Water Quality Protection Guidelines No. 6

Mining and Mineral Processing

Minesite stormwater

2000

1. Introduction

Stormwater management is essential to minimise the potential for dams containing toxic chemicals to overflow or for runoff to carry suspended solids to watercourses. In Western Australia a great deal of mining occurs in arid regions, and stormwater should be treated as a valuable resource that can be used in site operations.

2. Purpose

These guidelines are designed to be used for managing stormwater so the region's water resources are protected.

3. Scope

These guidelines are to apply where rainfall on minesite areas is likely to impact on the quality of water resources. This includes runoff generated from land such as stockpiles, process plants, dumps, haul roads and rehabilitated areas.

4. Regulatory requirements

Occupational health and safety issues and the impact of stormwater discharge on adjoining mineral tenements are governed by the Department of Minerals and Energy (DME) through administering the *Mining Act 1978*, Mining Act Regulations 1981, the *Mine Safety and Inspection Act 1994* and the Mine Safety and Inspection Regulations 1995.

There are provisions under the *Environmental Protection Act 1986* to issue a Works Approval (to construct) and Licence (to commission and operate) to control discharge of water from mine sites. If stormwater discharge is likely to occur at a mine site, the proponent/operator should address this in its Notice of Intent.

5. Guidelines

5.1 General

a. Stormwater management at the mine site should provide for the collection, storage and disposal of water. Stormwater may be diverted from the site if it is not contaminated. The Commission supports the philosophy of zero discharge and encourages the reuse of water where it is cost-effective.

b. Where practical, facilities that generate waste materials or wastewater, such as workshops, should be roofed or covered to prevent rainfall mixing with waste products.

c. Site drainage should aim to separate natural runoff from water generated by mining and processing operations. This will minimise the amount of water that needs to be treated or retained. It can be achieved by considering the project site as a number of individual 'catchments'. Each catchment will have design criteria that reflect the level of risk. Catchments should be characterised in terms of:
   - the type and quantity of mining material and waste (porosity, permeability, chemical composition);
   - the hydrological flow systems (slope, flow distance, dilution, recharge, hydraulic connection);
   - vegetation cover, soil and topography;
   - hydrogeochemistry of minesite water, surface water and groundwater.

   Drainage design for each catchment should be based on recommendations for flood events in the Institution of Engineers' publication *Australian Rainfall and Runoff*.

d. Waste or chemical containment facilities need to be placed above the level of extreme flood events where practical.

5.2 Natural runoff

Where possible, natural runoff should be diverted around or away from a mine site or vulnerable facilities and into a natural stream or watercourse.

5.3 Minesite runoff

a. Minesite runoff should be diverted around or away from any vulnerable facility to on-site storage areas, such as a sedimentation basin or retention basin. The stored water can then be used for:

- process water make-up;
- cooling water;
- fresh water supply;
- rehabilitation;
- dust suppression.

b. Vulnerable facilities such as hazardous material stores, power stations, maintenance workshops, leach pads, processing modules, fuel storage and waste stores should be built above the level of extreme flood events. As a minimum a **1-in-20 year** flood event should be incorporated into site planning in Western Australia.

c. Any stormwater diversion should be properly managed to control erosion and downstream sedimentation. Flow diversion is usually best achieved by building a bank from soil excavated from the channel. A broad-based, round-crested bank with gentle batters is preferred to a steep-sided ridge, as it is less susceptible to erosion and more easily maintained. The size of the bank and channel will vary with topography and the amount of water to be controlled.

d. The size, cross-sectional shape and gradient of the channel should be designed to avoid scouring and sudden changes in velocity. Parabolic or trapezoidal shapes are preferred to V-shapes, while channels with gradients greater than 1% should be lined. Drop structures should be constructed where slopes are steep.

e. Runoff from the diversion channel can be discharged to open ground (where the ground is well vegetated and will not scour) or to a constructed drainage depression or sedimentation basin. Consequences of potential failure of the containment system should be assessed using risk analysis methods.

f. Where possible, vegetation cover should be used to prevent erosion. Where there is insufficient cover alternatives may include the use of:

- jute mesh or geotextile;
- rip-rap or stone pitching;
- gabions and grout-filled mattresses;
- concrete or concrete-filled bags;
- drop structures and chutes (made of concrete, timber, metal, half pipes, old conveyor belting etc.);
- piping (using rigid or flexible pipes);
- dbase channel, weirs;
- deep ripping to increase infiltration in bore areas.

5.4 Contaminated stormwater

a. 'First flush' runoff (initial runoff after a long dry spell) will generally contain the greatest percentage of contaminants and, where practical, should be contained onsite. Once intercepted and treated, the water may be disposed of (along with any other uncontaminated water) as outlined in the Commission's *Water Quality Protection Guidelines No. 11 – Mine dewatering*. Where possible, minesite water should be recycled for on-site purposes. Water should only be discharged off-site to surface watercourses or groundwater where there are no other feasible methods of disposal, and DEP has agreed that there will be no unacceptable impact on the receiving environment. Stormwater of a quality that is unacceptable for maintenance of the downstream environment must not be released from the site.

b. Bunding used to control potential spills around facilities such as fuel storage compounds should be high enough to contain wave action and to minimise the containment area. The bunded area must be capable of holding a **1-in-20 year** flood event, 72-hour storm event and 110% of tank contents. The Commission's publication *Water Quality Protection Guidelines No. 10 – Above-ground fuel and chemical storage*, provides additional information on bunding. Further

advice is available in Australian Standard (AS) 1940.

c. The acidification of stormwater as it passes through sulfidic material is a process known as acid mine drainage (AMD). It can be a major water quality consideration, though generally not in Western Australia because the soils have naturally low concentrations of sulfidic materials. Where AMD is an issue, various methods can be used to minimise stormwater flow through sulfidic material. The Commission's publication *Water Quality Protection Guidelines No. 9 – Acid mine drainage* should be referred to for further information.

d. Further information on the discharge of water is available in the Commission's publication *Water Quality Protection Guidelines No. 11 – Mine dewatering.*

6. Useful references

Some components of these guidelines have been based on work already undertaken and reported in the following publications:

1. Davies, J. and van Hall, S. (1996). 'Stormwater Runoff'. in: *Advanced Manufacturing Technologies Centre, Principles of Water Auditing for the Power, Mining and Mineral Processing Industries*, Perth.
2. Department of Minerals and Energy (Queensland) (1995). *Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland*, DME, Brisbane.
3. The Institution of Engineers, Australia (1987). *Australian Rainfall and Runoff: A guide to flood estimation*, IEA, ACT.

Glossary and Abbreviations

1.	Acidification	The lowering of pH to less than 4.5.
2.	Drop structure	A terrace structure to transform a steep gradient into a gentle slope in drainage system.
3.	Gabion	A metal basket filled with rocks used for erosion control on the edges or banks of waterways.
4.	Geotextile	An artificial fabric designed to prevent water passing through it. Used underneath hard structures such as rip-rap and gabions to prevent them being moved by groundwater flow.
5.	Licence	Licence granted and in force under Part V of the *Environmental Protection Act 1986.*
6.	Permeability	The capacity of a porous rock, sediment or soil for transmitting a fluid when subjected to unequal pressure.
7.	Porosity	The percentage of the bulk volume of a rock or soil that is occupied by interstices, whether isolated or connected.
8.	Rehabilitation	The restoration of disturbed land to the condition that applied prior to development of the site or as agreed with regulatory authorities.
9.	Rip-rap	Rocks of varying sizes placed on the edge or bank of a waterway as erosion control.

Further enquiries

Any project where the proponent/operator is unable to comply with these guidelines, or where site conditions prevent the application of these guidelines, should be submitted to the Commission as early as possible in the development of the proposal so that the matter may be resolved.

Any queries relating to the **content of these guidelines** should be directed to:

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These guidelines are also available from the Water and Rivers Commission's web page at:
http://www.wrc.wa.gov.au/protect/policy/

Other related guidelines in this series include:

WATER QUALITY PROTECTION GUIDELINES NO. 1
Water quality management in mining and mineral processing: An overview

WATER QUALITY PROTECTION GUIDELINES NO. 2
Tailings facilities

WATER QUALITY PROTECTION GUIDELINES NO. 3
Liners for waste containment

WATER QUALITY PROTECTION GUIDELINES NO. 4
Installation of minesite groundwater monitoring bores

WATER QUALITY PROTECTION GUIDELINES NO. 5
Minesite water quality monitoring

WATER QUALITY PROTECTION GUIDELINES NO. 7
Mechanical servicing and workshop facilities

WATER QUALITY PROTECTION GUIDELINES NO. 8
Laboratory waste discharge

WATER QUALITY PROTECTION GUIDELINES NO. 9
Acid mine drainage

WATER QUALITY PROTECTION GUIDELINES NO. 10
Above-ground fuel and chemical storage

WATER QUALITY PROTECTION GUIDELINES NO. 11
Mine dewatering