include the risk of embankment failure on tailings and slime dams, and water supply retaining structures. However, the latter are often major embankments covered

Open-cut Coal Mining

CASE STUDY 2

The Hunter Valley No 1 Mine began in 1979 and is now one of the largest open-cut coal mines in Australia, with a capacity of about 7.5 million tonnes of coal per year. The mine was one of the first of the new generation open-cut collieries which have been prominent in research into mine planning for environmental protection.

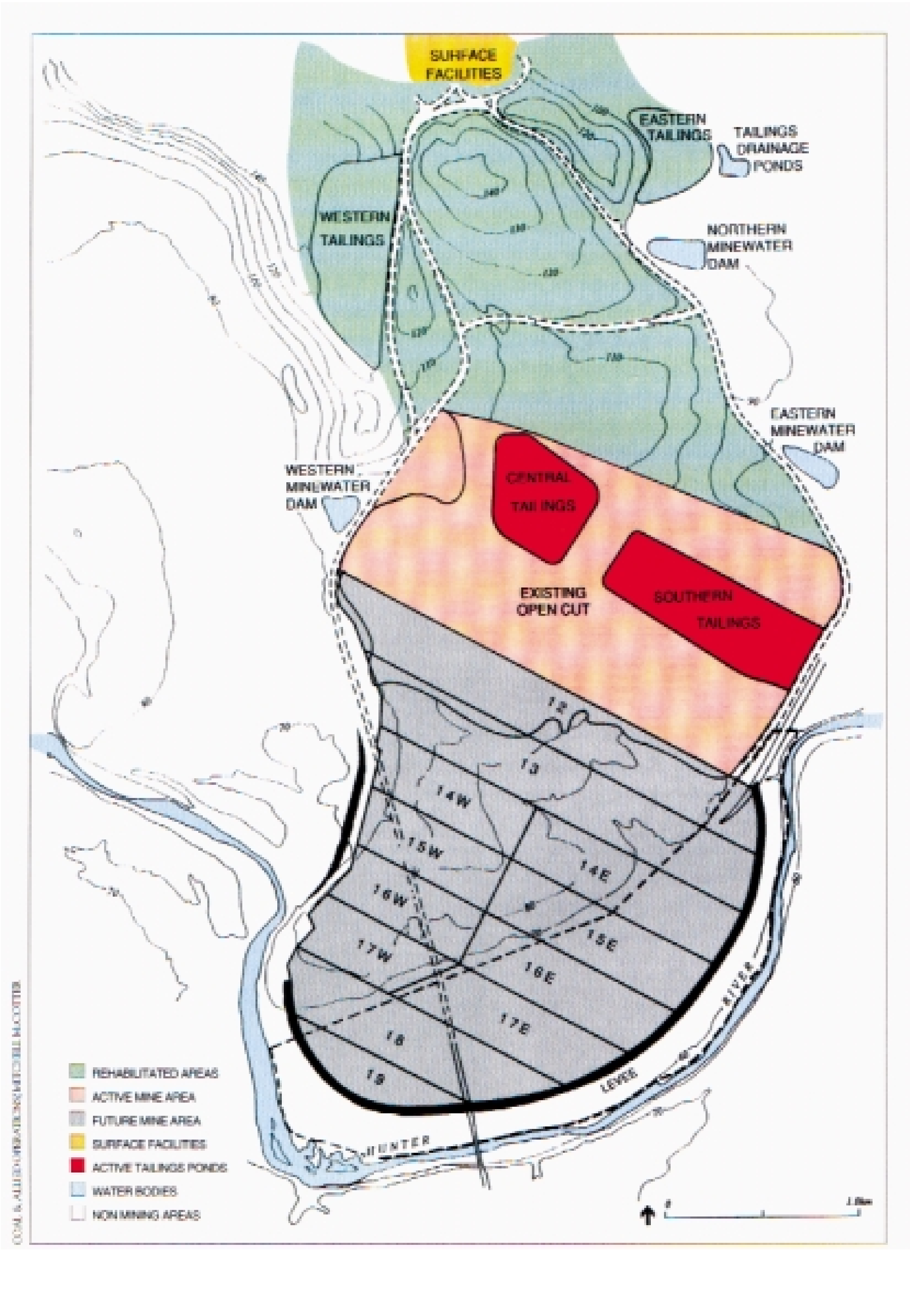
Early attention was given to environmental matters during the original planning of the mine. A substantial coal resource was available both north and south of the Hunter River and future mine approvals would be influenced by the company's environmental performance. One of the first planning principles adopted was the need to accommodate neighbours on surrounding rural properties. The company proactively purchased a substantial buffer zone of land around the mine and continued to farm it, often in association with the former owners. This gave credibility amongst the rural community, and at the same time built up experience in local farming techniques which could then be applied to the productive use of rehabilitated lands. This planning approach helped the company gain active community support for five subsequent changes to its mining approvals.

A feature of the mine has been its rehabilitation planning. Mined areas are backfilled, reconstructed and sown with pasture and native trees. The company was a pioneer in the coal mining industry of direct seeding techniques. The mine has used direct seeding of pasture grasses, legumes and native tree species into coal washery reject material which, up to that time, was regarded as a waste product. The coarse reject material can be used as a topsoil substitute, assisting in the germination of tree seeds.

Rehabilitated landforms have been developed that are visually and environmentally compatible with surrounding lowlands and foothills. The landform was planned as a series of rolling hills that keyed into existing topography, so that it is quite difficult to distinguish between original farmland and rehabilitated mined land. Drainage lines have been preserved and the pre-mined drainage density increased. Small sedimentation ponds were strategically placed to control soil erosion and reduce peak surface runoff rates. A series of much larger dams were built around the perimeter of refilled areas to control sediment and allow water to be reused for dust suppression.

Concerns for visual impacts saw the workshop, the coal preparation plant and product stockpiles placed in valleys shielded from major view lines. Where these manufactured features were not obscured by natural ridges or refilled areas, the mine planners placed tree screens along roads and bunds to filter visual impacts.

The mine has collected more than 15 years of environmental monitoring data, which is used to progressively refine mine operations and planning. The company has become one of the largest milk producers in the Hunter Valley and the sustained productivity of rehabilitated land has been confirmed through droughts as well as normal weather conditions.


SURFACE FACILITIES
EASTERN TAILINGS
TAILINGS DRAINAGE PONDS
WESTERN TAILINGS
NORTHERN MINEWATER DAM
EASTERN MINEWATER DAM
WESTERN MINEWATER DAM
CENTRAL TAILINGS
EXISTING OPEN CUT
SOUTHERN TAILINGS
12
13
14W
15W
16W
17W
14E
15E
16E
17E
18
19
LEVEE
HUNTER
RIVER
REHABILITATED AREAS
ACTIVE MINE AREA
FUTURE MINE AREA
SURFACE FACILITIES
ACTIVE TAILINGS PONDS
WATER BODIES
NON MINING AREAS

Site accidents can include chemical spills, haulage vehicle collisions and overbalanced mining equipment. The construction of bunds, elevated tanks, clean up procedures, traffic rules, operator training and established procedures are all matters that need to be addressed in mine planning for environment protection. Finally, there are risks associated with blasting, such as flyrock and hazardous materials storage. Careful blast designs that integrate hole diameter, depth, hole spacing, quantity of explosives and amount of stemming (or explosives cover) are able to minimise the hazards of flyrock.

◀ **Map Opposite:**

Strip Layout Plan for Hunter Valley Mine. Extension of Mining, December 1992.

The active mining area is currently in the central part of the mine. The eastern and western tailings ponds, which were used to dispose of coal washery fines, have now been incorporated into the final rehabilitation area. Their function has been replaced by two ponds, central and southern tailings, in the active mine area, which will be buried as the mine proceeds southwards. Major mine water dams were located on the eastern and western sides of the operation to accommodate excess water collected in the pit. This water is reused for dust suppression and is recycled back to the coal preparation plant.

A feature of the mine is the extensive levy system which runs parallel to the Hunter River. The levies are necessary to avoid flooding the pit and contaminating river water with coal and overburden from the mine.

The mine proceeds in a series of strips, each about 400 metres wide, oriented in a southeast/northwest direction. Under current planning, strips 14 to 16 inclusive will be excavated on the eastern side first. Once strips 17 to 19 are mined, the mine will move north with a final void in strips 14 and 15W. This means that the final void will be located on relatively high land, well away from the Hunter River. It will then be used for reject disposal and will be fully backfilled so no void will remain north of the Hunter River.

It must be stressed that planning from the outset can assess and minimise hazards and risks to the environment, personnel and the community.

1.13 WASTE MANAGEMENT

Mining creates many different waste products. In surface mines, removing waste overburden and interburden is the major physical activity on sites, so their effective handling is critical to the economic viability of the enterprise and an important environmental issue. The other major class of waste is refuse from ore processing plants including slimes, muds and tailings from ore concentrators and coal preparation plants. These were traditionally disposed of in wet ponds, though planners now have a wider range of methods to choose from. These include mechanical de-watering, co-disposal, in-pit disposal and incineration of coal wastes in fluidised bed furnaces to generate electricity. Another module on Tailings Containment details the environmental, planning and engineering considerations associated with this subject.

Other wastes include spent reagent solutions and maintenance wastes such as lubricating oils and greases. Finally, sewage and liquid wastes are generated from bathhouses and employee ablutions. It is rare to be able to connect to municipal sewerage schemes, so mines must treat liquid waste streams and either reuse or dispose of the resulting effluent, often via a land irrigation system.

The location, quantity and character of all these wastes must be examined so that they can be managed and their impact on the environment minimised.

CASE STUDY 3

Hard Rock Quarrying

The Albion Park quarry, an older operation owned by CSR Readymix Pty Ltd (CSR), is located 25 km south of Wollongong. The quarry has operated for many years producing high quality basalt aggregate for the Sydney and Wollongong markets. Changes in legislation meant that it had to obtain new environmental approvals.

When the quarry first began it was surrounded by farms but, over the years, surrounding residential development was permitted so that today the private access road is flanked by urban housing estates.

Urban encroachment along the quarry's access road jeopardised future operations. Product trucks use the access road as early as 3:00am to provide material to important metropolitan markets. Traffic noise is a source of conflict with neighbours, and one that cannot be easily reduced by further mining or urban planning safeguards.

When preparing a new quarry plan for the site, CSR had to address the following issues in detail:

- adjacent land zoning;
- residential development;
- visual impacts;
- rehabilitation; and
- endangered flora and fauna.

The site is surrounded by a visually sensitive area and adjoins land zoned Scenic Protection. While the lower sections of the quarry are well shielded from surrounding viewing points, the higher parts of the deposit are visually exposed. Numerous quarry plans were developed, ranging from complete extraction of the resource to selective recovery that took into account the various environmental constraints.

The favoured layout concentrated extraction on the lower part of the deposit. While approximately 2.7 million tonnes of aggregate resource could not be recovered, the favoured layout used intervening ridges to shield the workings. When combined with an adequate buffer of surrounding company-owned land, this ensured that visual and noise impacts were satisfactory at nearby houses.

The proposed extraction area contained four rare or endangered flora species, *Zieria granulata*, *Cynanchum elegans*, *Canthium coprosmoides*, and *Omalanthus stillingifolius*.

A number of the first two species exist within the area proposed for extraction and are of national conservation significance due to their restricted abundance and habitat. Rehabilitation procedures were planned to replant *Zieria* and *Cynanchum* in suitable areas, which feature rocky soils with minimal nutrients.

To reduce visual and environmental impacts, interburden/overburden and void volumes were analysed to develop a landform shaping and rehabilitation plan. An overall interburden ratio of approximately 30 per cent allowed depleted pits to be backfilled. Insufficient interburden/overburden material was available to backfill all cutting faces as part of the rehabilitation process. Instead, an assessment was made to determine which quarry faces should be left as benched cuttings and which should be backfilled with interburden/overburden quarry material. Where benched faces could be left, the benches were prepared and revegetated with *Zieria* and *Cynanchum*, both of which favour a rocky habitat. Importantly, the rehabilitation plan allowed systematic extraction of basalt from workable faces and floor areas, with interburden/overburden being used for rehabilitation to minimise long term visual and environmental effects.

1.14 SOCIO-ECONOMIC ISSUES

Mining projects affect the local and national economies in a variety of ways. They are a dominant land use that can shape surrounding settlement patterns. This is usually achieved through statutory planning schemes which regulate nearby land uses so that mineral resources are not prematurely prevented from being mined. Sometimes this is best achieved through buffer zones, where land uses are limited to those that are compatible with mining.

Mines are built by their owners to provide wealth to their share-holders and to provide economic benefits to the community and government. Some people will benefit directly via the creation of employment and business opportunities, while other people may feel aggrieved by the project proceeding.

Where communities exist at a potential minesite, mining impacts on the host environment can significantly influence community attitudes to the operation. Mine planners need to make specific allowance for sensitive adjoining land uses and neighbours. A successful mine plan will be developed after the concerns of local people are understood and the means of accommodating their needs considered.