

Rehabilitation:

environmental management
in the exploration and
mining industry



Why rehabilitation?

Sites of mining and exploration activity to be left:

- safe
- stable
- as non-erodable structure
- with sustainable ecosystem
(native fauna and vegetation cover)

Why is environmental regulation a requirement for the mining industry?

Current expectations are that exploration and mining sites have to be left as safe, stable, non-erodable structures with sustainable native vegetation cover.

This slide shows the Elverton Tailings just out of Ravensthorpe, Western Australia. These tailings were deposited more than 20 years ago before the mining industry was regulated.

The site is not safe (approx. 5 km out of town), is not stable (dispersing down a creek line), and is not supporting any kind of ecosystem.

To avoid this type of situation, the State Government (through the Department of Industry and Resources — DoIR) regulates the mining industry on behalf of the community.

Examples of bad environmental management



**Poor sump placement
resulting in tree death**



Excessive clearing

Rehabilitation during exploration

DoIR has several requirements to avoid environmental damage during exploration activity, such as that exemplified by this and the following slide. Amongst other things, DoIR requires:

- drillholes to be capped immediately and plugged at a minimum depth of 40 cm within 6 months with a concrete conical plug, in order to avoid falling and trapping of indigenous fauna down the holes
- plastic bags used for sampling to be removed within 6 months
- tracks scarified and access blocked
- rubbish removed
- hydrocarbon spills prevented and removed
- sumps rehabilitated.

Examples of bad environmental management

Inappropriately plugged drillhole



Sample bag in cow pat resulting in stock losses

Fauna affected by drilling activity

Western Bearded Dragon
(*Pogona minor*)



Knob-tailed Gecko
(*Nephurus laevissimus*)

Stick Insect



Tree Delta
(*Gehyra purpurascens*)

With particular regards to the trapping and killing of indigenous fauna caused by uncapped drillholes, a study undertaken in the early 1980s in the Fitzgerald River National Park tested 2 shallow drillholes by cleaning them out with a vacuum cleaner.

One hole contained the skulls of 23 honey-possum, 17 dunnart, 8 western-pygmy possums, and 82 reptiles including 3 bobtail skinks. The other hole contained 17 honey possum, 9 dunnart, 2 western-pygmy possums, 4 ash grey mice and 127 reptiles.

To avoid trapping of indigenous fauna, exploration and mining companies are now required to routinely plug holes and they are also required to plug the holes of previous explorers on their acquired leases.

Fauna affected by drilling activity

Pygmy possum
(Cercartetus concinnus)



Thorny Mountain Devil
(Moloch horridus)



Goulds sand goanna
(Varanus gouldii)

Teutonic Bore — acid mine drainage



Rehabilitation during and after mining

One of the main causes of environmental damage during mining is acid mine drainage (AMD). This is caused by the oxidation of sulphidic mine wastes produced by mining and mineral processing, and typically prevents the vegetation from growing.

The effect of acid mine drainage is greater in higher rainfall areas such as the Rio Tinto region in Spain (a source of AMD for 2000 years) or closer to home, such as in Queenstown (Tasmania). Acid mine drainage also occurs in arid zones, as exemplified by this slide from Teutonic Bore close to Leonora.

This slide exemplifies the need for waste characterization in the planning stages so that hostile wastes can be isolated and encapsulated to minimize the effect on vegetation.



**Erosion due to poorly designed
water-control structures**

Rehabilitation after rehabilitation

Rehabilitation needs to be conducted according to proper standards, to avoid damage such as that illustrated in this slide.

A major cause of serious erosion on newly created landforms (such as rehabilitated waste dumps) is the lack of adequate drainage control. Drainage control measures have to be designed and constructed to handle expected rainfall events. In arid zones such as the Eastern Goldfields, most designs should be water retaining (unless you have other factors such as AMD or dispersive clays).

Relevant Acts and Regulations

- Mining Act
- Mining Regulations
- Environment Protection Act
- CALM Act
- Wildlife Conservation Act
- Aboriginal Heritage Act
- Rights in Water and Irrigation Act

Acts and Regulations

The Acts and Regulations listed in this slide are the main tools for managing the environmental impact of mining and exploration.

The Mining Act in particular manages and regulates land tenure, i.e. Exploration and Prospecting Licences, Mining Leases etc.. The Act is complemented by several Ministerial Conditions that regulate the size of specific leases and licences, and impose operating conditions, limitations, and restrictions on mining activities. Some examples of these regulations are:

- Prospecting Licences are limited in size to 200 ha, a maximum handling of 500 tonnes, and are valid for a period of 2 years only;
- Exploration Licences can be granted for areas comprising a minimum of 1 block (2.83 km) and a maximum of 70 blocks (198 sq. km²) and are granted for 5 years;
- Mining Leases cannot exceed 10 km² and extend for 21 yr;
- Special Prospecting Licences may be granted over an Exploration Licence or Prospecting Licence and are limited to a depth of 50 m and handling of 500 t.

Notice of Intent — NOI

The NOI must contain a plan of operations and a programme to safeguard the environment

1. Existing environment:

- regional setting
- soils
- geology
- hydrology
- climate
- flora and fauna (surveys)
- social environment (e.g. Aboriginal heritage, national trust, pastoral leases)

Notice of Intent

A Notice of Intent (NOI) has to be submitted by a mining company to DoIR before mining can start. This document details all matters relating to the environmental management of the proposed project and the existing environment, and must contain a plan of operations and a programme to safeguard the environment.

Completion criteria provide the aims and goals of rehabilitation, so that they can be included into the mine management plan right from the commencement of ground disturbance (instead of being suddenly introduced at some stage well into the life of the mining operation, when some environmental damage could have already occurred).

This and the following slides detail all that a mining company has to include in the NOI.

Notice of Intent — NOI

2. Project description:

- Mining (waste dump design, waste characterization pit design)
- Ore processing
- Tailings storage facility (design, DEP licensing, waste characterization)
- Support facilities (location of offices, workshops, camp, accommodation)
- Workforce
- Transportation corridors
- Resource requirements

Notice of Intent

In addition to an assessment of the existing environment (previous slide), a Notice of Intent (NOI) has to include a detailed project description (this slide), as well as an assessment of the impact of mining on the environment and specific commitments toward environmental management (next slide).

Notice of Intent — NOI

3. Environmental Impact Assessment and the Management Commitments:

- Identify all likely environmental impacts and determine significance, for example:
 - land clearing
 - flora and fauna
 - dangerous goods + hazardous substances
 - atmospheric pollution
 - rehabilitation
 - heritage and Aboriginal sites
 - water
 - waste products
 - noise
 - post-mining land use
- Provide commitments necessary to minimize, control, ameliorate, and rehabilitate all of these significant effects



Bond

As part of their commitments towards environmental management, exploration and mining companies are now required to submit a bond before the starting of operations.

This Unconditional Performance Bond is a contract between the Minister and a third party of financial standing to unconditionally pay the agreed sum to the Minister on his request, if it is deemed that the mining company has not met previously agreed environmental commitments.

The Bond will cover all land required to be rehabilitated, for example, waste dumps, tailings, stockpile areas, backfilled pits, hardstand areas, plant sites, haul roads, and camps (pits are not normally bonded as they are not rehabilitated).

During mining, an Environmental Report also needs to be submitted annually. This report concisely documents the major mining activities, rehabilitation and environmental management for the reporting year and proposed activities for the following year.

Rehabilitation includes:

- Rehabilitation requirements (e.g. stockpiling topsoil, deep ripping, drillhole plugging, removal of infrastructure)
- Monitoring (e.g. pipelines, tailings storage facilities)
- Geotechnical review (e.g. tailings storage facilities, distance of waste dumps from pits)

This slide lists some of the most important steps to be undertaken during rehabilitation. Many of these steps (e.g. rehabilitation of waste dumps) can and must start as soon as mining proceeds. In addition, to satisfy all the standard rehabilitation requirements, monitoring of existing facilities is routinely conducted during mining (e.g. tailing dams). Geotechnical reviews are also essential to assess the impact of mining as it proceeds.

Primary rehabilitation tool



The 'humble' caterpillar is one of the most important rehabilitation tools in the mining industry, and it is mainly used in the rehabilitation of waste dumps (i.e. the huge piles of sterile rocks and materials left behind after excavation at the mine site).



Waste dumps have to be rehabilitated to minimize erosion.

Erosion control depends on two main factors: angle and length of slope.

DoIR recommends slopes of no greater than 20° with benches every 7–10 m of vertical height (20° is the maximum slope a machine can safely work on).

However, soil characteristics, rainfall, drainage and topography are all contributing factors that have to be taken into account in determining the optimal slope angle and slope length.

For example, the Red October Mine on Lake Carey in the northern Goldfields is within a salt lake (flat topography) and 90% of the waste material is made up of oxidized clays and sediments. Consequently the final landform design is low angle, with merging into irregular alluvial flats (approx. 7°).

Dumping topsoil



Topsoil is one of most important resources in land rehabilitation. It is an important source of: seeds, nutrients, mycorrhizal fungi and microbial biomass that facilitate the re-establishment of the native flora.

Topsoil is removed at the start of mining operations, and needs to be stockpiled appropriately to prevent sterility (usually in small piles, no greater than 2 m high).

During rehabilitation of waste piles, topsoil is dumped and spread on top of the waste dump. If topsoil is not available (e.g. due to poor planning that has led to it being under the waste dump or if it has not been preserved and stockpiled properly) then rehabilitation may never happen or will take an extremely long time.



Spreading topsoil

Topsoil spread on waste dump



Paddington mine contour ripping and seeding operation



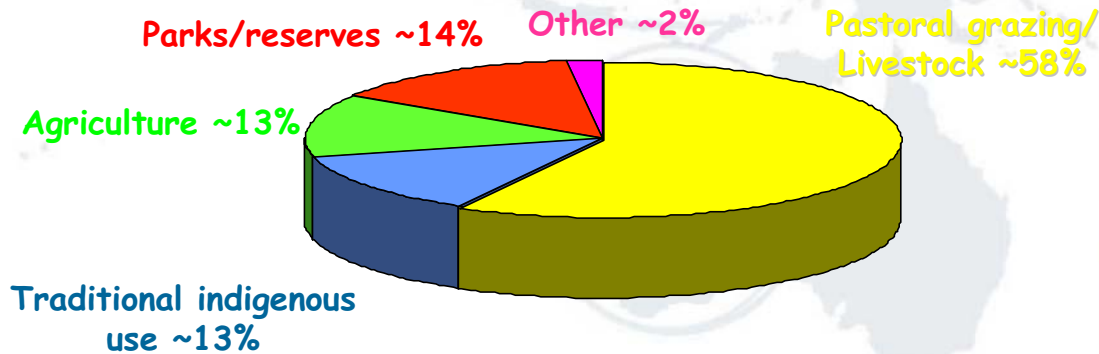


In addition to waste dumps, tailings (a byproduct of ore processing) are also rehabilitated. This is done by capping them with various materials, with topsoil spread over the top. DoIR recommends that the tailings are covered with at least 500 mm of waste in all cases where saline process water has been used. This acts as a capillary break and prevents surface expression of salts.

This slide depicts a successfully rehabilitated waste dump and a tailing dam, with indigenous flora already re-established.

Mining is the most highly self-regulating industry in Australia

Mining occupies only 12 000 ha of land in WA, (i.e. it constitutes only about 0.007% of land use in WA)



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Relative impact of exploration and mining

Although public opinion commonly has a very negative view of exploration and mining activity because of the perceived damage to the environment, it needs to be stressed that exploration and mining are at present the most highly self-regulating industries in Australia.

Also, it is worthwhile to point out that in Western Australia, the land directly affected by exploration and mining activity represents only 0.007% of the total land, a much smaller proportion than the land used for agriculture, pastoral grazing and livestock, and so on.

Data for the pie chart in this slide were derived from:

Beeston, G.R., Hopkins, A.J.M., and Sheperd, D.P., 2002, Land-use and vegetation in Western Australia: Department of Agriculture, Resource Management Technical Report 250, p.6–7.

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