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 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.

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

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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