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MONASH PLANNING SCHEME AMENDMENT C129
PLANNING PANEL HEARING – 30 OCTOBER 2017

SUBMISSION ON BEHALF OF ANGELO VALENTE AS A RESULT OF THE WORK AUTHORITY & WORK PLAN

1. WORK AUTHORITY 389

The documents provided to us on 4 September 2017 by Norton Rose numbered 23 on the Hearing Document List were the following:-

a) Letter dated 1 September 2017 addressed to Planning Panels Victoria;
b) Planning Permit No. 4731 dated 1st May 1989 issued by the former City of Oakleigh;
c) A "Site Layout Plan" described incorrectly by Norton Rose to be the site layout plan referred to in the former planning permit, but which in fact is the "Existing Conditions 9/'91" plan which was approved on 28th September 1998 as "Work Plan Approved";
d) the approved Work Plan numbered 1533/3 entitled "Proposed Works" endorsed on 28 September 1998 as "Work Plan Approved"
e) the Work Authority 389 dated 19 October 2000;
f) the Variation to that Work Authority dated 20 December 2001;

The Work Authority 389 provided by the proponent does not specify what "work" is being authorised by this work authority. Furthermore, the Approved Work Plan was endorsed on 28 September 1998, which pre-dates Work Authority 389. Therefore we are not certain as to whether there is a previous Work Authority applicable to the endorsed plans dated 28 September 1998, and/or whether there are other approved Work Plans that were endorsed pursuant to Work Authority 389 dated 19 October 2000. There may also be conditions attached to the Work Authority and/or the Variation of Work Authority dated 20 December 2001, as noted below.

2. INCOMPLETE DISCLOSURE OF WORK AUTHORITY DOCUMENTS

Tab 6 of the folder of documents handed out by the Proponent's representative on 12th October 2017 (numbered 29 on the Hearing Document List) includes the document headed "Status of Sand Quarrying Permit and Work Authority" which appears to be a legal opinion drafted by Norton Rose, but it is not signed by a Lawyer.

Paragraph 2 of that document refers to the following documents:-

a) Work Authority 389;
b) **Work Plan Conditions;**
c) **Reclamation Management Plan A**; and
d) Approved Work Plan 1533/3".

However, we were not provided with copies of documents numbered b) and c) above. Therefore we would be pleased if the Panel could direct the Proponent to provide us with these documents in order that a proper analysis of the status of the Work Authority applicable to the site can be made.

3. DESCRIPTION OF WORKS APPROVED BY WORK PLAN 1533/3 ON 28 SEPTEMBER 1998

From the approved Work Plan provided to us entitled "Proposed Works" and numbered 1533/3, it shows that the "proposed works" relate to the rehabilitation of the site, not for the extraction of sand.

For example, for the area that we now refer to as Zone 4, it states the following:-

- Extraction complete 1993;
- Zoning "R1";
- 1993 to 2014 Progressive Backfilling (south towards north) with clean fill;
- Two existing water storage areas, the one to the south shall be progressively backfilled, the other towards the north remains for foundry operation and its surface area increased.

For the area that we now refer to as Zone 2 and part of Zone 5, it states the following:-

- Water Storage Rehabilitation October 93
    - Commence draining;
    - Commence capping with clean fill to original ground levels;
    - Surface covered with 750mm soil including 100mm topsoil layer;
    - Zoning "IN-10".

From the above details, we submit that this Work Plan is the equivalent to a section 79 "rehabilitation plan" under "Part 7 – Rehabilitation" of the Mineral Resources (Sustainable Development) Act 1990, (MRSD Act).

However, "Part 7 - Rehabilitation" of the MRSD Act was inserted into the latter Act by the Resources Industry Legislation Amendment Act **in 2009** and therefore it was not in existence at the time the Work Plan for rehabilitation for this land was approved in 1998.

We also make the observation that the works approved by the Work Plan is generally in accordance with the covenants contained in the s.173 agreement registered on all the titles applicable to this land in 1993.

4. STATUS OF WORK AUTHORITY

As stated above, from the information provided to us so far by the proponent, there seems to be in existence approved plans for the rehabilitation of this land pursuant to:-

a) Approved Work Plans dated 28th September 1998. An important requirement on that Work Plan for Zone 4 is specified as:-

"1993 to 2014 Progressive Backfilling (south towards north) with clean fill"

Obviously, this was not done by the previous and present owners of the site and it appears that the Mineral Resources Department, (Earth Resources) has upto now neglected to enforce this requirement;

b) Approved planning drawings numbered 1 to 4 applicable to planning permit 43337 entitled "use and development of the land for stockpilling of earth, treatment of existing on-site slimes, sediments and uncontrolled fill material and associated earthworks to facilitate the backfilling of the former quarry", endorsed by Monash Council on 29th October 2015.

We have not been provided with approved planning drawings applicable to planning permit 43336 entitled "backfilling and site rehabilitation of the former quarry" as directed by the Planning Panel.

The reason for the existence of different rehabilitation plans for the site is a consequence of Monash Council not referring the planning applications to the Secretary of the Mineral Resources Department, (Earth Resources). The planning report in the Monash Council Meeting Agenda dated 28 April 2015 section 4.2 does not list Earth Resources as a referral authority. This is despite the fact that Clause 66.05 of the Monash Planning Scheme states that an application under Clause 52.09-8 to construct a building or construct or carry out works **on land for which a work plan has been applied for or granted** under the Mineral Resources (Sustainable Development) Act

1990, (MRSD Act), must give notice of that application to the Secretary of the Department administering the MRSD Act. Clearly the works that are the subject of both planning permits are "works on land which a work plan has been applied for or granted", namely approved Work Plan 1533/3.

The Norton Rose document headed "Status of Sand Quarrying Permit and Work Authority" at Tab 6 of the folder of documents numbered 29 on the Hearing Document List states at paragraph 10 that Work Authority 389 no longer remains in force "given that the carrying out of an extractive industry is no longer permitted on the land under the relevant planning scheme or a planning permit" pursuant to s. 77L of the MRSD Act, as Zone 4 is located in the General Residential Zone.

The Norton Rose document then states at paragraph 14 that it is not clear how the rehabilitation of the site will occur pursuant to s.81 of the MRSD Act "if the rehabilitation works specified in the rehabilitation plan are not permitted by the relevant planning scheme (eg if a permit does not exist or cannot be obtained for the works)".

In our opinion, the above statements have ignored the following:-

a) That part of the site currently zoned General Residential Zone has always had a residential zoning despite the fact that extractive industry work has occurred on that part of the site in the past. This is confirmed by Work Plan 1533/3 which highlights the zoning in 1998 of Zone 4 as "R1" namely Residential Zone 1;

b) Work Authority 389 is only referring to the rehabilitation of the site pursuant to the approved Work Plan. If rehabilitation of the site is not permitted under the planning scheme as stated in paragraph 14 of the latter Norton Rose document, then the planning permits issued by Council for works associated with the rehabilitation of the site in 2015, would also not be a permitted under the General Residential Zone.

The planning report recommending approval of the above planning permits relating to the backfilling and site rehabilitation of the site as noted in the Monash Council Meeting Agenda dated 28 April 2015 section 4.2, reproduces at pages 43-44 the response from the permit applicant, Urbis, to an objection lodged against the applications:-

"The application of Clause 52.10 would require the primary purpose/use to be characterised as an 'industry.' We submit this is clearly not the case, on the basis that:-

- *The primary use that is proposed by the applications is for rehabilitation of the site, not the carrying out of an industry;*
- *The proposed works are temporary in nature, and more particularly are not being carried out as part of a commercial enterprise;*
- *The works are necessary to fulfil the obligations of the existing Environmental Audit Overlay and the Section 173 Agreement, and are directly contemplated by the zone purpose which provides for the rehabilitation of the site;*
- *While some of the activities that will be carried out will include treatment of soils and aqueous materials, these are ancillary to the primary use.*

Legal advice obtained by our client in relation to these applications has confirmed that the proposed use should be characterised as rehabilitation works, which are an innominate use in both the Special Use and General Residential Zones. We note the definition of works in section 3 of the Act is:-

> *"'Works' includes any changes to the natural or existing condition or topography of land, including the removal, destruction, or lopping of trees and the removal of vegetation or topsoil."*
>
> *We submit that the use of land for 'rehabilitation works' is the most accurate way to characterise the proposal, and that that there is no legal basis to suggest that the works could be regarded as an 'industry' ".*

Therefore in our view it cannot be said that the rehabilitation of the land pursuant to the Work Authority and approved Work Plan is a prohibited use under the Monash Planning Scheme. As stated by Urbis, it is an innominate use in both the General Residential Zone and the Special Use Zone.

The Norton Rose document at paragraph 16 refers to the VCAT decision of *Illuka Resources Limited v Horsham Rural City Council [2017] VCAT 107* to support the proposition that the planning permits for rehabilitation of the land for this site prevail over the rehabilitation requirements pursuant to the work authority.

However, the planning permit sought in the *Illuka* case was not for the rehabilitation of the mine, as stated in paragraph 43 of the decision:-

> *"it is now proposed to use Pit 23 for a different purpose. Its use for the disposal of waste by-products from the MSP will no longer be tied to mining or mineral extraction on the land or even other mines in Victoria. In our view, the real and substantive purpose of the use of this land will be for waste disposal of by-products from Hamilton MSP. This purpose would come within the definition in the planning scheme of refuse disposal..."*

With respect to this site, the proposed works relate to the rehabilitation of the land which is incidental to or ancillary to its use as a sand quarry. Therefore, in our view the Work Authority remains in force. The owner of this land chose not to vary the approved Work Plans or Authority through Earth Resources, a Department which has the expertise to analyse the risks associated with the proposed rehabilitation works. Instead, the owner, through its planning consultants Urbis, applied to Monash Council for planning permits, which we submit that, without the assistance of Earth Resources, Council is not the government agency with the expertise to assess or deal with the issues that will arise from the rehabilitation works on this former quarry site that it has approved.

5. RESPONSIBILITIES OF DEPARTMENT OF MINERIAL RESOURCES

We are of the view that Earth Resources still has a responsibility regarding the rehabilitation of the site. Therefore, this rezoning application and the works currently being undertaken by the proponent pursuant to the planning permits should be assessed by Earth Resources against its Codes and Guidelines such as the following:-

A. The batters to the existing open quarry pit

The planning permits allow the removal of the slimes and other uncontrolled fill material from the bottom of the open quarry pit located in Zone 4. However, the current slopes of the open quarry pit exceed the guidelines recommended by Earth Resources as a stable batter slope for soils of this nature and therefore there is a real risk of failure of the current batters.

In this regard, please refer to Attachment A, which is entitled, "Code of Practice for Small Quarries" published by Earth Resources. This Code applies to quarries that are less than five hectares in area and less that five metres in depth, (see paragraph 1.2 page 1 of this Code) and it states the following regarding "Landform Design" at para 5.2 page 10;-

> *"A quarry should be carefully constructed so that the landform poses no slope failure, slumping or collapse risk to employees, the public, or the viability of the operation".*

It then states that one of the recommended practices is the following:-

> *"The angle of working faces should be determined by the nature of the material, in general:*
>
> - *Sand should have an overall slope of no greater than 1: 1.5 (vertical:horizontal)*

The existing slopes of the open quarry pit in Zone 4 are presently 2:1, which is well in excess of the recommended guidelines for small quarries. In addition, the current slopes were established at a time when safety buffers were present along the Centre and Huntingdale Road abuttals, which is now no longer the case.

Accordingly, we submit that the technical experts at the Earth Resources should now critically examine the works approved by the planning permits, the current state of the the batter stability in Zone 4, and analyse, amongst other things, the following:-

a) The planning permit allows the removal of the slimes and other uncontrolled material **from the toe of the batter**;

b) The top of the batter has now been developed with a four to five storey apartment building with basement which applies an increased load at the **head of the batter**;

c) The planning permit allows the dewatering of the quarry. Given that there is a water table that is above the proposed excavated base of the quarry, there will be flows of ground water into the quarry from the surrounding area.

d) The former Talbot Road which abuts the eastern side of this batter is now used as a haul road for heavy vehicles which upto now has not been used for more than 20 years.

e) The planning permit allows the removal of all the vegetation along the Huntingdale Road abuttal at the top of the batter.

Given the above, we are of the view that Earth Resources will need to be satisfied that the planning permits adequately address, amongst other things, the following:-

- That the health and safety of the workers on the site shall be protected;

- That there is no probability of slip failure occurring with the batter thereby destabilizing the adjoining apartment building located to the south;

- That the batter stability along Huntingdale Road will not be compromised thereby creating a risk to the general public.

In this regard, please refer to Attachment B, which is the publication of Earth Resources entitled "Guidance Material for the Assessment of Geotechnical Risks in Open Pit Mines and Quarries". It states the following on page 1:-

> *"Geotechnical risks at a mine or quarry are defined as those risks associated with ground movements. Ground movements are typically limited to the area of the mine and to a region around the mine. Ground movements may be significant (such as subsidence or natural rebound) or catastrophic (such as batter collapse). Irrespective of the type of ground movements, it is possible persons, infrastructure or the environment to be harmed. It is essential that the risks of harm arising from ground movements are minimized during the period of operation of the site, rehabilitation and post-closure".*

The Guidelines then outline the method of assessment of the geotechnical risks and the required information to be provided to the Department's Earth Resources Regulation Branch for a work plan submission that addresses the identification of such risks and their control or mitigation. As stated previously, this has not been done by the owner of the site chosing instead to obtain approved planning drawings from Council. Therefore, in our view, remediation of Zone 4 should proceed in accordance with the approved Work Plan, that is, progressively backfill from south towards north with clean fill without any excavations within the quarry pit in Zone 4.

6. SLIMES & TAILING DAMS

An assessment by technical experts from Earth Resources is essential in our view to the orderly strategic planning of this land given that this State Department has the historical records and the technical knowledge regarding rehabilitation of quarries and the management of tailing dams. As this site contains quarry pits filled with slimes, they fall within the definition of "Tailing Dams" under the publication issued by Earth Resources entitled "Management of Tailings Storage Facilities", which is Attachment C.

The latter publication notes that tailings from the mining and extractive industries are most commonly fine-grained or finely ground materials left over from such processes as "washing off sand, clay and coal". This publication lists **the hazards that are associated with these tailing dams**, one of which is **"the liquefaction of saturated fines during seismic activity or other vibration"**:- refer to page 5 of Attachment C.

In addition, the "Code of Practice for Small Quarries", (which is Attachment A), states at para 5.7 page 14, the following in relation to "Slimes Management",

> *"Slimes are normally discharged to a slimes dam for solar drying and consolidation. However, slimes can remain high in water content for a long time and may present safety hazards. Slimes dams can continue to be unstable even after the surface has dried and a crusted layer has formed. Dried out slimes may also become a source of raised dust".*

The planning permits allow the slimes and uncontrolled fill to be excavated from the bottom of the quarry and dried out and stockpiled within 30 metres of residential dwellings, a public park and an athletics track frequented by the local schools. As stated above, these slimes are a by-product of the sand extractive industry. Given the possibility of airborne contaminants, noise and vibration associated with the process of drying and stockpiling the slimes, Earth Resources is required to be satisfied that the

works approved by the planning permits comply with all the applicable Departmental Guidelines and Codes.

We note from the "Variation of Work Authority" document that the land that has been excised from that Work Authority contains tailing dams (slimes). However, we are not sure whether Earth Resources placed any conditions on the excision of the land containing the tailing dams from the Work Plan, and what is their view of this proposal to rezone the land to permit the construction of housing on these tailing dams.

The Proponents submission in support of the rezoning is based on the fact that the independent Environmental Auditor of this land will address all the environmental risks associated with the future use of the land. The "safeguards" in CDZ2 is that the Environmental Audit shall be completed prior to the sensitive uses or carrying out of the building works. This process is said to be in compliance with the recommendations of the "Potentially Contaminated Land Advisory Committee Report".

However, the Advisory Committee Report did not consider issues outside the Environmental Audit regime. This land contains more than just environmental risks. It has major geotechnical risks associated with:-

- slimes encapsulated in a tailing dam without a protective layer in Zone 3 and part of Zone 5 within a former quarry sand pit;

- municipal putrescible waste placed over slimes without a protective layer in Zone 1 within a former quarry sand pit;

- municipal uncontrolled waste placed over slimes without a protective layer in Zone 2, (within a former quarry sand pit) that is bounded to the west by the embankment of the former Talbot Road and to the south by Talbot Park, (which was also a former sand quarry pit), that was filled with municipal waste without a protective layer ; and

- slimes at the bottom of Zone 4, also a former sand quarry pit, which has batters with slopes that do not comply with the current guidelines issued by Earth Resources.

From our notes of Mr. Mival's evidence before the Planning Panel, he stated that the geological risks are outside his expertise and his audit. Mr. Mival stated in his evidence that he had a concern with the expert evidence of Mr. Pedler.

Mr. Mival stated that the *"settlement must be managed appropriately"* and that it *"must not compromise any protection measures for vapours"*. He stated that he is:-

> *"concerned about dynamic compaction, this causes vibration. This is not part of the Environmental Audit and will need to be managed by the proponent – it is outside of the audit process."*

You may recall Mr. Pedler's evidence is that he stated that the slimes must be compacted or preloaded prior to construction commencing.

The examples of other rezoned contaminated brownfill sites or quarry sites that have been provided to the Planning Panel by the proponent are very different from the characteristics of this site. We submit that the Planning Panel cannot extrapolate that the methods used on the other rezoned contaminated sites will be successful for this site, given that it has a completely different matrix of chemical and geological conditions from the other contaminated sites referred to by the proponent both in its written submission and in the evidence of its expert witnesses.

The only other remediated site which had only one similar characteristic to this site being that it was a former sand quarry, is the Cavanagh Street Cheltenham site. However, as can be seen from the material produced by the proponent in its folder of documents given to us on 12 October 2017 being Hearing Document List no.29, at tab 7 i) to vii), the Cheltenham site was filled predominately with inert waste (not putrid waste)

and there were no slimes in the former quarry of that site. At page 5 of the VCAT decision relating to the planning application for that site, Stuart Morris QC for the developer stated that "the fill material is 95% soil".

We submit that as a result of this, the actual gas migration from the Cheltenham site would have been negligible and that the gas monitoring devices were installed as a precaution, which would also explain why the "Post Construction Environment Plan" and the Owners Corporation Rules were thin on detail. Accordingly, the success of the Cheltenham development as detailed predominately in Mr. Sinclair's evidence cannot in our view be used as a justification for the proposition that the remedial measures as outlined by him will be successful to allow sensitive uses for this former quarry site containing putrid waste and slimes.

Should the Planning Panel consider it appropriate, it may wish to recommend that the Minister for Energy & Resources refer this matter to the Technical Review Board (TRB) pursuant to s. 54A of the MRSD Act to consider the environmental and geotechnical complexities of this former quarry site in order that the Planning Panel and the public can obtain a truly independent analysis from experts of the risks of this site.

Pursuant to this section of the MRSD Act, the Victorian Government in 2009 established the TRB, whose primary function is to provide independent advice to the Minister for Energy and Resources, (the Minister), the Department of Economic Development, Jobs, Transport and Resources, (DEDJTR) and industry through the Department on managing risks associated with mine instability and rehabilitation in the Victorian mining and quarrying sectors.

Please refer to Attachment D, which is the "Annual Report 2015-2016 Earth Resources Regulation Technical Review Board". This TRB Annual Report states at paragraph 6.3 that it is concerned about two emerging issues which is relevant to this site namely:-

"Two important issues have emerged out of the current focus on mine closure and rehabilitation that warrant focused attention in the future. The first concerns operational and legacy issues associated with mine waste dumps, especially tailing storage facilities (TSF) and the second relates to the legacy of abandoned mines.

The TRB Annual Report of 2015 – 2016 also states at paragraph 5.9 that:-

" accountability within government for overseeing risk management in the mineral resources sector is assigned to agencies on the basis of the consequences of an unwanted event occurring, rather than on the basis of the agency that is best qualified to provide assurance to government on the robustness of the risk management process required to prevent the event from occurring in the first place".

Given the geological risks associated with this site, it is our view that the Monash City Council, the Environmental Auditor and the EPA are not the appropriate government agencies that have the capabilities to oversee the geological risks of this site and thereby give confidence to the public that will "prevent an unwanted event occurring".

As stated by the TRB, the government agency that is best qualified to provide assurance to government **to prevent an unwanted event from occurring in the first place** should be assigned to assess risk management within the mineral resources sector. Therefore, given that the technical experts at Earth Resources and the TRB have been excluded from this planning scheme application and the planning permit process, we are of the view that the Planning Panel should abandon this rezoning.

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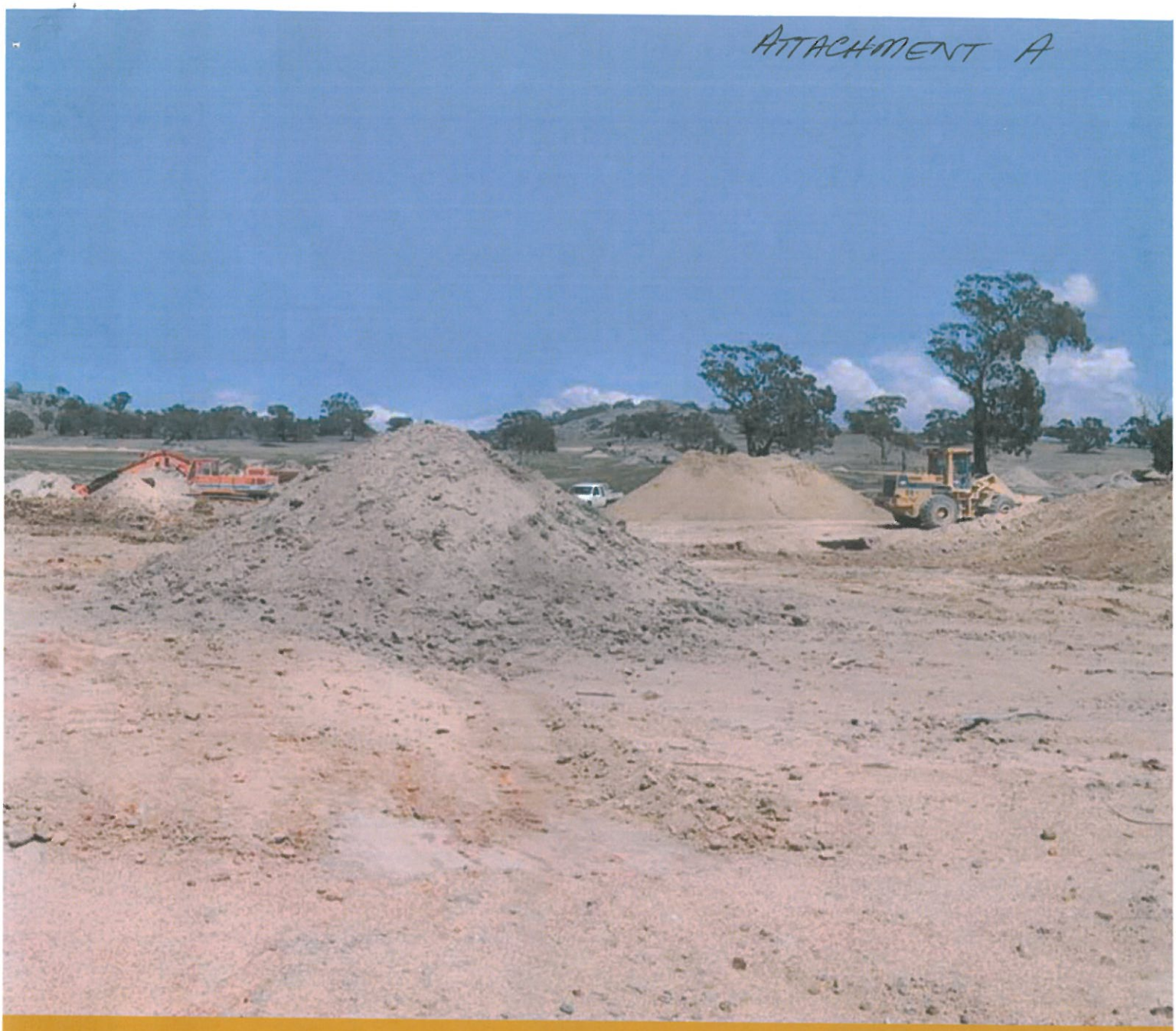
ATTACHMENT A



Code of Practice for Small Quarries

Victoria
The Place To Be

DEPARTMENT OF PRIMARY INDUSTRIES | earth resources

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Contents

Definitions

Angle of repose The maximum angle above horizontal of a stable slope formed by a given material (depends on friction, cohesion and the shapes of the material particles).

Batter The face of the slope.

Bench That part of a quarry where material is loaded and hauled away.

Bond An amount of money, usually in the form of a bank guarantee, which is forfeited if the rehabilitation of a site is not successfully completed in the allocated time or to an acceptable standard.

Bund An earthen mound wall which may be used for noise attenuation or visual screens. Bunds may also be used to contain spillage of liquid materials.

Community A broad term used to define groups of people, whether they are stakeholders, interest groups or citizen groups.

Contour bank An earth mound or similar, constructed approximately along the contour and which is designed to slow down and control water run-off.

Contour drain Drainage channel constructed approximately along the contour, and which is designed to slow down and direct the flow of water across a disturbed area to a sediment trap for sediment removal.

Crown land Land that is, or that is by any Act deemed to be, unalienated land of the Crown, and includes:

a) Land of the Crown that is reserved permanently or temporarily by or under any Act; and

b) Land of the Crown occupied by a person under a lease, licence or other right under the MRSD Act or any other Act;

but does not include land which is the subject of a licence granted under Part 3A of the *Victorian Plantation Corporation Act 1993*. (Source: *MRSD Act*).

Diversion drain A ditch and/or earth bank constructed to direct clean water from uphill of a disturbed area around the disturbed area.

Disturbed land Any area of land where the natural surface has been removed, excavated, shaped or otherwise altered from its natural condition.

Drip line: The outer most leaves on a tree defines its drip line; the ground within the drip line is known as the drip zone.

Environmental incident An occurrence that will, or is likely to cause, material harm to the environment.

Flocculation treatment The addition of an approved agent to water with high suspended sediment levels that cause the suspended material to clump together and fall out of solution as sediment.

Geotextiles Permeable fabrics used to stabilise slopes and prevent erosion.

Heritage sites Sites of cultural significance identified under the *Heritage Act 1995* or the *Aboriginal Heritage Act 2006*.

Level sill outlet A pond or drain outlet point which causes water to spread evenly across a level surface to dissipate energy before being released to the environment.

Noxious weed means a —

(a) State prohibited weed; or

(b) regionally prohibited weed; or

(c) regionally controlled weed; or

(d) restricted weed;

under the *Catchment and Land Protection Act 1994*.

Overburden Material which overlays the resource being quarried, excludes soil and topsoil.

Pest animal means —

(a) a restricted pest animal; or

(b) an established pest animal;

under the *Catchment and Land Protection Act 1994*.

Proponent The person or entity proposing to develop a quarry.

Relevant agencies	The relevant Catchment Management Authority, Local Government Authority, Department of Sustainability and Environment, Rural Water Authority and/or Urban Water Authority, Environment Protection Authority and Aboriginal Affairs Victoria with statutory obligations that may relate directly or indirectly to the small quarry operations.
Sediment trap	Collects waterborne sediment running off areas of disturbed land using a device, such as a structure, pond barrier, silt fences, hay bales or grassed strips.
Sediment pond	Collects highly turbid water and stores it while suspended sediments fall out of solution and discharge it to a vegetated area.
Sensitive land-use	Residential areas and zones (whether occupied or not), hospitals, schools, caravan parks, and other similar uses involving the presence of individual people for extended periods, except in the course of their employment or for recreation.
Significant slope failure event	A slope failure event that causes (or has the potential to cause) a public risk, an impact outside the Work Authority boundary or the need to review the design of the quarry.
Topsoil	This is usually the surface material to a minimum of 150 mm in depth.
Turbid water	Muddy or opaque water, which carries suspended sediment or foreign particles.
Waterway	A river, creek, stream, lake, lagoon, swamp, marsh or watercourse, or a channel in which water may flow.
Work Authority	means a Work Authority granted under section 77I of the *Mineral Resources (Sustainable Development) Act 1990*.
Work Authority boundary	The perimeter of the Work Authority.
Work Plan	means a Work Plan lodged under section 77G of the *Mineral Resources (Sustainable Development) Act 1990*.
Work site	The area within the Work Authority where operations are being undertaken.
Works Approval	means a Works Approval granted under the *Environment Protection Act 1970*.

Abbreviations

AAV	Aboriginal Affairs Victoria
AS	Australian Standard
CHMP	Cultural Heritage Management Plan
CaLP Act	*Catchment and Land Protection Act 1994*
CMA	Catchment Management Authority
DPI	Department of Primary Industries
DSE	Department of Sustainability and Environment
EP Act	*Environment Protection Act 1970*
EPA	Environment Protection Authority
ERR	Earth Resources Regulation Branch of the Department of Primary Industries
Heritage Act	*Heritage Act 1995*
HV	Heritage Victoria
MRSD Act	*Mineral Resources (Sustainable Development) Act 1990*
RWA	Rural Water Authority
SEPP	State Environment Protection Policies
UWA	Urban Water Authority
VPP	Victorian Planning Provisions
Water Act	*Water Act 1989*

1. Introduction

1.1 Background

From 1 January 2010, Victoria's extractive industries must operate according to new provisions included in the *Mineral Resources (Sustainable Development) Act 1990* (MRSD Act). The MRSD Act replaces the *Extractive Industries Development Act 1995* as the Act which governs extractive industries. The regulation of the mining and extractive industry sectors through one piece of legislation allows greater streamlining and consistency of regulation for these sectors.

The MRSD Act is administered by the Department of Primary Industries (DPI). One of the objectives of the MRSD Act is to ensure that operations are carried out within safe operating standards and in a manner that ensures rehabilitation of land to a safe and stable landform. A Code of Practice for Small Quarries (the Code) has been developed to support this objective in relation to certain small-scale quarries which are exempt from the Work Plan requirements of the MRSD Act.

Extractive industries are defined in the MRSD Act as the extraction or removal of stone from land if the primary purpose of the extraction or removal is the sale or commercial use of the stone, or the use of the stone in construction, building, road or manufacturing works. The MRSD Act defines stone as:

- sandstone, freestone or other building stone, or
- basalt, granite, limestone or rock of any kind ordinarily used for building, manufacturing, or construction purposes, or
- quartz (other than quartz crystals), or
- slate or gravel, or
- clay (other than fine clay, bentonite or kaolin), or
- peat, or
- sand, earth or soil, or
- other similar materials.

Extractive industries provide vital resources to the community for building, construction and infrastructure. However, extractive industry activities have the potential to have negative impacts on people and the environment. The Code creates obligations which Work Authority holders must meet in relation to the management and control of these impacts when operating small quarries.

1.2 Application of the Code

From 1 January 2010, quarries that are less than five hectares in area and less than five metres in depth, provided that no blasting or native vegetation clearance occurs, will be exempt from the requirement to work to an approved Work Plan (section 77G of MRSD Act). Such small quarries are instead required to comply with the Code, which is made under sections 89A – 89H of the MRSD Act.

The Code does not apply to quarries that are less than one hectare in area and less than two metres in depth. These quarries are exempt from regulation under the MRSD Act.

1.3 Development of the Code

The Code has been developed by the Earth Resources Regulation Branch (ERR) of the DPI through consultation with stakeholders. A working draft Code of Practice applied to eligible extractive industries from 1 July 2009. The Code has now been made under section 89E of the MRSD Act.

The Code will be regularly reviewed to incorporate changes in technology, new environmental information, public submissions, administration experience, as well as changes in legislation and policy.

1.4 Transitional arrangements for the Code

Under the MRSD Act, all new extractive industries that are less than five hectares in area and less than five metres in depth, where blasting and native vegetation clearance are not required, will be exempt from the Work Plan requirements. These extractive industries must instead comply with the Code. These extractive industries will still require an approved Work Authority.

Different arrangements apply to quarries that are less than five hectares in area and less than five metres in depth, with no blasting and no native vegetation clearance, and which have a Work Plan approved before 31 December 2009 (existing small extractive industries).

Existing small extractive industries can continue to operate according to the approved Work Plan. Alternatively, existing small extractive industries can seek approval to move to the Code. Existing operators with an approved Work Plan and Work Authority must apply to the DPI in writing and obtain approval if they wish to operate according to the Code rather than a previously approved Work Plan. Existing operators of small extractive industries cannot vary a Work Plan at any time after 31 December 2009.

After 1 January 2015, all existing operators of small extractive industries will be required to operate according to the Code.

If a Work Plan for a proposed extractive industry that is less than five hectares in area and less than five metres in depth, where no blasting and native vegetation clearance occurs, has been submitted before 31 December 2009 but has not been approved, the Work Plan cannot be approved. The applicant will instead be required to work according to the Code and the approved Work Authority.

2. Purpose of the Code

The Code sets out the minimum mandatory requirements that Work Authority holders must meet (see Requirements in sections 3, 5, 6, 7 and 8). Appendix 1 contains a full list of requirements. The Work Authority issued to proponents under the Code will specify that Work Authority holders are bound by the requirements of the Code.

The Code also provides practical guidance on how to achieve a well-designed and operated quarry (see Recommended Practice in sections 4, 5, 6, 7 and 8), which will help Work Authority holders to meet the minimum mandatory requirements of the Code. Appendix 2 contains a checklist to enable quarry operators to determine if they are meeting the objectives of the Code.

The Code is primarily for use by Work Authority holders operating small quarries. However, the Code will also provide useful information about quarries to a range of other stakeholders including community members, landowners/occupiers and environmental groups.

Extractive industry operators will use the Code to:

- understand and comply with minimum mandatory requirements of the Code; and
- implement best-practice operations.

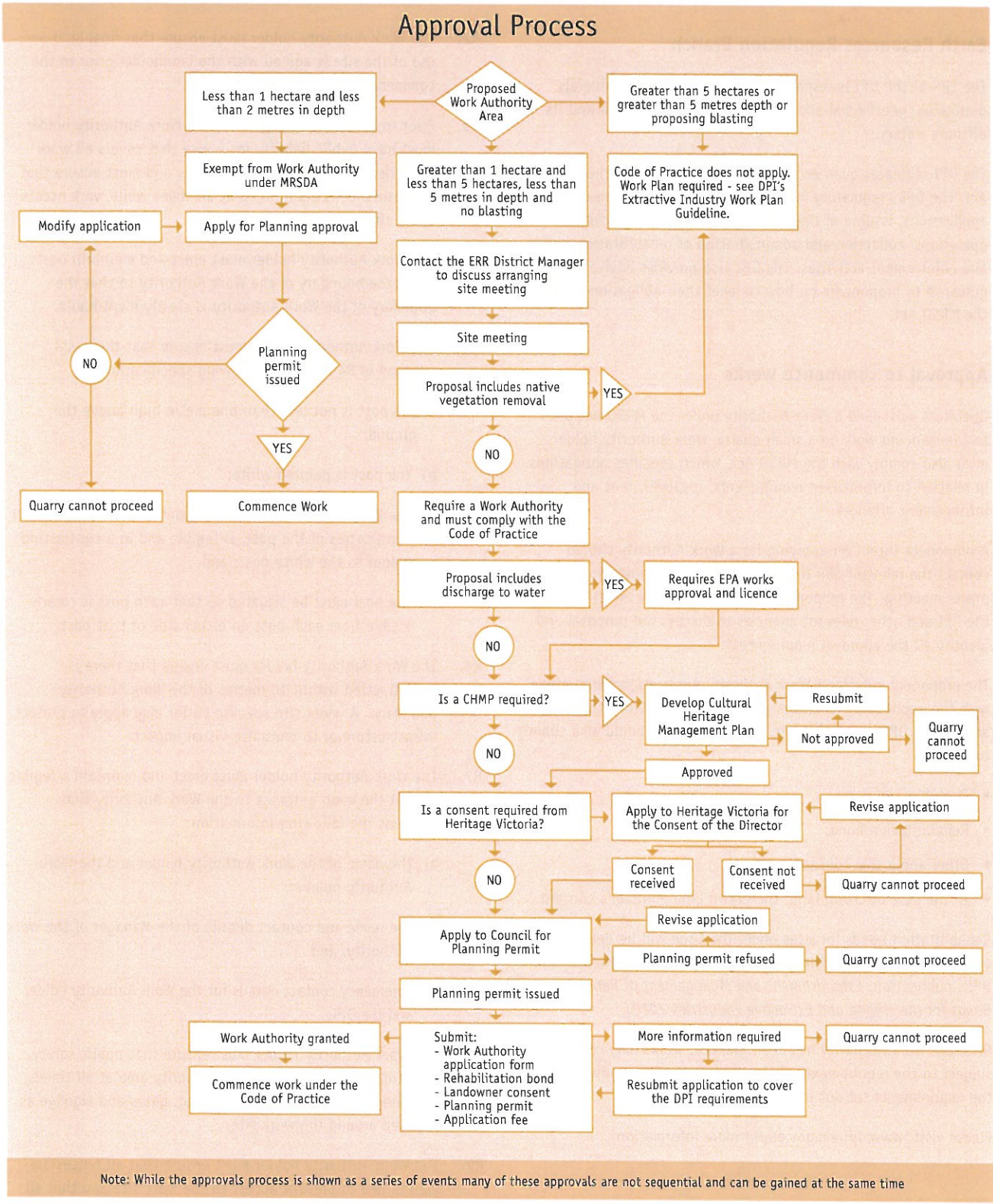
Community members and environment groups will use the Code to:

- understand the legislative framework that governs community and environmental issues for smaller quarries;
- identify the compliance requirements for Work Authority holders;
- enhance their capacity to engage with quarries; and
- improve their understanding of the regulation of quarries.

3. Approval Requirements

Key approval requirements for small quarries are summarised in Figure 1.

Figure 1 – Approvals process flow diagram



Note: While the approvals process is shown as a series of events many of these approvals are not sequential and can be gained at the same time

3.1 DPI approval for quarries under the Code

Earth Resources Regulation Branch

The ERR of the DPI is responsible for regulating the minerals, petroleum, geothermal and quarry resources in Victoria and its offshore waters.

The DPI regulates quarries through administration of the MRSD Act. The DPI's regulatory role is principally the assessment of applications, issuing of licences, monitoring and auditing of operations, collection and administration of rehabilitation bonds and enforcement activities. The DPI also provides advice and guidance to proponents on how to meet their obligations under the MRSD Act.

Approval to commence works

Operators must hold a Work Authority under the MRSD Act prior to commencing work on a small quarry. Work Authority holders must also comply with the MRSD Act, which specifies obligations in relation to information requirements, royalties, fees and infringement offences.

A proponent intent on applying for a Work Authority should contact the relevant ERR District Manager to organise an initial onsite meeting. The proponent must attend a site meeting with the DPI and other relevant agencies to discuss the proposal and identify all the approval requirements.

The proponent submits a Work Authority Application Form, along with the application fee and a plan defining the Work Authority area to the DPI for assessment. The proponent should also submit to the DPI:

- Planning consent;
- Rehabilitation bond;
- Other applicable consents; and
- In the case of Crown land, the Crown land Minister's consent.

Rehabilitation bonds for sites under the Code will be determined on a per hectare basis. The per hectare rates are specified in the DPI's publication: *Establishment and Management of Rehabilitation Bonds for the Mining and Extractive Industries 2010*.

Once the Work Authority has been granted, works may commence subject to the requirements of the Work Authority conditions and the requirements set out in the Code.

Please visit: www.dpi.vic.gov.au for more information.

Requirements

R1. The Work Authority holder must carry out work in accordance with the Code of Practice for Small Quarries.

R2. The Work Authority holder must ensure that final land-use of the site is agreed with the landholder prior to the commencement of work on the site.

R3. Prior to commencing any work, the Work Authority holder must have public liability insurance that covers all work authorised under the Work Authority and must ensure that the insurance is maintained at all times while work occurs under the Work Authority.

R4. The Work Authority holder must erect and maintain posts along the boundary of the Work Authority so that the boundary of the Work Authority is clearly identifiable.

R5. The Work Authority holder must ensure that the posts required in R4 meet the following specifications:

a) the post is not less than one metre high above the ground;

b) the post is painted white;

c) the Work Authority number is painted within the top 20 centimetres of the post, is legible and in a contrasting colour to the white post; and

d) the post must be situated so that each post is clearly visible from each post on either side of that post.

R6. The Work Authority holder must ensure that there is no extraction within 10 metres of the Work Authority boundary. A wider site specific buffer may apply to protect infrastructure or to minimise visual impact.

R7. The Work Authority holder must erect and maintain a legible sign at the main entrance to the Work Authority that contains the following information:

a) the name of the Work Authority holder and the Work Authority number;

b) the name and contact details of the Manager of the Work Authority; and

c) emergency contact details for the Work Authority holder and the DPI.

R8. The Work Authority holder must ensure that public safety is maintained within the Work Authority area at all times, including through the use of fencing, gates and signage as required around the work site.

R9. The Work Authority holder must ensure that all fences are maintained to prevent access to the work site and that all gates are locked when the work site is unattended.

R10. The Work Authority holder must as soon as is practicable after becoming aware of any non-compliance with the conditions of the Work Authority, and/or requirements of the Code of Practice for Small Quarries and/or an environmental incident that will, or is likely to cause, material harm to the environment, notify the relevant ERR District Manager of the non-compliance and/or environmental incident.

R11. The Work Authority holder must notify any other relevant government department or agency of the non-compliance and/or incident.

3.2 Non-DPI approval for quarries under the Code

Work Authority holders complying with the Code may also need to obtain approvals under other regulatory frameworks prior to undertaking any quarrying activity. Such frameworks may include the *Planning and Environment Act 1987, Environment Protection Act 1970, Occupational Health and Safety Act 2004, Aboriginal Heritage Act 2006, Heritage Act 1995, Water Act 1989* and the *Dangerous Goods Act 1985*.

Where applicable, the Code provides information about the requirements of related laws and policies. However, it is the Work Authority holder's responsibility to ensure compliance with all Victorian and Commonwealth legislation.

The Code does not replace other related laws and regulations and, to the extent there is a conflict between the Code and other related laws and policies, the laws and policies will prevail.

Laws and policies that may be applicable are provided below and in the Reference Material section at the back of this code.

Native vegetation

If site planning or a site meeting with relevant government agencies reveals that the operation of a quarry requires the removal of native vegetation, then the operator is required to have an approved Work Plan and the Code will not apply. Affected quarries are subject to the requirements of *Victoria's Native Vegetation Management: A Framework for Action*. The Work Authority holder would need to prepare an offset management plan to the satisfaction of the Department of Sustainability and Environment (DSE).

For help in identifying native vegetation on a site, please contact the DSE. For information about native vegetation management requirements, please refer to the DPI and DSE publication: *Native Vegetation Management Guide for the Earth Resources Industries;* available at: www.dpi.vic.gov.au

Water use, dams, crossings and outlet

All works associated with or near watercourses may require approvals from one of the following statutory referral authorities:

Catchment Management Authority (CMA)

The local CMA may have an interest and approval requirement for small quarries if the proposed site relies on riverine extractions or is situated:

- on a floodplain - the CMA is the statutory referral authority where a Flood or Land Subject to Inundation overlay is present in the local government planning scheme;
- on, or adjacent to a wetland or waterway - most of the CMAs have a Waterways Protection By-law.

Rural Water Authority (RWA)

The Rural Water Authority will need to be contacted if a small quarry requires:

- permits to take and use surface or ground water;
- bore construction;
- irrigation dams;
- dams on waterways; and
- where a site is a Special Water Supply Catchment of the RWA. To view areas affected by these requirements, visit: http://www.dpi.vic.gov.au/dpi/vro/vrosite.nsf/pages/dwsc_areas

Urban Water Authorities (UWA)

If a quarry site is connected to town water, the UWA delivers the water through reticulated town water supplies. The proponent must discuss any proposal with the relevant UWA. To view areas affected by these requirements, visit: http://www.dpi.vic.gov.au/dpi/vro/vrosite.nsf/pages/dwsc_areas

Off site discharge

Extractive industry premises that are licensed in accordance with the *Mineral Resources (Sustainable Development) Act 1990*, and that discharge solely to land are exempt from requiring a Works Approval or from holding a licence under the *Environment Protection (Scheduled Premises and Exemptions) Regulations 2007*.

Quarries that plan to discharge to water or air should contact the Environment Protection Authority for advice on applying for a Works Approval and licence under the *Environment Protection Act 1970* (EP Act). All operations are subject to controls on discharge, including noise, through the State Environment Protection Policies under the EP Act.

Site safety

All quarry sites are considered workplaces and are subject to the *Occupational Health and Safety Act 2004*. Please contact WorkSafe Victoria for advice on how to comply with this legislation.

Heritage sites

Sites with potential cultural heritage significance should be identified during the site selection phase. Identifying cultural heritage sites early at the proposal stage will avoid delays during construction and operation.

Aboriginal Cultural Heritage sites

The *Aboriginal Heritage Act 2006* protects places and objects of aboriginal cultural heritage significance in Victoria. Please contact Aboriginal Affairs Victoria (AAV) for advice on how to comply with this legislation.

If the proposed small quarry is located in an area of cultural heritage sensitivity the proponent may be required to prepare a Cultural Heritage Management Plan (CHMP). AAV or the Registered Aboriginal Party will approve the CHMP and it must be submitted to the DPI prior to a Work Authority being granted. To view areas affected by these requirements, visit: www.dpcd.vic.gov.au/aav

If a CHMP is required a quarry must then be planned and operated in accordance with the approved CHMP.

If items of Aboriginal cultural heritage or value are found during extraction activities and no CHMP was required, it should be reported to AAV. The Work Authority holder will then need to obtain a permit to continue to work a quarry or disturb the Aboriginal cultural heritage sites or items of value.

Other Cultural Heritage sites

Places and objects considered to be of non-indigenous cultural heritage significance to the State of Victoria may be protected under the *Heritage Act 1995* (Heritage Act). Places that have been assessed as having significance to the State of Victoria are included on the Victorian Heritage Register. It is necessary to obtain approval from Heritage Victoria (HV) to authorise any works that may affect the cultural heritage significance of a registered area.

There is blanket protection for all historical archaeological sites in Victoria under section 127 of the Heritage Act. All known historical archaeological sites are included in the Victorian Heritage Inventory.

The discovery of a cultural heritage site or object during the course of work must be reported as soon as possible to HV.

In some cases, places of significant heritage to a local community may be included in a Heritage Overlay of the Municipal Planning Scheme. Where the continuation of work could compromise the integrity of a site or object, the work must cease until advice has been obtained from HV.

Please contact HV for advice on how to comply with legislation, or for information about the Victorian Heritage Register and Heritage Inventory.

Planning approval

The proponent should discuss a proposal with the responsible planning authority (normally the local municipal council) very early in the process to determine if a planning permit is required; and to ensure that all the requirements of the planning scheme are met in an application.

The planning authority may refer an application to other authorities such as the Department of Sustainability and Environment, the relevant Catchment Management Authority, VicRoads, Heritage Victoria, the Environment Protection Authority and relevant water authorities.

Notice of the planning permit application must generally be provided to the owners and occupiers of adjoining land(s), and to any other people nominated by Council. However, this does not apply if the Council is satisfied that the proposed quarry operations will not cause material detriment to any person.

4. Quarry Design

Giving consideration to the layout of a quarry operation prior to starting work, or when opening up new areas will greatly reduce the effort required to meet environmental and safety requirements in future. Some proponents may benefit from engaging a consultant to assist in the design of a quarry.

The selection of a site, construction of access tracks, location of plant and equipment, site security and final land-use should all be carefully planned prior to commencement of work at a quarry. Proper planning will assist in efficient extraction and progressive rehabilitation and help to reduce costs and minimise the potential for issues or negative environmental impacts to arise.

4.1 Checklist for site design and planning

Site selection

- Ensure that there is sufficient resource in the proposed quarry to make a site financially viable; including rehabilitation expenses.
- Locate a site at a sufficient distance from watercourses to ensure that turbid waters do not enter a watercourse.
- Identify land-use conditions, local planning provisions and legislative responsibilities of the proponent and or land manager; like the responsibilities for pests, plant and animal management, cultural, heritage and catchment issues and environmental protection.
- If the quarry is located on a floodplain or waterway discuss the design with the CMA.
- Analyse the potential visual impact of a quarry from surrounding and frequently used roads or vantage points. Some methods used to minimise impacts include: orientation of quarry faces, tree screening and progressive rehabilitation.
- Locate a quarry to minimise all environmental impacts, including visual, dust and noise impacts on adjacent land-users.
- Aboriginal and European heritage sites must be identified and protected.
- Ensure native vegetation is protected and that extraction does not occur any closer than to the drip line of remnant vegetation.
- Ensure all easements are identified and where applicable, protected.

Minimising disturbance/staging of operations

- Control erosion caused by storm water run-off, raised dust and weed invasion, minimise the area of disturbed ground at any one time in the operation of a quarry.

Access tracks and road traffic

- Locate the entrance gate and any weighbridge operation away from sensitive land-uses.
- Locate the entrance to a quarry so that its workings are not visible from public roads (see Figure 2).
- Restrict the hours of truck access to minimise disturbance to nearby residents.
- When determining the point of access to a site and internal haulage roads, plan for empty trucks being louder than when loaded and that vehicle speed may significantly affect the noise of a vehicle.
- Minimise gradients of tracks to reduce noise from the use of brakes and/or increased engine power to climb slopes, especially when fully loaded. A maximum gradient of 1:10 (vertical:horizontal) is generally recommended for haul roads.

Figure 2 – Preferred location of access roads to reduce visual impact

Drainage

- Construct roads with sufficient diversion drains and culverts to ensure that clean stormwater is diverted away from roads.
- Ensure that the gradient and orientation of tracks do not cause runoff to be fast flowing.
- Drainage of roads should be to a vegetated area.

Weeds

- Identify noxious weeds (see the declared weed species under the *Catchment and Land Protection Act 1994*) and develop a control plan.
- Establish vehicle and equipment hygiene practices to prevent the spread of weeds and pathogens. This may include wash down facilities/areas.

Safety

- Access tracks must be of adequate width. As a guide, in the case of one-way traffic, the track should be twice the width of the widest vehicle that will use the track. In the case of two-way traffic, the track should be three times the width of the widest vehicle to use the track.
- Please contact WorkSafe Victoria for more information on adequate track construction.

Plant location

- Ensure that the proposed site of the plant complies with industry standards, municipal planning schemes and legislative requirements.
- Locate fixed plant with consideration for surrounding sensitive land-uses and land-use conditions.
- Site a plant with consideration of the direction of prevailing winds. For example, avoid siting machinery likely to cause a dust nuisance upwind of a sensitive land-use.
- Consider the likely visual, dust or noise impact of each piece of plant.
- Use topographical features that may form a barrier between the plant and the surrounding sensitive land-uses.
- Consider constructing bunds to provide barriers to shield from noise, visual impacts and dust.
- Consider the use of vegetation as a visual screen.

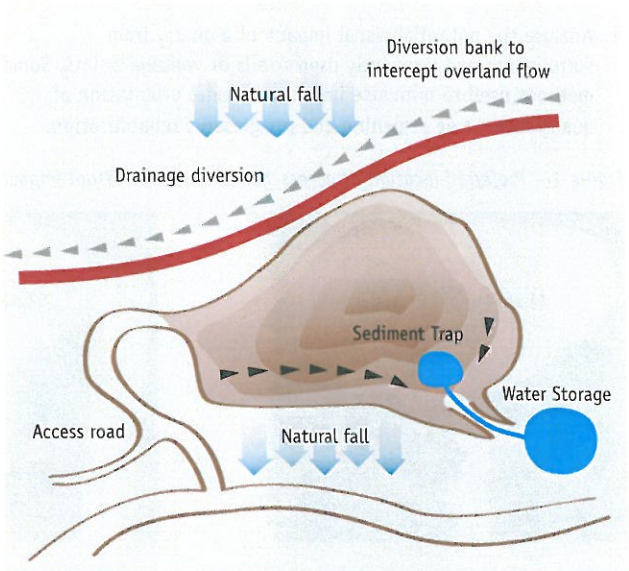
Site security

- Gates and fences should be designed to prevent unauthorised entry and be regularly inspected and repaired.
- Install signs at any hazardous locations on a site indicating the hazard.

Planning for final land-use

- Determine the intended future-use and final landform of a site at an early stage. This should be in consultation with the landowner or Crown land Manager, the local council and the CMA. Typical final land-uses include: grazing land, dams, wetlands, native vegetation and plantation forest.
- Ensure that topsoil is stockpiled and appropriately managed so it is suitable for rehabilitation works. Topsoil should not be buried, driven on, excessively handled, contaminated or stockpiled so as to hinder final land-use.
- Plan the location of roads, working areas and facilities to minimise the total area required to be disturbed.
- A plan of drainage works and the final drainage pattern should generally be determined prior to beginning work (see Figure 3). If located on a floodplain or waterway the layout will need to consider the form and function of the waterway and floodplain, e.g. no loss of flow conveyance or flood storage. Significantly changing the drainage pattern of a site may require water authority approval.

Figure 3 – Typical Drainage Plan to Manage Water across the Work Site



Adapted from *Quarry Code of Practice*, Department of Primary Industries Water and Environment, Tasmania 1999

5. Operational Management

5.1 Topsoil management

Topsoil is a valuable resource for low-cost revegetation of disturbed sites, particularly where it contains viable seeds, nutrients and microbes. However, the way topsoil is collected and stored can affect soil characteristics and reduce its revegetation value.

Soil seeds, nutrients and microbes rely on oxygen to survive. Where topsoil has to be stockpiled these qualities will gradually deteriorate over time. Growing vegetation on the stockpile helps reduce topsoil losses through erosion and assists in maintaining biological activity in the soil.

Soil structure can deteriorate if topsoil is collected when saturated or if the soil is compacted during handling.

Subsoils and overburden may also need to be kept on site for future use in building final landforms or providing additional rooting medium over hard rock areas. However, subsoils and overburden materials are of lower value for revegetation than topsoil, and contamination of topsoil with these materials can reduce its value.

The costs of respreading stockpiled materials can be reduced through the careful location of stockpiles.

Objective

To protect the regenerative capacity of the natural topsoil.

Requirements

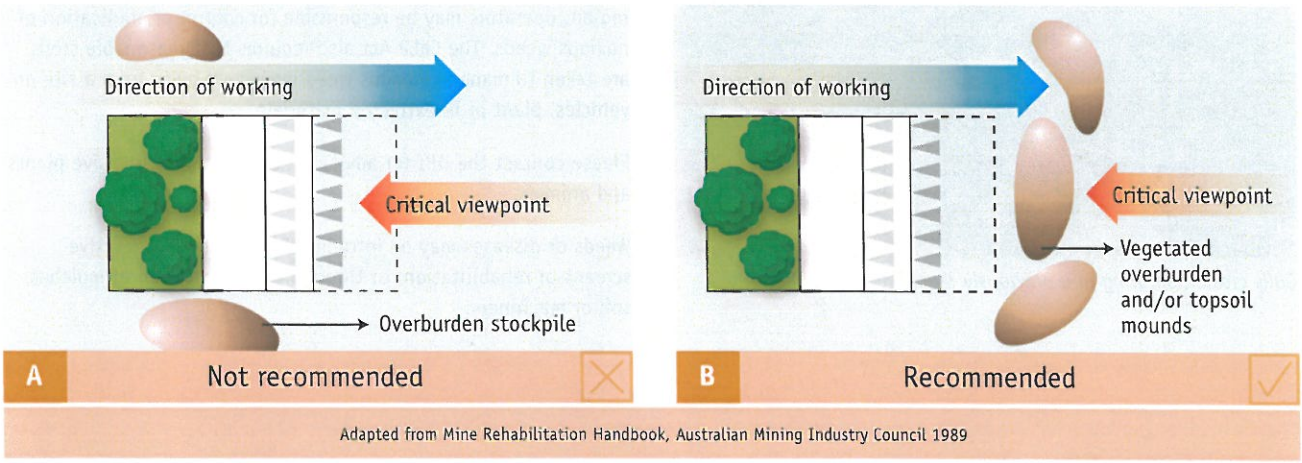
R12. At the commencement of quarrying excavation, the Work Authority holder must ensure that topsoil to a depth of 150 millimetres below the natural surface is removed and placed in stockpiles not exceeding two metres in height.

R13. The Work Authority holder must ensure that topsoil stockpiles are protected from erosion and compaction.

Recommended Practice

- Avoid stripping topsoil when it is saturated or when very dry.
- Minimise handling of topsoil.
- Keep topsoils separate from overburden, gravel and other materials.
- Protect topsoil stockpiles from erosion.
- Avoid burying topsoil.
- Store topsoil above or beside the excavation, depending on which direction the deposit is being worked, to allow for easier respreading.
- Avoid long term stockpiling of topsoil by using it to rehabilitate worked out areas immediately.
- Locate topsoil stockpiles away from traffic, waterways and sources of pollution.
- Install drainage measures to allow drainage through or around large soil stockpiles.
- Grow vegetation on stockpiles (shrubs and grasses).
- Control and/or prevent the spread or establishment of noxious weeds.
- Avoid driving on stockpiles.
- Align stockpiles parallel to the slope contour in stable heaps.
- For longer term stockpiles, use stockpiles strategically as noise or visual barriers (see Figure 4).

Figure 4 – Placement of Overburden for Visual, Noise and Dust Screening



5.2 Landform design

A quarry should be carefully constructed so that the landform poses no slope failure, slumping or collapse risk to employees, the public, or the viability of the operation.

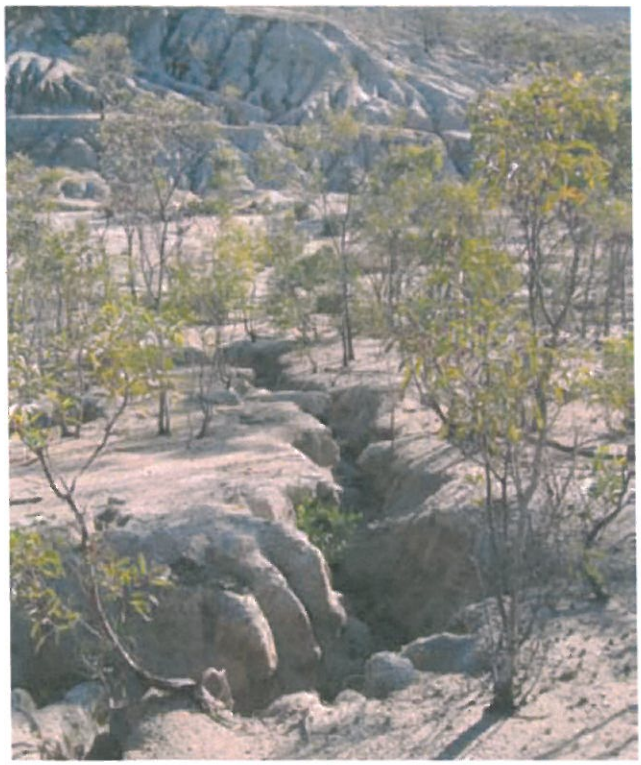
Objective

All landforms on a site should be safe and stable.

Requirements

R14. The Work Authority holder must ensure that all slopes/ batters including excavations, roadways, stockpiles and dumps are designed, constructed and maintained to ensure stability.

R15. If there is a significant slope failure event, the Work Authority holder must cease all operations, notify the relevant ERR District Manager and not recommence operations until authorised to do so by the relevant District Manager.



Gully erosion occuring in a previously rehabilitated sand quarry.

Recommended practice

- Construct benches to be self-draining.
- Ensure that stockpiles are constructed with no greater than the angle of repose for the material.
- The angle of working faces should be determined by the nature of material, in general:
  - Clay should have an overall slope of no greater than 1:1 (vertical:horizontal).
  - Sand should have an overall slope of no greater than 1:1.5 (vertical:horizontal), and
  - Vertical faces should be less than two metres.
- Locate stockpiles away from drainage lines and natural waterways.
- Seek advice on flooding from the CMA.
- Establish drainage and sediment controls around unstabilised stockpiles and batters.

5.3 Control of noxious weeds, pest animals and plant disease (Invasive species)

The establishment of a quarry site may provide the opportunity for invasion or spread of noxious weeds. A site should be managed so that:

- it does not become a source of noxious weeds, plant diseases and pest animals; and
- to prevent their introduction throughout establishment, operation and rehabilitation phases of a quarry.

Quarry operators need to abide by the *Catchment and Land Protection Act 1994* (CaLP Act). Depending upon the catchment region, operators may be responsible for control or eradication of noxious weeds. The CaLP Act also requires that reasonable steps are taken to manage noxious weed movement away from a site on vehicles, plant or in extracted materials.

Please contact the DPI for advice on the control of invasive plants and animals.

Weeds or diseases may be introduced by planting vegetative screens or rehabilitation, or through the importation of mulches, soil or machinery.

Uncontrolled artichoke thistle outbreak.

Imported mulches or topsoil can be a source of weed species. It is an offence under the CaLP Act to sell material that contains noxious weeds or seeds of noxious weeds.

Plant diseases can also enter a site by the movement of mud or organic matter on vehicles, plant, equipment and/or people's clothing or footwear.

Movement of contaminated quarried material can also spread the root rot pathogen *Phytophthora cinnamomi*, which causes dieback. This risk should be addressed according to the sensitivity of the area to be quarried and the sensitivity of the area receiving the quarried material. Crushed rock can be considered free of contamination by *Phytophthora cinnamomi*, provided it is not contaminated with topsoil.

The working of quarries can create habitat for pest animals such as rabbits and foxes. Poor housekeeping and having unsecured waste bins can also attract pest animals to the area.

Objective

To ensure that operations of a quarry do not lead to the spread or proliferation of noxious weeds, plant disease and pest animals.

Requirements

R16. The Work Authority holder must establish and implement a program to control and/or eradicate noxious weeds and pest animals within the Work Authority area.

R17. The Work Authority holder must take measures to prevent the spread of declared noxious weeds, pest animals and plant diseases within the Work Authority area.

R18. The Work Authority holder must ensure that all mobile machinery is thoroughly cleaned prior to coming onto, or leaving a work area affected by noxious weeds and/or plant diseases.

R19. The Work Authority holder must ensure that all soil that is imported into and exported out of the Work Authority area is free of disease and noxious weeds.

Recommended Practice

- Operators should be familiar with noxious weeds in the area and regularly inspect a site for the presence of noxious weeds. For more information, visit: www.dpi.vic.gov.au
- Develop and implement a plan to manage noxious weeds and pest animals.
- Employ appropriate control or eradication measures. If a problem is not responding to current management techniques it is recommended that advice be sought from the local council, the DSE or relevant DPI officers.
- Contact the DPI to determine if the *Plant Health and Plant Products Act 1995* impacts on activities.
- When using chemicals in the control or eradication of weeds, contact the Chemical Standards Branch of the DPI for appropriate Codes of Practice to ensure: operator safety, environmental protection and protection of other land-users.
- Use organic mulches that are free of seeds of noxious weeds.
- Clean all heavy equipment entering or leaving a site of all soil and organic matter in a designated onsite wash-down area.
- To avoid product contamination, stockpile and quarantine soil and subsoil likely to contain weed seeds or pathogens.
- Provide animal-proof bins for contractors and employees at locations where they consume food and ensure bins are regularly emptied to an appropriate offsite facility.

Phytophthora cinnamomi

- Where possible, locate new quarries in areas free of *Phytophthora cinnamomi*.
- Source soil that is imported into the Work Authority area from areas that are free of *Phytophthora cinnamomi*.
- Maintain good drainage to prevent mud building up in working areas.
- Provide diversion drains to prevent spores of *Phytophthora cinnamomi* washing into the pit from surrounding areas.
- Wash machinery that is brought onto the site.
- Stockpile topsoil so that water from the stockpile drains away from working areas.

5.4 Drainage and erosion control

The greater the area disturbed, the greater the risk of environmental impact such as erosion caused by stormwater run-off, dust and weed invasion. This can lead to increased problems on site and management requirements in the future.

Good drainage and sediment capture systems prevent erosion and ensure run-off does not contaminate offsite areas or waterways. Erosion leads to instability of faces and slopes and also allows the movement of soil offsite which can negatively impact waterways. Stormwater should be diverted away from disturbed areas to avoid it being contaminated with sediment.

To avoid and control erosion, vegetation clearance should be kept to a minimum as it mitigates high volume of run-off occurring at high speed which increases the rate of erosion.

Drainage control measures should be used to control the flow of stormwater as much as possible. Measures should maximise infiltration and minimise the speed that water flows over a site.

Construct access tracks so they do not increase the movement of water or increase erosion, as both have potential to impact on water quality.

Drainage around areas where hazardous materials are handled or stored should be captured and treated, to ensure that there is no movement of these substances into the environment.

Objective

To minimise offsite erosion and turbid water impacts from small quarry operations.

Rock lined discharge point to prevent erosion.

Requirements

R20. The Work Authority holder must minimise the area of ground disturbance throughout the life of the quarry operation.

R21. The Work Authority holder must design, install and maintain erosion and sediment controls to prevent erosion of areas of disturbed land and sedimentation of waterways.

R22. The Work Authority holder must ensure that any drainage from an area where fuels, lubricants and/or hazardous materials are stored, and/or used is directed to a sump or interceptor trap.

Recommended Practice

Minimise disturbed area

- Work a site in discrete stages so that the minimum area is exposed at any one time, subject to seasonal constraints.
- Mark out areas to be disturbed for machinery operators using boundary markers, like stakes or flagging tape.
- Supervise machinery operators to ensure they are taking action to limit disturbance to required areas only.
- Stabilise disturbed land as soon as possible to minimise erosion.

Drainage

- Use drains or bund walls to direct clean stormwater away from disturbed areas, working areas and stockpiles.
- Construct drainage works to mimic natural drainage patterns and use natural drainage lines with retained vegetation.
- Use diversion drains and contour drains to capture and slow down water that would otherwise gather momentum as it travels down a slope.
- Surface drains should have slopes that prevent the erosion or scouring of drains. A maximum slope of 1:100 (vertical:horizontal) is considered appropriate for earthen drains.
- Stabilise drains and channels in high velocity areas using stone, concrete or vegetation.
- Drains should discharge clean stormwater into vegetated natural drainage lines, or via a level sill that distributes run-off across a stable area or to water storage dams.

Access Tracks

- Minimise gradients of access tracks.
- Maintain table drains and install regular cross drains or culverts.

5.5 Water storage and discharge control

All water which passes through a site should be managed to either avoid areas where it would become silt laden or be sufficiently treated to ensure that there is no contamination remaining when it is released from a site.

Sediment ponds must be of sufficient size to retain water until all sediment has fallen out of suspension.

Approval may be required for the construction of any sediment pond or other form of dam, under the *Water Act 1989*. Please contact the relevant Rural Water Authority (RWA) for more information regarding the construction of dams. Contact the Catchment Management Authority for more information regarding the construction of outlet works to a waterway, or any access that crosses over waterways.

Objective

To ensure that all discharges from a site are free of sediment and other pollutants.

Requirement

R23. The Work Authority holder must prevent contaminated runoff from entering receiving waterways.

Recommended Practice

Capture of contaminated water/stormwater

- Install diversion drains uphill of a site, to minimise the amount of water flowing through a site.
- Collect all run-off from working areas (including washing, screening and dust reduction facilities) in sediment ponds before discharging it from the premises.
- Capture sediment in erosion prone areas by placing hay bales, silt fences or other control devices in drainage lines.
- Design the drainage system to address seasonal factors, high rainfall events, the area exposed and nature of the soils.
- Remove sediment from sediment traps and ponds on a regular basis to ensure there is sufficient capacity to capture all contaminated run-off in the event of a storm.
- Dispose of sediment removed from traps and ponds so as to avoid polluting downstream waterways.
- Continuously assess the effectiveness of sediment control measures and make necessary improvements.

Construction of sediment ponds

- Calculate drainage capacity and water balance in the design stage.
- Design storage ponds and other drainage measures to contain and control rainfall for a one in ten year storm event. In sensitive areas a higher storm event such as a one in 100 year may be required.
- Where complete containment is a design goal, facilities should be designed to contain all water in a one in ten wet year.
- Where finer particles such as clay are present, flocculation treatment or a 24 hours or longer retention period in sediment ponds may be required.
- Sediment pond outlets and drain outlet points will usually require erosion protection mechanisms, like: spillways to undisturbed natural drainage lines; level sill outlets; pond decant pipes; riprap outlets; straw bale barriers or other methods of energy dissipation.

Discharge

- Direct discharge of all treated stormwater should be to vegetated areas.
- A 40 metre filter strip of undisturbed native vegetation adjacent to all waterways is one of the best available means of protecting water quality.

Reuse

- Design an adequate stormwater system to ensure that stormwater from roofed areas is directed to dedicated stormwater drains.
- Use water from sediment ponds onsite for dust control purposes or for watering vegetation.

5.6 Groundwater

Groundwater is becoming an increasingly common source of water for both industry and domestic purposes. Therefore, the quality and quantity of groundwater resources must be maintained.

Groundwater contamination can occur through a range of activities, from fuel and chemical storage areas to the operation of waste dumps and settlement areas for quarry tailings.

State Environment Protection Policies (Groundwaters of Victoria) require all practicable measures be taken to prevent pollution of groundwater or those that create changes to the beneficial uses that groundwater is suited.

Extractive sites may alter the water table by either extraction from or discharge to groundwater. Where a quarry intersects groundwater, the appropriate Rural Water Authority will need to give approval for the collection and pumping of groundwater as part of a quarrying process.

Permission must also be obtained from the appropriate RWA should an operator choose to install a groundwater bore for groundwater investigation or extraction purposes.

Objective

To meet groundwater quality objectives and to minimise any environmental impact on the quality of groundwater.

Requirement

R24. Prior to the intersection and removal of any groundwater from a Work Authority, appropriate approvals need to be obtained from a groundwater licensing authority.

Recommended Practice

- Comply with all requirements of the Water Act, the Water Authority Approvals and/or SEPP (Groundwaters of Victoria).
- Install above-ground, bunded facilities in preference to underground fuel tanks.
- Manage water in and surrounding a site to reduce the potential for impacts on groundwater.

5.7 Slimes management

The majority of sand quarries wash sand to produce a marketable product. The waste from this operation is a fine, clay slurry, generally referred to as slimes. Slimes may also be generated from cleaning out sediment ponds or erosion protection mechanisms.

Slimes are normally discharged to a slimes dam for solar drying and consolidation. However, slimes can remain high in water content for a long time and may present safety hazards. Slimes dams can continue to be unstable even after the surface has dried and a crusted layer has formed.

Dried out slimes may also become a source of raised dust.

Objective

To manage the disposal and rehabilitation of slimes to minimise the risk to public safety and the environment.

Requirements

R25. The Work Authority holder must take all reasonable measures to minimise the generation of slimes material.

R26. The Work Authority holder must ensure that the location, design, construction, operation and safe management of slimes dams within the Work Authority area are undertaken in a way that prevents the release of slimes to the environment.

R27. The Work Authority holder must ensure that slimes dams on site are not accessible to the public.

Recommended Practice

- Plan for and ensure a site has adequate storage capacity for all slimes produced.
- Design slimes disposal areas to promote, where possible, rapid drying and consolidation.
- Minimise storage of slimes in dams wherever possible.
- Monitor the stability of slimes dams.
- Control dust from dried slimes.
- Ensure that slimes are securely fenced and appropriate signs are in place to warn of potential hazards.
- Properly cover and rehabilitate slimes dams as quickly as practicable after filling.
- Dried slimes may be useful in rehabilitation works.

5.8 Fire management

Many human activities like quarrying can increase the risk of fire in an area and pose a hazard to the surrounding population and environment.

Objective

To ensure that a quarrying activity does not contribute to, or exacerbate fire hazards.

Requirements

R28. The Work Authority holder must take all reasonable measures to prevent the ignition and spread of fire.

R29. The Work Authority holder must ensure that all buildings, fixed plant and mobile equipment are fitted with fire-fighting equipment, such as fire extinguishers, fire blankets, knapsack spray pumps and rake-hoes.

Recommended Practice

- Develop a fire management plan.
- Maintain appropriate fire fighting equipment at a work site.
- Check the undersides of vehicles periodically to ensure they are kept free of vegetation debris that could dry out and ignite.
- Store flammable materials such as waste hydrocarbons away from ignition sources.

5.9 Hazardous materials management

Hazardous materials are known to pose serious risks if released to the environment. The management of hazardous materials must therefore include the appropriate storage of these materials, and preparation for leaks and spills to ensure that the risk of hazardous materials being released into the environment is minimised.

Objective

To manage the storage, use and handling of hazardous materials in a way that minimises the risk of environmental harm.

Requirements

R30. The Work Authority holder must prevent contamination of the environment by the release of fuels, lubricants and/or hazardous materials.

R31. The Work Authority holder must ensure that all fuels, lubricants and/or hazardous materials are stored in accordance with the relevant requirements of AS 1940:2004 The Storage and Handling of Flammable and Combustible Liquids.

R32. The Work Authority holder must ensure that spill prevention and clean-up equipment is readily available and accessible in the vicinity of all plant and machinery, including mobile and fixed fuel storages.

R33. The Work Authority holder must ensure that spills of fuels, lubricants and/or hazardous materials are cleaned up as quickly as practicable. Such spillage must not be cleaned up by hosing, sweeping or otherwise releasing such contaminant into waterways. Equipment and soil contaminated by fuels, lubricants, hazardous materials and clean up substances which cannot be salvaged must be disposed of in an approved waste facility.

Recommended Practice

Hazardous materials storage areas

- Design and install bunding and surface sealing of fuel storage areas.
- Provide high-performance grease traps and oil traps near workshops and places where vehicles and machinery are parked.
- Locate storage areas away from waterways or areas prone to flooding.
- Install bund walls or diversion drains to divert surface water away from areas dedicated for the storage of hazardous materials.
- Line bunded storage areas with impervious material.
- The volume of bunded areas should be at least 125 per cent of the maximum volume of the fuel and lubricant capable of being stored.
- Bund heights should be at least 150 millimetres.
- Bunded areas should be drained to a sump if the volume of the hydrocarbons exceeds 1200 litres.
- Minimise the amount of hazardous substances kept onsite.

Fuel spill beneath a mobile fuel storage tank.

Spill and leak response

- Develop contingency plans to address spills and leaks.
- Install trays, thick plastic mats or similar beneath stationary machinery to protect the soil from oil or fuel spills and leaks.
- Install spill trays immediately if there is any potential for, or evidence of, leakage.
- Ensure that appropriate clean-up equipment is readily accessible.
- Maintain a supply of oil-absorbent material.
- Contain and treat spills and leaks.
- Notify relevant authorities of significant spills or leaks.
- Ensure that drainage from areas where spills may occur like a refuelling area is diverted through a sump or interceptor trap to remove hydrocarbon contamination.

5.10 Noise

Quarry activities have the potential to produce significant noise. Where residences or other sensitive land-users are located adjacent to quarries; precautions should be taken to reduce the impact of noise.

Solid barriers, such as bund walls and topographical features, provide the most effective reduction of sound levels when directly along the line of sight from the source of noise to the neighbour. Vegetation will only marginally reduce noise levels.

Objective

To avoid a quarry being a source of nuisance noise to surrounding land-users.

Requirement

R34. The Work Authority holder must avoid causing unacceptable noise.

Recommended Practice

Site Layout

- Provide an adequate buffer distance between a quarry and sensitive land-users.
- Locate crushing and screening equipment in appropriate locations to reduce existing and potential noise impacts. Where possible, take advantage of natural topographical features when planning a site.

- Provide noise barriers such as earthen bunds to shield residential or other sensitive land-users.

Operation planning

- Limit operating hours where necessary to comply with SEPP (Control of Noise from Commerce, Industry and Trade) N-1. This is usually achieved by restricting operations, including: the loading of trucks in the vicinity of residential premises between 0700 and 1800 hours on Mondays to Fridays and from 0700 to 1300 hours on Saturdays, with no work on Sundays or public holidays.
- Maintain access and haul roads in good condition to prevent corrugations which can contribute to truck road noise.
- Identify road routes to and from a quarry that minimise nuisance noise and direct trucks to use these routes.
- Give preference to haul routes with low grades.
- Maintain and lubricate plant and equipment to manufacturer's specifications.
- Locate materials-processing in the least noise-sensitive area, or enclose these operations if necessary.
- Fit equipment with mufflers, housing or silencers where necessary.
- Fit multi-frequency broadband reversing beepers to mobile equipment.

5.11 Dust control

Dust can impact on nearby residences and sensitive land-users. As a general rule, dust should be confined to the Work Authority area. However, certain weather conditions make dust control difficult.

Dust can have health impacts and quarry operators should use best-practice site management techniques for dust control. Dust control and monitoring for quarries is specified in the EPA's Protocol for Environmental Management - Mining and Extractive Industries, which is required by the SEPP (Air Quality Management).

Quarrying, crushing and screening are also a significant source of dust from some quarry facilities.

Some dust mitigation measures include:

- Minimising the area of disturbance and progressively revegetating to prevent the generation of dust.
- Minimising truck and vehicle movements onsite and on public roads that are often a source of dust.

Dust emanating from a quarry site.

Objectives

To avoid dust impacting on surrounding land-users and people.

Requirement

R35. The Work Authority holder must prevent dust release that causes adverse impacts to the surrounding area and people.

Recommended Practice

Site

- Consider the direction of prevailing winds when designing the Work Area, plant, work faces and stockpile layouts to minimise dust nuisance.
- Plant trees as windbreaks or use topography and embankments to shield stockpiles and working areas from prevailing winds.

Overburden or topsoil stockpiles

- Revegetate stockpiles that will not be used for some time.

Vehicle movements

- Minimise vehicle movements.
- Reduce onsite vehicle speeds, especially during dry or windy conditions.
- Apply water to access tracks to prevent raised dust occurring.
- Use dust suppressants where watering is not possible or appropriate; oil must not be used as a dust suppressant.
- Cover or dampen loads leaving a site.

Plant

- Service and maintain plant and equipment so that it is in proper operating condition.
- Fit plant and equipment with appropriate dust suppression devices, such as water sprays.
- If required, locate crushers and conveyors within a purpose-built housing.

Dry, windy conditions contributing to nuisance dust

- Stop the crushing plant.
- Increase use of watering systems.
- Stop work in some areas of the site.

Operations

- Minimise the exposure of bare surfaces.
- Ensure vegetation used for rehabilitation or vegetative screens is compatible with surrounding vegetation or is sourced from local native plant stocks.
- Develop the size and shape of any bunds to blend in with existing landforms.
- Paint all exterior surfaces of buildings and fixed plant with matt non-reflective colours to blend with the environment.
- Rehabilitate the uppermost bench as soon as possible.
- Use progressive rehabilitation to minimise exposed surfaces.

5.12 Visual management

The visible impact of quarries on the landscape may be significant despite their size. High visual impact could be due to: the location or design of a site, its inconsistencies with surrounding areas; or its proximity to sensitive land-uses.

Objective

To ensure that a quarry is not visually intrusive to neighbours or other sensitive land-users.

Requirements

R36. The Work Authority holder must ensure that the colour of fixed plant and buildings do not cause an unwarranted negative impact on surrounding visual amenity.

R37. The Work Authority holder must take all reasonable measures to reduce visual impact on the surrounding area.

Recommended Practice

Site layout

- Carefully choose the direction of the working so that the working face is shielded from the most critical views (see Figure 5).
- Use topographic features to assist in reducing visual impact when designing a quarry.
- Use natural screening when locating entry to a quarry to reduce the view into the site.
- Provide visual screening or use natural features to screen plant and stockpile areas.

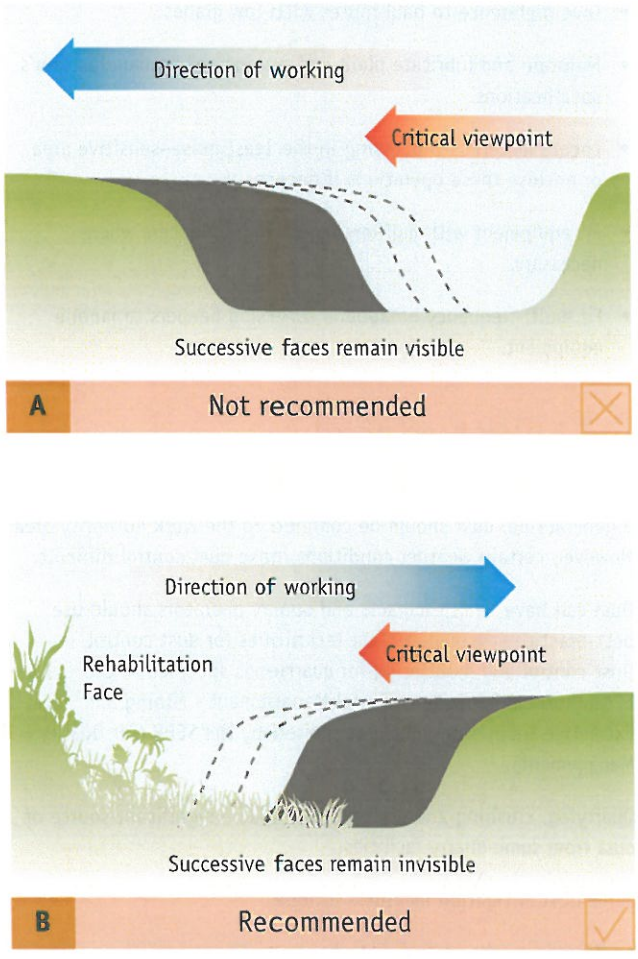


Figure 5 – Designing Pit Development to Minimise Visual Impact

5.13 Community

Relevant communities should be engaged at an early stage and throughout the life of a quarry to assist in creating open communication and a good working relationship. Under the MRSD Act, the holder of an extractive industry Work Authority has a duty to consult with the community throughout the period of the Work Authority.

The community may include residents or groups surrounding the Work Authority area. This could include a Landcare group or a group who have a special or legal interest in the land.

Good communication is essential to good working relationships with the community and will help to ensure the effective management of any impacts of a quarry.

Developing a process for formal and informal community engagement is advisable. This can include one-on-one meetings, site visits and an effective complaints handling process.

Objective

To inform and engage the community regarding the operation of a quarry.

Requirements

R38. The Work Authority holder must maintain a complaints register.

R39. In response to a complaint, the Work Authority holder must record the following information in the complaints register:

a) the date and time of the complaint;

b) who the complaint was from;

c) the specific issue/s raised in the complaint; and

d) the actions taken to address the specific issue/s raised in the complaint.

Recommended Practice

- Identify how the operations on a site may impact on the local environment, people and their surroundings and take measures to reduce the risks.
- Establish good working relationships early in the project's development to better understand community expectations and possible issues.
- Be contactable and flexible in dealing with community concerns and issues.
- Listen to all community concerns and facilitate a reasoned response to all issues raised.
- Identify and acknowledge special interest groups.
- Commit to ongoing engagement as projects develop.

6. Rehabilitation

The term rehabilitation encompasses any measures taken to repair disturbed or degraded land and return it to a stable and non-polluting state; suited to the proposed future use of the land (see section 7.1).

6.1 Progressive rehabilitation

Progressive rehabilitation refers to the rehabilitation of worked out, or surplus areas while extractive operations continue.

As new quarry sections are opened, worked out areas should be progressively rehabilitated to avoid increasing the total disturbed area of a quarry. Overburden and topsoil can be stripped from areas being opened up and placed directly onto worked out areas which are being rehabilitated. This will avoid double handling of materials and prevent degradation of the topsoil (see Figure 6).

Rehabilitation works may be considerably more efficient if carried out while the necessary machinery is onsite and operating, rather than having machinery transported back to a site.

Progressive rehabilitation can reduce the total liability of rehabilitation and should be conducted while there is a steady cash flow from a quarry.

Progressive rehabilitation helps to minimise the visual impact of a quarry and control dust, erosion, and the invasion of weeds. It also assists in fostering good community relations.

Objective

To efficiently and effectively rehabilitate a quarry.

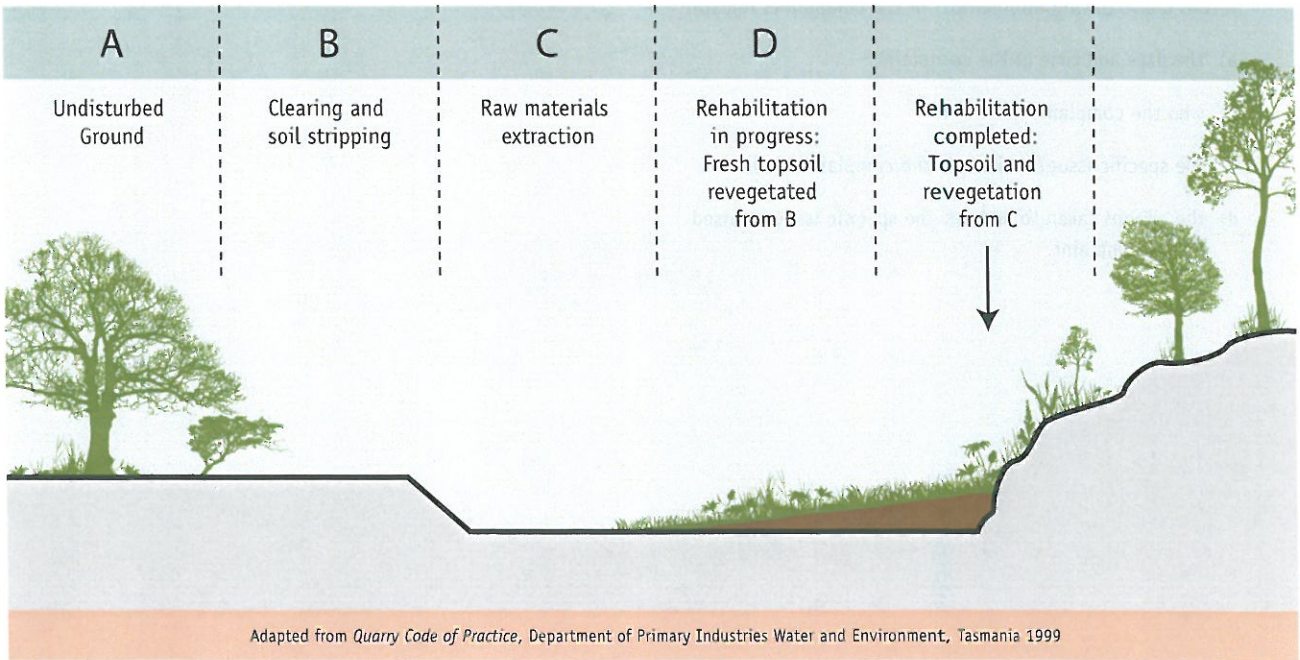
Requirement

R40. The Work Authority holder must ensure that progressive rehabilitation of disturbed land is carried out as soon as possible.

Recommended Practice

- Agree on the final land form and use of a site with the relevant landowner/manager in consultation with the DPI and the local council.
- Rehabilitate in accordance with the intended final use of the land.
- Develop work areas systematically, as a series of benches or bays.
- Fully work out each section of a quarry and commence progressive rehabilitation works as soon as possible.
- Once the final landform is established, revegetate areas to stabilise the landform and to give the vegetation maximum time to establish while the quarry is still in operation.

Figure 6 – Progressive Rehabilitation to Maximise Visual Amenity



Adapted from *Quarry Code of Practice*, Department of Primary Industries Water and Environment, Tasmania 1999

Reclaimed quarry face, cross ripped and hydroseeded.

6.2 Earthworks

The area should be reshaped to blend in with the surrounding landscape as much as possible. A site should be left in a stable, free draining state.

Well designed and maintained drainage works will help to avoid flooding and erosion.

On erodible sites it is most important that slopes be reduced when constructing final landforms.

Ripping of compacted areas will improve the 'roughness' of the seedbed and provide suitable sites for lodgement and germination of seeds as well as promoting water infiltration and root penetration.

Objective

To reconstruct the landform to be compatible with the surrounding landscape and to prepare the ground for revegetation.

Requirement

R41. The Work Authority holder must ensure that the site is left in a safe and stable condition.

Recommended Practice

- Reduce all slopes to a gradient of 1:3 (vertical:horizontal) or less, or apply an artificial means of stabilising the slope such as with the use of geotextiles, mulch mats or benching to break up the slope.
- Where long slopes cannot be avoided and have the potential to erode, it may be necessary to use contour banks or reverse incline benches.
- Once a stable landform has been created, respread topsoil uniformly over the area at a suitable depth to support revegetation.
- Leave topsoil with a rough surface.
- Do not spread soil when saturated or sticky, as compaction and other damage to the soil structure will occur.
- Where topsoil is not available, extreme care should be taken when importing topsoils that may contain weed seeds and soil pathogens like *Phytophthora cinnamomi*.
- Deep rip compacted areas along the contour; either before or after spreading topsoil.
- Ripping after soil spreading will help to 'key' in the soil to the underlying material.
- To increase soil break-up carry out ripping when the soil is relatively dry.

6.3 Erosion prevention

Unless preventative measures are implemented, erosion will continue long after extractive activities have ceased. Poor drainage can damage rehabilitation work.

The best erosion prevention at a site is the establishment of vegetation on a stable landform. However, while vegetation is becoming established, it may be necessary to employ other erosion prevention techniques.

Objective

To minimise erosion of final landforms and transportation of sediment offsite.

Recommended Practice

- To slow down surface runoff retain drainage controls, like diversion drains, contour banks and rock filters upslope of the area being rehabilitated.
- Leave surfaces in a rough or uneven state. Rough surfaces will capture more water and allow rainfall to infiltrate rather than flow away. It may be beneficial to retain any sediment ponds onsite with the owners consent. However, ponds will need to be periodically cleaned out for the first year or so.
- Apply surface mulches around growing seedlings on steep batters to reduce erosion, weed establishment and to conserve soil moisture and add nutrients to the soil.

6.4 Revegetation

Establishing a self-sustaining cover of vegetation is the best way to stabilise disturbed sites in the long term. Revegetation also minimises the visual impact of quarries. Generally, the vegetation type which existed before the disturbance, or a similar vegetation type will regenerate most successfully.

Prior to the commencement of a quarrying activity the type of revegetation should be agreed with the landowner/manager, and should be consistent with the proposed final land-use.

Timing of revegetation is critical to its success (see Timing of Revegetation section below).

Objective

To provide a stable self-sustaining cover that protects the rehabilitation asset and is consistent with the final land-use.

Recommended Practice

Steps of successful revegetation

- Prepare the revegetation area.
- Where native vegetation is to be used, select appropriate species with the advice of the DSE, CMA and the council so that the species used is: sourced from the local area; of local provenance; and appropriate to a site's Ecological Vegetation Class (EVC).
- Sow seed or plant tubestock.
- Use high quality seeds free from noxious weeds.
- Apply mulch or fertiliser.
- Protect the new plants from pest animal browsing or disturbance.
- Control weeds in accordance with the CaLP Act; some ongoing weed control is often necessary on rehabilitated sites.

Revegetated quarry face.

Timing of Revegetation

- Carry out site preparation earthworks in the drier months.
- Plant seed and/or tubestock at a time when it is most likely to be successful at that location (usually autumn or spring). However, where frost sensitive species are involved, seeds should be sown after the last frosts.
- Apply seeds to recently disturbed ground.
- Plant seedlings in early spring.

6.5 Monitoring and maintenance

Revegetation may take several years to produce a stable, safe and self-sustaining ecosystem.

After the substantial work of the rehabilitation has been completed the monitoring and maintenance phase begins to ensure the successful rehabilitation work long after the operator has left a site. Any damage to rehabilitation should be quickly rectified.

Objective

To monitor and maintain a site until the rehabilitation is stable, safe and self-sustaining.

Recommended Practice

- Inspect rehabilitated areas regularly to assess the health of the vegetation and to check for erosion, pest animal browsing damage and weed infestation.
- In areas where germination has failed, carry out enrichment planting of seedlings into unstocked areas or spot sowing by hand sowing of seed into small cultivated patches.
- Apply fertiliser if poor growth and yellow leaves indicate nutrient deficiencies.
- When revegetating using native vegetation, plant a diverse range of species to increase the likelihood of success. Natural disturbances such as fire, flood and the incursion of noxious weeds, pest animals and plant diseases have the potential to compromise the success of a rehabilitation project.
- Where significant erosion has occurred, bring machines back onto a site to repair the landform and install more effective drainage as quickly as possible.

7. Decommissioning and Closure

Quarrying activities create changes to topography with ongoing potential to impact the environment long after a quarrying activity has ceased. The DPI holds rehabilitation bonds over quarries with a Work Authority and it only releases these once the rehabilitation is successfully completed.

7.1 Final land-use of a site and criteria for determining completion of rehabilitation

Consult the landowner and the DPI about potential final land-uses for a site. Municipal Council agreement may also be required if the proposed final land-use will change the land-use zone currently applied to the area, or the area is subject to planning overlays.

When the final land-use has been agreed, the completion criteria can be determined. The completion of rehabilitation must be assessed by a DPI Inspector of Mines, in order for the rehabilitation bond to be returned to the operator. It is advisable to consult the DPI prior to commencing rehabilitation works.

Requirement

R42. The Work Authority holder must ensure that:

a) the rehabilitated area is left in a stable, safe, non-polluting state;

b) the area is suitable for the planned final use or rehabilitation objective;

c) rehabilitated areas are not excessively affected by erosion;

d) the revegetated area is free from noxious weeds; and

e) vegetation is consistent with the final land-use.

Recommended Practice

- Consult the DPI regarding any proposed final land-use and rehabilitation of a site that was agreed to by the landowner/manager prior to commencing works.
- Carry out progressive rehabilitation in order to maximise the efficiency of the rehabilitation and to ensure that the majority of the rehabilitation liability is addressed prior to the closure of a site.
- Upon site closure, discuss final works and monitoring and maintenance with a DPI Inspector of Mines.

7.2 Site clean up

After the productive life of a quarry has finished, it is the responsibility of the Work Authority holder to ensure that the site is cleared of all of the remnants of a quarry operation.

Objective

To have a clean site ready for the final land-use.

Requirements

R43. The Work Authority holder must ensure that all derelict and redundant plant, vehicles, machinery and equipment is removed from the Work Authority area and deposited at an appropriate waste disposal site.

Recommended Practice

- Remove all fixed and mobile plant.
- Remove all temporary and permanent structures unless required for an agreed future use.
- Level off any noise-control bunds and overburden stockpiles, or shape to an appropriate form for the site's final land-use requirements.
- Identify and dispose of all waste materials including hazardous and contaminated materials to appropriately licensed landfills.
- Break up and remove concrete slabs, unless required for future use.
- Remove surplus roads, office sites and hard standing areas where necessary.
- Dispose of all materials to appropriately licensed landfills.

7.3 Final rehabilitation

While most of the rehabilitation should take place during the working phase of a quarry, some areas will need to be rehabilitated after work has finished. All rehabilitation work should be in accordance with the principles detailed in section 6.

Monitoring of rehabilitation may be required for some time before it is established that the works are safe, stable and non-polluting. The level of monitoring required may vary according to site characteristics and the proposed final land-use.

Once the DPI Inspector of Mines has agreed that the rehabilitation is satisfactorily completed, the proponent may apply to have the rehabilitation bond released and the site can be returned to the land owner/manager.

8. Exceptional Circumstances - Riverine Extractions

In some areas, land management practices have resulted in erosion and transportation of large quantities of sediment, particularly sand, into rivers and streams. These sediments can be a significant threat to the health of river systems through:

- destruction of in-stream habitat;
- damage to riparian vegetation;
- reduction in bed and bank stability; and
- increased risk of damage to infrastructure by flooding.

Catchment Management Authorities (CMA) allow strategic extraction of materials from rivers to manage these threats to river health. Where a riverine extraction proposal is exempt from the requirement to prepare a work plan, the Code applies. However, it is understood that some of the requirements of the Code are inconsistent with operations in a riverine context and it is considered an exceptional circumstance.

Sediment extraction is conducted in locations and in a manner that minimises impacts to a river environment. Many stakeholders have an interest or statutory requirements with regard to riverine extractions as shown in the table below.

Stakeholder	Interest/statutory requirement
Private landowner	Access to and operation at a site
Catchment Management Authority	Permits under the *Water Act 1989*
Local Government	Planning Permit
DSE	Crown land permits to occupy
Aboriginal Affairs Victoria	Aboriginal cultural heritage
DPI	Work Authority

☐ Specific to riverine extractions

Proponents should understand key stakeholder requirements when considering riverine extraction. The DPI will work closely with other stakeholders to ensure that requirements are met.

Potential environmental impacts of sediment extraction from riverbeds and banks requiring management include: bank erosion, damage to riparian flora and fauna and channel bed erosion that can work its way up or downstream in the main channel and upstream in lateral waterways.

Requirements

R44. The Work Authority holder must have authorisation under the *Water Act 1989*, prior to commencing any extraction activities in or on a waterway.

R45. Riverine extractions are exempt from compliance with requirements R12 and R23.

R46. Only deposited material is to be extracted from the waterway, and no extraction is to be undertaken below the natural bed of the waterway.

Recommended Practice

Site selection

- Riverine extractions are only permitted at locations and at rates agreed to by the CMA based on its confidence that extraction will cause minimal environmental risk and be of benefit to river health.

Site preparation

- Use existing access tracks where available.
- Where new tracks or turning areas are planned, choose the location with the minimum impact and do not excavate below existing surface levels or remove vegetation.
- Locate stockpile and screening areas where they will: have minimum impact on the riparian zone; have low likelihood of being impacted by floodwater; and not require removal of native vegetation. Stockpiles should not extend or intrude into the drip-line zone around large established trees.
- Establish stockpiles on the existing ground surface with no excavation below ground surface.

Extraction

- Confine extraction to the material deposited in the river bed with care not to disturb the riverbank and river bed.
- Do not scrape or remove the surface of the river banks or the bed when accessing the river bed or constructing ramps to access the river bed.
- Relocate exposed in-stream logs and large woody debris downstream of the extraction area in accordance with requirements of the CMA.

Screening

- Stockpile any river debris removed by screening and spread it back into the extraction area.
- Remove any rubbish separated by screening from a site and dispose of appropriately.

Site rehabilitation

- Smooth displaced materials, tracks and ramps in the waterway to simulate natural conditions.
- Collect and remove all rubbish from a site and dispose of appropriately.
- Remove all stockpiles and hardstand areas.
- Rehabilitate disturbed areas adjacent to the waterway (including roads, turning areas and hardstands) by grading, adding topsoil and revegetating.

Reference Material

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A number of publications have been used in the preparation of this Code. Use of these publications is gratefully acknowledged:

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Mine Rehabilitation Handbook, Australian Mining Industry Council 1989.

Quarry Code of Practice, Department of Primary Industries, Water and Environment Tasmania, 1999.

Water Act 1989 - Guidelines for Quarries and Mines, Department of Sustainability and Environment, 2004.

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Crown Land (Reserves) Act 1978.

Dangerous Goods Act 1985.

Environment Effects Act 1978.

Environment Protection Act 1970.

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National Parks Act 1975.

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State Environment Protection Policy (Prevention and Management of Contamination of Land) Publication 859, 2002.

Protocol for Environmental Management (Mining and Extractive Industries) EPA Publication 1191, December 2007.

Industrial Management Policy (Waste Acid Sulfate Soils) 1999.

Waste Management Policy (Siting, Design and Management of Landfills) 2004.

Standards

Australian Standard AS 1940:2004, *The Storage and Handling of Flammable and Combustible Liquids,* 2004.

Australian/New Zealand Standard, AS/NZS ISO 3100:2009 *Risk management - Principles and guidelines.*

Guidelines

A Guide to the Sampling and Analysis of Waters, Wastewaters, Soils and Wastes EPA Publication No. 441, March 2000.

A Guide to the Sampling and Analysis of Air Emissions and Air Quality, EPA Publication No. 440.1, December 2002.

Bunding Guidelines, EPA Technical Guideline, Publication No. 347, December 1992.

Classification of Wastes, EPA Information Bulletin, Publication No. 448, May 2007.

Construction Techniques for Sediment Pollution Control, EPA Publication No. 275, May 1991.

Designation of types of zones and reservations in the metropolitan region planning schemes for the purposes of State Environment Protection Policy (Control of Noise for Commerce, Industry and Trade) No. N-1.

EPA Information Bulletin *Guidelines for Preparation of Waste Management Plans,* Publication No. 383, 1993.

Environmental Guidelines for Major Construction Sites, EPA Publication No. 480, 1995.

Explanatory notes: State Environment Protection Policy (Control of noise from commerce, industry and trade) No. N-1. EPA publication N4/91.

Extractive Industry Work Plan Guideline, Department of Primary Industries, June 2010 (replaces WorkPlan Guidelines for Areas of 5 Hectares or More or Greater than 2 Metres in Depth - G3, Department of Primary Industries).

Interim Guidelines for the Control of Noise from Industry in Country Victoria, EPA Information Bulletin N3/89, April 1989.

Guidelines for Environmental Management – Use of Reclaimed Water - EPA Publication 464.1.

Guidelines for Preparation of Waste Management Plans, EPA Information Bulletin, Publication No. 383, 1993.

Guidelines on the Design, Installation and Management requirements for Underground Petroleum Storage Systems (UPSS), EPA Publication No. 881.1, January 2009.

Industrial Waste Resources Guidelines, EPA publication IWRG600, June 2009.

Interim Guidelines for the Control of Noise from Industry in Country Victoria, EPA Information Bulletin N3/89, April 1989.

Native Vegetation Management Guide – For the Earth Resources Industry, Department of Sustainability and Environment and Department of Primary Industries, 2009.

Recommended Buffer Distances for Industrial Residual Air Emissions, EPA Publication AQ 2-86, July 1990.

Ten Steps to Successful Community/Industry Consultation, EPA Information Bulletin 520, November 1996.

The New SEPP (Air Quality Management) – Information for All EPA Licence Holders - Publication 843, May 2002.

Appendix 1 - Requirements

R1. The Work Authority holder must carry out work in accordance with the Code of Practice for Small Quarries.

R2. The Work Authority holder must ensure that final land-use of the site is agreed with the landholder prior to the commencement of work on the site.

R3. Prior to commencing any work, the Work Authority holder must have public liability insurance that covers all work authorised under the Work Authority and must ensure that the insurance is maintained at all times while work occurs under the Work Authority.

R4. The Work Authority holder must erect and maintain posts along the boundary of the Work Authority so that the boundary of the Work Authority is clearly identifiable.

R5. The Work Authority holder must ensure that the posts required in R4 meet the following specifications:

a) the post is not less than one metre high above the ground;

b) the post is painted white;

c) the Work Authority number is painted within the top 20 centimetres of the post, is legible and in a contrasting colour to the white post; and

d) the post must be situated so that each post is clearly visible from each post on either side of that post.

R6. The Work Authority holder must ensure that there is no extraction within 10 metres of the Work Authority boundary. A wider site specific buffer may apply to protect infrastructure or to minimise visual impact.

R7. The Work Authority holder must erect and maintain a legible sign at the main entrance to the Work Authority that contains the following information:

a) the name of the Work Authority holder and the Work Authority number;

b) the name and contact details of the Manager of the Work Authority; and

c) emergency contact details for the Work Authority holder and the DPI.

R8. The Work Authority holder must ensure that public safety is maintained within the Work Authority area at all times, including through the use of fencing, gates and signage as required around the work site.

R9. The Work Authority holder must ensure that all fences are maintained to prevent access to the work site and that all gates are locked when the work site is unattended.

R10. The Work Authority holder must as soon as is practicable after becoming aware of any non-compliance with the conditions of the Work Authority, and/or requirements of the Code of Practice for Small Quarries and/or an environmental incident that will, or is likely to cause, material harm to the environment, notify the relevant ERR District Manager of the non-compliance and/or environmental incident.

R11. The Work Authority holder must notify any other relevant government department or agency of the non-compliance and/or incident.

R12. At the commencement of quarrying excavation, the Work Authority holder must ensure that topsoil to a depth of 150 millimetres below the natural surface is removed and placed in stockpiles not exceeding two metres in height.

R13. The Work Authority holder must ensure that topsoil stockpiles are protected from erosion and compaction.

R14. The Work Authority holder must ensure that all slopes/batters including excavations, roadways, stockpiles and dumps are designed, constructed and maintained to ensure stability.

R15. If there is a significant slope failure event, the Work Authority holder must cease all operations, notify the relevant ERR District Manager and not recommence operations until authorised to do so by the relevant District Manager.

R16. The Work Authority holder must establish and implement a program to control and/or eradicate noxious weeds and pest animals within the Work Authority area.

R17. The Work Authority holder must take measures to prevent the spread of declared noxious weeds, pest animals and plant diseases within the Work Authority area.

R18. The Work Authority holder must ensure that all mobile machinery is thoroughly cleaned prior to coming onto, or leaving a work area affected by noxious weeds and/or plant diseases.

R19. The Work Authority holder must ensure that all soil that is imported into and exported out of the Work Authority area is free of disease and noxious weeds.

R20. The Work Authority holder must minimise the area of ground disturbance throughout the life of the quarry operation.

R21. The Work Authority holder must design, install and maintain erosion and sediment controls to prevent erosion of areas of disturbed land and sedimentation of waterways.

R22. The Work Authority holder must ensure that any drainage from an area where fuels, lubricants and/or hazardous materials are stored, and/or used is directed to a sump or interceptor trap.

R23. The Work Authority holder must prevent contaminated runoff from entering receiving waterways.

R24. Prior to the intersection and removal of any groundwater from a Work Authority, appropriate approvals need to be obtained from a groundwater licensing authority.

R25. The Work Authority holder must take all reasonable measures to minimise the generation of slimes material.

R26. The Work Authority holder must ensure that the location, design, construction, operation and safe management of slimes dams within the Work Authority area are undertaken in a way that prevents the release of slimes to the environment.

R27. The Work Authority holder must ensure that slimes dams on site are not accessible to the public.

R28. The Work Authority holder must take all reasonable measures to prevent the ignition and spread of fire.

R29. The Work Authority holder must ensure that all buildings, fixed plant and mobile equipment are fitted with fire-fighting equipment, such as fire extinguishers, fire blankets, knapsack spray pumps and rake-hoes.

R30. The Work Authority holder must prevent contamination of the environment by the release of fuels, lubricants and/or hazardous materials.

R31. The Work Authority holder must ensure that all fuels, lubricants and/or hazardous materials are stored in accordance with the relevant requirements of AS 1940:2004 The Storage and Handling of Flammable and Combustible Liquids.

R32. The Work Authority holder must ensure that spill prevention and clean-up equipment is readily available and accessible in the vicinity of all plant and machinery, including mobile and fixed fuel storages.

R33. The Work Authority holder must ensure that spills of fuels, lubricants and/or hazardous materials are cleaned up as quickly as practicable. Such spillage must not be cleaned up by hosing, sweeping or otherwise releasing such contaminant into waterways. Equipment and soil contaminated by fuels, lubricants, hazardous materials and clean up substances which cannot be salvaged must be disposed of in an approved waste facility.

R34. The Work Authority holder must avoid causing unacceptable noise.

R35. The Work Authority holder must prevent dust release that causes adverse impacts to the surrounding area and people.

R36. The Work Authority holder must ensure that the colour of fixed plant and buildings do not cause an unwarranted negative impact on surrounding visual amenity.

R37. The Work Authority holder must take all reasonable measures to reduce visual impact on the surrounding area.

R38. The Work Authority holder must maintain a complaints register.

R39. In response to a complaint, the Work Authority holder must record the following information in the complaints register:

a) the date and time of the complaint;

b) who the complaint was from;

c) the specific issue/s raised in the complaint; and

d) the actions taken to address the specific issue/s raised in the complaint.

R40. The Work Authority holder must ensure that progressive rehabilitation of disturbed land is carried out as soon as possible.

R41. The Work Authority holder must ensure that the site is left in a safe and stable condition.

R42. The Work Authority holder must ensure that:

a) the rehabilitated area is left in a stable, safe, non-polluting state;

b) the area is suitable for the planned final use or rehabilitation objective;

c) rehabilitated areas are not excessively affected by erosion;

d) the revegetated area is free from noxious weeds; and

e) vegetation is consistent with the final land-use.

R43. The Work Authority holder must ensure that all derelict and redundant plant, vehicles, machinery and equipment is removed from the Work Authority area and deposited at an appropriate waste disposal site.

R44. The Work Authority holder must have authorisation under the *Water Act 1989*, prior to commencing any extraction activities in or on a waterway.

R45. Riverine extractions are exempt from compliance with requirements R12 and R23.

R46. Only deposited material is to be extracted from the waterway, no extraction is to be undertaken below the natural bed of the waterway.

Appendix 2 - Checklist and reference for operators of small quarries

Issue	Objectives	Objective achieved by	Guideline reference	√
Quarry Design	See Checklist for site design and planning.		4.1	
Operational Management				
Topsoil management	To protect the regenerative capacity of the natural topsoil.		5.1	
Landform design	All landforms on the site should be safe and stable.		5.2	
Control of noxious weeds, pest animals and plant disease (Invasive species)	To ensure that the working of the quarry does not lead to the spread or proliferation of noxious weeds, plant disease and pest animals.		5.3	
Drainage and erosion control	To minimise erosion and turbid water impacts offsite.		5.4	
Water storage and discharge control	To ensure that all discharges from the site are free of sediment and other pollutants.		5.5	
Groundwater	To meet groundwater quality objectives and to minimise any environmental impact on the quality of groundwater.		5.6	
Slimes management	To manage the disposal and rehabilitation of slimes in order to minimise the risk to public safety and the environment.		5.7	
Fire management	To ensure that the quarrying activities do not contribute to, or exacerbate, fire hazards.		5.8	
Hazardous materials management	To manage the storage, use and handling of hazardous materials to minimise the risk of environmental harm.		5.9	
Noise	To avoid the quarry being a source of nuisance noise to surrounding land-users.		5.10	
Dust control	To avoid dust impacting on surrounding land-users and people.		5.11	
Visual management	To ensure that the quarry is not visually intrusive.		5.12	
Community	To inform and engage the community regarding the operation of the quarry.		5.13	
Rehabilitation				
Progressive rehabilitation	To efficiently and effectively rehabilitate the quarry.		6.1	
Earthworks	To reconstruct the landform to be compatible with the surrounding landscape and to prepare the ground for revegetation.		6.2	
Erosion prevention	To minimise erosion of final landforms.		6.3	
Revegetation	To provide a stable self-sustaining cover through revegetation that protects the rehabilitation asset and is consistent with the final land-use.		6.4	
Monitoring and maintenance	To monitor and maintain the site until the rehabilitation is stable, safe and self-sustaining.		6.5	
Decommissioning and Closure				
Site clean up	To have a clean site ready for the final land-use.		7.2	

Earth Resource Regulation Branch Contacts

For further information or to submit comments on the Code, please contact the ERR at one of the following offices:

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Ballarat
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Fax: (03) 5336 6800

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Corner Midland Hwy and Taylor Street
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Bendigo Mail Centre
BENDIGO VIC 3554
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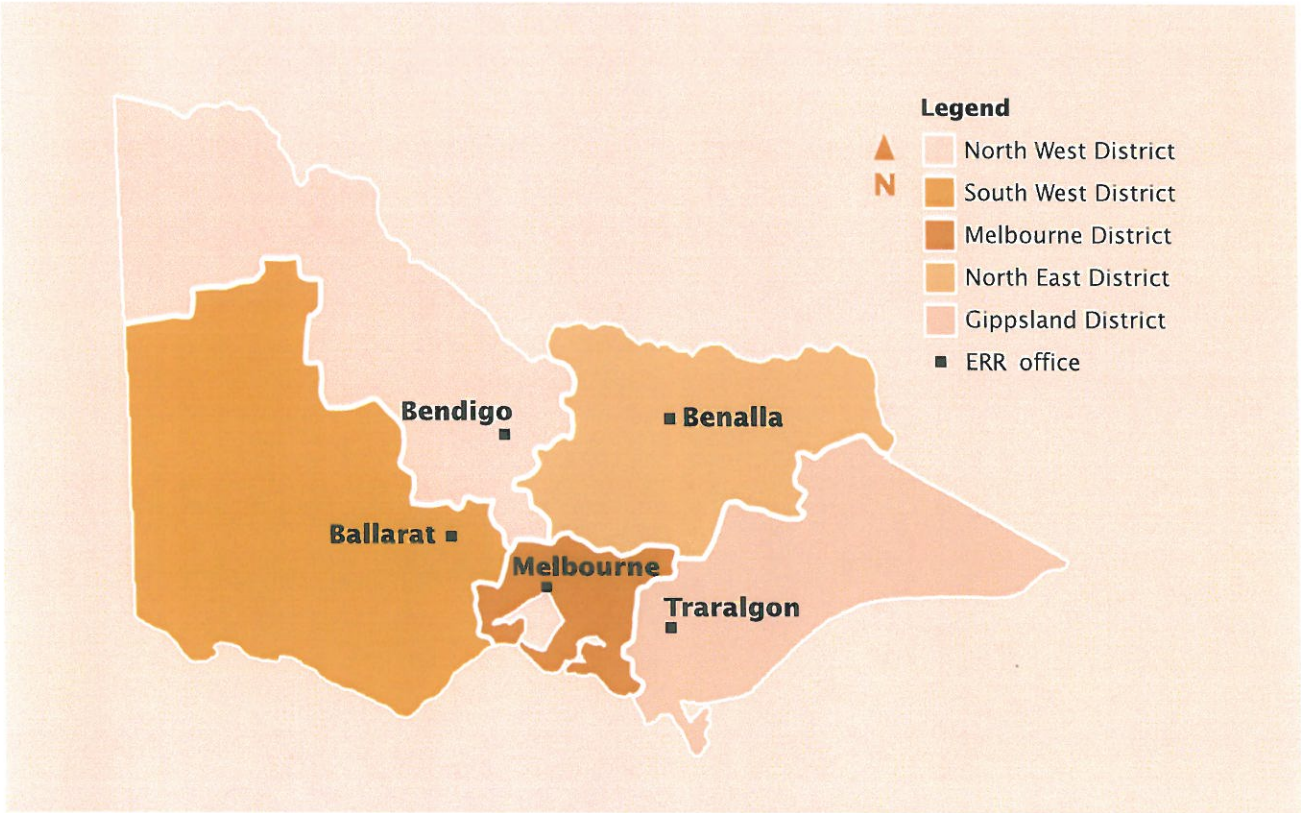
Traralgon
Department of Primary Industries
55 Grey Street,
TRARALGON VIC 3844
Ph: (03) 5160 9011
Fax: (03) 5160 9055

For a detailed list of contacts, please visit www.dpi.vic.gov.au



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Back
to Top

earth resources regulation

Guidance Material for the Assessment of Geotechnical Risks in Open Pit Mines and Quarries

Executive Summary

This guidance material is concerned with the assessment of geotechnical risks associated with the development, operation and rehabilitation of an open pit mine or quarry within Victoria. Large mines or quarries which are considered to have significant ground stability risks to public safety, the environment or surrounding infrastructure may be declared by the Minister under the *Mineral Resources (Sustainable Development) Act 1990* (MRSDA).

Declared mines and quarries are required to regularly submit reviews of stability assessments to the Department of Economic Development, Jobs, Transport and Resources (the department) Earth Resources Regulation Branch (ERR). The ongoing review of the Ground Control Management Plan (GCMP) is critical to the management of geotechnical risks on these large and complex sites. Declared mine stability requirements and processes are provided in Part 2 of Schedule 15 in the *Mineral Resources (Sustainable Development) (Mineral Industries) Regulations 2013*.

The assessment of geotechnical risks to public safety, public infrastructure and the environment is required by the department's Earth Resources Regulation Branch as part of the submission of a work plan for a new open pit mine/quarry or for a variation to a work plan for an existing mine or quarry. Work plans are required for all open pit mines and quarries where the areal extent of the excavation exceeds five hectares or five metres depth or where working practices including ground controls or wet working are necessary or where environmental assets are affected. The requirements for submission of a work plan or work plan variation are detailed in the *Mineral Resources (Sustainable Development) (Mineral Industries) Regulations 2013* and the *Mineral Resources (Sustainable Development) (Extractive Industries) Regulations 2010*.

Administration of Occupational Health & Safety (OHS) in mines (including safety issues associated with operating slopes within open pit mines and quarries), is carried out by WorkSafe Victoria (WorkSafe). This guidance material does not address geotechnical risks that are associated with the OHS issues of a site, site infrastructure, equipment or personnel. All of these risks are considered separately by WorkSafe. This guidance material also does not address geotechnical risks associated with underground mining methods.

Under the National Mines Safety Framework (NMSF), a code of practice for both underground and open pit mines is currently under preparation. This guidance material is consistent with these codes and if there is an overlap, then this will be managed through the Memorandum of Understanding (MoU) between the department's Earth Resources Regulation Branch and WorkSafe.

Geotechnical risks at a mine or quarry are defined as those risks associated with ground movements. Ground movements are typically limited to the area of the mine and to a region around the mine. Ground movements may be significant (such as subsidence or natural rebound) or catastrophic (such as batter collapse). Irrespective of the type of ground movements, it is possible for persons, infrastructure or the environment to be harmed. It is essential that the risks of harm arising from ground movements are minimised during the period of operation of the site, rehabilitation and post-closure.

A simplified method of assessment of the area potentially affected by mining induced ground movements and the geotechnical risks to public safety, public infrastructure and the environment is presented. Guidance on the delineation of the area within which ground movements may occur is given. Identification of assets within the area of movement that could be at risk is required.

For each asset, the hazards arising from any ground movements and the level of risk to the asset for the given hazards should be elaborated. Where risks are deemed to be significant, the requirements for reducing the risks to a level that is as low as reasonably practical are recommended. The requirements for documenting the geotechnical risk assessment method and their inclusion in a work plan are summarised.

The steps in the assessment method are briefly:

1. Definition of the Geotechnical Risk Zone (GRZ) within which the impacts on public safety, the environment and public infrastructure should be examined.
2. Identification of all current and planned assets (public access, infrastructure and environments) within the GRZ.
3. Determination of any impacts from the GRZ applicable to each asset.
4. For significant impacts an outline of all controls proposed to reduce the risk to as low a level as reasonably practical.
5. For all significant impacts posing significant risks a statement may be required detailing the method to be used to monitor and evaluate ground movements and their impact on the asset during operation and rehabilitation of the site.

If geotechnical investigations are required to demonstrate that risk levels are as low as reasonably practical then these may be carried out by a competent individual or organisation and be undertaken in accordance with current best practice. Where the assessed risks are to be mitigated/managed through engineering and/or administrative controls then appropriate monitoring and evaluation may be adopted to demonstrate the ongoing safety of the site. When geotechnical investigations are not required, it is recommended that movement monitoring (e.g. crack surveys, movement pin surveys) is continued around the perimeter of the site to identify at the earliest opportunity any unexpected ground movements. Unexplained movements may be resolved through timely risk-based geotechnical investigations.

1. Introduction

1.1 Background

The department's Earth Resources Regulation Branch is responsible for regulating mines and quarries in Victoria. As part of the approvals process, all mines and quarries are required to submit a work plan in accordance with the *Mineral Resources (Sustainable Development) (Mineral Industries) Regulations 2013* and the *Mineral Resources (Sustainable Development) (Extractive Industries) Regulations 2010*. All mines or quarries that extend over an area greater than five hectares or involve blasting and/or native vegetation clearance must have an approved work plan. Existing sites that propose to change a work plan for a mine or quarry are required to submit a work plan variation. The conditions for preparing and approving a work plan variation are essentially the same as for a work plan for a new mine/quarry.

The standard information to be covered in a work plan includes:

1. Geological information
2. Location and regional plan
3. Site plan (or development plan)
4. Processing methods
5. Rehabilitation plan
6. Environmental management plan
7. Community engagement plan

The department's Earth Resources Regulation Branch requires that all mines and quarries are operated, rehabilitated and closed in such a way that they do not pose unacceptable risks to public safety, public infrastructure and the environment. Therefore, a work plan submission must also address the identification of such risks and their control or mitigation. This guidance material has been prepared to assist mine and quarry owners in providing the required information in relation to risks arising from ground movements (geotechnical risks).

Mines and quarries that are exempt from requiring an approved work plan are required to adhere to the Code of Practice for Low Risk Mines or the Code of Practice for Small Quarries. These codes identify reasonably practicable practices for developing and operating low risk mines and small quarries and they cover many of the same issues that are addressed in work plans for larger sites. However, if the final depth of an operation is proposed to be more than 5m then operators should apply the methodology explained in this guidance material. Operators are encouraged to read the current guidelines and, where appropriate, carry out a geotechnical risk assessment prior to commencement of excavation. The guidance material should assist low risk and small operators with avoiding unintended property or personal damages and unexpected costs.

This guidance material only applies to work plan submissions for open pit mines and quarries. It does not address geotechnical issues which may relate to underground mines' work plan submissions.

1.2 Purpose

Geotechnical risks arise from movement of the ground during and following excavation. Risks may relate to slope failures, to changes to flows in water courses and surface water bodies or they may relate to movements of structures and infrastructure adjacent to or within the mine. The requirement is to carry out a prior assessment of the extent and magnitude of ground movements that could take place and to examine the potential impact of any ground movements on the area around and within the mine on the environment and infrastructure. The details of this assessment and its findings should be recorded. If risks are identified where the risk level is not reasonably practical, then a record may also be required of the actions that will be taken to implement adequate controls. It is recommended that any documents pertaining to the risk assessment and the planned actions identified to control risks be submitted with the work plan.

Given this background, this guidance material has been prepared to assist mine and quarry owners in:

- understanding risk concepts;
- identifying geotechnical risks associated with mine and quarry developments;
- developing assessments of the scale of the perceived risks; and
- developing control measures to reduce risks to a level that is as low as practically possible.

2 Risk Assessment

2.1 Risk concepts

To understand risk, it is useful to expand risk into its three parts: hazard, the likelihood of a hazard becoming an event, and the magnitude of the consequences of an event.

Hazard: a hazard is any physical activity, situation or condition with the potential to cause harm. Harm can involve human injury or death, damage to the environment, damage to physical assets or loss of production. An event occurs if harm occurs.

Likelihood: the likelihood of a hazard becoming an event (i.e. causing harm) indicates the chance that an event will occur, usually, within a given period of time.

Likelihood is a qualitative concept and is typically a subjective assessment of the chance of an event occurring. For some hazards it is possible to provide a more quantitative evaluation and a probability can be assigned on a scale of zero to one, where a probability of zero indicates that the hazard can never become an event and one indicates that it is guaranteed to become an event. Probabilities are usually determined on the basis of the frequency with which an event has arisen previously for similar conditions. In many situations frequency data is not available and if probabilities are assigned on the basis of limited historical data then they are also subjective. Depending on their sensitivity to the harm that may arise or their prior knowledge, different people will often assign different probabilities to an event for the same hazard.

Magnitude: the consequences of an event can vary in size from essentially harmless, when there is little need to remedy the harm caused, to severe where the losses from the event are large. The magnitude of an event can be measured in many ways, such as loss of life, loss of production, loss of habitat for wildlife etc.

Typically, a measure of the risk from an individual hazard is given by multiplying the probability of occurrence by the magnitude of the consequence. Consistent measures of probability and consequence need to be used if risks are to be compared.

Total risk is given by the set of all possible hazards and their individual risks. Establishing a single measure of risk for a number of hazards can be complicated and is not usually done.

In summary, the assessment of risk relates to future events and involves:

- an expectation of harm
- an element of uncertainty
- unwanted consequences
- an assessment of severity and likelihood of a loss

Risks can be mitigated: hazards can be avoided or the likelihood of an event and/or the consequences of an event can be reduced. Risks can be managed, but only if the risks have been identified, quantified and understood.

This guidance material is seeking to increase the awareness of one particular area of risk in open pit mining and quarrying and to encourage appropriate methods for identifying, quantifying and managing the risks.

For further information on risk concepts, refer to AS/NZS ISO 31000:2009 Risk management - Principles and Guidelines.

2.2 What is a geotechnical risk?

Geotechnical risk arises when a hazard can be identified that is related to ground movement. Unforeseen ground movements are likely to pose hazards but all movements should be considered as potentially creating a risk. Subsidence, landslips, toppling, settlement, heave, slumping and fracturing are all examples of ground movements that can lead to harm.

Other risks, closely related to geotechnical risk, can also arise. Disturbance of ground can lead to chemical leachates that are harmful to the environment or people. Prevention of heave or dewatering of an excavation may involve groundwater pumping that can reduce available water and increase harm from drought or deplete surface water bodies and harm the habitats supported by these water bodies.

Identification of geotechnical risks involves an understanding of the potential future movements of the ground, any related groundwater movements and the identification of the possible impacts of the movements on the environment, infrastructure, operations and people. Assessing the scale of the risks depends on an understanding of the possible consequences arising from the movements and their significance.

While it is suggested that an initial geotechnical risk assessment be completed, carrying out a geotechnical risk assessment should not be a static activity. As a site develops more knowledge may be available about the geological conditions and a greater understanding of the behaviour of the ground may develop. The areas being mined will alter and batters will continually be renewed. In all cases, risks may change. It is suggested that the assessment of geotechnical risk be an iterative and on-going process throughout the life of a site.

2.3 Geotechnical information required for a work plan or variation

Hazard identification, assessing risk severity, the implementation of risk controls and monitoring of outcomes for a safe and stable site may be considered when collecting the geotechnical information required for a work plan or variation. The suggested key requirements are to provide information on the following:

1. The delineation of the potential area of ground movement around the mine or quarry.
2. The existence of surface features that may be affected by or affect mine or quarry induced ground movements
3. The geological and hydrogeological data for the affected area.
4. The existence of subsurface features that may be affected by or affect mine or quarry induced ground movements.
5. Information on the strength, compressibility, durability and quality of the ground to be mined/quarried or removed.
6. Operational methods and the mine/quarry form (depth and batter slopes)
7. Information on the wastes to be generated as part of the mining/quarrying processes and the storage/disposal of the wastes.
8. Dewatering requirements and methods including surface drainage and water disposal.
9. Any analyses carried out to predict the stability of the site.

The following section provides information to support the suggested provision of the appropriate data within a work plan.

3 Carrying out a geotechnical risk assessment

3.1 Assessing the Geotechnical Risk Zone (GRZ)

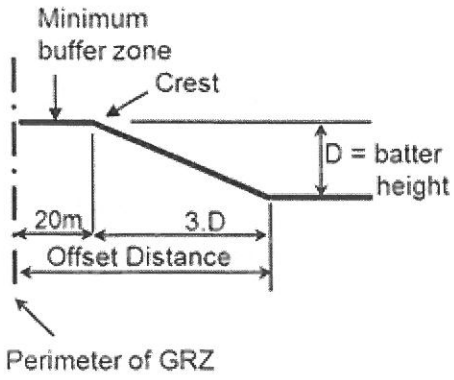
The area affected by a mine or quarry is not limited to the perimeter of the excavation or to the limit of the mining licence within which the mine or quarry is located. Excavation related ground movements can take place over considerable distances away from the excavation perimeter.

As a guideline, an offset distance of four times the final batter height may be used to define the limit of potentially significant ground movements from the foot of the final rehabilitation batters. The batter height is the height of the final crest measured from the closest foot of the batter and may vary around the mine or quarry perimeter. The offset distance is measured at right angles to the strike of the batter. This distance is based on an assumed final batter slope of 1:3 (vertical:horizontal) and

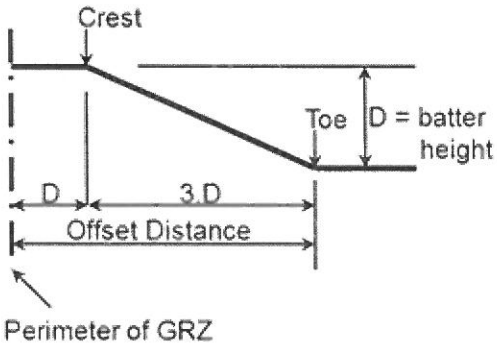
a buffer strip equal to the height of the final batter. A minimum buffer strip of twenty metres (measured horizontally) may be required for operational reasons, so for batter heights less than twenty metres the offset distance may be three times the final batter height plus twenty metres. Figure 1 illustrates the suggested criteria for determining the offset distances.

Figure 1 Defining the GRZ

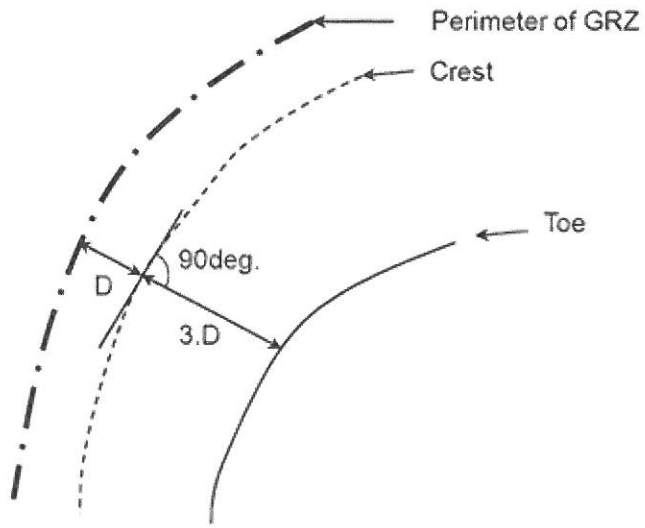
a) Batter heights up to 20m



b) Batter heights greater than 20m



c) Plan view of the offers from toe



Note: Assumes a final batter slope of 1:3(vertical:horizontal).

The area defined by the limit of potentially significant ground movements is hereafter referred to as the geotechnical risk zone (GRZ). The suggested GRZ should lie completely within the boundary of the mine or quarry's lease if no further geotechnical assessment is to be undertaken.

It should be noted that the GRZ is not determined from the proponent's boundary in the first instance. The GRZ is based on the final area of the proposed quarry/pit floor, which defines the location of the designed or expected toe of the final batter around the site. The toe of the final batter is the determining line for the identification of the GRZ, although the designed or expected toe position is constrained by other factors. Thus, it is necessary to define the quarry area and depth to satisfy the constraints of the proponent's boundary, the offset distance for the GRZ perimeter from the designed or expected toe of the final batter and the extent of the mineral resource (depth and area) as well as any infrastructure that may be affected by ground movements. In practice, the suggested determination of the GRZ depends upon an iterative approach to satisfying all constraints (see Figure 2 for illustrations of GRZs for different scenarios.)

There can be occasions when it may be appropriate to reduce or extend the offset distance and the corresponding GRZ. Strong ground with few joints may show little movement within an offset distance much less than four times the batter height. Soft ground with shallow dipping strata and weak bedding plane surfaces may fail at distances well beyond four times the batter height. If the offset distance is to be altered from the guideline distance then it is suggested that clear evidence be produced to justify the change.

Where the proponent wishes to reduce the GRZ, it must be demonstrated that a reduced GRZ will not have an impact on public safety, the environment or public infrastructure. Normally this demonstration would require a geotechnical stability analysis with the appropriate controls in place to ensure the risk levels are at a level as low as reasonably practical.

Maintaining the offset distance at the guideline value when it is recognised that the offset distance should be larger to reflect the ground conditions may expose the operator to greater risks and should be avoided.

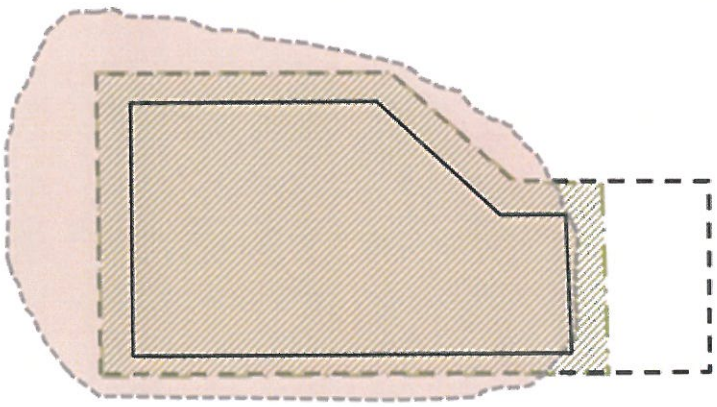
The GRZ may be altered by adjusting the final extent of excavation. Limiting the area of excavation may be one means of reducing the geotechnical risks (see section 3.3).

The GRZ potentially provides the basis for limiting the assessment of geotechnical risk geographically. The GRZ may be used for the assessment of public safety and/or public and environmental loss as required by the department's Earth Resources Regulation Branch. Geotechnical risks relating to work place safety are subject to planning considerations under separate codes of practice and legislation. By suggesting that the GRZ falls within the mine or quarry lease, the potential risks to public safety and/or public and environmental loss should be relatively few.

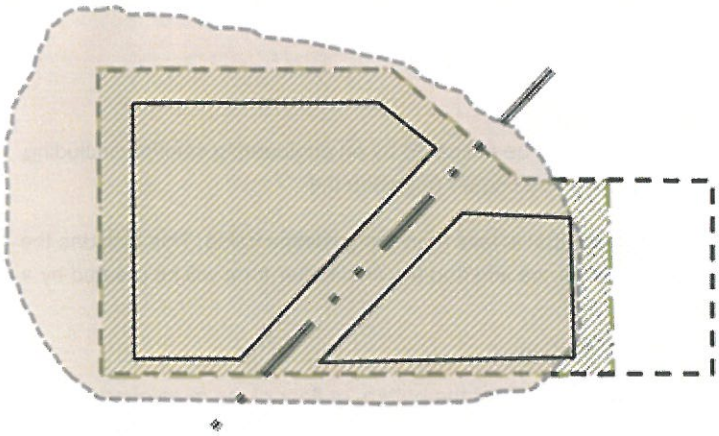
The GRZ definition is based on ERR experience from coal material and unconsolidated sediments and may differ with different geology, such as basalt. Experiences within these materials should be demonstrated when determining the GRZ for hard rock materials.

Figure 2 Schematic Scenarios of a GRZ

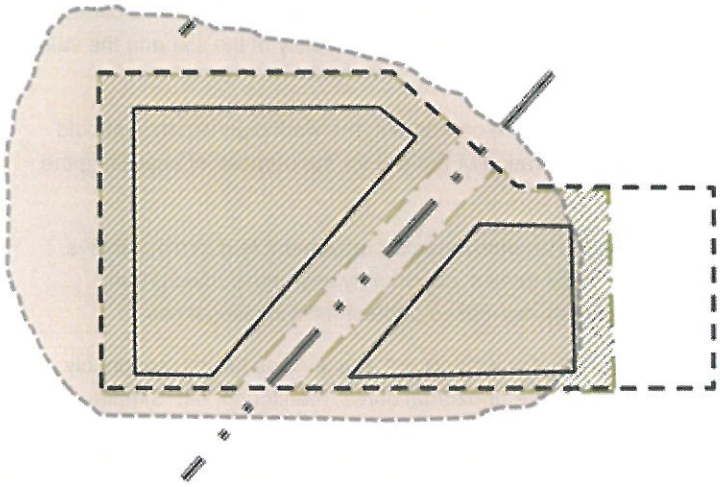
a) GRZ limited by landholding and limit of resource, no utilities, low risk.



b) GRZ limited by landholdings, and limit of resources; significant risk to Utility pipeline. Planned geotechnical assessment to maximise resource extraction.



c) GRZ limited by landholding, limit of resource and utility pipeline; no significant risk.



3.2 Assessing the hazards and consequences

A register of all infrastructure, environmental areas or areas accessible by the public within the GRZ is suggested. Infrastructure includes public buildings, private dwellings, utility lines (water/gas pipes, water and wastewater drains, and power and communication cables) and roadways. Environmental areas include surface water bodies and ecologically significant vegetation. The register may also include all planned infrastructure or environmental plans for the area. The registered assets should be marked on the plan of the GRZ. For each registered asset an assessment may then be made of the possible hazards created by the presence of the asset in the GRZ in relation to any ground movements that might arise during the operation of the mine/quarry as well as during the period of rehabilitation and post closure. The potential consequences arising from an event associated with each hazard may then be identified.

As far as reasonably practicable, all necessary steps should be taken to ensure that all items of interest in the GRZ are identified, the hazards listed and the consequences arising from any event defined.

3.3 Examining the potential risks

Using the information developed for the register, it is recommended to assess the level of risk posed by the mine/quarry. For each hazard it is suggested to assess the potential impacts on public safety, the environment and public infrastructure. For hazards where the assessed impacts are unlikely and the assessed consequences are low, there is no need for further examination. For all other cases the risks should be considered to be too high and it is necessary to mitigate the risks by completing a geotechnical stability analysis to assess controls to reduce risk to a level that is as low as reasonably practical.

Risk mitigation can take a number of forms. A basic approach is to reduce the extent or depth of the planned excavation in order to decrease the area of the GRZ so that the asset at risk falls outside of the boundary of the GRZ and the hazard is avoided. A more complicated approach is to relocate or remove the affected asset from the GRZ. If the asset lies within the area to be quarried then removal at some stage is assumed. In this case, the suggestion is to time the removal to avoid any risk of failure of the asset due to the mining or quarrying operations. In all other cases, geotechnical investigations are proposed to identify the necessary operations to reduce the risks to the infrastructure/environment to a level that is as low as reasonably practical.

In all cases, where a geotechnical risk is identified within the GRZ, it is advised to detail in the work plan or work plan variation the proposed measures to mitigate the risk.

3.4 Geotechnical investigations

In addition to those cases where a geotechnical risk is identified and may be mitigated by an engineering solution, including changes to the operation of the site, geotechnical investigations should be carried out when the:

1. GRZ is defined using an offset distance from the toe of a batter that is less than the guideline value. This includes the case where operations will involve mining beyond the final batter toe line and the final batter form will be created by a buttress.
2. method of working includes wet operations (e.g. dredging or sluicing).
3. method of working includes dewatering operations to maintain stability of the batters or floor of the mine/quarry.

Geotechnical investigations generally involve an assessment of the geological conditions at the site, determination of the geotechnical properties of all the geological materials and the determination of the stability of the batters and floor based on the proposed method of working. Geotechnical investigations and analysis of the results are recommended to be carried out by a competent person/organisation and use recognised methods for the evaluation of the stability of the site and the safety of any public assets.

Where a mining/quarrying proposal requires geotechnical investigations to be carried out, the work plan/variation should identify geotechnical monitoring methods and procedures during the operation of the site for the purpose of assessing the adequacy of the plan.

Where geotechnical investigations are not required, it is encouraged to regularly monitor movement (e.g. crack surveys, movement pin surveys) around the perimeter of the site to identify at the earliest opportunity any unexpected ground movements. Unexplained movements should be resolved through timely risk-based geotechnical investigations.

Geotechnical investigations are not the only measure to demonstrate that risk levels are at a level as low as reasonably practical. Other controls which can be demonstrated to lower risk levels are horizontal bores, monitoring, etc. Simple monitoring techniques may involve measuring and monitoring the changes in crack width and direction of crack propagation to establish the extent of the unstable area. The simplest method for monitoring tension cracks is to spray paint or flag the ends so that new cracks or propagation along existing cracks can be easily identified on subsequent inspections. Measurements of tension cracks may also be as simple as driving two stakes on either side of the crack and using a survey tape to measure the separations. Other more sophisticated monitoring methods include inclinometers, piezometers, wireline and multipoint borehole extensometers.

4 Documenting the geotechnical risk assessment

4.1 Checklist for a geotechnical risk assessment

In the previous section the suggested main contributions for a geotechnical risk assessment are described. These are:

1. Definition of the geographical area within which geotechnical risks should be examined. (Preparation of a map showing the extent of the GRZ).
2. Identification of all current and planned assets (structures, infrastructure, natural features/environments) within the GRZ that may be affected by mining/quarrying induced ground movements. (Preparation of a table of the assets and identification of the assets on the map of the GRZ).
3. Determination of the hazards applicable to each asset associated with ground movements and the possible consequences. (Inclusion of the hazards in the table of assets).
4. Identification of the likelihood and magnitude of the consequence of the hazards becoming events within the period of the mining/quarrying operation and the subsequent period of site rehabilitation and post closure. Identification of the overall risk level for the hazard.
5. For all hazards where the risk is deemed to be significant, a statement is required of the method(s) proposed for reducing the risk to a level that is as low as reasonably practical, either by reducing the likelihood or the magnitude of the consequences. Details of the information and data collected to support the adoption of each method should be provided.
6. For all hazards posing significant risks for which a plan has been developed to reduce the risk to an appropriate level a statement is required detailing the method to be used to monitor and evaluate ground movements and their impact on the asset during operation and rehabilitation of the site. Monitoring and evaluation of the monitoring data are

required to confirm that the risk is as predicted or to allow remedial work to be carried out if the risk appears to be higher than predicted.

For many small sites where ground controls or wet working are not required, it is likely that no public assets will be within the GRZ and therefore the reporting will be limited to the determination of the GRZ and the confirmation that the GRZ does not include reportable assets.

For sites where there are concerns and these cannot be removed by altering the extent or depth of the excavations, then it may be necessary to employ a qualified individual or organisation to carry out the geotechnical risk assessment and any geotechnical investigations required to demonstrate that the risks can be managed.

5 Conclusions

Identifying the risks to public safety, public infrastructure and the environment is an important requirement for the preparation of a work plan or a work plan variation. A simplified method is advised for the identification of the assets and the hazards associated with ground movements induced by the mine/quarry. The method is proposed to explore the potential risks from mining/quarrying and where necessary to consider revision of the mining/quarrying operations to reduce the risks. Where the assessed risks are deemed to be high then it is recommended to reduce the risks to a level that is as low as reasonably practical and to demonstrate the proposed methods for achieving the required risk reduction. In all cases where engineering, operational or management approaches to risk reduction are required, the preparation of the required investigations and plans is advised to be carried out by an individual or organisation competent to carry out such work. The information requested for inclusion with the work plan should be sufficient for ERR to review the assessment of the geotechnical risks and any actions arising from the assessment.

References

1. *Mineral Resources (Sustainable Development) Act 1990* (MRSDA).
2. *Mineral Resources (Sustainable Development) (Mineral Industries) Regulations 2013.*
3. *Mineral Resources (Sustainable Development)(Extractive Industries) Regulations 2010.*
4. National Mines Safety Framework – Draft Code of Practice for Underground Mines.
5. National Mines Safety Framework – Draft Code of Practice for Open Pit Mines.
6. Code of Practice for Small Quarries
7. Code of Practice for Low Risk Mines
8. AS/NZS ISO 31000:2009 Risk management - Principles and guidelines.

ATTACHMENT C

Back
to Top

earth resources regulation

Management of Tailings Storage Facilities

Introduction

1. BACKGROUND

The Earth Resources Regulation Branch (ERR) of the Victorian Department of Economic Development, Jobs, Transport and Resources - Earth Resources (the department) is responsible for regulating the minerals, petroleum and extractive industries in Victoria and its offshore waters, including Commonwealth waters. It manages the administration of the Mineral Resources Development Act 1990 (MRD Act) and the Extractive Industry Development Act 1995 (EID Act).1

This document sets out departmental policies and provides guidelines for the management of tailings from mining or extractive industries in Victoria. Appendix I summarises the guidelines, Appendix II outlines the administrative process for obtaining a Work Authority and Appendix III lists the main documentation required by the department for the approval and operation of a Tailings Storage Facility (TSF).

Tailings comprise deposits of fine-grained residues from mining, processing and extractive operations. Management of tailings is one of the main environmental issues to be addressed by the mining and extractive industries, particularly the goldmining sector where the tailings often contain cyanide.

Most tailings dams in Victoria are relatively small and significant environmental incidents associated with the management of tailings have been rare. However, in recent years a number of serious environmental incidents have occurred at mines in other parts of the world. The lessons learned from these incidents highlight the need for a clear regulatory framework to ensure the ongoing safe and environmentally responsible management of tailings.

The department is of the view that, wherever possible, the management of tailings should be objective based. It recognises, however, that the community must have confidence in the regulatory system and would expect prescriptive measures for a number of key areas to ensure that risks have been addressed. In addition, for objective based measures to be acceptable, they must be subject to periodical audit by the department or another independent expert.

Wherever possible, the guidelines enable flexibility in approaches to allow innovation in tailings management and to accommodate variations between sites in the physical, technical and social environments. The overall aim is to encourage the adoption of the best industry standards and practice in tailings management and to minimise the cost of the operations to current and future generations.

Tailings storage operations embrace four main stages – design, construction, operation and decommissioning. However, these stages are not discrete as decisions and actions at each stage impact on the subsequent ones, and the planned decommissioning processes have implications for the earlier stages.

Early planning and development of an appropriate tailings management strategy is essential to the success of the overall project. In particular, proponents for tailings dams will be required to demonstrate that other options have been fully considered. Proponents are therefore encouraged to discuss their proposals at an early stage with the Minerals and Petroleum Regulation Branch.

2. TAILINGS

Tailings from the mining and extractive industries are most commonly fine-grained or finely ground materials left over from such processes as:

- the crushing of ore or other processes for extraction of metals or other valuable minerals;
- upgrading of ore or coal by removing unwanted materials;

- washing of sand, clay and coal;
- burning of coal or blast furnace operation (ash or fume);
- chemical reactions as part of a process (as for gypsum) and
- preparation of construction materials.

In Australia, tailings are usually transported to, and discharged into, a TSF as slurry. The impoundment structure of a TSF, or tailings dam, has many similarities to a conventional water-holding dam although there are important differences in terms of the way the dam is constructed and its contents.

Tailings are chemically similar to the parent material, but the presence of process reagents, evaporation of water and weathering after deposition may significantly change their properties. All tailings have been subjected in some way to physical and/or chemical separation processes, such as flotation, cyanidation or acid leaching.

A TSF may therefore contain constituents that require careful environmental management, particularly as the pore fluid may include a variety of metals, chemicals, salts or radioactive materials. In arid regions the process water may also be saline or hypersaline. Further information on the nature of tailings can be found in ANCOLD (1999) and Environment Australia (1995).

The most common adverse characteristics of deposited tailings in Victoria are likely to be:

- remnant cyanide;
- high pH;
- sulphide minerals which, through oxidation, have the potential to generate acid and consequently mobilise heavy metals;
- elevated arsenic levels;
- highly saline pore water and
- colloidal clays.

Deposition of tailings in a TSF may be subaqueous (below water) or sub-aerial (above the water line on the ground or on a 'beach' formed by tailings). Other techniques include the production of pastes and disposal in-pit or underground. Tailings can also be deposited in conjunction with waste rock or other materials; a technique referred to as codisposal. Another technique is dry stacking. Appendix VI discusses the nature and construction of TSFs.

3. APPLICATION OF THE GUIDELINES

These guidelines aim to ensure that tailings management in Victoria is environmentally sensitive and safe. To that end, they seek to ensure that a TSF is:

- safe, both during its operating life and after closure;
- managed to minimise waste generation;
- managed to minimise environmental pollution and
- rehabilitated and revegetated after closure to minimise long-term risks to the environment, social impacts, future land use and visual amenity.

Although separate Acts and Regulations govern mining and extractive activities in Victoria, the administrative requirements and processes are similar. Accordingly, while the focus of these guidelines is on tailings from the mining sector, it is intended that many aspects of the guidelines should also be applied by the extractive industries.

TSFs are not relevant to oil or gas production. Further, although coal extraction is governed by the MRD Act, the tailings-like waste stream (ash) from coal burning for power generation is not. Ash disposal is subject to licence under the Environment Protection Act 1970 (EP Act).

The various Acts and Regulations relevant to tailings management in Victoria are set out in Appendix VIII.

The discharge of mining wastes to land contained within an approved mine or quarry site is regulated under the EID Act and MRD Act and is exempt from Works Approval and Licensing under the Environment Protection (Schedule Premises and Exemptions) Regulation 1996, Appendix VIII). However, any external discharges from a mine or quarry is regulated by the EP Act (1970).

A range of approaches to the management of tailings has been adopted around the world in response to jurisdictional legislation, climatic and geomorphological constraints and historical experience. These guidelines are framed in the light of contemporary methods of tailings management in Victoria. They are not intended to constrain innovative proposals and are

intended to encourage best practice and continual improvement. However, disposal techniques involving the submarine placement of tailings, or any uncontrolled placement of tailings in natural waterways, are considered unsuitable and the department cannot foresee the circumstances in which this would be permitted in Victorian waters. Accordingly, these guidelines do not address such activities.

The guidelines are intended to apply to TSFs of all sizes. However, for the purpose of application of the policy requirements set out in the following sections, the guidelines discriminate in a number of cases between 'small' and 'large' TSFs. These are categorised as follows.

Large TSFs are those:

- with an embankment of 5 m or higher and a storage capacity of 50 ML or more;
- with an embankment of 10 m or higher and a storage capacity of 20 ML or more;
- with an embankment of 15 m or higher, regardless of storage capacity or
- where the combined storage capacity of all TSFs on the site is greater than 50 ML.

The height of the embankment should be determined from its maximum height above natural surface.

Small TSFs are those which do not meet or exceed the above criteria.

TSFs storing contaminated tailings must meet the same requirements as large TSFs.

For the purpose of these guidelines, tailings are classified as contaminated if they contain, or are predicted to contain, concentrations of contaminants exceeding those levels specified in *Definitions and Acronyms*. Tailings that do not exceed these criteria may exhibit low level contamination.

Departmental Policies and Requirements for Tailings Management

A. GENERAL

4. WORK PLAN

Both the MRD Act and the EID Act require a Work Plan to be lodged and approved before construction or operation of a TSF can commence. Where a TSF is part of a larger mining or quarrying proposal, the Work Plan requirements described in these guidelines may be addressed as part of the Work Plan for the overall project. However, where a TSF is proposed as supplementary work on an existing site, outside the provisions of the current work plan, the operator must submit an appropriate Work Plan variation. Proponents should also ensure that appropriate planning approval is obtained where required.

Appendix II sets out the application and approval process.

A Work Plan should include plans for:

- the development of the proposed operation
- and associated infrastructure;
- occupational health and safety;
- environmental management and closure and rehabilitation works.

The Work Plan documentation for a TSF should include:

- the design plan;
- details about the proposed management of the tailings and water;
- plans for the minimisation of impacts on native vegetation;
- plans for environmental monitoring and for managing rehabilitation, risks and emergencies, and
- plans for the intended end-use of the TSF site.

Appendix III describes the site information usually required in a Work Plan for a TSF.

The **Environmental Management Plan** is part of the Work Plan. For a TSF, it should include proposals and processes for monitoring standard environmental parameters, principally the groundwater and nearby surface water, and show compliance with the Acts and Regulations relevant to water management at the site. It may also require elements to address other

significant risks identified for the particular site, such as impacts on flora and fauna or the generation of dust or odour. Monitoring is discussed in Section 16 of these guidelines.

The Risk Assessment and Emergency Response Plan are also important elements of the Work Plan for a TSF. These are discussed in Sections 7 and 8 of these guidelines.

Work Plan

Proponents should ensure that the Work Plan for a TSF contains the details required by either the *Mineral Resources Development Regulations* 2002 (for a mine) or the *Extractive Industry Development Regulations* 1996 (for a quarry), and those set out in these guidelines and Appendix III.

5. PLANNING APPROVAL

In addition to the departmental Work Plan requirements, the proponent for a TSF may also need to apply to the Responsible Authority (usually the local municipality) for planning approval under the Planning and Environment Act 1987.

Where a proposed TSF represents a minor variation to a pre-existing operation, the proponent should confirm with the Responsible Authority whether further planning approval is required.

Where a proposed TSF has the potential for significant environmental impacts, approval via an Environment Effects Statement (EES) in accordance with the *Environment Effects Act* 1978 may be required.

For mining projects, approval via an EES precludes the need to seek approval by way of a Planning Permit.

The approval process is set out in Appendix II and the provisions of the Acts are summarised in Appendix VIII. Proponents requiring further information about planning permits or EES requirements should consult MPD.

In addition to work plan and planning approval, a project may require approval under the *Commonwealth Environment Protection and Biodiversity Conservation Act* (1999).

This Act protects matters of 'national environmental significance'. A proponent is required to determine whether the Act applies to their proposal. Proponents who are seeking approval, or who are unsure about whether approval is required, should contact the Department of the Environment and Heritage.

Planning approval

The Proponent for a TSF should ensure that appropriate planning approval is in place.

Where a proposed TSF has the potential for significant environmental impacts, approval via an EES may be required.

6. CONSULTATION

Consultation is a process in which the proponent and the public are able to exchange information and views about a project, its potential hazards and approaches to address them.

The principal aspects of effective consultation include:

- identification of key stakeholders and other interested parties, and provision of information that is appropriate and timely for their needs and to facilitate their meaningful participation in the process;
- establishment of consultative processes to ensure ongoing engagement with the community and
- responding to community concerns in a transparent and effective manner.

Consultation before and during the design and operation of the TSF should be part of the broader consultative process associated with the mining or extractive venture. Structured community participation should also be undertaken should a major variation to a project be proposed. Effective consultation is an integral part of risk management and can provide benefits if it is undertaken in conjunction with monitoring and auditing.

It is also likely that Planning Permit or EES processes will require any project of significant scale to undertake consultation activities with local communities potentially affected by a proposed facility and other stakeholders.

Where a proposed TSF represents a minor variation to a pre-existing operation, consultation may not be necessary. However, proponents are advised to seek confirmation from MPD about this issue.

Consultation The proponent of a new TSF should undertake adequate consultation with the community and interested stakeholders.

Where a proposed TSF represents a minor variation to a pre-existing operation consultation may not be necessary. However proponents are advised to seek confirmation from MPD about this issue.

7. RISK MANAGEMENT

Risk management is about minimising safety, health, environmental and financial risks associated with the transportation and storage of tailings. Although, for the most part, they cannot be entirely eliminated without affecting the technical or economical viability of the overall operation, the risks must be managed to remain within acceptable limits.

Hazards associated with operation of a TSF may arise through:

- inadequate site security;
- structural failure;
- operational failure;
- equipment failure, and
- unforseen circumstances or consequences.

Deficiencies in design, management or operational practice, inadequate controls, unauthorised access, climatic events or geotechnical instability can reduce the safety margin.

For instance, the main threats to the stability of an artificial embankment are (EPA, 1995):

- overtopping by flood waters;
- Slope instability caused by high piezometric pressures;
- piping of fine-grained material during seepage and
- liquefaction of saturated fines during seismic activity or other vibration.

The more serious potential impacts associated with a TSF include:

- threat to human life, health or infrastructure;
- short-term and long-term pollution of ground and/or surface waters;
- raised groundwater levels resulting in salinisation of the surface and streams;
- the release of a large volume of water and semi-fluid tailings which smother vegetation, blanket the land surface and restrict stream flow with sediment;
- threat to health or life of wildlife, livestock or domestic animals;
- loss of significant native vegetation and
- generation of dust or odour.

It is incumbent upon the proponent or owner of a TSF to demonstrate that the immediate and long-term risks associated with tailings handling and storage are acceptable and to justify the design and operational decisions using conventional risk management techniques. Innovative solutions to the control or elimination of risks are encouraged.

Management of risks involves a structured and systematic approach that enables protective measures to be well targeted rather than either excessive or inadequate.

7.1 Risk assessment

Proponents of large TSFs or those storing contaminated tailings should undertake a formalised Risk Assessment as part of the Work Plan submission.

Risk assessment for a TSF should include a systematic assessment of the likelihood and consequences of identified hazards and encompass all aspects of its design, construction, operation and closure. The assessment should be reviewed regularly, based on the performance of the facility against its design parameters and the outcome of the annual Audit Report. Auditing requirements are outlined in Section 16.5

Key elements in the design of a large TSF or one storing contaminated tailings that require consideration in the Risk Assessment include:

- location;
- containment system;

- type of lift and
- cyanide management.

The responsibilities of the operator of a mine in identifying hazards and assessing the risks to health and safety Regulation 302 are set out in the *Occupational Health and Safety (Mines) Regulations* 2002. Proponents of potentially high risk TSFs in the extractive industries are also encouraged to consider these issues.

Risk assessment planning incorporates the following steps:

Risk analysis

a. Description of every element and phase of the equipment, infrastructure and operation and identification of the associated potential hazards.

b. Establishing the level of risk by a case by case analysis of those hazards to estimate the likelihood of an event occurring and its likely consequences.

Risk assessment

c. Establishment of the criteria under which a level of risk is acceptable.

d. Prioritisation of the hazards and identification of those where the risk exceeds, or has potential to exceed, the levels of acceptability.

Risk treatment

e. Development of response mechanisms to minimise the major risks. These could include accepting the risk or eliminating the hazard, avoiding the risk, reducing the consequences, reducing the likelihood or transferring the risk. Risk control measures should be carefully assessed to prevent unintended consequences.

f. Implementation of the established plan.

Follow-up

g. Monitoring of environmental indicators and the performance of the safeguards, auditing of the implementation process and the risk profile, periodic review and updating of the Risk Assessment.

Risk minimisation also involves:

- adoption of rigorous operational procedures that ensure compliance with the assumptions made in the design and
- correct implementation of performance monitoring procedures.

Risk analysis for a TSF should take into account such factors as the proximity of surface water and groundwater resources and their use.

However, irrespective of Risk Assessment results, TSFs must comply with relevant environmental legislation and policy, such as the State environment protection policy water quality objectives (EPA, 2003).

The processes involved in environmental risk management, and its applicability to the mining industry as a whole, is described more fully in Environment Australia (1999).

Risk Assessment

The proponents of a TSF should adhere to the principles of risk management and ensure that potential risks to the community, workforce and environment are minimised.

Proponents of large TSFs or those storing contaminated tailings should undertake a formalised Risk Assessment as part of the Work Plan submission.

Proponents of large TSFs or those storing contaminated tailings should also demonstrate that the provisions of the Emergency Response Plan are based on a comprehensive Risk Assessment.

Irrespective of Risk Assessment results, TSFs must comply with relevant environmental legislation and policy, such as State environment protection policy (SEPP) water quality objectives.

8. EMERGENCY RESPONSE PLAN

The consequences of a major failure at a TSF could be very serious. These may include contamination of waterways and potable water supplies, impacts on flora and fauna or even the loss of human life. Part of the documentation that is required

for approval of any TSF is an ***Emergency Response Plan*** (ERP).

The ERP should be prepared on the basis of a worst case scenario and include procedures describing and prioritising such actions as protection of personnel, notification of emergency services and resource management agencies, advice to neighbours and immediate and longer term remedial actions. Implementation of such a plan could make a significant difference to the outcome of an accident. The ERP should make specific provision for the TSF but may be included as part of the ERP for the overall operation.

The scope and content of each ERP would depend on the size of the particular TSF and the identified hazards. For instance, the proforma safety emergency plan set out in Appendix V may be appropriate for small TSFs and could form the basis for a more comprehensive ERP for large ones.

An ERP should conform to the requirements for 'Emergency planning' as set out in Regulation 322 of the *Occupational Health and Safety (Mines) Regulations* 2002 and include, at a minimum:

- an assessment of persons (such as water diversion and groundwater extraction customers), property and environmental features at risk;
- actions to be taken appropriate to the scale of the emergency, including lines of responsibility (and names and contact details of nominated safety personnel), communications, and involvement of police and emergency services;
- details of any necessary evacuation procedure, including the location of assembly points, in the event of failure or impending failure;
- accessible advice to all personnel on site as to the nature of the emergency warning system or warnings and procedures to be followed and
- training and refreshment programs of safety procedures for all personnel involved.

An ERP should be produced in an appropriate format separate from the main body of the Work Plan for the TSF. The approved ERP should be kept in a prominent and accessible location at the operation centre of the mining or extractive operation and should be available to all staff and emergency services for use in the case of an emergency. A copy should also be forwarded to each of the emergency services likely to attend the facility.

Emergency Response Plan

A documented Emergency Response Plan (ERP) should be prepared specific to the TSF (but which may be included as part of the ERP for the overall operation) and kept in a prominent and readily accessible location at the operation centre.

8.1 Incidents

The safety of tailings storage operations can be enhanced through the sharing of experiences and knowledge about accidents and incidents. Systems already function in Victoria for the notification and dissemination of information on workplace accidents and environmental incidents.

TSF operators should make provision for immediate notification of incidents (including near-miss incidents) to the department for timely and rigorous investigation. The department will then circulate relevant information from the incident reports to other operators and jurisdictions as appropriate.

'Incidents' include:

- injury or death of personnel (whether legitimately on site or otherwise);
- injury or death of fauna (domestic or native) on or near the TSF;
- uncontrolled release of tailings or supernatant water (pipe breaks, overtopping of dam);
- major, unplanned, seepage (discernible impact on vegetation, soil contamination, groundwater accession) and
- defects in the structure of the TSF (cracking, slumping or significant erosion of the wall, faults in the decant system.

Incidents

Incidents and accidents associated with the management of tailings should be reported immediately.

9. WASTE MINIMISATION

Tailings are one of the principal waste streams in the mining and extractive industries. It is acknowledged that, although it may be possible to reduce the volume of tailings waste at some mines and extractive operations, avoidance or elimination of waste is not practicable in many cases.

It is also appreciated that, while drying or stabilisation of tailings can result in lower risks to the environment, they also add cost to the operation and could make some proposed operations uneconomic. Further, some technologies that offer promise for avoidance or elimination of waste, may introduce other environmental risks.

The proponent for a TSF should consider potential waste minimisation programs and reuse opportunities as an integral part of a submission for a tailings storage proposal.

Subject to the practicabilities offered by the nature of the materials involved and economics of the operation, the order of preference for managing waste should be:

1. Avoidance – processes or materials should be changed, where possible, to eliminate the generation of the waste;
2. Reuse – some wastes may be redirected to other uses such as underground backfill and packing sand;
3. Recycle – materials included in the waste may be suitable as feedstock for further processing such as in concrete or shot crete production;
4. Recovery of energy – wastes may be useful as fuel for energy production or substitution;
5. Treatment – it may be possible to make wastes innocuous by further treatment or processing;
6. Containment – secure storage of wastes in facilities that are isolated from the environment is often preferable to disposal and
7. Disposal – discharge of waste to the environment under controlled conditions and in a manner which does not cause environmental harm.

Waste minimisation

The proponent for a large TSF should provide an assessment of appropriate alternative waste management programs based on the principles of waste minimisation. The submission should include a description of the method and should consider practicability, cost and current industry best practice.

Proponents for small TSFs should consider the principles of waste minimisation in development of the TSF proposal. The department may request further analysis where it is considered necessary for the protection of the environment or reduction of risks to the community.

B. DESIGN

10. SITING OF A TAILINGS STORAGE FACILITY

One of the earliest and most important stages in the design of a TSF is the selection of an appropriate site.

Site selection often requires analysis of a number of competing factors, some of which may be subject to regulation. It may, for instance, be influenced by the potential impacts of the TSF on environmental, social,

cultural and landscape values or by local planning issues. Factors related to the site itself, such as the potential for flood or seismic activity, foundation conditions, availability of construction and rehabilitation materials, or the depth to groundwater, would also influence its selection. In turn, the chosen site may affect the overall cost: for example because of wall or lining requirements.

TSFs should be designed and located to have the smallest practical catchment. The advantages and disadvantages of siting a TSF in a valley or away from a waterway are discussed in Appendix VI. It should be noted, however, that it is departmental policy that a TSF with a significant upstream catchment will not be approved unless the proponent can demonstrate that environmental risks are adequately addressed and there are no practicable alternatives.

Matters that will be considered in assessing the proposal include:

- the area and nature of the catchment above the TSF;
- climatic conditions, such as peak flows from critical design storms and wet seasons;
- the long term stability of structures, such as stream diversions;
- location of domestic water supplies;
- effects of drainage works on downstream flow regimes, particularly flooding;
- landscape design and
- the planned rehabilitation outcomes.

Siting of a TSF

The proponent for a TSF should identify and investigate reasonable potential alternative sites and undertake realistic assessments of comparative risks.

Where a valley dam is the only practicable alternative, the proponent should demonstrate that all environmental risks have been identified and are adequately addressed.

TSFs should be designed and located to have the smallest practical catchment.

11. TAILINGS STORAGE FACILITY DESIGN

TSFs are tailored to the particular site, the mineralogy and treatment of the raw material and the desired ultimate landform. The primary design objectives outlined by the

Australian National Committee on Large Dams are (ANCOLD 1999):

- the safe and stable containment of tailings;
- the management of decant and rainfall runoff;
- the minimisation or control of seepage;
- a cost effective storage system and
- a planned system for effective closure.

The design should be adequate for the proposed use, meet contemporary standards and have identified and addressed all the likely risks associated with the site, the nature of the containment materials, the nature, quantity and treatment of the tailings, construction process and closure.

The design of large TSFs should be based on appropriate standards and principles such as those outlined in 'Guidelines on Tailings Dam Design, Construction and Operation' (ANCOLD 1999) and 'Guidelines on Selection of Acceptable Flood Capacity For Dams' (ANCOLD 2000) and subject to adequate Risk Assessment. For small TSFs (not storing contaminated tailings), appropriate design criteria can be found in the guide to managing the safety of farm dams – *Your dam, your responsibility* (NRE 2002).

The Design Plan of large TSFs, and those of any size that will store contaminated tailings, should be undertaken and certified by a suitably qualified and experienced person (*Definitions and acronyms*).

The designers should clearly define the parameters and assumptions that are made in the design process and develop an appropriate design response. The designer should specify any particular requirements for ensuring the ongoing stability of the embankment including monitoring programs. The designer should submit Design Certification to the department that the plans meet appropriate engineering and safety standards and are consistent with these guidelines The design should include a description/specification of what parameters and methods should be used in construction monitoring to verify the design assumptions.

Where a proponent can demonstrate that they meet criteria (b) to (g) of a suitably qualified and experienced person the department may allow for internal design of the TSF. However independent certification of the design, by a person fulfilling all the criteria of the above definition, will be required.

Proponents should demonstrate that the most appropriate disposal method has been selected. Alternatives to wet storage systems for tailings discharge are encouraged. This is particularly important if the nature of the tailings materials may compromise final rehabilitation (such as slimes that will not dry successfully). In such cases proponents of large TSFs will be required to show that alternatives to wet deposition have been examined and to justify its use if no alternative is proposed.

Contemporary types of TSF and their construction are described in Appendix VI. Construction of a conventional dam style TSF usually involves an initial embankment with subsequent lifting of the dam crest as the need arises. Proponents should specify the type and number of lifts at the time of initial design and display control of any risks associated with the design.

Proponents should avoid the use of tailings to construct the dam embankment, because of the nature of tailings and the climate in Victoria. This is particularly important in high rainfall areas or for large TSFs. A Risk Assessment will be required where it is proposed to use tailings for dam embankment construction.

Proponents must submit the design of the TSF to the department for approval. The relevant details of the planned operation should also be entered on the Tailings Storage Facility Data Sheet (Appendix IV), which should be presented with the design.

TSF design

The proponent of a large TSF using wet deposition should demonstrate that this method is the most appropriate for the site and that alternatives have been examined.

Design Plans for large TSFs and those TSFs storing contaminated tailings, should be prepared by a suitably qualified and experienced person who should submit the design as well as Design Certification to the department that the plans meet appropriate engineering and safety standards and are consistent with these guidelines.

Where a proponent can demonstrate that they meet criteria (b) to (g) of a suitably qualified and experienced person the department may allow for internal design of the TSF. However independent certification of the design, by a person, fulfilling all the criteria of the above definition will be required.

11.1 Design for water management

Good water management is critical to the safety of the TSF and the quality of the final outcome. The design of a large TSF should display a quantitative water balance of all gains and losses (Appendix III and VI) and satisfy the 'worst case' combination of risk factors (e.g. full TSF, wave action, design storm, breakdown of decant process).

Water design requirements for TSFs including freeboard and emergency spillways are specified in Appendix VII. These are adapted from criteria outlined by ANCOLD (2000).

Proponents of small TSFs containing benign or low level contaminated tailings and without an external catchment may choose to adopt the requirements outlined in NRE (2001). In this case the TSF must be sufficient to contain the waste inputs and rainwater during a one in ten year wet year and still retain a minimum one metre freeboard.

Large TSFs, TSFs with external catchments or TSFs storing contaminated tailings must provide assessments to demonstrate that the TSF has the capacity to meet the requirements of Appendix VII. To this end, the catchment size should be as small as practicable as runoff from the rain falling on the surrounding land surface as well as that within the TSF are to be accounted for. Runoff calculations should be made in accordance with appropriate methods as outlined in IEA (1998) and Bureau of Meteorology (BOM, 2003).

Most TSFs in Victoria are designed to have no discharge. However, appropriately designed emergency spillways are required for all new large TSFs or any TSFs storing contaminated tailings to deal with the exceptional circumstance where there is a risk of embankment failure.

The spillway should be designed and maintained to the peak flow from the storm event (Appendix VII) without damage to the embankment and infrastructure. The spillway should lead to an emergency overflow dam, which is kept empty during normal operations.

The department and the EPA must be notified prior to the commencement of the emergency discharge and implementation of the ERP may be required.

Where sub-aerial deposition (in which final rehabilitation requires drying of the tailings mass) is proposed in a large TSF, the design should include decant or water recovery facilities to minimise the amount of supernatant water in the dam at any one time.

Alternatively, the proponent should demonstrate why a decant or water recovery facility is not required and that risks have been adequately addressed.

The type of water decant system used and, particularly, the location of any decant pond may influence the stability of the embankment. Where upstream lifts are proposed, the decant pond, should be situated away from the outer wall of the TSF to reduce both the degree of saturation of the embankment materials and the piezometric levels.

Where diversion of clean runoff water around a TSF is required, works should be carefully designed to prevent downstream impacts such as erosion or siltation. Design of diversion works should be based on site specific hydrological data.

Design for water management

The design of a large TSF or one storing contaminated tailings should display a quantitative water balance of all gains and losses.

Large TSFs or ones storing contaminated tailings should comply with the water design requirements specified in Appendix VII.

Emergency spillways are required for all new large TSFs and all new TSFs storing contaminated tailings. The spillway should lead to an emergency overflow dam, kept empty during normal operations. Where sub-aerial deposition is proposed in a large TSF, the design should include decant or water recovery facilities.

Where sub-aerial deposition is proposed in a large TSF, the design should include decant or water recovery facilities.

11.2 Seepage Containment

TSFs must be designed to ensure that the beneficial uses of groundwater and surface water are protected and to prevent other undesirable impacts such as waterlogging and land salinisation.

Although the permeability of deposited tailings sediment is often low and they may have the capacity to quickly attenuate contaminants, some seepage from TSFs, both during the deposition phase and after decommissioning, is inevitable. Where seepage may contain contaminates it must be minimised to levels that will not cause groundwater or surface water pollution.

Seepage may be controlled by the installation of a liner and/or adequate under drains. Proposed under drainage systems should be subject to appropriate Risk Assessment. In some cases, an external seepage collection system may be required.

Where tailings are inert (e.g. small mines and extractive industry) and the underlying substrate provides a firm, low permeability foundation, seepage rates may be of little concern and a liner may not be required. However all proposals for TSFs should demonstrate that the proposed design is appropriate to the particular circumstances. As specified in section 7.1, a documented Risk Assessment is required for the design of a large TSF, or one storing contaminated tailings. This should consider not only the chemical composition of the seepage but also whether the seepage has the potential to cause or exacerbate waterlogging and land salinisation.

In the mining industry where tailings often contain cyanide, heavy metals or other undesirable constituents, seepage rates usually need to be managed by the installation of a suitable liner and often an under drainage system. A number of options for liner construction are available including clay and artificial liners or a combination of both.

Where a liner is required for a large TSF or one storing contaminated tailings, the Risk Assessment process should be used to specify an appropriate design permeability and liner thickness. The Risk Assessment should include consideration of the:

- potential rate of seepage under and through the embankment and the base of the TSF;
- predicted chemical composition of seepage;
- predicted physical and chemical properties of the tailings;
- characteristics of the underlying substrate, and
- potential impacts on the beneficial uses of groundwater and surface water systems.

TSF design proposals incorporating a clay liner should specify a minimum thickness for the liner, taking the following factors into account:

- the thickness required to ensure construction is practicable given the need to compact in layers and minimise the development of preferential pathways;
- the applicability of assumptions about the degree of compaction to be achieved and the extent of homogeneity in the liner material;
- the permeability of the underlying substrate;
- the expected permeability of the emplaced tailings and
- the risk of the liner integrity being compromised by cracking or mechanical damage while tailings are being deposited or prior to commencement of deposition.

As stated above, the primary objective of TSF design is assurance of an appropriate level of containment for tailings. For TSFs storing contaminated tailings (Definitions and Acronyms), the department requires that the standard of containment is at least equivalent to a constructed liner of 0.6m thickness of clay, with a permeability of 10-8m/s.

In some cases, the containment system proposed for a TSF storing contaminated tailings, may include artificial liners or incorporate a low permeability substrate or tailings mass. Where this is the case, the proponent must demonstrate that the proposed system provides the required level of containment. The department may consult other relevant agencies before determining whether to approve such proposals.

Seepage Containment

TSFs must be designed to ensure that the beneficial uses of groundwater and surface water are protected and to prevent other undesirable impacts such as waterlogging and land salinisation.

Where a liner is required for a large TSF or one storing contaminated tailings, the Risk Assessment process as outlined in section 7.1 should be used to specify an appropriate design permeability and liner thickness.

For those TSFs storing contaminated tailings, the standard level of containment should be at least equivalent to 0.6 metre of clay with permeability no greater than 10-8 m/sec.

11.3 Design for closure

Most TSFs require large quantities of cover material for closure. Accordingly, the Work Plan should describe how the TSF is to be closed and the source of the cover material. A preliminary assessment of the geochemistry of the tailings, to identify any constituents with the potential to have an environmental impact, is fundamental to assessing requirements for closure.

The type and depth of cover are also influenced by the desired revegetation outcomes and future activities permitted on the closed TSF. These matters are discussed later in this document.

Design for closure

The Work Plan should describe how the TSF is to be closed and the source of the cover material. The design should account for the end use of the land, the nature of closure and the proposed rehabilitation.

12. MANAGEMENT OF CYANIDE

Sodium cyanide solutions are widely used in the mining industry for the recovery of gold and other non-ferrous metals. Industry favours cyanide because the technology is proven, well understood, and available at reasonable cost. However, cyanide is highly toxic and must be very carefully managed to minimise the associated risks.

Tailings containing toxic chemicals, such as cyanide, can often be treated to neutralise their toxicity. However, the processing costs must be weighed against the benefits. A further consideration is that cyanide compounds degrade rapidly in the environment. Potential technologies to replace cyanide exist but are not in wide use and are, in some cases, considered more hazardous.

The approach to be taken in the management of cyanide at a particular site is best determined by considering the hazards and risks applicable to the location. For example, the operator of a site close to wetlands that support a high waterbird population may consider the risk of bird mortality to be high. In such a case it may be appropriate to consider neutralisation of the cyanide or the erection of physical barriers to exclude the birds.

On the other hand, in a different location where large bird populations are unlikely, the normal operational concentration of cyanide may be considered acceptable. Similarly, the proponent of a TSF within a domestic or any potable water supply catchment would need to consider the risk of contamination of water supplies. In this case it is highly likely that neutralisation of cyanide would be required to adequately reduce the risk.

As indicated above, decisions about the management of cyanide depend on a number of interacting factors. A formal hazard identification and assessment approach is needed to determine the best approach. It is also essential that this assessment be undertaken in conjunction with Risk Assessments (section 7.1) for other elements of TSF design, such as location, water management and permeability, so that the outcomes are complementary.

Factors to be considered in relation to management of cyanide include:

- planned and possible discharge concentration and amounts from the plant to the TSF;
- potential impact on wildlife;
- risks to surface waters;
- risks to groundwater;
- risks to livestock and domestic animals and
- risks to people.

Controls that should be considered to mitigate the risks of cyanide include:

- reduction or elimination of the amount and concentration of cyanide in tailings;
- animal deterrents (acoustic or visible);
- physical barriers to access by animals to the supernatant water, such as fencing, mesh covers or floating barriers;
- decant systems or seepage control to reduce the surface area of the supernatant pond;
- more intensive site supervision and
- amendments to design criteria, such as structural design or deposition method.

In addition to the above requirements, operations that use cyanide must comply with the Occupational Health and Safety (Mines) Regulations 2002 regarding the protection of people in mines against risk.

Cyanide management

The proponent for a TSF shall provide a detailed and operation specific Risk Assessment for the management of cyanide tailings. The TSF design and management approach should ensure risks are adequately addressed.

C. CONSTRUCTION

13. CONSTRUCTION TO DESIGN

It is essential that construction of a TSF accords with the approved design and is carried out to a high standard of workmanship. Adequate supervision of the works is essential to ensure relevant factors are addressed.

A suitably qualified and experienced person should undertake supervision of the construction of large TSFs and those where contaminated tailings are to be stored.

'As Constructed' Reports detailing the construction of each lift should be prepared and retained to assist determination of the overall stability and the future life of the TSF.

The reports should include survey drawings of:

- the original ground surface contours inside and outside the TSF;
- the locations of test boreholes and pits (and details about their backfilling);
- the locations of the drainage system;
- the locations and profiles of any borrow pits inside the facility;
- embankment profiles and
- confirmation that the lining has been constructed to the required specifications.

The retention of Construction Records is essential for the effective monitoring of long term performance (MCMPR and MCA 2002).

Ground conditions should be properly monitored and appropriate remedial works undertaken where zones of higher permeability or lower structural strength are encountered in the substrate. This information should be included in the 'As Constructed' Report.

The embankment walls should be correctly keyed in. Some designs may rely on such technically complex features as grout curtains or geo-membrane liners.

The materials used should be appropriate and compatible with the rest of the design, emplaced to the correct compaction levels and gradient and produce an erosion resistant outer wall.

Where it is necessary to vary the design during construction of a large TSF, the operator should verify that the changes do not compromise the design objectives. The changes should be reviewed and endorsed by a suitably qualified and experienced person (such as the original designer).

The licensee is required to submit a detailed 'As Constructed' Report for each lift of any large TSF or one where contaminated tailings are to be stored, which confirms that construction complies with the design and sets out any modification to the design.

A suitably qualified and experienced person should certify the report.

Where a significant change to the design of a large TSF is necessary a revised design, prepared and certified by suitably qualified and experienced person, must be submitted to the department for approval.

A significant change in the design is one that would affect the Risk Assessment of the TSF.

Construction of a TSF

Upon completion of the initial construction of a large TSF or one that will store contaminated tailings, and upon the completion of each lift, the licensee should:

a) obtain certification from a suitably qualified and experienced person that the construction of the TSF 'as constructed' accords with the certified and approved Design Plans, and

b) submit the 'As Constructed Report' and the Construction Certification to the department.

When it is necessary to modify the design of a large TSF during construction, the licensee should:

a) determine if the modification is significant; b) obtain prior agreement to the modification from the person who certified the original design; c) if a significant change is proposed, submit a revised design to the department for approval certified by suitably qualified and experienced person; d) on completion, obtain certification from a suitably qualified and experienced person that the modification 'as constructed' meets appropriate engineering and safety standards and is consistent with these guidelines and e) submit the Modification Certification to the department.

The licensee of a small TSF should ensure that construction is undertaken in accordance with the design and to professional standards.

D. OPERATION

14. OPERATIONAL PHASE MANAGEMENT

Well planned operational practices can reduce long term costs and minimise risks to the environment. The Work Plan should set out the planned operational phase of the TSF. This should include planning for the systematic deposition of tailings, water and process chemicals in the facility. Although these processes are simple, minor variations in the way they are carried out can significantly impact on the outcomes.

To this end an Operations Manual, for utilisation by operational personnel, should be in place from the time of commissioning of the TSF. This should provide the basis for converting the objectives of the Work Plan into appropriate actions on the site.

The level of detail in an Operations Manual would be determined by the characteristics of the specific site. However, the manual should document all relevant operational procedures such as:

- roles and responsibilities;
- method for tailings deposition;
- water management and maintenance of freeboard (e.g Appendix VI and VII);
- inspection schedule and maintenance;
- dam safety and environmental monitoring;
- record keeping;
- reporting requirements and
- any additional requirements specified by the designer.

TSF personnel should have a detailed understanding of those aspects of the Operations Manual relevant to their day to day functions and responsibilities. The operations manual should be updated as required to reflect any significant changes in site conditions.

Operation An Operations Manual, for utilisation by operational personnel, should be in place from the time of commissioning of a TSF.

The manual should document all relevant operational procedures for the specific site.

TSF personnel should have a detailed understanding of those aspects of the Operations Manual relevant to their day to day functions and responsibilities.

15. PIPELINES

Most tailings management operations involve pumping and conveying of tailings and decant water by pipeline, discharge spigotting and, in some cases, separation or drying processes. All of these activities introduce a risk of accidental discharge as a result of failure of mechanical systems -such as broken pipelines or faulty control devices -or materials. Appropriate maintenance and replacement schedules for mechanical equipment are necessary for safe operation.

Tailings pipelines may be required to have control systems designed to shut the supply pump down if a no-flow condition is detected at the discharge end. This ensures that the tailings supply is stopped if a catastrophic failure occurs in the pipeline. These systems do not, however, eliminate the risk of a discharge event where a pipeline develops a serious leak but does not fail completely.

Most existing pipelines are constructed in trenches or between parallel bunds so that spillage is directed to dedicated catch dams. Escapes may still occur where liquid under pressure escapes as a jet at an elevated trajectory. Mechanisms to minimise the chance of such events include completely encasing the pipeline in a secondary sleeve or constructing covers over pipe joints.

Although the department does not specify particular measures for increased safety for tailings pipelines and other equipment, the proponent and operator should be able to demonstrate that the measures proposed and implemented reduce the risks to an acceptable level.

Procedures for pipeline inspections should form part of the Operations Manual.

Pipelines

Written records of inspection and maintenance of tailings pipelines and other tailings equipment should be maintained and made available for audit.

The proponent and operator should demonstrate that measures proposed and implemented to prevent accidental discharge reduce the risk of a discharge event to an acceptable level.

16. MONITORING, AUDITING AND REPORTING

Monitoring and auditing are essential management tools for the operation of a TSF. Where monitoring or audit indicates deficiencies in the Risk Assessment or risk reduction activities, there should be a clearly defined process for review of those measures.

Monitoring, auditing and reporting

A program for monitoring, auditing and reporting operational and environmental factors appropriate to the nature and scale of the operation should be included in the Work Plan for a TSF. The monitoring and reporting components of the program should be specified in the Operations Manual.

16.1 Monitoring

A site specific monitoring program should be developed for a TSF based on the key risks identified in the Risk Assessment process and on other known issues.

The monitoring program should ensure early detection of any unexpected impacts. It should also enable validation of the assumptions made in the Risk Assessment and indicate aspects of the operation where further risk analysis is warranted.

A program to monitor a large TSF or one storing contaminated tailings should:

- identify the scope of the program;
- define the objectives of the program;
- determine the indicators to be measured;
- select sample collection sites (for example, for surface and groundwater);
- determine the monitoring frequency (daily, weekly, monthly, etc);
- where necessary, establish a site based laboratory and/or select an appropriate testing laboratory (NATA registered);
- report results, particularly any that exceed specified limits and
- ensure that licensees are able to fulfil the requirements of Schedule 15 of the *Mineral Resources Development Regulations* 2002.

Monitoring

The Work Plans for all TSFs should include a site specific monitoring program based on the key risks identified in the Risk Assessment process and on other known issues, and a process for reporting outcomes to the community.

16.2 Safety monitoring of tailings storage facilities

Routine monitoring of a TSF dam is aimed at avoiding failure by giving early warning of any symptom of trouble so that timely maintenance can be carried out.

Further, a TSF is usually designed for particular tailings characteristics. Deviations from these particular characteristics (such as grading, density or chemical constituents) could influence the operating procedures and the performance of the facility.

Depending on the facility, features to be included in a safety monitoring program for a large TSF may include:

- seepage or leakage through the embankment;
- cracking, slips, movement or deformation of the embankment;
- erosion of the embankment;
- pond level;
- pond location (location of the pond against the embankment may pose particular problems);
- piezometric levels in embankments (to this end, knowing the location of the phreatic surface would assist);
- structural defects or obstruction in infrastructure (outlet pipes, spillway, decant system);
- borehole groundwater elevations;
- under-drain flow rates;
- obstruction or erosion of diversion drains and
- characteristics and consolidation behaviour of the tailings (enabling prediction of final settlement and refinement of design to suit the predicted conditions).

In preparing a safety monitoring program, proponents should also consider the provisions of ANCOLD (2003) guidelines on dam safety management.

Simpler but nevertheless systematic and effective monitoring programs can usually be devised for smaller TSFs based on the above features. The guide Your dam, your responsibility (NRE 2002) also provides useful information on safety surveillance of small dams.

Safety Monitoring of TSFs

Monitoring of TSFs should be tailored to the size and nature of the TSF and its contents and the associated risks identified in the Risk Assessment process.

Proponents should include an appropriate TSF safety monitoring program in the work plan including an Annual Audit as required by Section 16.5.

Operators of large TSFs should ensure that an inspection and review of dam safety is undertaken at least annually by a suitably qualified and experienced person.

16.3 Environmental monitoring

Work Plans for all large mining and extractive sites are required to incorporate a monitoring program to address key environmental issues and a process for reporting outcomes to the community. Environmental monitoring may also be required for TSFs at small mine or extractive sites depending upon the size of the TSF, type of tailings and the risks involved.

Properly designed, a monitoring program should assist the operator to run the mining or extractive operation and TSF efficiently and with minimum impact on the environment. The data produced can also help demonstrate performance to the community and should fulfil the reporting requirements of Schedule 15 of the *Mineral Resources Development Regulations* 2002.

The environmental monitoring program for the TSF should be incorporated into the overall Environmental Management Plan for the site.

Environmental aspects that may require monitoring include:

- impacts on surface water;
- impacts on groundwater quality;
- impacts on groundwater level;
- impacts on vegetation;
- impacts on fauna (birds in particular are susceptible to poisoning by drinking tailings supernatant water);
- impacts on aquatic ecosystems;
- generation of dust, noise or odour, and
- spray drift and its effects on the vigour of adjacent vegetation, where aerial sprays are used to enhance evaporation or to reduce dust.

Remedial action should be implemented if conditions are found to be outside the design or predicted parameters.

Groundwater is one of the most commonly monitored environmental aspects. A number of bores are usually installed at selected locations around a TSF to enable monitoring of both the level and quality of groundwater. A good understanding of the local groundwater environment and chemistry is necessary to ensure that bores are located in appropriate places and drilled to the correct depth. In some cases, multiple bores are required to intercept different aquifers.

It is also common to install shallow bores near dam walls to permit detection of any seepage that might occur. Where a TSF is constructed near surface watercourses it is also good practice to monitor upstream and downstream from the facility. Although, in most cases, no discharge is permitted, monitoring allows the operator to verify compliance and ensure that no contamination has occurred by any pathway associated with the TSF. Samples will need to be collected before, during and after the life of the operation.

Additional parameters to be monitored and the nature and detail of the monitoring would depend on the site-by-site Risk Assessment that would identify the critical hazards.

Factors that should be monitored following decommissioning of a TSF, and until the site is resumed by the land owner or land manager, are discussed later in this document.

Environmental monitoring

The monitoring program should address key environmental issues.

16.4 Monitoring of transfers

In accordance with Schedule 15 of the Mineral Resources Development Regulations 2002, the volumes and chemical characteristics of tailings and process water transferred to or from a mining TSF shall be monitored and included in the Annual Report as part of the normal reporting of the operation. Appendix IV Tailings Storage Facility Data Sheet, provides a reporting proforma.

The reports can provide an understanding of the characteristics of the waste stored in the TSF and may be important for future land management decisions. They could also provide the operator some insight into the degree to which application of the principles of waste minimisation has been successful.

Monitoring of transfers

The volumes and chemical characteristics of tailings and process water transferred to or from a mining TSF shall be monitored.

16.5 Auditing and reporting

Regular independent audits ensure that essential systems and procedures are maintained and improved where necessary.

Periodic operational audits also provide a valuable status report of actual performance of the TSF against the design parameters, expectations or assumptions. The records provide an ongoing history of the facility, which is vital on sites where frequent personnel changes occur, and assist with tailings management planning, wall lift scheduling and improvements to the overall operation.

The operator of a large TSF, or one storing contaminated tailings, should ensure that a suitably qualified and experienced person (preferably the original designer) implements an Annual Audit and review of the facility. This should confirm that the operations are consistent with the Work Plan and should assess the adequacy, applicability and implications of the program. The Annual Audit Report should be submitted to the department.

Periodic Audit and Review Reports should include the following:

- updated site plan;
- updated survey plan of the facility including cross-sections and contours of the embankment and tailings beach; including certification from a suitably qualified and experienced person that any construction (since the last report) meets appropriate engineering and safety standards and is consistent with the conditions set out in these guidelines;
- data on the engineering properties (including dispersion/erodibility tests) of any construction and lining materials actually used, comparison of performance against design criteria, and their sources;
- updated data on the properties of the tailings stored in the facility;
- reconciliation of the stored volume and densities of the tailings against the Work Plan;
- calculations of the deposition rate against capacity and of the remaining capacity in terms of time and volume;

- water balance data;
- climatic conditions over the period between reports;
- data from daily (routine inspections) and periodic monitoring during TSF operation for such factors as dust, odour and water management (where not otherwise required in the Schedule 15 report);
- A review of the results of the safety and stability monitoring done in accordance with Section 16.2;
- A review of the results of environmental and tailings transfer monitoring done in accordance with Sections 16.3 and 16.4;
- information on operation of diversion; drains, TSF capacity and freeboard and downstream areas during storms and wetter seasons;
- information on the location and depth of boreholes and the proposed monitoring program for boreholes;
- inspection and maintenance schedules for tailings pipelines and other tailings equipment;
- information on the conduct of the operations in terms of the risk assessment and
- planned operations for the next reconciliation period.

Auditing

The operator of a large TSF or one storing contaminated tailings should implement an Annual Audit and review of the facility to confirm operations are consistent with the Work Plan.

The Annual Audit should be undertaken by suitably qualified and experienced person, preferably the original designer.

For mining TSFs, the report on the Annual Audit should be submitted to the department accompanied by the Tailings Storage Facility Data Sheet (Appendix IV).

E. DECOMMISSIONING

17. OVERVIEW

Tailings material must be securely stored for an indefinite period and present no hazard to public health and safety or the environment. Therefore the closure of a TSF and rehabilitation works must be as inherently stable, as resistant to degradation and as consistent with the surrounding landscape as possible. The design should also seek to minimise maintenance or upkeep.

The nature of the tailings, the process by which they were deposited and the design for water recovery can significantly influence the costs and risks associated with closure of a TSF.

The diversity in materials and objectives makes it impractical to prescribe designs for TSF covers. Operators are encouraged to undertake research into cover designs and to justify the type proposed based on a case –by case analysis of the objectives and risks. Proposed designs will be assessed on their merits.

18. CLOSURE

18.1 Closure strategy

Early planning for closure of a TSF can reduce risks for both the community and operator and minimise costs at the end of the project's life. Most TSFs require large quantities of cover material for closure. Accordingly, a proponent must demonstrate in the initial Work Plan. how the TSF is to be closed and the source of cover material. Sometimes at the end of a project aspects of the initial Rehabilitation Plan will no longer be appropriate. In this situation a revised closure proposal, submitted, as a Work Plan Variation may be required.

Closing a TSF can involve a number of processes. In many cases stored tailings must be dried over a long period to enable the passage of earthmoving equipment. In some, significant engineering works may be required, such as the construction of a spillway and alteration of surface drainage, the provision of a layered dry cover or controls to establish a permanent water cover.

The progressive closure and rehabilitation of individual TSFs, or cells of TSFs, is encouraged, provided this is integrated into the overall closure strategy. Progressive closure provides the opportunity to monitor the success of reclamation strategies and to refine future programs in the light of operational experience (MCMPR and MCA 2002).

The potential environmental impacts of decommissioned TSFs include groundwater contamination, acid drainage and erosion of material by water and wind. While the threat of catastrophic failure is usually reduced due to the de-watered nature of the deposit, under certain circumstances it remains an important consideration.

The final landform design must be compatible with the form of containment or encapsulation of the tailings, the nature of the embankment materials, the needs of the community and the landowner, any legal requirements, climate, local topography and the level of management available after reclamation.

Closure

Plans for the closure of a TSF should be included in the initial Work Plan for the TSF.

The nature of closure of a TSF should be appropriate to the nature of the contents, the desired final landform and accord with community and landowner expectations.

Progressive closure and rehabilitation of individual TSFs, or cells of a TSF, is encouraged, provided this is integrated into the overall closure strategy.

18.2 Cover design

The characteristics of the particular tailings and the topographic, hydrogeological, geotechnical and climatic characteristics of the disposal site usually determine the appropriate cover design. Covers range from complex multilayers of earth and rock to those where only a relatively thin growing medium is required on the surface.

Where the tailings is, for example, sulphitic, it may be essential to exclude oxygen from the substrate, in which case the cover must include an anoxic layer or impermeable barrier. In those circumstances, water covers or designs incorporating an artificially high watertable are often used. Where the tailings are less reactive, impermeable layers may not be required but it may be necessary to install a layer of broken rock to stop capillary rise or to use a large volume of material in order to provide a sufficient depth of soil for root establishment. Typical covers for TSFs are described in EPA (1995).

Cover design

The proponent should demonstrate that the type and depth of cover proposed for closure of a TSF is suitable for the nature of the contained tailings, the proposed revegetation and subsequent management regime.

18.3 Revegetation

The type and depth of cover used in rehabilitation of a TSF are also influenced by the desired revegetation outcomes and future activities permitted on the closed facility.

In some cases large depths of soil and rock may be required to ensure adequate resources for tree growth, while, where the area is expected to return to pasture, less cover would be required. Caution should be exercised in revegetating with trees, however, as the cover or lining may be compromised by roots or when trees fall or are removed.

The potential for erosion of enclosures is also of concern, and the risk increases considerably where the area is used for intensive agriculture (cultivation) and with the steepness of the embankment. Even with less intensive agriculture, such as grazing, potential for erosion exists along frequently used stock routes and during drought.

In Victoria, the vegetative cover of a TSF is likely to be burned by wildfire at some time, potentially exposing the soil surface to erosion.

Revegetation

Performance criteria should be developed for revegetation of a decommissioned TSF. Actual performance should be assessed for an agreed period against expectations and alternative plans implemented in the event that objectives are not being met.

18.4 Post-closure monitoring and management

Unless full scaled pre-closure trials have been carried out, it is unlikely that the success of the method of closure and cover design for a large TSF or one storing contaminated tailings can be demonstrated in less than five years following cessation of operations.

Another consideration in determining the length of the post closure and management programs is the time frame for environmental monitoring programs to detect any impacts. This is particularly important with respect to TSFs containing material with a potential to impact on groundwater. In such cases the migration of a contaminated plume may take several years before it reaches a groundwater monitoring bore.

Broadly, and within the land use objectives set for closure, monitoring of a decommissioned TSF should continue until formal closure and resumption of management by the landowner.

Post-closure monitoring should include:

- revegetation performance;
- flood mitigation and drainage control;
- seepage;
- erosion control;
- control of pest plants and animals (including the establishment of wilding trees in forested or plantation areas) and
- groundwater quality.

The monitoring should be able to demonstrate that (MCMPR and MCA 2002):

- structures are geotechnically stable, and covers are not eroding at unacceptable rates;
- there is a low risk of an uncontrolled release of tailings or contaminants;
- the contaminants or tailings will not result in recognisable detrimental effects on the surface water and groundwater, soil and air surrounding the closed facility and
- required plant growth has been successful and that, over a period of several growing seasons, a self-sustaining community has developed.

Post-closure monitoring

The operator should design a monitoring program to demonstrate that completion criteria have been met and that the site is safe and stable.

19. LONG TERM RESPONSIBILITY

TSFs must be designed for the long term. Ultimately, however, even the best designed facilities will require maintenance or care. Facilities on private land would normally be subject to the requirements of the landowner agreement. It is assumed that landowners will take into account the long term maintenance costs when considering such agreements. However, many such facilities are constructed on Crown land and will therefore be the responsibility of the community in the long term.

Recent amendments to the MRD Act make compensation payable to the Crown for losses associated with the use of land. In addition, Section 26 of the MRD Act allows for the Minister to impose conditions on a licence for an environmental levy.

It is departmental policy that the TSF operator should provide for the long term maintenance and up keep costs associated with such facilities. Where a TSF is located on Crown land, the department will seek to ensure that this is addressed by one or more of the following mechanisms:

- suitable provision in a Crown land compensation agreement;
- establishment of an appropriate environmental levy and
- conclusion of a suitable closure agreement between the operator and the Government.

Long term responsibility

Proponents and operators of a TSF should make provision for the long term costs associated with the up-keep and maintenance of the TSF.

20. FURTHER INFORMATION

For further information on matters discussed in this guideline or to discuss a proposal for a TSF, proponents should initially contact ERR at one of the offices listed in Appendix IX.

Appendices

APPENDIX I: SUMMARY OF DEPARTMENTAL REQUIREMENTS FOR MANAGEMENT OF A TAILINGS STORAGE FACILITY.

	Section	Requirement	Page

4	Work Plan	Proponents should ensure that the Work Plan for a TSF contains the details required by either the *Mineral Resources Development Regulations 2002* (for a mine) or *the Extractive Industry Development Regulations 1996* (for a quarry), and those set out in these guidelines and Appendix III.	**4**
5	Planning approval	The Proponent for a TSF should ensure that appropriate planning approval is in place. Where a proposed TSF has the potential for significant environmental impacts approval via an EES may be required.	**4**
6	Consultation	The proponent for a new TSF should undertake adequate consultation with the community and interested stakeholders. Where a proposed TSF represents a minor variation to a pre-existing operation consultation may not be necessary. However proponents are advised to seek confirmation from MPD about this issue.	**5**
7	Risk Assessment	The proponents of a TSF should adhere to the principles of risk management and ensure that potential risks to the community, workforce and environment are minimised. Proponents of large TSFs or those storing contaminated tailings should undertake a formalised Risk Assessment as part of the Work Plan submission. Proponents of large TSFs or those storing contaminated tailings should also demonstrate that the provisions of the Emergency Response Plan are based on a comprehensive Risk Assessment. Irrespective of Risk Assessment results, TSFs must comply with relevant environmental legislation and policy, such as State environment protection policy (SEPP) water quality objectives.	**7**
8	Emergency Response Plan	A documented Emergency Response Plan (ERP) should be prepared specific to the TSF (but which may be included as part of the ERP for the overall operation) and kept in a prominent and readily accessible location at the operation centre.	**8**
8	Incidents	Incidents and accidents associated with the management of tailings should be reported immediately.	**8**
9	Waste minimisation	The proponent for a large TSF should provide an assessment of appropriate alternative waste management programs based on the principles of waste minimisation. The submission should include a description of the method and should consider practicability, cost and current industry best practice. Proponents for small TSFs should consider the principles of waste minimisation in development of the TSF proposal. The department may request further analysis where it is considered necessary for the protection of the environment or reduction of risks to the community.	**9**

	Section	**Requirement**	**Page**
10	Siting of a TSF	The proponent for a TSF should identify and investigate reasonable potential alternative sites and undertake realistic assessments of comparative risks. Where a valley dam is the only practicable alternative, the proponent should demonstrate that all environmental risks have been identified and are adequately addressed. TSFs should be designed and located to have the smallest practical catchment.	**10**
11	TSF design	The proponent of a large TSF using wet deposition should demonstrate that this method is	**10**

		the most appropriate for the site and that alternatives have been examined. Design Plans for large TSFs and those TSFs storing contaminated tailings, should be prepared by a suitably qualified and experienced person who should submit the design as well as Design Certification to the department that the plans meet appropriate engineering and safety standards and are consistent with these guidelines. Where a proponent can demonstrate that they meet criteria (b) to (g) of a suitably qualified and experienced person the department may allow for internal design of the TSF. However independent certification of the design, by a person, fulfilling all the criteria of the above definition will be required.	
11	Design for water management	The design of a large TSF or one storing contaminated tailings should display a quantitative water balance of all gains and losses. Large TSFs or ones storing contaminated tailings should comply with the water design requirements specified in Appendix VII. Emergency spillways are required for all new large TSFs and all new TSFs storing contaminated tailings. The spillway should lead to an emergency overflow dam, kept empty during normal operations. Where sub-aerial deposition is proposed in a large TSF, the design should include decant or water recovery facilities. Where sub-aerial deposition is proposed in a large TSF, the design should include decant or water recovery facilities.	**11**
11	Seepage Containment	TSFs must be designed to ensure that the beneficial uses of groundwater and surface water are protected and to prevent other undesirable impacts such as waterlogging and land salinisation. Where a liner is required for a large TSF or one storing contaminated tailings, the Risk Assessment process as outlined in section 7.1 should be used to specify an appropriate design permeability and liner thickness. For those TSFs storing contaminated tailings, the standard level of containment should be at least equivalent to 0.6 metre of clay with permeability no greater than 10-8 m/sec.	**12**
11	Design for Closure	The Work Plan should describe how the TSF is to be closed and the source of the cover material. The design should account for the end use of the land, the nature of closure and the proposed rehabilitation.	**14**

	Section	**Requirement**	**Page**
12	Cyanide management	The proponent for a TSF shall provide a detailed and operation-specific Risk Assessment for the management of cyanide tailings. The TSF design and management approach should ensure risks are adequately addressed.	**14**
13	Construction of a TSF	Upon completion of the initial construction of a large TSF or one that will store contaminated tailings, and upon the completion of each lift, the licensee should: a) obtain certification from a suitably qualified and experienced person that the construction of the TSF 'as constructed' accords with the certified and approved Design Plans and b) submit the 'As Constructed' Report s and the Construction Certification to the department. When it is necessary to modify the design of a large TSF during construction, the licensee should: a) determine if the modification is significant; b) obtain prior agreement to the modification from the person who certified the original design; c) if a significant change is proposed, submit a revised design to the department for approval, certified by suitably qualified and experienced person; d) on completion, obtain certification from a suitably qualified and experienced person that the modification 'as constructed' meets appropriate engineering and safety standards and is consistent with these guidelines and e) submit the modification certification to the department. The licensee of a small TSF should ensure that construction is undertaken in accordance with the design and to professional standards.	**16**

14	Operation	An Operations Manual, for utilisation by operational personnel, should be in place from the time of commissioning of a TSF. The manual should document all relevant operational procedures for the specific site. TSF personnel should have a detailed understanding of those aspects of the Operations Manual relevant to their day to day functions and responsibilities.	**18**
15	Pipelines	Written records of inspection and maintenance of tailings pipelines and other tailings equipment should be maintained and made available for audit. The proponent and operator should demonstrate that measures proposed and implemented to prevent accidental discharge reduce the risk of a discharge event to an acceptable level.	**18**
16	Monitoring, auditing and reporting	A program for monitoring, auditing and reporting operational and environmental factors appropriate to the nature and scale of the operation should be included in the Work Plan for a TSF. The monitoring and reporting components of the program should be specified in the Operations Manual.	**19**
16	Monitoring	The Work Plans for all TSFs should include a site specific monitoring program based on the key risks identified in the Risk Assessment process and on other known issues, and a process for reporting outcomes to the community.	**19**

	Section	**Requirement**	**Page**
16	Safety Monitoring of TSFs	Monitoring of TSFs should be tailored to the size and nature of the TSF and its contents and the associated risks identified in the Risk Assessment process. Proponents should include an appropriate TSF safety monitoring program in the Work Plan including an Annual Audit as required by Section 16.5. Operators of large TSFs should ensure that an inspection and review of dam safety is undertaken at least annually by a suitably qualified and experienced person.	**19**
16	Environmental monitoring	The monitoring program should address key environmental issues.	**20**
16	Monitoring of transfers	The volumes and chemical characteristics of tailings and process water transferred to or from a mining TSF shall be monitored.	**21**
16	Auditing	The operator of a large TSF or one storing contaminated tailings should implement an Annual Audit and review of the facility to confirm operations are consistent with the Work Plan. The Annual Audit should be undertaken by suitably qualified and experienced person, preferably the original designer. For mining TSFs, the report on the Annual Audit should be submitted to the department accompanied by the Tailings Storage Facility Data Sheet (Appendix IV).	**21**

18	Closure	Plans for the closure of a TSF should be included in the initial Work Plan for the TSF. The nature of closure of a TSF should be appropriate to the nature of the contents, the desired final landform and accord with community and landowner expectations. Progressive closure and rehabilitation of individual TSFs, or cells of a TSF, is encouraged, provided this is integrated into the overall closure strategy.	**23**
18	Cover design	The proponent should demonstrate that the type and depth of cover proposed for closure of a TSF is suitable for the nature of the contained tailings, the proposed revegetation and subsequent management regime.	**24**
18	Revegetation	Performance criteria should be developed for revegetation of a decommissioned TSF. Actual performance should be assessed for an agreed period against expectations and alternative plans implemented in the event that objectives are not being met.	**24**
18	Post-closure monitoring	The operator should design a monitoring program to demonstrate that completion criteria have been met and that the site is safe and stable.	**24**
19	Long term responsibility	Proponents and operators of a TSF should make provision for the long term costs associated with the up keep and maintenance of the TSF.	**25**

APPENDIX II: ADMINISTRATIVE PROCESS FOR OBTAINING A WORK AUTHORITY

This appendix sets out the sequential actions required by the proponent and ERR leading to grant of a Work Authority or approval of a Work Plan Variation.

NB: Where a TSF is part of a larger mining proposal, the Work Plan requirements described in these guidelines may be addressed as part of the Work Plan for the overall project. However, where a proposed TSF is outside the provisions of the current work plan, the operator must submit an appropriate Work Plan variation, which may require planning approval.

Proponent	**Earth Resources Regulation**
In consultation with the department, the local municipality and the department managing the Environmental Effects Statement (EES) process, determines if the project requires an EES or planning permit. Where an EES is required, consult with the department and the department managing the EES process regarding the appropriate process to follow.	
Consults with the department, the local municipality, the community and other stakeholders to prepare a satisfactory Work Plan or Work Plan Variation.	
Prepares a draft Work Plan or Work Plan Variation and lodges it with MPD.	
	Endorses draft Work Plan and approves proponent to proceed with application for Planning Permit (if necessary).
Applies to Responsible Authority (usually the local municipality) for a Planning Permit on the basis of the endorsed draft Work Plan. (Note: for an existing project, a pre-existing Planning Permit or EES approval may permit the TSF to proceed without further approval. Proponents should determine whether this is the case.) • Municipality refers application to Referral Authorities (who include ERR) • Municipality makes a determination in the light of comments by the Referral Authorities and grants or refuses a Planning Permit	
Advises ERR that the Planning Permit is approved (and or any conditions).	
Makes any final amendments to the Work Plan and lodges it with ERR.	
	Where appropriate: On receipt of the Work Plan, lodges a copy with Ministers administering the *Crown*

	Land (Reserves) Act 1978 and/or the *Forests Act* 1958 for comment.
	Approves the Work Plan in consideration of comments and assessment information from the relevant authorities and subject to any required variations or conditions.
	Assesses the appropriate level of rehabilitation bond.
For new projects, applies to ERR for a Work Authority.	
Lodges the rehabilitation bond.	
Satisfies other requirements of relevant Acts of Parliament.	
	Grants the Work Authority (if a new project) Grant may be subject to conditions.
Proceeds with development.	

APPENDIX III: DOCUMENTATION AND INFORMATION TO BE SUPPLIED FOR THE OPERATION OF A TAILINGS STORAGE FACILITY

Documentation and Work Plan requirements referred to throughout this guideline are summarised in the table below. More detailed information on Work Plan requirements is provided in the following parts A (large TSFs) and B (small TSFs).

All mining and extractive industry operations must be detailed in an approved Work Plan. The Work Plan must include at least the information set out in Schedule 13 of the *Mineral Resources Development Regulations* 2002 (for mining) or Schedule 3 of the *Extractive Industry Development Regulations* 1996 (for quarries).

Work Plans for TSFs also must comply with these requirements. However, where the TSF is proposed as an addition to an existing site, much of the required information will be detailed in the Work Plan for that site and need not be reiterated in the TSF submission.

DOCUMENTATION REQUIREMENTS FOR A TAILINGS STORAGE FACILITY

Document	Description	TSF categories	Guideline Section
Approved Work Plan	Key elements include: • Waste Minimisation • Risk Assessment • TSF Design and water management • Environmental Management Plan, monitoring, auditing and reporting • Closure and long term responsibility.	All TSFs	4
Emergency Response Plan	Deals with the worst case scenario and includes procedures describing and prioritising such actions as protection of personnel, notification of emergency services and resource management agencies, advice to neighbours and immediate actions.	All TSFs	8
Incident and Accident Reporting	Reports about all accidents, incidents and emergencies affecting health or safety of personnel, fauna, surface and groundwater, vegetation and infrastructure.	All TSFs	8.1
Design Certification	Certification from a suitably qualified and experienced person that the design plans meet appropriate engineering and safety standards and are consistent with the guidelines.	Large TSFs and contaminated tailings TSFs	11
Construction Certification	Certification from a suitably qualified and experienced person that the construction of the TSF 'as constructed' accords with the certified and approved Design Plans	Large TSFs and contaminated tailings TSFs	13
'As Constructed' Reports	As Constructed' Reports detailing the construction of each lift prepared and retained to assist determination of the overall stability and the future life of the TSF.	Large TSFs and contaminated tailings TSFs	13

Operations Manual;	Documents all relevant operational procedures for the systematic deposition of tailings, water and process chemicals in the facility.	All TSFs	14
Annual Report: Monitoring of transfers	Reports on the volumes and chemical characteristics of the tailings and process water transferred to or from a mining TSF. The reporting proforma is provided in Appendix IV *Tailings Storage Facility Data Sheet.*	All mining TSFs	16.4
Annual Audit Reports	Reports the results of the annual audit to ensure that essential systems are maintained and improved where necessary.	Large TSFs and contaminated tailings TSFs	16.5

A. INFORMATION TO BE SUPPLIED IN A WORK PLAN FOR A LARGE TSF OR A TSF STORING CONTAMINATED TAILINGS

The following schedule lists detailed information required by the department in relation to proposals for construction, operation and closure of large TSFs (see Size of TSFs in Definitions and Acronyms for the criteria that determine a large TSF) and those storing contaminated tailings. These are additional to the basic requirements set out in the *Mineral Resources Development Regulations* 2002 or the *Extractive Industry Development Regulations* 1996.

Where possible, information should be displayed on a suitably scaled and referenced maps and plans.

Introduction

- objectives;
- general description of method of raw material processing and tailings storage;
- overview of the proposal, including commencement and expected closure dates, and the relationship with any existing (if relevant) or proposed operation and
- location map with AMG coordinates.

Environmental Features of the Site

- site Geology;
- potential for seismic activity;
- load bearing ability of TSF foundation;
- permeability of foundation/substrate;
- regional topography including the nature and extent of catchment to the TSF (the size of catchment should be the smallest practicable);
- site topography (contour plan), including surface drainage;
- proximity of surface water resources and their uses;
- flooding potential;
- depth and nature of the groundwater and its uses;
- sources of materials for construction of the embankment, liners and closure (if the borrow pits are located outside the area subject to the mining licence, an extractive licence may be required under the *Extractive Industry Development Act* 1995);
- location, extent and conservation status of potentially affected natural values at or near the site(extant native vegetation, rare or endangered flora or fauna wetlands, etc) and
- where removal of native vegetation is proposed an assessment in accordance with the *Native Vegetation Management Framework*, 2003.

Cultural Features of the site

- location of other infrastructure (built-up areas, dwellings and other buildings, storage sites, mine sites, access roads and ramps) on the site and on adjoining land;
- location and nature of cultural features (aboriginal, historic, recreational or landscape) and
- nature of adjacent agricultural activities, and local planning features.

Tailings Deposition Methodology and Waste Minimisation

- analysis of appropriate alternative waste management programs based on the principles of waste minimisation and justification of the selected method of waste management based on practicability, cost and current industry best practice (section 9 of guidelines);
- source of the tailings including process throughput rate (dry tonnes/year);
- tailings production rates (dry tonnes/year), rates of rise of the tailings surface within the TSF, expected changes with time and the potential for unplanned changes;
- details of the geotechnical (density and consolidation behaviour) and chemical properties of the tailings, reagents, process and return waters and residual process chemicals; expected changes with time;
- how deposition and drying is to be managed: expected changes with time and the potential for unplanned changes and
- design, location and operation (movement) of delivery system: to include pipe-break contingency plans.

Risk Assessment (section 7 of guidelines)

- identification of significant hazards to the environment, people and infrastructure;
- evaluation of the location of the TSF;
- evaluation of the type of lift to be used;
- identification appropriate design features or actions required to eliminate or reduce risks to an acceptable level;
- determination of the appropriate level of cyanide in the tailings and
- identification of matters to be addressed in the Emergency Response Plan.

TSF Design

- description of site preparation;
- plan of the TSF site itself showing details and total area of structure, working area and ultimate tailings capacity (volume to include allowance for non-recovered water content); to include conditions at start-up, during production and at close of operations;
- data on the engineering properties (including dispersion/erodibility tests) of construction materials;
- construction method – for initial embankment and type and number of lifts;
- engineering designs of the initial embankment and each lift. The design to show a section through the long axis of the embankment and cross sections (including final outer wall angle);
- 'As Constructed' Report to be provided when dam is completed;
- erosion control measures for the embankment and toe;
- stability computations for the embankment, both for static and for the 'expected' seismic events and
- design details and comparative assessments as required by Sections 10, 11 and 12 of the guidelines.

TSF Design for Water Management

- data on the source and engineering properties (including permeability and dispersion tests) of liner materials (if used);
- seepage (permeability) analyses for the TSF, both downward and through the embankment;
- design, location and Risk Assessment of any under-drainage (filter drains), catch drains, sumps and outfall pipes to intersect seepage and details of blanket drains;
- design, location and operation of any de-watering bores;
- determination of appropriate extreme rainfall events (see section 11.1 and Appendix VII of guidelines);
- analysis of the runoff into the TSF catchment for rainfall both on the storage itself and on the surrounding catchment (if applicable);
- design, location and operation of pond control and water decant facilities;
- quantified water balance model for all gains and losses;
- design, location and operation of return pipelines;
- design, location and materials of diversion drains and
- information to show that the design of the TSF and diversion drains satisfies the 'worst case' combination of factors (e.g. full TSF, overflow of tailings delivery system, failure of decant/recovery facilities, wave action, design storm); this

to include the impact on surrounding areas of the combined effect of the design storm runoff and the diverted waters, and detailed information on the management of cyanide (where relevant) and to show that the management is in accordance with an operation-specific Risk Assessment.

Environmental Management Plan

- identification of the key environmental issues based on the environmental features of the site and the Risk Assessment;
- proposals for the management and reduction of environmental impacts and
- a program for monitoring, auditing and reporting environmental factors appropriate to the nature and scale of the operation as required by Section 16 of the guidelines.

Safety Monitoring Program

- a program for monitoring, auditing and reporting safety and operational aspects appropriate to the nature and scale of the operation as required by Section 16 of the guidelines.

Incident management:

- plans for recording and reporting all accidents, incidents and emergencies affecting health or safety of personnel, fauna, surface and ground water, vegetation, infrastructure (Section 8.1).

Closure and rehabilitation:

- information on how closure is to be achieved in accordance with Section 18 of the guidelines;
- data on the source and engineering properties (including dispersion tests) of cover materials;
- detailed design of the cover, including demonstration that the proposed design will be suitable for the proposed vegetation type;
- details on erosion management and
- a revegetation program.

B. INFORMATION TO BE SUPPLIED IN A WORK PLAN FOR A SMALL TSF

(NB – Proposals for small TSFs where storage of contaminated tailings is proposed should submit information in accordance with Schedule A)

The following schedule lists detailed information required by the department in relation to proposals for construction, operation and closure of small TSFs. These are additional to the basic requirements set out in the *Mineral Resources Development Regulations* 2002 or the *Extractive Industry Development Regulations* 1996.

Introduction:

- general description of method of raw material processing and tailings storage;
- brief summary of the proposal, including commencement and expected closure dates, and the relationship with any existing (if relevant) or proposed operation, and
- location map with AMG coordinates.

Environmental features of the site:

- geology of the area to be covered by the TSF (especially any features that might effect the water tightness of the TSF;
- topography of the site and immediate surrounding area, particularly to indicate the nature and extent of catchment and surface drainage pattern (the size of catchment should be the smallest practicable);
- details of any watercourses or water supply dams likely to be affected in the event of an accidental discharge from the site;
- the potential for flooding;
- sources of materials for construction of the embankment, liners and closure (if the borrow pits are located outside the area subject to the mining licence, an extractive licence may be required under the Extractive Industry Development Act 1995);

- location, extent and conservation status of any known potentially affected natural values (extant native vegetation, wetlands, groundwater, etc);
- where removal of native vegetation is proposed an assessment in accordance with the Native Vegetation Management Framework, 2003 and
- location or indications of any known rare or endangered flora or fauna at or near the site.

Cultural features of the site:

- location and nature of cultural features (aboriginal, historic, recreational or landscape).

Tailings Deposition methodology and Waste Minimisation:

- consideration of the principles of Waste Minimisation (section 9 of guidelines)
- source of the tailings including approximate process throughput rate (dry tonnes/year),
- details of the chemical properties of the tailings, reagents, process and return waters and residual process chemicals.

TSF Design:

- design parameters used (these may derive from approved small dam design manuals);
- plan of the TSF site itself showing details and total area of structure, working area and ultimate tailings capacity (volume to include allowance for non-recovered water content) and
- erosion control measures for the embankment and toe.

TSF Design for water management:

- for TSFs with external catchments, determination of appropriate extreme rainfall events (see section 11.1 and Appendix VII of guidelines);
- for TSFs with external catchments, analysis of the runoff into the TSF catchment for rainfall both on the storage itself and on the surrounding catchment (if applicable);
- design, location and operation of discharge and return pipelines and
- design, location and materials of diversion drains.

Monitoring:

- a program for monitoring, auditing and reporting safety, operational and environmental factors appropriate to the nature and scale of the operation as required by Section 16 of the guidelines.

Incident management:

- plans for recording and reporting all accidents, incidents and emergencies affecting health or safety of personnel, fauna, surface and ground water, vegetation, infrastructure (section 8.1 of guidelines).

Closure and rehabilitation:

- information on how closure is to be achieved in accordance with Section 18 of the guidelines;
- details on erosion management and
- revegetation program.

APPENDIX IV: TAILINGS STORAGE FACILITY DATA SHEET

The following proforma is to be used for providing basic data about the proposed TSF for the initial Work Plan (supplemented with the balance of the required information as set out in Appendix III) and for annual reporting.

- Tailings Storage Data Sheet

- Explanatory Notes for Completing Tailings Storage Data Sheet

APPENDIX V: SMALL TAILINGS STORAGE FACILITY EMERGENCY PROCEDURES

The following procedures should be followed by the operator of a small Tailings Storage Facility in the case of a major event or incident occurring at the facility. Procedures for larger facilities could follow this format but should be more detailed.

EMERGENCY EVENTS

high rainfall, storm, earthquake

EMERGENCY INCIDENTS

overtopping, wave damage, cracking, slips, structural failure, slides, slumping, increased or new seepage, piping, pipeline leakage or other abnormal signs or behaviour

Priority of action

saving life
protecting highly significant environmental values
saving property
dam structure damage control

Failure to apply due diligence under circumstances that could result in
injury or damage to public or private property
may constitute a liability against the TSF operator

Be alert to potential developments and maintain close vigilance during extreme events or perceived abnormal behaviour of the TSF

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Maintain safety requirements at all times during response actions

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Take actions as outlined in the following pages

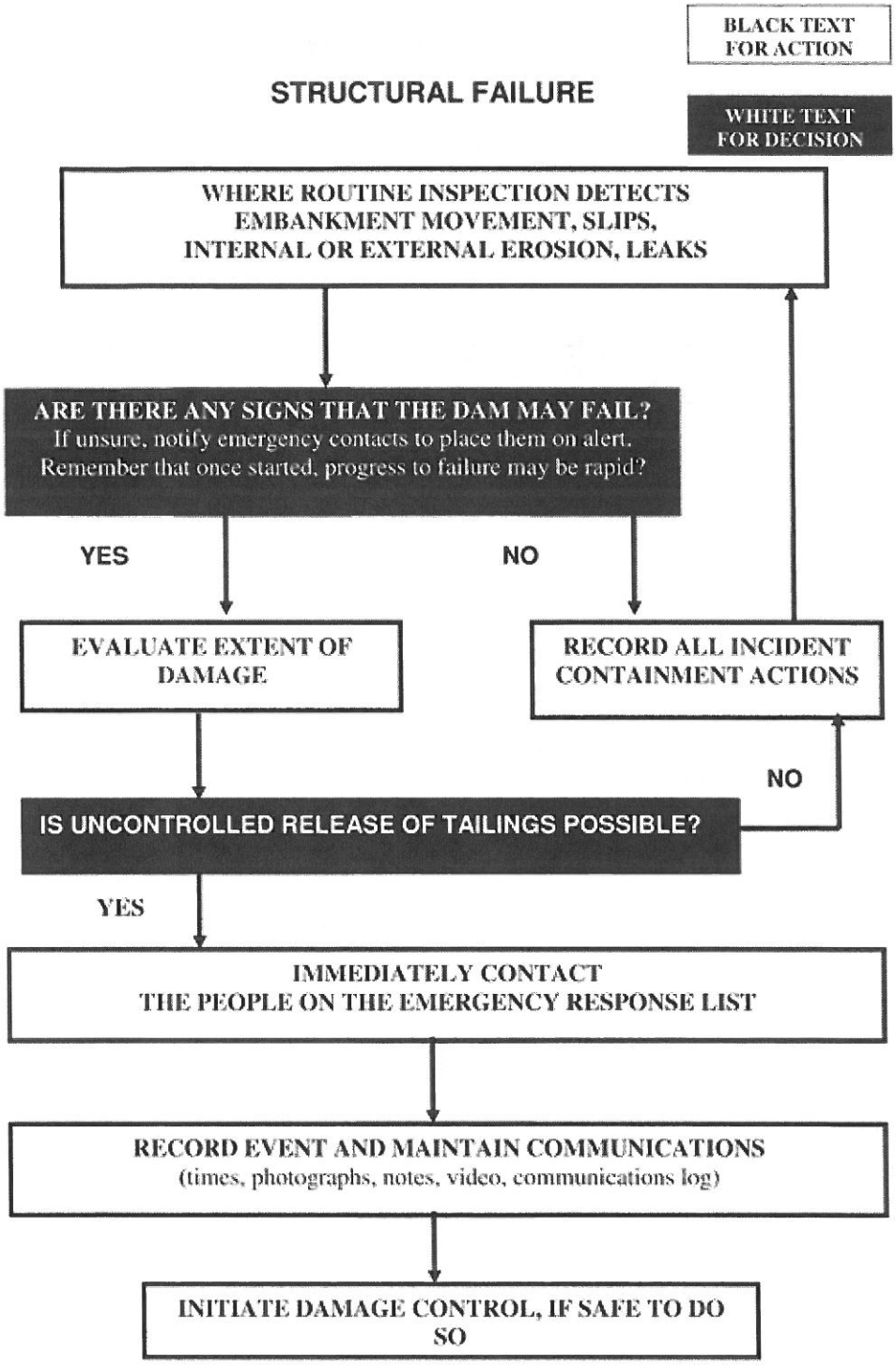
Appendix V cont: Small tailings storage facility emergency procedures.

EMERGENCY RESPONSE CONTACTS

Contact	Phone Number
POLICE	Office
	After hours
STATE EMERGENCY SERVICE	Office
	After hours
ENGINEER	Office
	After hours
MINERALS & PETROLEUM	Office
	After hours
ENVIRONMENT PROTECTION AUTHORITY	Office
	After hours
BUREAU of METEROLOGY(weather reports)	Office
	After hours
DOWNSTREAM NEIGHBOURS (eg. surface water diversion and groundwater extraction customers)	
WATER AUTHORITY (where operation is in water supply catchment)	

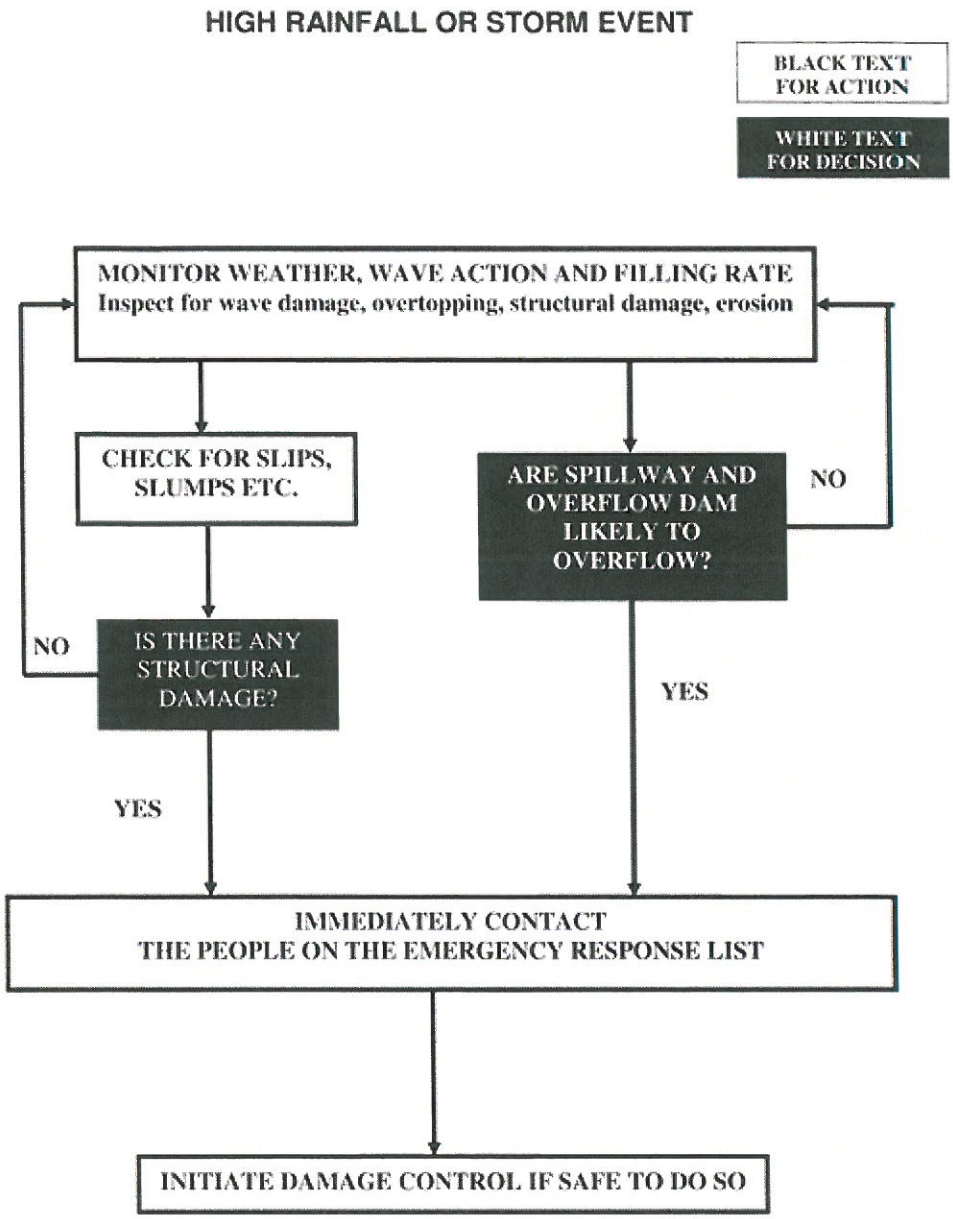
Having made initial contact, the TSF operator shall make arrangements to maintain continuous contact and provide timely advice on changes of conditions

Appendix V cont: Small tailings storage facility emergency procedures.



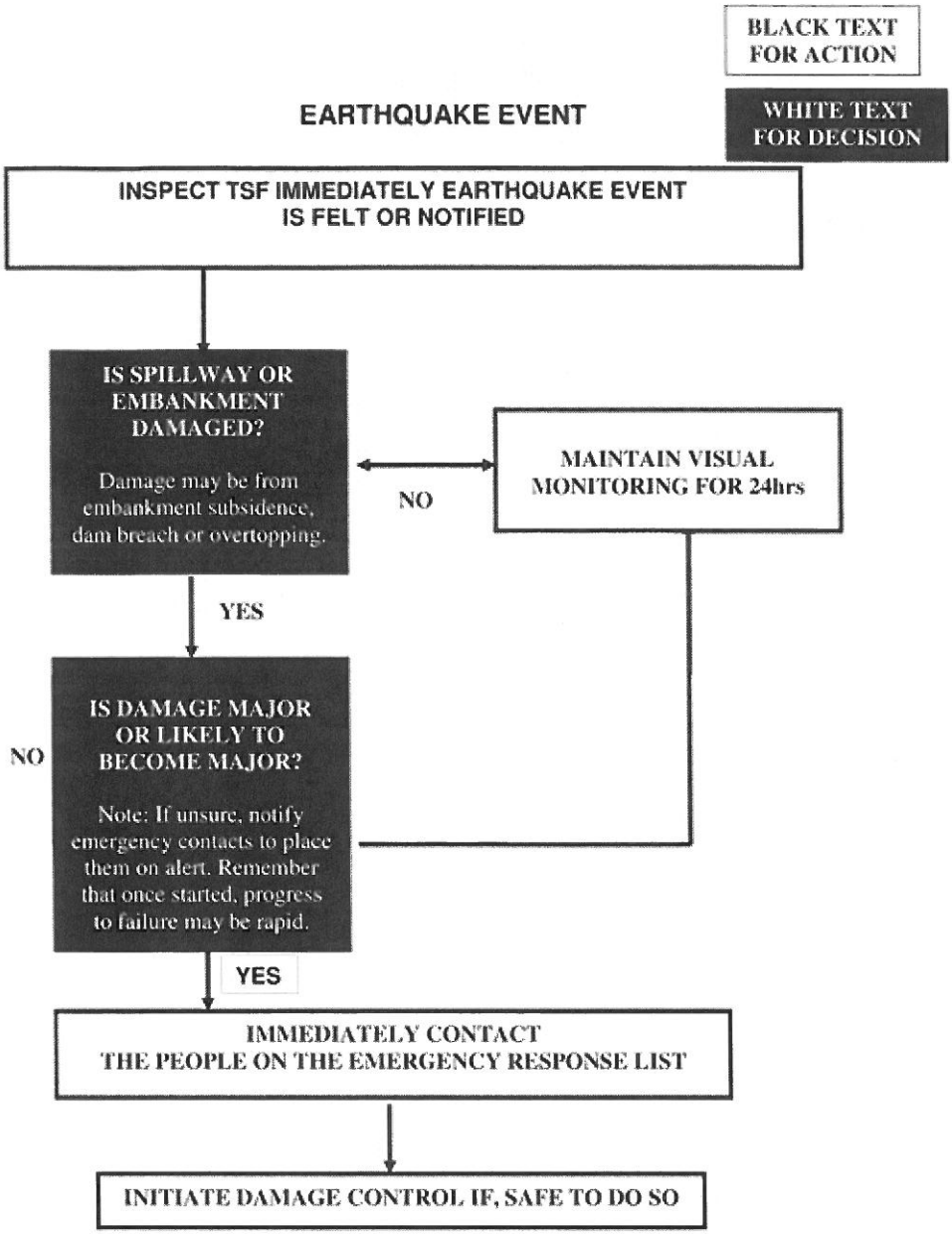
Appendix V cont: Small tailings storage facility emergency procedures.

HIGH RAINFALL OR STORM EVENT



Appendix V cont: Small tailings storage facility emergency procedures.

EARTHQUAKE EVENT

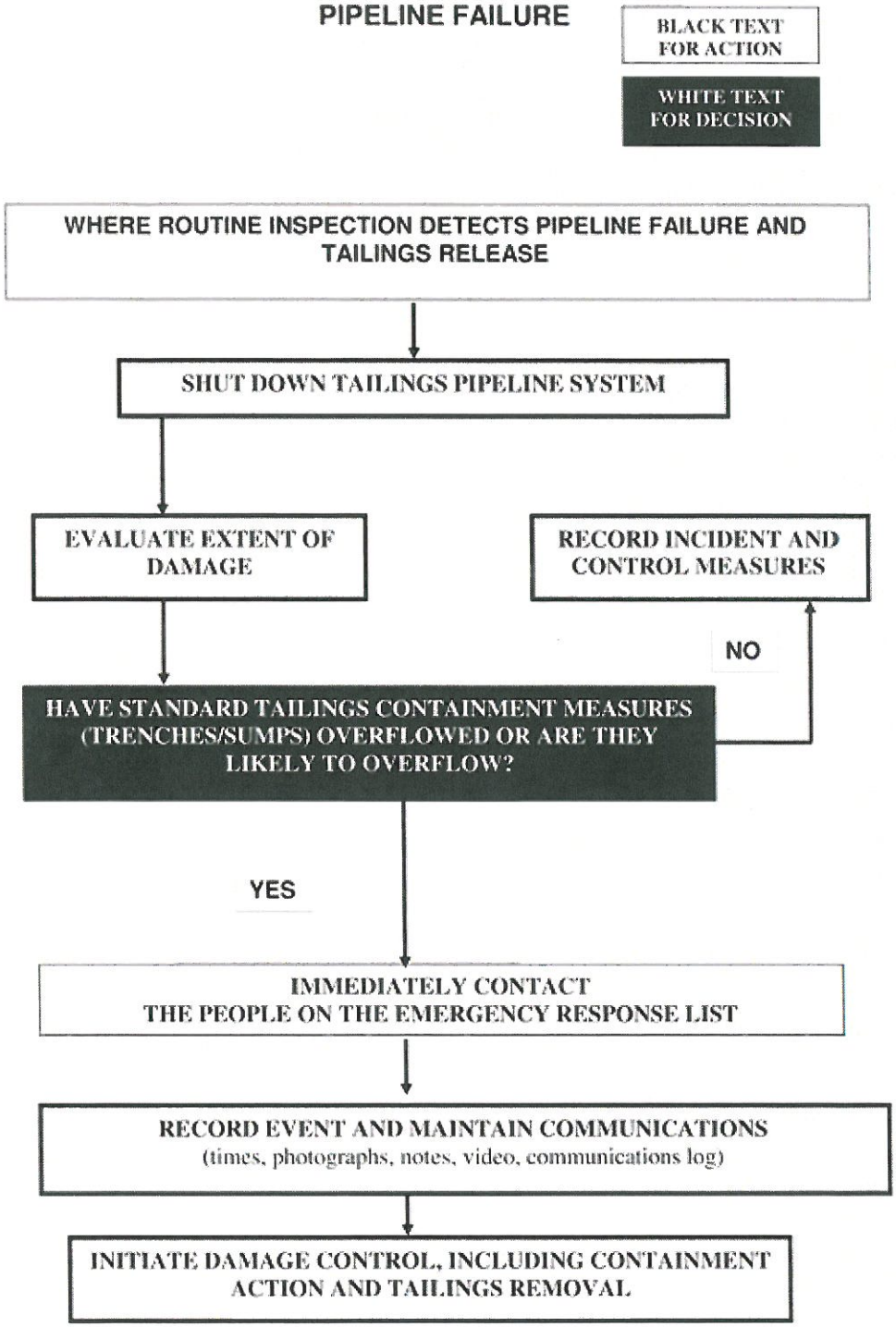


Note: If the initial inspection was at night, follow-up inspections should be carried out in daylight.

Note: If the initial inspection was at night, follow-up inspections should be carried out in daylight.

Appendix V cont: Small tailings storage facility emergency procedures.

PIPELINE FAILURE



APPENDIX VI: TAILINGS STORAGE FACILITIES

Tailings storage facilities (TSF) are designed essentially as dams to retain tailings slurry, to enable the reclamation of water and for the permanent storage of the contained effluents and solids.

The retaining embankment(s) of a tailings dam can be built in a single stage, as for conventional water dams, or built progressively in raises or lifts (Figure 1). These methods are described below and discussed in further detail in EPA 1995.

- **Single-stage embankment construction to full height.** This option is usually adopted for facilities of relatively low height (less than 5 m), where sufficient capital is available at the outset or where it is impracticable to effect future lifts.
- **Downstream lifting of the embankment**, whereby the embankment crest moves progressively downstream, or outwards from the stored tailings. It is the most inherently safe means of construction and its adoption is mandatory in some countries due to seismic loading conditions. It is by far the most expensive means of lifting an embankment due to the large volume of material required in its construction and the greater incidental impacts generated through expansion of the footprint of the TSF during operation.

- **Centreline lifting of the embankment**, whereby the embankment crest remains in the same plan position as the embankment is lifted. This system is a compromise between the upstream and downstream techniques and offers some of the advantages of both. It offers greater stability than upstream construction and is not as costly as downstream construction. It is usually used where the embankment would tend to be unstable under the upstream-lift method.
- **Upstream lifting of the embankment**, whereby the embankment crest moves progressively upstream, or partially over previously deposited tailings. This is usually the least expensive option, but is less inherently safe than the other methods and necessitates careful consideration of stability and potential for settlement, as well as the practicability of construction and the potential for seepage. It is a system commonly (and safely) employed in arid environments that have low seismic activity, such as occurs over large tracts of Australia.

These methods can be used together, in a variety of combinations, and some relatively elaborate schemes have been developed to minimise costs while achieving an acceptable level of risk. Each situation needs to be considered on its particular merits, with particular emphasis on the factors that influence the stability of the embankment.

The long term stability of a tailings dam is vital. The main factors influencing its stability are the height and slope of the embankment and the nature, strength and degree of compaction of foundation and embankment materials. Depending on circumstances, the retaining embankment may be constructed of mine wastes, imported materials or desiccated mill tailings sourced from the adjacent tailings beach. Although tailings usually increase the stability of the structure and, once settled, are often relatively impervious, the extent to which this occurs depends on their unique chemical and physical properties.

In arid areas of Australia dried tailings may be used in the construction of TSF walls. A segregated slurry is spigotted onto a beach and then the coarse fraction, after drying by evaporation, is reclaimed for use in embankment construction. Because of the nature of tailings materials and the climate, however, it is generally inappropriate to use tailings for the construction of embankments in Victoria.

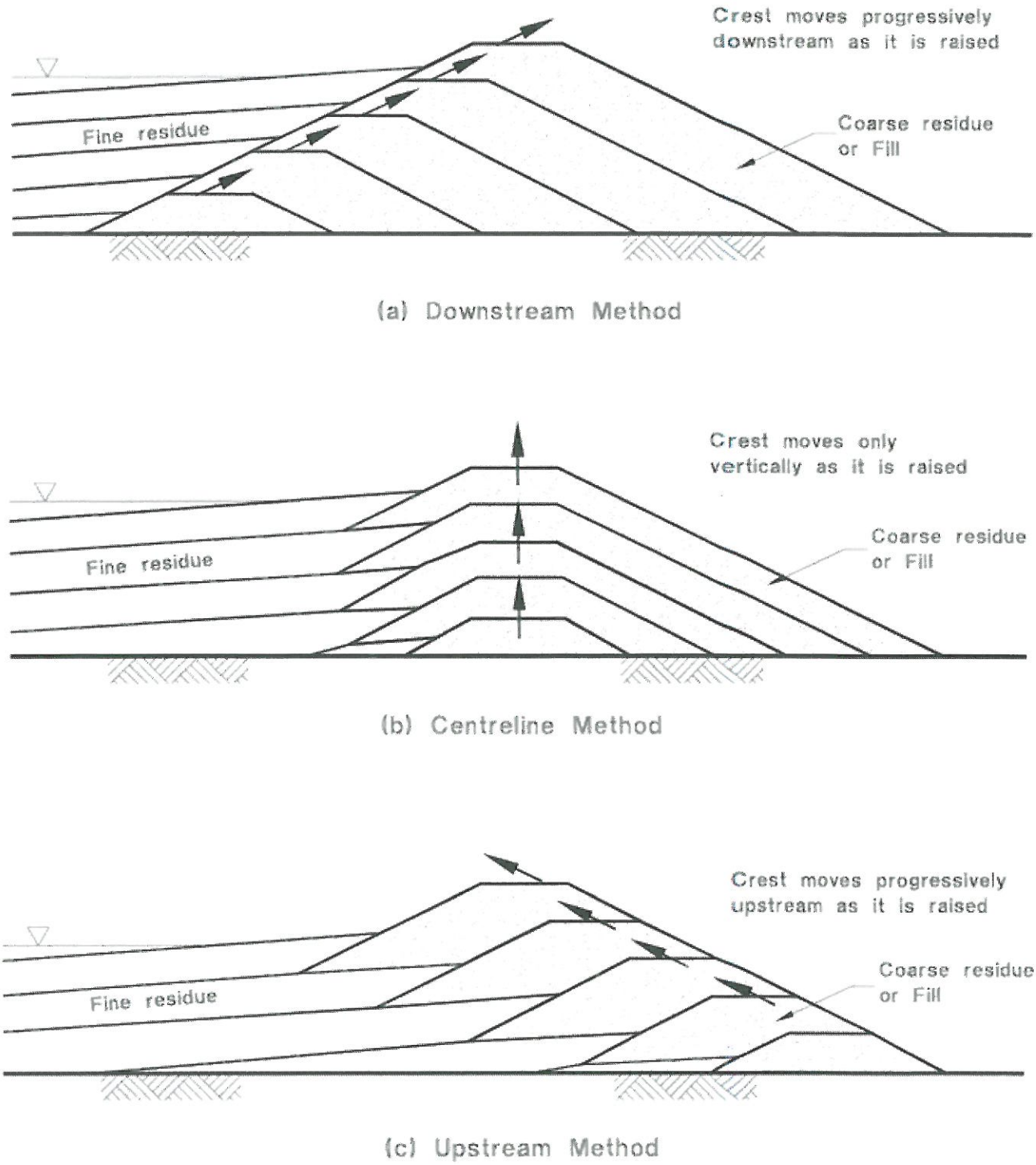


Figure 1: Methods of lifting TSF perimeter embankments
(After Chamber of Mines of South Africa, 1996)

Location of TSFs

TSFs can be constructed across a valley in the landscape or off-valley:

- **Cross-valley storage**, whereby a dam wall is constructed across a natural valley. This has the principal advantage of requiring a relatively small amount of earthworks for the volume of tailings that can be contained. In addition, any escape or seepage of tailings or supernatant water can be expected to occur along the drainage line and backup structures or systems can be emplaced there for greater security. The main disadvantages are the initial capital costs, the need to permanently divert the stream and probably construct substantial spillways, the risks of failure of the diversion system causing erosion of the embankment and escape of tailings materials, and the environmental impacts may be high. Further, diversion of a watercourse may represent negligible risk if rainfalls are low but may be a difficult engineering problem in high-rainfall areas.
- **Off-valley storage**, which can be located on land ranging from near horizontal to the side slope of a gentle valley. This approach requires the construction of confining embankments on either the downhill side(s) or around the full

perimeter to form an impoundment ('ring dyke' or 'turkey nest'). The advantages of this approach over a cross-valley storage are that runoff management is simpler and impacts on groundwater and surface waters are likely to be lower.

Variations of the above exist and, in some instances, a combination of cross-valley and side-valley configurations may be adopted. In Australia, off-valley storage is preferred for environmental reasons. Moreover, the cross-valley option is not often technically viable due to the typically flat terrain of many mine sites.

Management of water in a TSF

The Work Plan for a TSF should include a quantitative water balance that accommodates all gains and losses.

Gains to a TSF include:

- water forming the slurry;
- rainfall (direct onto the TSF and as runoff from its catchment) and
- water as waste from the operation and from flushing of facilities.

Losses from a TSF include:

- decanted supernatant water;
- evaporation;
- drainage water;
- water retained in the pores of the tailings (interstitial losses) and
- seepage water.

Many TSFs are used to store water as well as tailings, but should be managed to minimise the quantity of water retained. Most TSFs in Victoria to date have been managed to recover water and contained process chemicals from the TSF and re-use them in the treatment plant. Water can be removed using a variety of methods, including floating or submerged pumps, decant towers or syphons.

Where sub-aerial deposition is used, it is often important to minimise the amount of water held by the TSF to aid drying and ensure consolidation of the tailings mass. In some cases water is continually drained from the TSF into a separate water recovery dam (or decant dam). Some TSFs are constructed with pre-installed drainage pipes under the tailings. This feature has been successful in some cases in improving the consolidation of tailings but is expensive and can fail quickly if the consolidated tailings material is low in permeability.

TSFs must be large enough to accommodate water from the slurry, rainwater falling on the storage catchment as well as the volume of tailings deposited. In the past, TSFs in Victoria have been designed with no allowance for the discharge of water as it is assumed that the designs account for the highest likely rainfall events and discharge will never be required.

Based on the concern that design information may be imperfect or an unprecedented rainfall event might compromise the capacity of the facility, Victoria and some other jurisdictions require large tailings storages to include discharge spillways and overflow dams. This enables controlled discharge via an engineered spillway rather than an uncontrolled overtopping of a dam which, although unlikely, could have very serious consequences, including structural failure of the TSF.

TSFs containing potentially acid-forming tailings materials are often designed to have a permanent water cover (ie sub-aqueous deposition). In such cases the above discussion clearly does not apply. Management of such storage facilities introduces a range of additional issues. To ensure permanent cover, water recovery, losses and rainfall must be carefully balanced. This is most critical after rehabilitation when the facility must be safe with a minimum of management intervention.

APPENDIX VII: TAILINGS STORAGE FACILITIES WATER DESIGN CRITERIA

Table 1: Minimum TSF freeboard and design requirements for water management, applicable to individual TSFs (refer also to figure 2 below).

TSF Category	**Flood Capacity** (AEP 72 hour rainfall event)	**Additional freeboard** (m)	**Emergency Spillway** (AEP 1 hour rainfall event, TSF full at the beginning of the storm)
Small TSF: Benign to low level contaminated Tailings	1×10^{-2}	0.6	1×10^{-2}

Large TSF: Benign to low level contaminated Tailings or Small TSF: Contaminated Tailings	1 x 10^{-3} to 1 x 10-4	0.6	1 x 10-3 to 1 x 10^{-4}
Large TSF: Contaminated Tailings	1 x 10^{-5} to PMP	0.6	1 x 10^{-5} to PMP
All TSFs	Capacity to contain the waste inputs and rainwater during a one in ten wet year as well as meet the above Flood Capacity and Additional Freeboard Requirements		
All TSFs	Where tailings are against the embankment, specify and maintain an appropriate minimum vertical distance between the top of the tailings beach and the lowest point of the embankment.		

Definitions:

AEP: Annual exceedence probability: The probability that the rainfall event occurs in any one year.

Additional freeboard: the vertical height between the lowest point of the emergency spillway and the TSF pond water level after the AEP 72 hour rainfall event.

PMP: The theoretical greatest depth of precipitation for a given duration that is physically possible over a particular catchment area. (ANCOLD 2000, IEA 1998 and BOM 2003).

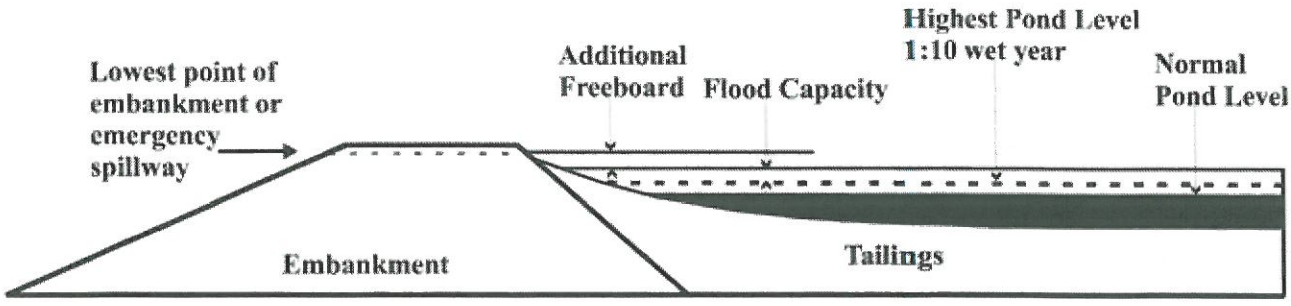
Notes:

1. Where a range has been given for the AEP the lower probability shall be initially adopted. However the proponent may submit a detailed Risk Assessment and hydrological analysis consistent with recognised methodologies (eg ANCOLD 2000) justifying the adoption of a higher probability AEP for the department's consideration.
2. The department may require lower probability AEPs than above where a TSF poses a particularly high risk, such as a downstream threat to life.

Example:

A small TSF storing contaminated tailings must have the capacity to:

1. Contain the waste inputs and rainfall during a 1 in 10 wet year;
2. Store the inputs from a 1 x 10-4 AEP 72 hour rainfall event and retain a minimum additional freeboard of 0.6 m and
3. In an exceptional circumstance where there is a risk of embankment failure pass a 1 x 10-4 AEP 1 hour rainfall event (storm) via an appropriately constructed emergency spillway.



(a) Pond located away from embankment.

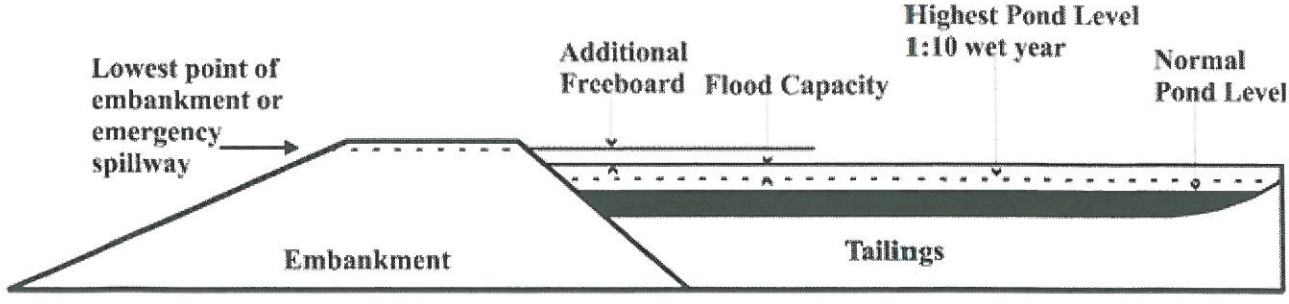


Figure 2. TSF minimum freeboard and water design criteria.

APPENDIX VIII: RELEVANT LEGISLATION AND POLICIES

***Mineral Resources Development Act 1990* (MRD Act)**

The purpose of the MRD Act is, among other things, to encourage an economically viable mining industry that operates in a way that is compatible with environmental, social and economic objectives of the State. Its objectives include encouraging and facilitating exploration for minerals and establishing a legal framework that ensures that mineral resources are developed in ways that minimise impacts on the environment.

The MRD Act establishes a two-stage process for the approval of mining work:

- the granting of a licence and
- the approval of a Work Plan and the granting of a Work Authority.

Prior to issuing a Work Authority, the head of the department administering the MRD Act must be satisfied that the applicant has an approved Work Plan. The contents of a Work Plan are prescribed under Schedule 13 of the *Mineral Resources Development Regulations* 2002.

***Extractive Industry Development Act* 1995 (EID Act)**

The purpose of this Act is, among other things, to ensure that extractive industry operations are carried out with safe operating standards and in a manner that ensures the rehabilitation of quarried land to a safe and stable landform.

The EID Act establishes the following staged process for the approval of extractive operations:

1. proponent prepares a proposal or Work Plan
2. proponent applies to local municipality for a Planning Permit
3. local municipality refers application to Referral Authorities (which includes ERR)
4. local municipality makes a determination
5. ERR approves the Work Plan in consideration of comments by local municipality and others
6. ERR grants the Work Authority subject to any conditions.

The EID Act also sets out the procedure for notification of proposed extractive industries to holders of licences under the MRD Act.

Occupational Health and Safety (Mines) Regulation 2001

The purpose of these regulations is to protect people in mines against risk to their health and safety. All operations which use cyanide must comply with these regulations. Additional duties are required for prescribed mines. Prescribed mines include mines that use cyanide and have inventories of more than 5 tonnes of cyanide, including solutions of inorganic cyanides with total cyanide ion content greater than 3 %.

Environment Effects Act 1978

This Act provides for the Minister administering the Act to decide whether any proposed development requires an Environment Effects Statement (EES). Where an EES is required for a mining project, approval procedures are coordinated as closely as possible and the proponent is not required to obtain further planning approvals for the activity assessed in the EES.

Planning and Environment Act 1987

This Act provides a framework for planning the use, development and protection of land in Victoria. It has a number of aims related to environmental protection, social equity and facilitation of appropriate development.

The Act provides the overarching process for responsible authorities (RA) to consider and approve or refuse to approve applications by mining and extractive industries. In most instances the RA is the relevant municipality. The RA utilises the approved local municipality Planning Scheme, including the State Planning Policy Framework, in support of its considerations. The RA is required to refer all applications to the appropriate Referral Authorities. ERR is a Referral Authority for mining and extractive industries although the respective water management authority may be the Referral Authority with respect to a proposal for any on-stream construction. Approval takes the form of a Planning Permit.

The holder of a mining licence may be granted a Planning Permit regardless of the provisions of the approved planning scheme. Further, even if a Planning Scheme requires a permit to be issued for mining on land covered by a mining licence, the MRD Act exempts the licensee from having to obtain the permit if an Environment Effects Statement for the work has been prepared and assessed in accordance with the Environment Effects Act 1978, and a Work Authority granted in the light of that assessment.

Victoria's Native Vegetation Management - a Framework For Action, 2003

The framework is a whole of government policy applicable to the mining and extractive industries through Earth Resources's approvals process. The framework establishes the strategic direction for the protection, enhancement and revegetation of native vegetation across the State and identifies 'net gain' as the primary goal for native vegetation management. At the on-ground level it expresses the principle that where losses are unavoidable and permitted requirements for offsets must be met. DELWP has released 'Native Vegetation Operational Guidelines' to provide tools to consistently apply the framework.

ERR is currently working with DELWP to ensure the guidelines reflect the nature of rehabilitation in the mining and extractive industries. Where a proposal involves clearing native vegetation, the proponent should contact ERR about current requirements.

Environment Protection Act 1970

This Act is concerned with all aspects of the environment and makes provision for the establishment of environmental objectives as well as management of waste discharges. The EP Act aims to:

- encourage waste avoidance, reduction and re-use;
- control emissions of waste into the atmosphere and on land and water and
- impose sanctions against those who have polluted.

Industrial Waste Management Policies

Section 16(1A) of EP Act requires the management of industrial waste to be in accordance with the provisions of Industrial Waste Management Policies (IWMP).

IWMP (*Waste Minimisation*) 1990 and IWMP (*Prescribed Industrial Waste*) 2000 require the adoption wherever possible of a waste management hierarchy. This hierarchy of preferred waste avoidance, reuse and recycling to waste treatment or disposal. Specifically, the policies require the use of commonly available technology to minimise the volume of material from waste streams containing defined wastes.

State Environment Protection Policies

The EP Act provides for the preparation of State Environment Protection Policies (SEPP) which set quality objectives for segments of the environment (air, water and land and noise emissions) and seek to protect their beneficial uses. Being statutory instruments, the provisions of SEPPs are legally enforceable and apply to government departments, agencies and private companies. They provide a basis for the application of Works Approvals, licences, pollution abatement notices and regulations.

SEPP (*Waters of Victoria*) determines the beneficial uses of the water environment to be protected, water quality indicators and objectives for specific segments of the water environment.

SEPP (*Groundwaters of Victoria*) aims to maintain and, where necessary, improve groundwater quality sufficient to protect existing and potential beneficial uses.

If an operator proposes to discharge water to the environment, it is likely that a Works Approval and Waste Discharge Licence will be required under the EP Act. Works Approvals permit work to be undertaken which will result in a discharge of waste to the environment or an increase in, or alteration to, an existing discharge, a change in the way waste is treated or a change in the way waste is stored.

Premises requiring Works Approval and licences under the EP Act are described as 'scheduled premises' and listed in the *Environment Protection (Scheduled Premises and Exemptions) Regulations* 1996. Under these regulations disposal of wastewater to land within a mine or quarry site in accordance with an approval under the MRD Act or EID Act does not also require a Works Approval or licence under the EP Act. This situation applies where water is discharged to a TSF, an evaporation pond or to some other system that ensures no offsite discharge occurs.

Catchment and Land Protection Act 1994

This Act aims to:

- establish a framework for integrated management and protection of catchments;
- encourage community participation in the management of land and water resources and
- set up a system of controls on pest plants and animals. Catchment Management Authorities (CMA), established under the Act, are responsible for the development and coordination of approved regional catchment management strategies, which may include Catchment Management Plans.

These Plans cover land use and regional development issues and set out management strategies for a particular catchment or sub-catchment. The process aims to maximise community involvement in decision-making about development of detailed

work programs within a catchment. The main priorities of CMAs include salinity, pest plants and animals, nutrient inflows to streams and declining biodiversity.

Where off-site discharge of mine or quarry waters is proposed it is likely that the respective CMA will be consulted.

Water Act 1989
This Act applies to all surface water in Victoria, including river management, water supply, irrigation and sewerage.

Any construction on a waterway, and any works to deviate a waterway, requires a Construction Licence issued under Section 67 of the Water Act 1989. Issue of Construction Licences is the responsibility of the respective CMA.

Flora and Fauna Guarantee Act 1988
This Act establishes a legal and administrative structure to enable and promote the conservation of Victoria's native flora and fauna and to manage potentially threatening processes. It also provides a list of species and communities of flora and fauna which are threatened and mechanisms for their protection.

Forest Act 1958
This Act provides for the management and protection of State forests, defines the powers of the Director and the power to issue leases and licences, places restrictions on the cutting or removing of timber or forest produce, and makes provision for other forest related matters.

Crown Land (Reserves) Act 1978
Amongst other matters, this Act provides for the reservation of Crown lands for certain purposes and for the management of such reserved lands.

Archaeological and Aboriginal Relics Preservation Act 1972,* and the *Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (Cth)
These Acts provide for the protection of Aboriginal places and objects. The Commonwealth Act also requires that protection of the places and objects be in consultation with the Aboriginal communities with an interest in them.

Environment Protection and Biodiversity Conservation Act 1999
This Act deals with Commonwealth environmental assessment and approval, biodiversity conservation and reporting/enforcing mechanisms. Under this framework, unless a person has Commonwealth approval, they must not take an action that has, will have, or is likely to have, a significant impact on a " matter of national environmental significance." The Act lists species and communities of national environmental significance.

APPENDIX IX: MINERALS AND PETROLEUM DIVISION CONTACTS

Cnr Mair and Doveton Streets
BALLARAT 3350

Tel. (03) 5333 6727

35 Sydney Road
BENALLA 3672

Tel. (03) 5761 1502

Cnr Midland Hwy & Taylor Street
EPSOM 3551

Tel. (03) 5430 4444

1 Spring Street
MELBOURNE 3001

Tel. (03) 9658 4400

55 Grey Street
TRARALGON 3844

Tel. (03) 5172 2111

Definitions and acronyms

Bentonite – a species of clay used as an absorbent or filler

CMA -Catchment Management Authority

Contaminated tailings –

(1) tailings solids with contaminant concentrations (or predicted concentrations) above any of the levels specified in table 2, and/or sulphidic tailings with the potential to cause acid generation. Current methods for determining acid generation potential are provided in Environmental Australia (1997) and EPA (1999);
and/or

(2) tailings liquor (or predicted tailings liquor) with a total cyanide concentration exceeding 1 mg/l or a pH outside the range 5 to 9.

Tailings with these characteristics require higher standards of TSF design, construction and management.

Table 2: Maximum contaminant concentrations and elutriable fractions allowed in soil to be disposed of as contaminated soils (low level), based on EPA Victoria's classification of contaminated soils (EPA, 2004)

Contaminant	Maximum Concentration (total) mg/kg dry weight	Elutriable Fraction (pH 5.0 extract) g/m3
Arsenic	300	5.0
Cadmium	50	0.5
Chromium	2500	5.0
Copper	1000	10
Cobalt	500	-
Lead	3000	5.0
Mercury 1	2	0.1
Molybdenum	400	-
Nickel	1000	-
Tin	500	-
Selenium	100	1.0
Zinc	5000	50
Cyanide	500	10
Fluoride	4500	150
Phenols	10	-
Monocyclic Aromatic Hydrocarbons	70	-
Polycyclic Aromatic Hydrocarbons	200	-
Total Petroleum Hydrocarbons (C6 to C9)	1000	-
Total Petroleum Hydrocarbons (>C9)	10000	-
Organochlorine Compounds	10	

Department – the Victorian State Department for the time responsible for the administration of the Mineral Resources Development Act 1990 and the Extractive Industry Development Act 1995

DELWP – Department of Environment, Land, Water & Planning

EID Act – *Extractive Industry Development Act 1995*

EP Act – *Environment Protection Act 1970*

ERP – Emergency Response Plan

ERR – Earth Resources Regulation Branch of the Department of for Economic Development, Jobs, Transport and Resources

Freeboard – the vertical distance between the operating or predicted water level in a storage and the crest level where water would flow over the dam Hazard – a source of potential harm or a situation with potential for harm and its potential consequences

Likelihood – a qualitative term encompassing both probability and frequency

MRD Act – *Mineral Resources Development Act 1990*

Phreatic surface – the position at which soil water is saturated; essentially the water table

Piezometric level - the level that groundwater rises to in a piezometer. This is a measure of groundwater pressure

Pore water – water in the spaces between particles (of sand, rock, tailings materials, etc)

Rheological – flow characteristics of liquids with suspended particles

Risk – the likelihood of particular event or set of circumstances being realised as compounded by its consequences

Risk analysis – the systematic use of available information to identify hazards and to estimate, quantitatively or qualitatively, the likelihood and consequences of those hazards being realised (how often a specific event may occur and its magnitude)

Risk assessment – the evaluation of the results of risk analysis against predetermined standards, target risk levels or other criteria to determine acceptability or tolerability of the levels of risk remaining after control measures have been implemented, or to determine risk management priorities (or the effectiveness or cost-effectiveness of alternative risk management options and strategies)

Risk management – the systematic application of policies, procedures and practices to the task of identifying hazards; analysing the consequences and likelihoods associated with those hazards; estimating risk levels (quantitatively or qualitatively); assessing those levels of risk against relevant criteria and targets; making decisions and acting to reduce risk levels. Actions involve consideration of legal, economic and behavioural factors.

Size of TSFs - 'Large' TSFs are generally classified as having:

- an embankment of 5 m or higher and a capacity of 50 ML or more;
- an embankment of 10 m or higher and a capacity of 20 ML or more;
- an embankment of 15 m or higher regardless of capacity
- (the above three criteria derive from Section 67(1A) of the Water Act 1989) or
- a combined storage capacity of all TSFs on the site greater than 50 ML.

The height of the embankment should be determined from its maximum height above natural surface.

Slime – silt- or clay-sized material; usually with high water content

Suitably qualified and experienced person – a person who:

a) is independent of the TSF proponent and operator.

b) has qualifications sufficient for eligibility for membership of The Institution of Engineers, Australia or The Australasian Institute of Mining and Metallurgy.

c) has appropriate professional indemnity insurance (adapted from Ministerial Guidelines 2002).

d) has knowledge of engineering principles related to the structures, geomechanics, hydrology, hydraulics, chemistry and environmental impact of TSFs.

e) has a total of at least five years of suitable experience and demonstrated expertise in at least four of the following areas:

- investigation, design or construction of TSFs;
- operation and maintenance of TSFs;
- geomechanics with particular emphasis on stability, geology and geochemistry;
- hydrology with particular reference to flooding, estimation of extreme storms, water management or meteorology;
- hydraulics with particular reference to sediment transport and deposition, erosion control and beach processes;
- hydrogeology with particular reference to seepage, groundwater, solute transport processes and monitoring thereof;
- safety of TSFs and
- safety and environmental audits of TSFs.

f) where appropriate has experience in forming and managing multi-disciplinary teams with the relevant expertise for complex projects and

g) can provide evidence of the arrangements that will be in place to provide technical expertise on areas in which the suitably qualified and experienced person is not an expert.

Supernatant Water – free water that has collected on the surface of deposited tailings or slurry.

Tailings – a solid waste product or residue from a process. The residue or waste that comes out of the 'tail' end of a processing plant. In the context of mining, the term is used as a singular noun and refers to the fine-grained waste material remaining after the economically recoverable metals and minerals have been extracted from the raw material.

Tailings dam – an artificial barrier or embankment, together with appurtenant works, constructed for storage, control or diversion of water, other liquids, silt, debris or other liquid-borne material associated with tailings.

TSF - Tailings storage facility – an area used to confine tailings and includes the tailings dam or other structure and associated infrastructure. It refers to the overall facility, and may include one or more tailings (or water) dams.

Waterway – defined under the *Water Act 1989* to be any river, creek, stream or watercourse in which water regularly (but not necessarily continuously) flows and a channel resulting from the alteration or relocation of a waterway.

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1 Victorian legislation can be viewed or printed on the Victorian Law Today web page at www.dms.dpc.vic.gov.au

2 At the time of publication of this guideline, the *Environment Effects Act* and associated guidelines were subject to review. Proponents should contact the Earth Resources Branch of the Department of Economic Development, Jobsm Transport and Resources for further information on current requirements.

3 The employer is also required to provide immediate notification of "reportable incidents" relating to personnel safety under the *Occupational Health and Safety (Incident Notification) Regulations 1997*

4 Some of the elements listed are required in accordance with Schedule 15 of the *Mineral Resources Development Regulations* 2002. Audit Reports should refer to the schedule 15 report where appropriate. Other elements should be included in the final report at decommissioning of the facility in addition to the Annual Report.

5 Because of the potential for leakage along the roots, guidelines for conventional water-storage dams caution against allowing trees or other deep-rooting plants to grow within five metres (or the anticipated height of mature growth) of an embankment or spillway (NRE 2002).

ATTACHMENT D

VICTORIA State Government | Economic Development, Jobs, Transport and Resources

Annual Report 2015-2016

Earth Resources Regulation

Technical Review Board

TABLE OF CONTENTS

1 Executive Summary

The Technical Review Board (TRB) was established by the Victorian Government in 2009 as an Advisory Panel under Sections 54A, 54C, 54D and 54E of The Mineral Resources (Sustainable Development) Act 1990 following the Warden's Inquiry into the collapse of the North East Batter at Yallourn Mine in the Latrobe Valley. A primary function of the TRB is to provide independent advice to the Minister for Energy and Resources (the Minister), the Department of Economic Development, Jobs, Transport and Resources (DEDJTR) and industry (through the Department) on managing risks associated with mine instability and rehabilitation in the Victorian mining and quarrying sectors.

The Terms of Reference (TOR) for the TRB at the time of its establishment had a focus on risks to the environment, public safety and infrastructure. These were expanded in July 2015 to also include rehabilitation. The composition of the TRB was revised at the start of the current reporting period to reflect the new TOR.

The TRB was reappointed for a 10 month period in September 2015. During that period, the full Board met on eight occasions. This was a particularly busy period for the TRB. The reform process implemented within Earth Resources Regulation (ERR) by Minister D'Ambrosio, the reopening of the Hazelwood Mine Fire Inquiry, and the commencement of the Batter Stability Project (BSP) added to the TRB's usual activities.

All four TRB members assisted the Hazelwood Mine Fire Inquiry in the lead up to formal proceedings, although Professor Mackay's contributions were in his role as Director of the Geotechnical and Hydrogeological Engineering Research Group (GHERG) based at the Churchill campus of Federation University, Australia. Two TRB members along with Professor Mackay gave evidence at these proceedings. The TRB produced 11 written advices to government and the Chair met formally with Minister D'Ambrosio on two occasions (with a change in Minister causing a third scheduled meeting to be postponed) and informally on another occasion to introduce new TRB member, Ms Corinne Unger.

The TRB had involvement in a wide range of activities associated with its TOR. The more important of these, with summary comments on their status, were:

- **Reform of Earth Resources Regulation:** In September 2015, Minister D'Ambrosio announced that the Earth Resources Regulation (ERR) Branch of DEDJTR was to be reformed in order to improve regulatory practice, processes and operations, and restore community confidence in the regulator. The TRB was consulted extensively by Department management and the Minister during the development and implementation of the reform package and provided a response to the Minister's Statement of Expectations for the TRB.

- **Hazelwood Mine Fire Enquiry:** TRB members assisted the Hazelwood Mine Fire Inquiry and presented evidence at the hearings in relation to the rehabilitation of Latrobe Valley brown coal mines. The Inquiry subsequently made 18 recommendations, three of which have specific regard to the positive contributions and role of the TRB and the ongoing resourcing of this body. The Inquiry also singled out the TRB for commendation, noting its robust and independent advice to the Minister for Energy and Resources and to DEDJTR.

- **Batter Stability Project:** The TRB was very pleased to see ERR's Batter Stability Project launched by Minister D'Ambrosio on 11 April 2016. The TRB has had considerable input into the development of this research project over the last two years. It considers this project to be an essential element of the substantial research effort required to better understand the material and mechanical properties of brown coal and its local and regional behaviour as a basis for reliable design for mine stability and rehabilitation. Professor Ian Johnston (TRB member) was Chair of the Technical Advisory Group for the early work for this project.

- **Managing mining-induced impacts extending beyond a mining lease:** Experience in the Latrobe Valley has shown that brown coal mining-induced ground movements are not necessarily confined to the immediate vicinity of a mine batter face but can extend well outside a mining lease. A number of incidents have highlighted a lack of definition and clarity around responsibilities and accountabilities for responding to and managing mining-induced impacts on the natural and man-made environment. The TRB prepared two advices to the Department in that regard. The current reform process within ERR provides the opportunity to address this important and overdue matter. This involves giving consideration to changes in legislation and government administrative procedures.

- **Mine closure and rehabilitation:** The TRB has reported on a number of occasions since 2012 that it considers the original measures proposed for the rehabilitation of the Latrobe Valley brown coal mines fell well short of what could reasonably be considered as adequate. The Hazelwood Mine Fire Inquiry

brought a focus to this concern. It recommended further studies and consultation to address a range of issues related to mine rehabilitation. The Victorian Government has responded in a number of ways including the allocation of $12.6 million to Earth Resources Regulation to fund an integrated study of the requirements and implications of brown coal mine rehabilitation and closure for government and the Latrobe Valley. The TRB welcomes this initiative. There are a number of areas in which the TRB can provide valuable input and advice to the project team. Initiatives to do so are already in hand. It is also assisting the Department in developing guidelines for mine closure and rehabilitation.

- **Anglesea Coal Mine:** Since its inception in 2009, the TRB has maintained a watching brief on Anglesea Coal Mine in response to pre-existing and new concerns regarding mine stability. The mine closed in 2015. Subsequently, the TRB has been involved in a number of discussions with ERR officers in relation to the development of a Rehabilitation and Closure Plan for Anglesea Coal Mine and for all mines in general.

- **Peer Review of Morwell River Diversion:** The 2014-15 TRB Annual Report noted that the ongoing stability of the Morwell River Diversion (MRD) outside of the remediated section is an important matter that requires further assessment and that careful and comprehensive risk assessments are essential to understanding and managing the risks still associated with the MRD. Risk assessments of the stability of the remediated section and other areas of the MRD were not available for review by the TRB at that time and have not been provided subsequently to the TRB. The TRB places high importance on undertaking these reviews in fulfilling its TOR. Understandably, staff changes associated with the reform of ERR have impacted on progress. It is important that the TRB pursues these outstanding matters with the Department in going forward.

- **Agency Roles, Responsibilities and Accountabilities:** The TRB has been concerned for some time that, in general, accountability within government for overseeing risk management in the mineral resources sector is assigned to agencies on the basis of the consequences of an unwanted event occurring, rather than on the basis of the agency that is best qualified to provide assurance to government on the robustness of the risk management process required to prevent the event from occurring in the first place. The Hazelwood Mine Fire Inquiry also reported that there were several examples before the inquiry that demonstrated that the regulatory framework is inadequate. The TRB remains of the view that there is need for wider regulatory reform relating to how the Victorian government oversees risk management in the mineral resources sector, particularly in regard to clarifying roles, responsibilities and accountabilities of agencies.

- **Quarrying operations in the mid-Goulburn Valley floodplain:** It was noted in the 2014-15 TRB Annual Report that the TRB had been requested to provide advice on risk to the environment and public infrastructure presented by quarry operations on the mid-Goulburn Valley floodplain. The TRB submitted a written advice to the Minister on this matter in December 2015. This was followed up with a second advice specific to Seymour Quarry (WA1189), which is located in the Goulburn Valley flood plain, near the town of Seymour.

- **Geotechnical and Hydrogeological Engineering Research Group (GHERG):** The TRB continues to engage with GHERG and to review its research activities, which it considers to constitute an important element of the substantial research effort required to underpin effective mine stability and rehabilitation in the Latrobe Valley brown coal sector.

- **Stakeholder Engagement and Education:** For a number of years, the TRB has advocated the fostering of greater engagement and collaboration amongst all stakeholders in order to achieve cultural change in how mine stability and rehabilitation are managed in the Latrobe Valley. The TRB continued to actively facilitate cultural change initiatives during the current reporting period.

- **The status of other initiatives:** Several important initiatives associated with past activities and advices of the TRB are still 'works in progress' or on-hold. This is mainly due to the distraction of the Hazelwood mine fire and the subsequent attention to mine rehabilitation and closure, the lack of appropriate technical capabilities within ERR in the past, and the loss of corporate memory within ERR as a consequence of organisational and staff changes associated with the reform process to improve the department's performance.

The issues canvassed in this annual report, their current status and the need to bring some to fruition sooner rather than later provides considerable ongoing work for the Department. Two important issues have emerged out of the current focus on mine closure and rehabilitation that warrant specific attention in the future relate, first, to the operational and legacy issues associated with mine waste dumps, especially tailing storage facilities (TSF) and, second, to the legacy of abandoned mines.

The TRB has reported to three governments, six ministers and three government departments since its inception seven years ago. A number of key ERR staff who had an appreciation of the history of risks presented by mining in Victoria and a technical understanding of what needed to be done to effectively manage these risks and the status of these actions are no longer with the Department. This changing landscape requires careful consideration to be given to how corporate memory is being retained with DEDJTR.

The TRB acknowledges that many of the matters discussed in this annual report are symptomatic of the need for the reform of ERR that was initiated during the current reporting period.

It is vitally important that the current focus on mine closure and rehabilitation does not result in a reduction in focus on mine stability. Assuring mine stability is a prerequisite to successful rehabilitation of mine workings.

2 Introduction

The Technical Review Board (TRB) was established by the Victorian Government in 2009 as an Advisory Panel under Sections 54A, 54C, 54D and 54E of *The Mineral Resources (Sustainable Development) Act 1990* following the Warden's Inquiry into the collapse of the North East Batter at Yallourn Mine in the Latrobe Valley. The Inquiry identified several areas where improvements in the Victorian mining industry could be made. A primary function of the TRB is to provide independent advice to the Minister for Energy and Resources (the Minister), the Department of Economic Development, Jobs, Transport and Resources (DEDJTR) and industry (through the Department) on managing risks associated with mine instability and rehabilitation in the Victorian mining and quarrying sectors.

The Terms of Reference (TOR) for the TRB at the time of its establishment had a focus on risks to the environment, public safety and infrastructure. These were expanded in July 2015 to also include rehabilitation. The composition of the TRB was revised at the start of the current reporting period to reflect the new TOR.

In the past, the TRB's Annual Reports have aligned with the date of the establishment of the Board and, therefore, covered the months of September through to August. As part of the reforms of Earth Resources Regulation (ERR) initiated by the Minister in 2015, this reporting period has now been adjusted to align with the financial year, with the result that this 2015-16 Annual Report covers the period September 2015 to June 2016.

3 Terms of Reference

The TOR for the TRB have a wide scope and call for advice to be provided to the Minister and the Department in four general areas. These are:

1. Strategy
2. Mine and quarry stability assessments
3. Rehabilitation
4. Other activities, including education, research and interaction with industry.

The overall aim of the TOR is to improve geotechnical and hydrogeological performance and knowledge and mine rehabilitation within the Victorian mining industry. The current TOR are:

"The Board will report to the Minister on an annual basis. The Minister may subsequently release the Board's report to the Department and relevant industry stakeholders.

The Board will periodically provide advice on mine and quarry stability, to the Minister and Department, in the following areas:

a. *Strategy*

- *Written and/or verbal advice on the Department's strategies and regulatory approach to mine and quarry stability and geotechnical issues.*
- *Written and/or verbal advice on new developments in technology and science relating to the understanding, monitoring or management of mine and quarry stability and related geotechnical and hydrogeological issues.*

b. *Stability Reports*

- *Review mine and quarry stability reports including monitoring data that has been submitted to the Department and provide written advice to the Minister.*

c. *Other Activities*

- *Advise the Minister in formulating appropriate responses to significant events related to mine and quarry stability and related geotechnical and hydrogeological issues.*
- *Advise the Minister on appropriate guidelines and educational initiatives related to mine and quarry stability.*
- *With the knowledge and agreement of the Minister, interact directly with industry on mine and quarry stability and related geotechnical and hydrogeological issues, including participation in site visits, presentations and dialogue, particularly with respect to communicating findings of reviews with relevant stakeholders.*
- *In conjunction with the Department, interact directly with Federation University Australia (formerly Monash University, Gippsland campus) in relation to the Research and Development program on brown coal geotechnical and hydrogeological issues.*

d. *Rehabilitation*

- *Provide written advice and guidance to the Department on any issues related to rehabilitation, including progressive rehabilitation within the mines and quarries."*

4 Board Members

The Board comprised the following four members during the current reporting period:

Jim Galvin - Board Chairman

Emeritus Professor Galvin has tertiary qualifications in science and in engineering and extensive international experience in mining and geotechnical engineering, risk management and workplace health and safety. His career encompasses working in and managing underground mines, leading and directing research bodies, headship of the School of Mining Engineering at the University of New South Wales, and consulting. Past appointments include Professor and Head of the School of Mining Engineering at the University of New South Wales; Commissioner of the NSW Planning Assessment Commission; statutory member of the NSW Mining Qualifications Board; statutory member of the Commonwealth Government Taxation Concession Committee, and Safety Advisor to the Board of BHP Billiton and the Boards of a range of other organisations. Jim has been a member of the TRB since its inception in 2009 and Chair since 2011. Currently he is also Chair of the NSW Government's Coal Innovation Board; Chair of the Mine Managers Association of Australia CPD Committee; Safety Advisor to Solid Energy New Zealand, a New Zealand Government mining instrumentality; and a member of a number of NSW Government appointed independent panels charged with advising on and overseeing implementation of mine approval conditions.

Corinne Unger – Board Member

Ms Unger joined the TRB in September 2015. Corinne is an environmental scientist with more than 30 years' international experience in mine rehabilitation. She has a Bachelor's degree in earth sciences, Diploma of Education and Post-Graduate Diploma in Geoscience (Applied Geomorphology) from Macquarie University. Following her role as a Soil Conservationist for the NSW government, Ms Unger managed mine rehabilitation and research at ERA's Ranger Mine in the Northern Territory for 10 years. Subsequently, she was appointed Senior Environmental Officer in an environmental regulatory role in Central Queensland and then Project Manager for 5 years for the Mount Morgan Mine Rehabilitation Project, the largest legacy mine in Queensland. For the past 11 years she has been a self-employed consultant, specialising in mine rehabilitation and closure planning. In 2009, Ms Unger was awarded a Churchill Fellowship to undertake research overseas on 'Leading practice abandoned mine rehabilitation and post-mining land use'. Since 2011 she has also been a part-time senior researcher at the Sustainable Minerals Institute, University of Queensland undertaking research into coal mine rehabilitation and closure. Corinne was the inaugural Chair of the AusIMM's Community and Environment Society (2013-2015) and is a member of AusIMM's Board of Chartered Professionals.

Ian Johnston - Board Member

Professor Johnston graduated from the University of Southampton, UK with a bachelor's degree in civil engineering and a PhD in geotechnical engineering. After practicing in the UK, the USA and Europe, he joined Melbourne's Monash University in 1975. Ian became Dean of Engineering at Melbourne's Victoria University in 1993 and five years later moved to Coffey Geotechnics where he was a Senior Principal. In 2009, he was appointed to the Golder Chair of Geotechnical Engineering at the University of Melbourne. Ian retired from the university at the end of 2015 but maintains an involvement with research and consulting as a Professorial Fellow. He has more than 40 years' experience in geotechnical engineering, both as an academic and as a consultant for major projects in Australia and overseas. His interests cover a wide range of topics and he is particularly well known for his work on soft and weak rock and the engineering problems associated with the stability of this material in civil and mining engineering.

Rae Mackay - Board Member

Professor Mackay holds a degree in civil engineering from Imperial College, London University and a PhD in Hydrogeology from the University of Newcastle upon Tyne. In 2011, he was appointed as Director of the Geotechnical and Hydrogeological Engineering Research Group at Monash University – Gippsland Campus. Prior to moving to Australia to take up this appointment, Professor Mackay was an advisor to the UK nuclear waste management program. He was also Professor of Hydrogeology and Head of the Hydrogeology Research Group at Birmingham University, UK, where he worked on a diverse range of subjects including arid zone hydrogeology, sustainable urban water resources, geothermal energy exploitation and nuclear waste disposal. His current research role is directed at understanding risks and impacts associated with the ongoing development and eventual long-term rehabilitation of the brown coal mines in the Latrobe Valley, with his primary interests being in understanding subsurface flow and transport processes and developing predictive models for engineering and environmental applications.

5 2015-16 Activities and Status

5.1 Summary of TRB Activities

A summary of key TRB activities during the September 2015 – June 2016 reporting year is presented in Table 1. This was a particularly busy period for the TRB. The reform process implemented within Earth Resources Regulation (ERR) by Minister D'Ambrosio, the reopening of the Hazelwood Mine Fire Inquiry, and the commencement of the Batter Stability Project (BSP) added to the TRB's usual activities.

The full Board met on eight occasions. All four TRB members assisted the Hazelwood Mine Fire Inquiry in the lead up to formal proceedings, although Professor Mackay's contributions were in his role as Director of the Geotechnical and Hydrogeological Engineering Research Group (GHERG) based at the Churchill campus of Federation University. Two TRB members along with Professor Mackay gave evidence at these proceedings. The TRB produced 11 written advices to the Minister and the Department and the Chair met formally with Minister D'Ambrosio on two occasions (with a change in Minister causing a third scheduled meeting to be postponed) and informally on another occasion to introduce new TRB member, Ms Corinne Unger.

Table 1. Summary list of key TRB activities – September 2015 to June 2016

Date		Who	Activity
2015			• Welcome to new TRB member Corinne Unger • Visit to Yallourn Mine – Inspection of mining impact areas of Latrobe Road and HVP Plantation area. • Tour of research laboratories and review of GHERG's research program. • Meeting with AGL and discussion on recently submitted AGL Loy Yang Work Plan and rehabilitation concepts
	22 – 24 September	Full TRB Board	
	23 September	TRB Chair Galvin	• Meeting with Minister D'Ambrosio
	12 October	TRB	• Submission of advice to the Department re *Loy Yang Work Plan Variation*
	14 October	Galvin & Johnston	• Meeting with Department management regarding ERR Reform Initiative
	26 & 29 October	Full TRB Board	• Preparation of TRB advice to the Department on the Jacobs consulting report titled *Risk Assessment of Floodplain Mining Pits in the Mid-Goulburn Valley* • Inspection of Hazelwood Mine and meeting with senior management of the Latrobe Valley brown coal mines.
	27 - 28 October	Galvin & Unger	• Participation in Hazelwood Mine Fire Inquiry Workshop, Melbourne, on Jacobs consulting report regarding future rehabilitation options for Latrobe Valley brown coal mines. (TRB member Mackay participated as Director of GHERG)
	9 November	TRB	• Submission of TRB advice to the Department re *Managing Mining Induced Impacts*
	24 – 25 November	Full TRB Board	• Preparation of advice on Goulburn Valley Floodplain Mining • Discussion on Management of Mining-Induced Impacts Outside of Mine Lease Boundaries • Formulation of TRB response to Minister's Statement of

Date		Who	Activity
			Expectations • Discussion with Deputy Secretary - Regulation and Compliance Group
	26 November	TRB	• Submission to the Minister of TRB Response to Ministerial Statement of Expectations
	2 December	TRB	• Submission of TRB advice to the Minister re *Quarrying Operations in the Mid-Goulburn Valley Floodplain*
	3 December	TRB Chair Galvin	• Participation in Hazelwood Mine Fire Inquiry Workshop, Melbourne. (TRB member Mackay participated as Director of GHERG)
	9 – 10 December	TRB Chair Galvin	• Attend hearing and give evidence at Hazelwood Mine Fire Inquiry. (TRB member Mackay gave evidence as Director of GHERG)
	11 December	Unger	• Give evidence at Hazelwood Mine Fire Inquiry
2016	10 – 12 February	Full TRB Board	• Updated on and provide input into the ERR Reform Process • Visit to Anglesea Mine to discuss mine closure and rehabilitation planning and to inspect site. Formulation of advice to the Department. • Discussion and formulation of advice to the Department on mine closure and rehabilitation planning for the Latrobe Valley brown coal mines. • Review of Enterprise Risk Management Framework (ERMF) with the ERR Reform team
	20 February	TRB	• Submission of advice to the Minister re *Anglesea Coal Mine, Seymour Quarry (WA1189) Risk Assessment and Departmental Reform*
	26 February	TRB Chair Galvin	• Meeting with Minister D'Ambrosio
	8 – 9 March	Full TRB Board	• Discussion on Minister's Statement of Expectations Action Plan for ERR • ERR Reform Team and PwC advisors meeting to update to TRB on ERMF and to seek TRB input on strategic risk register developed by ERR • Presentation on Rehabilitation and Closure Framework and Policies by TRB member Unger • Discussions with ERR management on mine rehabilitation and closure planning
	11 April	Galvin, Johnston & Mackay	• Attend launch by Minister D'Ambrosio at Yallourn Coal Mine of government funded Batter Stability Research Project
	19 – 21 April	Full TRB Board	• Discussion on TRB advice previously provided to the Department regarding matters arising from Anglesea Coal Mine visit, including recommendations relating to the ongoing closure of Coal Mine Road and the pumping of groundwater from beneath the mine

Date	Who	Activity
		floor. • Review and formulation of advice regarding the ERR Reform Risk Assessment Framework Summary Report • Meeting with the Executive Director, Earth Resources Policy and Programs and briefing on the evolution of Clean Coal Victoria (CCV) into Coal Resources Victoria (CRV). Presentation from the Director of CRV on the future of brown coal operations and CRV's coal research strategy and community and stakeholder engagement strategy • Yallourn Mine visit - general site inspection of areas having relevance to ground stability, including Morwell River Diversion, Maryvale operations, Batter Stability Project site, rehabilitated batters and area of current backfilling of pit floor • Update from Department management on ERR Reform Project and discussions on ERMF and roll out strategy for it within ERR
3 May	TRB	• Submission of advice to the Minister re *Departmental Reform and Hazelwood Mine Fire Inquiry Recommendations*
23-24 May	Full TRB Board	• Critique of Hazelwood Mine Fire Inquiry Recommendations 2, 3, and 4 since they are premised on the involvement of the TRB • Discussion on integrated closure management plans for the Latrobe Valley brown coal mines, including the need for stakeholder engagement • Discussion on regulatory processes for approval of Risk Assessment and Management Plans (RAMPs) • Review of status of 'works in progress' associated with TRB activities and advices since its inception in 2009 • Presentation from the Department on some of its responses to the Volume IV findings of the Hazelwood Mine Fire Inquiry • Discussion and formulation of a strategy to identify and prioritise research and development needs in relation to mine stability and rehabilitation in the Latrobe Valley • Review of TRB's performance against Minister's Statement of Expectations
20-22 June	Full TRB Board	• Inspection of Batter Stability Project site at Yallourn Mine in company of senior management from the Latrobe Valley brown coal mines, and presentation from GHERG on research elements and progress to date • Inspection of sites of previous ground movement and cracking on Latrobe Road and the Princes Highway • Preparation of an advice re *Management of Cracking beside Latrobe Rd.* • Meeting with Coal Resources Victoria to discuss strategy for the development of the Regional Rehabilitation Plan as per recommendations of Hazelwood Mine Fire Inquiry • Briefing from Loy Yang Mine management on research being undertaken by the company into batter rehabilitation • Briefing from Elizabeth Radcliff on those aspects of ERR reform process concerned with authorised officers • Drafting of 2015-16 TRB Annual Report

Aspects of the more significant activities recorded in Table 1 are expanded upon in the following sub-sections of this report.

5.2 Reform of Earth Resources Regulation

In September 2015, Minister D'Ambrosio announced that the Earth Resources Regulation (ERR) Branch of the Department of Economic Development, Jobs, Transport and Resources (DEDJTR) was to be reformed in order to improve regulatory practice, processes and operations, and restore community confidence in the regulator. In response, an Action Plan was developed by ERR that set June 2016 as the target date for the development and implementation of the reforms.

The reform process impacted on the TRB in a number of ways, including:

- The TRB was reappointed in September 2015 for only ten months, such that the conclusion of this appointment would coincide with the ERR reform implementation target date of 30 June 2016.
- The TRB was consulted extensively by Department management and the Minister during the development and implementation of the reform package.
- The Minister provided the TRB with a Statement of Expectations (SOE) for the operation of the TRB. This SOE and the TRB's response to it are presented in Appendix 1.

The TRB strongly supports the reform of ERR, with the reform agenda addressing a number of concerns raised in the past by the TRB. The Board recognises that reform will take several years to become fully effective and that some of the necessary improvements are constrained in the short term during this rebuilding process.

The TRB is optimistic that the successful implementation of the reform agenda, in particular the move to an Enterprise Risk Management Framework (ERMF) consistent with International Standard ISO 31000 Risk Management, will provide a platform for addressing the underlying causes of key concerns to the TRB. This is because ISO 31000 has specific regard to governance, organisational structure, organisational resilience, roles and accountabilities, people skills, experience and competencies, training, transparency and culture.

Since its inception, the TRB has been particularly concerned about the scope and level of technical capability within the Department. For the reforms to be effective, it is essential that ERR:

- has a sound understanding of the principles and technologies underpinning geotechnical, hydrogeological and rehabilitation practice;
- has the capability to recognise when there is an issue and whether it can be dealt with internally or by consulting the Technical Expert Panel that ERR is proposing to establish;
- is able to competently distil data about an issue, either for internal or panel assessment;
- is capable of evaluating outcomes from multi- disciplinary perspectives and assess whether these are reasonable; and
- is competent to effect the appropriate action.

The TRB is of the view that ERR should possess a much stronger technical capability. It is hoped that the reform process will lead to this in time to come.

The TRB's response to the Minister's Statement of Expectations was finalised in late November 2015. The Board believes that it satisfied the Statement of Expectations to the fullest extent possible within the constraints imposed by the substantial reforms taking place within ERR. In addition to being consulted on aspects of the reform process, the Board continued to address and provide advice on a range of ongoing matters. TRB members made substantial contributions to the Hazelwood Mine Fire Inquiry, as reflected in the Inquiry's findings. The Chair met with the Minister in accordance with the committed timeline, except in May when there was a change in Minister just prior to the scheduled meeting.

5.3 Hazelwood Mine Fire Inquiry

During the 2015-16 reporting period, the Hazelwood Mine Fire Inquiry presented the fourth and final volume of its findings. This volume addressed Paragraphs 8, 9 and 10 of the Inquiry's Terms of Reference relating to short, medium and long-term options to rehabilitate the Hazelwood mine, the Yallourn mine and the Loy Yang mine.

At the request of the Hazelwood Mine Fire Inquiry Panel, the Minister agreed to the TRB assisting the Inquiry with these aspects of its TOR. All four TRB members made some contribution, although Professor Mackay's

contributions were made in his role as Director of GHERG. Professor Galvin and Ms Unger along with Professor Mackay participated in two workshops to critique advice that the Inquiry commissioned from Jacobs Australia Pty Limited prior to taking evidence. These TRB members gave evidence at the Inquiry.

The TRB has been reporting since 2012 that it considers the original measures proposed for the rehabilitation of the Latrobe Valley brown coal mines fall well short of what could reasonably be considered as adequate. Experience has revealed that rehabilitation is a far more complex matter than envisaged when rehabilitation plans were developed as part of the Work Plans for the mines. Successful rehabilitation is contingent on forming final mine batters that are stable in the long-term and appropriate for post-mining land uses. The Board has advised many times that this requires considerable further research into material properties and behaviour mechanics of brown coal.

Volume IV of the Hazelwood Mine Fire Inquiry made 18 recommendations, all of which have been accepted by Government. The TRB features directly in three of these recommendations and is pleased to see the need for further research recognised in another. These recommendations are:

Recommendation 2

Redress gaps in expertise by employing or engaging suitably skilled and experienced personnel in mine closure and rehabilitation liability assessments, and obtaining regular advice and guidance from the Technical Review Board.

Recommendation 3

Provide appropriate and ongoing resources to the Technical Review Board, particularly for the purpose of providing strategic advice on mine stability and rehabilitation.

Recommendation 4

Increase the rate of progressive rehabilitation by developing milestones within the mines' progressive rehabilitation plans in consultation with the mine operators and the Technical Review Board, and require the successful achievement of the milestones.

Recommendation 18

By 31 December 2016, develop an integrated research plan that identifies common research areas and priorities for the next 10 years, to be reviewed every three years. The plan should be developed in consultation with the Mining Regulator and relevant agencies, research bodies and experts.

In concluding its report, the Inquiry singled out the TRB's work for commendation, stating:

The Board commends the work of the Technical Review Board, in particular its provision of robust and independent advice to the Minister for Energy and Resources and the Department of Economic Development, Jobs, Transport and Resources on mine stability and rehabilitation.

5.4 Batter Stability Project

The TRB was very pleased to see ERR's Batter Stability Project launched by Minister D'Ambrosio on 11 April 2016. The TRB has had extensive input into the development of this research project over the last two years. The project is considered an essential element of the substantial research effort required to better understand the material and mechanical properties of brown coal and its local and regional behaviour as a basis for reliable design for mine stability and rehabilitation. Professor Ian Johnston (TRB member) was Chair of the Technical Advisory Group for the preparatory stages of this work in 2014.

This type of research is needed for many reasons, some of which are:

- Reviews of the Latrobe Valley mines by past and current members of the TRB have highlighted that there are processes and mechanisms related to the response of brown coal to mining that are not well understood.
- There has been limited research undertaken in the past 30 years into the geotechnical behaviour of the geological formations of the Latrobe Valley.

- Important aspects of many mine design methods being used in the Latrobe Valley are based on assumed or general material properties and behaviour mechanisms, rather than on direct observations and measurements.
- There has been very limited back analysis of recent batter movements and failures to confirm the governing mechanisms.
- There is limited information available on the reliability of existing material properties data.
- There is insufficient understanding of the data requirements for applying probabilistic risk methods, that are increasingly accepted in industry elsewhere as best practice.

The TRB is working with the regulator to develop a coordinated approach to identifying and prioritising research needs to address the requirements of Recommendation 18 of the Hazelwood Mine Fire Inquiry.

5.5 Managing Mining-Induced Impacts Extending Beyond a Mining Lease

Consistent with the results of theoretical assessments and computer modelling over the last three decades, experience has shown that mining and quarrying induced ground movements are not necessarily confined to within a mining or quarrying lease. In the case of brown coal mines, these movements can extend well beyond one kilometre of the crest of a mine batter. The consequence of these movements for public safety and the structural integrity of private and public infrastructure is a function of the distance from the crest of the mine or quarry and the tolerance of infrastructure to differential ground movements.

A number of mine instability events in the Latrobe Valley in recent years have highlighted a lack of definition and clarity around which stakeholders are responsible and accountable for responding to and managing mining-induced impacts on the natural and man-made environment. The lack of a management framework that clearly defines the roles and accountabilities of a mine owner and the various government agencies can, and has, resulted in delayed, uncoordinated and ineffective responses between primary stakeholders. During the current reporting period, the TRB prepared two advices in this regard. Based on experience in some other Australian states, addressing this situation in Victoria is likely to involve both changes to legislation and to the internal workings of the relevant government departments.

The current reform process within ERR provides the opportunity to address this important matter. This involves giving consideration to changes in legislation and government administrative procedures that result in, amongst other things:

- A mine operator being accountable for detecting all mining-induced effects that have a potential to impact natural and man-made features, irrespective of whether the effects occur within or outside of their mining lease.
- The identification and mapping of hazards and the monitoring and remediation of mining impacts being an expense of the mine operator.
- Work Plans being premised on a thorough consideration of the potential mining impacts outside of the mining lease (as well as inside).
- Approval of Work Plans being contingent on the development of risk-based management plans to manage the impacts and consequences of mining-induced effects in an effective and timely manner.
- Clearly defined roles, responsibilities and accountabilities of those government agencies involved with approving Work Plans in respect of monitoring and managing mining impacts on natural and man-made features.

5.6 Mine Closure and Rehabilitation

Mine closure is a process that takes place in the period between when the operational stage of a mine is coming to an end or has ended and when mine decommissioning and mine rehabilitation are complete. Completion is

reached when the mine site is in a state where the mining lease ownership can be relinquished and responsibility for the site accepted by the next land user[1].

Rehabilitation is an element of the closure process. However, it may be undertaken progressively to either a temporary or permanent standard while mining is occurring for reasons that include aesthetics, dust control, water control, revegetation and additionally, in the case of the Latrobe Valley brown coal mines, fire risk management. Planning for mine closure and rehabilitation should be considered in every stage of the life-of-mine cycle, commencing with prefeasibility studies. Decisions made early in a project life about mine design and treatment and processing of ores and minerals can have serious implications for the cost and effectiveness of mine closure processes and, hence, legacies for future generations.

The TRB has reported on a number of occasions since 2012 that it considers the original measures proposed for the rehabilitation of the Latrobe Valley brown coal mines fall well short of what could reasonably be considered as adequate. Rehabilitation assumed a higher profile in the 2014-15 TRB reporting period due to the focus of the Hazelwood Mine Fire Inquiry on fire fighting activities on the Hazelwood Mine batters and on covering batters to reduce fuel load. This lead to rehabilitation being included in the TRB's TOR at the start of the current reporting period and TRB membership being reconstituted to include a specialist (Ms Corinne Unger) on mine closure and rehabilitation. Rehabilitation assumed an even higher profile during the current reporting period due to the final stage of the Hazelwood Mine Fire Inquiry having a specific focus on mine rehabilitation.

Volume IV of the Hazelwood Mine Fire Inquiry recommends further studies and consultation to address a range of issues related to mine rehabilitation, including post-mining land use options, long term stability issues, water availability for final void filling, progressive rehabilitation for fire control purposes, community engagement, rehabilitation research needs and the relative roles of industry and government in this process. The Victorian Government has responded in a number of ways including the allocation of $12.6 million to Earth Resources Regulation to fund an integrated study of the requirements and implications of brown coal mine rehabilitation and closure for government and the Latrobe Valley.

The TRB welcomes this initiative. The proposed level of funding and four year duration of the program of studies should permit an appropriate level of research and development work to be completed and it can be anticipated that the outputs of the program will provide confidence to the government that a sustainable outcome for the Latrobe Valley can be achieved. Experience suggests that success will be highly dependent on the responsiveness and flexibility of government processes for procuring the necessary technical work to deliver the best quality product. The TRB is optimistic that the adoption by ERR of an enterprise risk management framework will improve outcomes in this regard.

There are a number of areas in which the TRB can provide valuable input and advice to the project team and initiatives to do so are already in hand. Areas of particular note are:

- advising on proven successful and unsuccessful mine rehabilitation and closure strategies;
- scoping the research and development program;
- advising on required technical capabilities;
- assisting with sourcing appropriate technical capabilities; and
- facilitating stakeholder engagement, consultation and collaboration.

DEDJTR has recognised the need for regulatory guidelines for mine closure and rehabilitation and has commenced work on their development. There are existing global, national and other Australian jurisdiction guidelines that can be used to inform this process to ensure leading practice principles are applied. The TRB has directed ERR to some of these guidelines. A detailed and rigorous evaluation of existing tools and guidance will be required as a basis for developing robust guidance and integrating it with existing regulatory requirements.

5.7 Anglesea Coal Mine

Since its inception in 2009, the TRB has maintained a watching brief on Anglesea Coal Mine in response to pre-existing and new concerns regarding mine stability. The mine closed in 2015. The TRB inspected the site in the company of a number of ERR officers during the current reporting period and received a presentation from Anglesea mine management on the mine rehabilitation and closure planning process, which is in its very early stages. This inspection formed the basis of a TRB advice to the Minister regarding the approach to mine closure

[1] *Leading Practice Sustainable Development Program for the Mining Industry. Mine Closure and Completion.* Department of Industry, Tourism and Resources. Australian Government. 2006

and rehabilitation and ongoing concerns regarding the mining-induced impacts on Coal Mine Road which runs along the southern boundary of the mine.

Subsequently, the TRB has been involved in a number of discussions with ERR officers in relation to the development of a Rehabilitation and Closure Plan for Anglesea and for all mines in general. It is particularly important that ERR has regard to past advice from its external technical advisors and the TRB as to the limited data acquisition, investigations, monitoring, modelling and analysis to inform mine stability assessment at Anglesea Coal Mine. Unexplained batter and floor movement at this mine in association with the limited knowledge base could have implications for ongoing mine stability and for mine rehabilitation and closure.

5.8 Peer Review of Morwell River Diversion

The 2014-15 TRB Annual Report discussed the status of the peer review process implemented by ERR in relation to the repair of the Morwell River Diversion (MRD) and the integrity of that section of the river diversion that did not fail. The annual report noted that the ongoing stability of the MRD outside of the remediated section is an important matter that requires further assessment and that careful and comprehensive risk assessments are essential to understanding and managing the risks still associated with the MRD. It reported that risk assessments of the remediated section and other areas of the MRD were not available for review by the TRB at that time and that the TRB placed high importance on undertaking these reviews in fulfilling its TOR.

This situation remains unchanged. Staff changes associated with the reform of ERR have impacted on progress. It is important that this outstanding work is completed.

5.9 Agency Roles, Responsibilities and Accountabilities

For some time the TRB has been concerned that, in general, accountability within government for overseeing risk management in the mineral resources sector is assigned to agencies on the basis of the consequences of an unwanted event occurring, rather than on the basis of the agency that is best qualified to provide assurance to government on the robustness of the risk management process required to prevent the event from occurring in the first place. For example, DEDJTR has jurisdiction if ground instability affects the general public while WorkSafe has jurisdiction if it affects employee health and safety.

The Hazelwood Mine Fire Inquiry also reported that there were several examples before the Inquiry that demonstrated that the regulatory framework is inadequate. This situation has resulted in inconsistencies in how risk management plans are developed, duplication of effort on the part of agencies and the stakeholders being regulated, and a lack of clarity regarding responsibility. Unfortunately, this tends to become apparent at the worst time, being when there is a critical incident. Hence, the TRB remains of the view that there is need for wider regulatory reform relating to how the Victorian government oversees risk management in the mineral resources sector, particularly in regard to clarifying roles, responsibilities and accountabilities of agencies.

5.10 Quarrying Operations in the Mid-Goulburn Valley Floodplain

It was noted in the 2014-15 TRB Annual Report that the TRB had been requested by the Department to meet with the Goulburn Broken Catchment Management Authority (GBCMA) and to visit a number of active and defunct quarry mining operations on the mid-Goulburn Valley floodplain in the vicinity of the township of Seymour. This was for the purpose of providing advice on risk to the environment and public infrastructure presented by these operations. The GBCMA, in particular, had expressed concerns that quarry mining operations could result in environment and infrastructure being adversely affected by scouring of watercourses and changes in the pathways of watercourses resulting from quarries becoming inundated (captured) during flood events.

The TRB submitted a written advice to the Minister on this matter in December 2015. It concluded that key consulting reports associated with the matter were not sufficiently robust and did not provide a reliable basis for decision making relating to the severity and management of the risks presented by quarrying operations in the mid-Goulburn Valley floodplain.

In order to establish a sound basis for planning, approving and regulating quarrying operations in the mid-Goulburn Valley floodplain, the TRB recommended that the Department seek the views of a broader scientific and engineering community in order to establish the extent and magnitude of quarrying induced impacts and consequences likely to be experienced in this local setting. This needs to be supported by a resource study to inform high level policy making and strategic planning. The TRB is of the view that the resource study and the

potential impacts study should be led by Minerals Development Victoria or an equivalent planning agency and not by ERR.

The TRB followed up this advice with a second advice specific to Seymour Quarry (WA1189), which is located in the Goulburn Valley flood plain, near the town of Seymour. The Goulburn River is approximately 100 m to the south of the quarry crest, while the Sydney – Melbourne rail corridor is approximately 60 m to the east of the quarry crest. ERR had issued a Section 110 Notice requiring risk assessment in response to concerns raised by the GBCMA and others that the inundation of the quarry by water could present a serious risk to public safety, the environment and public infrastructure. At the request of ERR, the TRB reviewed the risk assessment report prepared in response to the Section 110 Notice and advised accordingly.

5.11 Stakeholder Engagement and Education

For a number of years, the TRB has advocated the fostering of greater engagement and collaboration amongst all stakeholders in order to achieve cultural change in how mine stability and rehabilitation are managed in the Latrobe Valley. Its involvement with initiatives in this regard was ongoing during the reporting period. This included meeting informally with industry senior management on two occasions to explore issues and views and supporting the organisation of the *Second Symposium on Engineering in Brown Coal* to be held in late 2016.

The Latrobe Valley Geotechnical Interest Group (LVGIG), which the TRB was instrumental in establishing in 2013, continued to conducted regional seminars. Its September 2015 – June 2016 program is presented in Table 2.

Table 2: Seminar program of the LVGIG for the September 2015 – June 2016 reporting period

Date	Seminar Topic
October 2015	Landslides, Risk Concepts and Case Studies.
November 2015	Aspects of Ground Improvement – Effectiveness of Different Treatments from Case Histories.
February 2016	Advanced Triaxial Testing Using On-specimen Transducers
April 2016	Stress Measurement Techniques

5.12 The Status of Other Initiatives

Several important initiatives that have some association with past activities and advices of the TRB are still 'works in progress' or on-hold. This is mainly due to the distraction of the Hazelwood mine fire; the Hazelwood Mine Fire Inquiry; the attention to mine closure and rehabilitation; the lack of appropriate technical capabilities within ERR; and the loss of corporate memory within ERR as a consequence of organisational and staff changes driven by the reform process.

Examples of these outstanding initiatives include:

- the development of Hazard Management Plans for all infrastructure within 1 km of the crest of Latrobe Valley brown coal mine workings;
- the development and implementation of a Geotechnical Guideline for the Latrobe Valley brown coal mines;
- the development of robust Ground Control Management Plans for some sites;
- the risk profiling of quarries operating on flood plains; and
- the previously noted peer review of risk assessments relating to the stability of the Morwell River Diversion.

The TRB is concerned that the corporate memory of the need for these initiatives and their state of completion now largely resides within the current TRB membership. It would be unfortunate if these initiatives did not come to fruition.

5.13 GHERG

In 2014, the role of GHERG was broadened at the request of ERR to include rehabilitation as one element of its research program. During the current reporting period, aspects of this research informed the evidence presented to the Hazelwood Mine Fire Inquiry by the Director of GHERG, Professor Mackay.

GHERG's research staff comprise geotechnical and hydrogeological specialists and, therefore, it has chosen to concentrate on those aspects of rehabilitation that are associated with final landform stability. This choice reflects current work being undertaken at the Latrobe Valley brown coal mines. At Loy Yang, research efforts are targeted at the development of trial rehabilitation slopes to examine the durability of these slopes for long term rehabilitation. At Yallourn, research efforts are targeted at the implementation of the Batter Stability Project.

Loy Yang mine's rehabilitation trials are planned for an initial five year period (2016-2020). The trials will include the construction of several rehabilitated batter slopes and include geotechnical data collection, site monitoring of ground movements, water quality and flows, and sediment transport. Modelling will be undertaken to explore the major processes and the effectiveness of the slope designs. The first rehabilitation trial is under construction at the intersection of the north and western batters. GHERG is supporting these trials through geotechnical and geo-environmental data collection, analysis of shallow ground and water movements and the monitoring and assessment of sediment fluxes. Planning for this work has been carried out in conjunction with the Mining and Geotechnical Engineering groups at Monash University. GHERG students are also working on options for integrating drainage layers beneath the cap layers to mitigate the risks of excess pore water pressures that can induce mechanical failure of the capping layer.

The Batter Stability Project commenced in mid-April on the northern batters of Yallourn mine. The first phase of the project comprises invasive site investigations using borehole drilling to build a more complete understanding of the geological variability of the interseam formations, the jointing of the coals, the groundwater regimes and the in situ stresses in the coal and interseam formations. This phase will be followed up with detailed geotechnical and hydrogeological experimentation and modelling of the ground conditions impacting ground movements and groundwater flows along the northern Latrobe River batters adjacent to the 2007 batter failure. As part of the first phase, a back analysis of the batter failure will also be undertaken using the available historical and collected data. The first six boreholes are being drilled, sampled and tested in the current reporting period. The remaining seven boreholes, outside of the mine, will be constructed and tested after the end of the 2016 winter season. As noted earlier, this project provides an excellent and important opportunity to explore the adequacy of historical data collected for ground control management and to unravel the coupled hydraulic and geo-mechanical processes that are influential in controlling ground stability post mining.

GHERG is also undertaking a broad range of other research, including:

- groundwater depressurisation impacts on batter stability;
- the development of stress measurements in brown coal;
- the investigation of coal relaxation governing the time-dependent reduction of stress in this formation;
- environmental controls governing creep behaviour of brown coal;
- the interactions between mining induced coal strains and overburden fracturing; and
- the impact of discontinuities on the measurement of coal strength parameters.

These activities will all follow through into the next year and beyond.

6 Going Forward

6.1 Completion of Outstanding Issues

The range of issues canvassed in this annual report, their current status and the need to bring some to fruition sooner rather than later provides considerable ongoing work by the Department.

6.2 Actions arising from Hazelwood Mine Fire Inquiry

Recommendations 2, 3 and 4 of the Hazelwood Mine Fire Inquiry place reliance on the involvement of the TRB in providing strategic advice and guidance on mine stability and rehabilitation and in being consulted on the progressive rehabilitation plans of the Latrobe Valley brown coal mines. The TRB perceives a role for it to be consulted and to add value in relation to the implementation of other recommendations, in particular Recommendation 18 of the Inquiry.

6.3 Emerging Issues

Two important issues have emerged out of the current focus on mine closure and rehabilitation that warrant focused attention in the future. The first concerns operational and legacy issues associated with mine waste dumps, especially tailing storage facilities (TSF) and the second relates to the legacy of abandoned mines.

The TRB is aware that all states in Australia, except Victoria, have been engaged in a process under the Coalition of Australian Government (COAG) of developing a 'Strategic Framework for Managing Abandoned Mines in the Minerals Industry' that was completed in 2010. This is a matter that needs consideration in going forward.

7 Concluding Remarks

The TRB has reported to three governments, six ministers and three government departments since its inception seven years ago. Many of the ERR staff who had an appreciation of the history of risks presented by mining in Victoria and a technical understanding of what needs to be done to effectively manage these risks and the status of these actions are no longer with the Department. This changing landscape requires careful consideration to be given to how corporate memory is being retained within DEDJTR.

The TRB acknowledges that many of the matters discussed in this annual report are symptomatic of the need for the reform of ERR that was initiated during the current reporting period.

It is vitally important that the current focus on mine closure and rehabilitation does not result in a reduction in focus on mine stability. Assuring mine stability is a prerequisite to successful rehabilitation of mine workings.

8 Appendices

APPENDIX 1: STATEMENT OF EXPECTATIONS – MINISTER'S REQUEST

Hon Lily D'Ambrosio MP
Minister for Industry
Minister for Energy and Resources

121 Exhibition Street
Melbourne Victoria 3000
Telephone: 03 8392 2100
DX210074

Ref: D2015/35519

Professor Jim Galvin
Chair, Technical Review Board
PO Box 1228
MANLY NSW 2095

Dear Professor Galvin

STATEMENT OF EXPECTATIONS FOR THE EARTH RESOURCES REGULATION TECHNICAL REVIEW BOARD

I am pleased to provide you with this Statement of Expectations (SOE) for the operation of the Technical Review Board (TRB). This SOE applies from receipt of this letter to 30 June 2016, or until otherwise amended.

This Statement applies to all members of the TRB as appointed by me on 4 September 2015. The TRB is an Advisory Panel under Part 4A of the *Mineral Resources (Sustainable Development) Act 1990*, and this Statement should be read within the context of the objectives, obligations and functions outlined in that Act.

I acknowledge the TRB's support to Earth Resources Regulation Branch (ERR) in the Department of Economic Development, Jobs, Transport and Resources (DEDJTR) over the past six years, and the valuable analysis provided in its Annual Reports over that time.

The purpose of the Board, as set out in its Terms of Reference (attached), is to provide advice to me and DEDJTR on mine and quarry stability issues, specifically in relation to reducing risks to the environment, public safety and infrastructure. Advice on any issues related to rehabilitation was recently added to the Terms of Reference.

Expectations
This SOE sets out my expectations and priorities for the TRB, and they apply to advice and activities under the current Terms of Reference.

1. *Increasing strategic advice to the Government*

My priority is for the TRB to provide strategic advice to the Government in the areas of mine and quarry stability, rehabilitation and other strategic risks. This will include advice on regulatory approaches to assist ERR achieve its strategic objectives in these areas. I will ask ERR to ensure you are regularly briefed about strategic developments in ERR, so you have the context to brief me.

Victoria

2. *Progressively reducing the provision of advice on technical stability reports*

I understand that ERR has previously requested the TRB to review technical stability reports for mines and quarries. ERR will change its practice in that regard to seek those technical services from other sources and reduce requests for the TRB to provide such routine technical advice. I am advised that ERR will be establishing an expert panel to provide routine advice regarding technical work that has previously been provided by the TRB.

I request that you support the rebuilding of ERR by assisting the Department to build expertise and providing a mentoring role in the way you provide your strategic advice.

3. *Continuing other activities*

The TRB should continue to undertake other activities as specified in the Terms of Reference, and to provide advice on other matters on request from me or DEDJTR.

Reporting

I request that the Chair of the TRB meet with me on a quarterly basis.

The TRB should report progress in achieving these priorities in its 2015/16 Annual Report, which it should submit by 30 June 2016, within the Board's current term.

I expect the TRB to respond to this Statement within 30 days, outlining how it intends to achieve these priorities.

I look forward to working with you as you fulfil this more strategic advisory role.

Yours sincerely

Hon Lily D'Ambrosio MP
Minister for Energy and Resources

Date: 23 /11 /2015

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APPENDIX 2: STATEMENT OF EXPECTATIONS – TRB RESPONSE

Technical Review Board

26 November 2015 Our Ref: TRB.L63

Hon Lily D'Ambrosio MP
Minister for Energy and Resources
Parliament House
Victoria

Dear Minister

TECHNICAL REVIEW BOARD RESPONSE TO YOUR MINISTERIAL STATEMENT OF EXPECTATIONS FOR IT

I am pleased to respond to your letter of 23/11/15 which set out your Statement of Expectations and priorities for the Technical Review Board (TRB) during the remainder of its current term.

This response is provided against the background that since the inception of the TRB six years ago, information exchange between the Department and the TRB has occurred primarily at the level of General Manager Operations, Earth Resources and Regulation. Typically, the TRB has met formally every two months for two to three days, with board members undertaking one to two days of TRB related work between meetings. The board has reported to five different Ministers during that time, all of whom apart from yourself it met only once or twice.

1. Increasing strategic advice to the Government

The TRB commits to providing an increased level of strategic advice to the Department.

In order to achieve this, the TRB will:

- seek to improve information flows by engaging with the Department at a higher organisational level (at least, Director level) than has been past practice;
- seek regular briefings from senior management in the Department about strategic developments in Earth Resources and Regulation;
- extend its understanding of the risk profile of current and defunct mine and quarry operations, including tailings containment and rehabilitation, across Victoria; and
- encourage the Department to utilise the TRB in a proactive manner (rather than in a reaction to incidents, as has predominantly occurred in the past).

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The TRB may be contacted through the TRB Executive Officer:
TRB EO. Karen Sonnekus
Telephone: (03) 9092 1969
Email: karen.sonnekus@ecodev.vic.gov.au

Victoria AUSTRALIA

2. **Progressively reducing the provision of advice on technical stability report**

The TRB will:

- assist the Department to develop in-house capabilities and to source external resources (e.g. the proposed technical expert panel) to advise the Department on routine technical aspects of mine stability, whilst still fulfilling its Terms of Reference *to review mine and quarry stability reports including monitoring data, that has been submitted to the Department and provide written advice to the Minister*;

- encourage and mentor Department staff to distil relevant information from reports for referral to the TRB in advance of its meetings (rather than providing full reports as per past practice);

- provide advice on the expertise/skill set required to deliver improved regulatory functions and to support the rebuilding of Earth Resources Regulation; and

- consistent with its recently expanded Terms of Reference, provide advice on mine rehabilitation.

3. **Continuing other activities**

The TRB will:

- continue to promote initiatives to achieve cultural change in how mine stability and progressive rehabilitation is managed in the brown coal sector, including engagement with senior mine management, the development of a geotechnical guideline and the fostering of education and continuing professional development programs for all stakeholders;

- continue to advocate for basic and applied research into brown coal properties and behaviour, mine design and rehabilitation procedures;

- continue to support and guide the activities of the Geotechnical and Hydrogeological Engineering Research Group (GHERG) at the Gippsland campus of Federation University;

- provide guidance to any technical forums which may be held to assist in capacity building within the Victorian mining and quarrying sectors; and

- provide advice on any matters of relevance to its Terms of Reference on an 'as required' basis, including input into the Hazelwood Mine Fire Inquiry.

The TRB may be contacted through the TRB Executive Officer:
TRB EO: Karen Sonnekus
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Email: karen.sonnekus@ecodev.vic.gov.au

As Chair of the TRB, I welcome the opportunity to meet with you on a quarterly basis and commit to submitting the 2015/16 Annual Report by 30 June 2016, this being the last day of the term of appointment for current TRB members.

The TRB has been of the view for some time that there was a need to change within Earth Resources and Regulation. You have the full support of all TRB members in taking your reform process forward and embedding it for the future.

The TRB looks forward to working more closely with you.

Yours sincerely

Emeritus Professor Jim Galvin

Chair, Technical Review Board

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Telephone: (03) 9092 1969
Email: karen.sonnekus@ecodev.vic.gov.au