Department of
Industry and Resources

Mining Environmental Management Guidelines

Safe Design and Operating Standards for Tailings Storage

May 1999

Environment Division

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SAFE DESIGN AND OPERATING STANDARDS FOR TAILINGS STORAGE

1. INTRODUCTION

The prime functions of a tailings storage facility (TSF) are the safe, long term storage of tailings with minimal environmental impact. Tailoring the design of a TSF to the site conditions, to ensure safety and minimise the environmental impacts, can lead to a reduction in total project costs.

These guidelines have been prepared by the Department of Industry and Resources, Western Australia (DoIR) to assist in the design, construction, management and decommissioning of TSFs in Western Australia so as to achieve efficient, cost effective, safe and environmentally acceptable outcomes. The guidelines are intended to provide a common approach to the safe design, construction, operation and rehabilitation of TSFs, and to provide a systematic method of classifying their adequacy under normal and worst case operating conditions.

The approach adopted in these Guidelines recognises the desire of the mining industry to move towards self management by the use of a certificate of compliance for TSF design and a certificate of compliance for TSF construction.

The following Acts of Parliament currently govern safety and environmental issues of TSFs in Western Australia:

- Mines Safety and Inspection Act
- Mining Act
- Environmental Protection Act:
  - Part IV, Environmental Impact Assessment
  - Part V, Approval and Licenses for prescribed premises
- The Rights in Water and Irrigation Act: Part III, Control of Waters

In some circumstances, TSFs may also be subject to additional legislation under the following:

- Aboriginal Heritage Act
- Conservation and Land Management Act
- Land Administration Act
- Local Government Act
- Native Title Act
- Soil and Land Conservation Act
- Wildlife Conservation Act

Among the aims of these guidelines is encouragement of the mining industry to take a longer term approach to the planning of TSFs. One of the factors critical to the final rehabilitation of a TSF is the management of the tailings deposition during the TSF operation. Without systematic tailings deposition and careful water management, the final rehabilitation could be very costly, and be required at a time when cash flow is limited or non-existent. Much of this challenge can be overcome by adequate planning, associated with good tailings management and the use of sound technical approaches early in the life of the facility.

It is recognised that not all of these guidelines may necessarily be applicable to all forms of tailings storage. A notable example is below ground storage of mineral sands tailings within mined out dredge ponds. In such circumstances the management of the operation should recognise and address the issues that are applicable to a particular tailings storage system.

For additional information on TSF design, construction and operation, readers are referred to the suggested further readings listed in Section 7 of this document. Guidelines on the safe design and operating standards for tailing storages 2.2.

2. TYPES OF TAILINGS STORAGE FACILITIES

The prime functions of any TSF are two-fold, namely:

- safe and economical short-term storage of fine grained wastes to minimise the possible environmental impacts; and
- construction of an erosion resistant, non-polluting structure which is stable in the long-term.

To achieve these functions, TSFs will need to be individually tailored to the site, the ore mineralogy, the process, and the desired long-term landform. As a result, TSFs would be expected to have a variety of designs and construction techniques. The design approach, construction method and decommissioning concept should be selected to suit the individual local conditions.

The total costs of investigation, site selection, design, construction, operation, monitoring and decommissioning should be considered for each possible design approach, and the most suitable and cost effective design should be selected. It is often the case that the lowest initial capital cost design may not be the most cost effective when decommissioning is also considered.

2.1 Above Ground Storage

In an above ground facility tailings are generally stored behind a purpose built embankment. The embankment may be constructed in several stages or in one pass to its designed maximum height. The purpose built tailings storage embankments differ significantly from conventional water storage dams in a number of important aspects, including:

- The design life of a TSF is, effectively, perpetuity. A TSF could be considered to have two phases in its life - a depositional phase with active human involvement followed by an erosion free, environmentally benign, stage with no further human intervention, forever. A water storage dam on the other hand does have a finite design life, after which it may be removed and the site rehabilitated; alternatively it may be strengthened for further use. Throughout its working life a water storage dam will be monitored, and on-going maintenance and remedial work shall be carried out as long as water is stored behind the dam.
- Rehabilitation aspects require careful consideration as TSFs cannot be breached at the end of their service allowing the containment area or valley to return to its original condition. Instead, material and liquids or leachate must remain safely stored.
- The materials stored behind the embankment may be loose or poorly consolidated with some contained water. Contaminants of varying toxicity may also be contained within the impounded material. Under severe seismic shock, saturated tailings may liquefy to produce a mobile fluid of high unit weight, which may lead to additional loading on the embankment.
- The containing embankments are occasionally constructed by hydraulic deposition, rather than mechanised placement, of loose and saturated tailings materials and may themselves be subject to liquefaction and loss of strength under seismic loading.
- Many TSFs are developed progressively as part of a mining operation; they may be constructed in stages, over a period of years, with the embankment being raised to keep pace with tailings production. This in-built “performance and design review” allows for flexibility in approach when compared to conventional water Guidelines on the safe design and operating standards for tailing storages 3 storage dams. However, this flexibility in design may be, to a certain degree, offset by a generally lower standard of construction control than is the case for water storage dams.
- A well designed, constructed and operated TSF can achieve a significant drawdown of the phreatic surface in the tailings material near the embankment. As tailings deposition continues, with embankment raising, the embankment may derive a significant amount of structural support from the tailings material.
- The storage of waste rock and tailings material in the same facility (co-storage) requires careful consideration of a number of factors including the available void volume in the rock material, the relative proportions of waste rock, tailings solids and tailings fluids, and the strength of the waste rock material and its resistance to compaction and consolidation with a consequent reduction in void volume.
- The presence of sulphide materials in the TSF and their propensity to generate acid rock drainage will also need to be considered. The potential seepage of acidic leachate from the TSF needs to be recognised and managed in an environmentally appropriate manner. In common with water storage dams, however, the control of seepage waters from TSFs is important for the maintenance of stability. Because of the arid climate in most of Western Australia, the water management aspects of TSFs are important from an operational viewpoint, in addition to their impact on wall building and final decommissioning.

2.2 Below Ground Storage

Direct storage in previously mined out open pits or underground openings is an alternative method for tailings storage used by some mine operators. In practice, this approach is more difficult to manage than above ground storage due to the difficulties with the removal of contained fluid, and the resultant low densities of deposited materials. Because of these challenges, approval to adopt below ground storage will usually require extensive geotechnical, hydrogeological and environmental studies to establish the viability and long-term safety of below ground storage of tailings.

Below ground storage should only be considered when:

- there is no possibility of there being a potentially viable mineral resource being sterilised by the deposition;
- rehabilitation measures are provided to ensure that there is no long-term environmental impact or public safety hazard;
- there is no possibility that the safety in the operating underground mines in the vicinity be jeopardised by the proposed TSF; and
- future underground mining beneath the stored tailings is not contemplated or likely.

The prime difficulty with in-pit storage is the rapid rate of rise of tailings level in the early phases of deposition where the pit is deepest and the exposed surface area is smallest, with a consequent reduction in the effect of solar drying and desiccation on a given volume of tailings, when compared with usual above ground TSFs of the same overall capacity. Water management in these circumstances can be very difficult, and consideration should be given to methods of increasing water recovery, or to water extraction and tailings slurry thickening before deposition.

The issues that need to be addressed when designing in-pit TSFs are discussed in more detail in Appendix H.

3. HAZARD RATING OF TAILINGS STORAGE FACILITIES

These guidelines have been prepared using a hazard rating system in accordance with other nationally and internationally accepted standards on TSF safety and rehabilitation. Individual TSFs are classified using a hazard rating that recognises the potential impact on the environment and any life, property, or mine infrastructure as a result of possible uncontrolled leakage or failure of the embankment.

By using a hazard rating system, these guidelines clearly recognise that differences in design philosophy, the degree of technical input, and the type and nature of construction are appropriate for mine TSFs constructed in the various regions of Western Australia.

The hazard rating is derived by considering:

- the potential impact in terms of safety on any nearby community infrastructure and/or mining developments (including the TSF operator) in the event of either controlled or uncontrolled escape of material, seepage and/or abrupt failure of the TSF embankment at any stage in its life; and
- the potential environmental impact in the event of either controlled or uncontrolled escape of material, seepage and/or abrupt failure of the storage embankment at any stage in its life;
- the potential impact in terms of economics on any nearby community infrastructure and/or mining developments (including the TSF operator) in the event of either controlled or uncontrolled escape of material, seepage and/or abrupt failure of the TSF embankment at any stage in its life; such economic impacts should also consider the impact on the mining operation due to the temporary loss of the TSF resulting from the failure or uncontrolled escape of tailings from the facility.

The hazard ratings to be applied to TSFs in Western Australia are shown in Table 1.

The hazard rating given to an individual TSF is not an assessment of the risk of failure, but rather the potential impact in the event of controlled or uncontrolled escape of material or seepage, or the partial or complete failure of the embankment. Therefore, a well engineered and constructed embankment, or a well operated TSF, may still receive a High or Significant hazard rating. TSFs should be classified by considering the impact of both embankment failure and controlled, or uncontrolled, escape of material, or seepage.

The least favourable classification using this approach becomes the designated hazard rating for the TSF under consideration.

4. DERIVATION OF STORAGE CATEGORIES

The hazard rating system is used, together with the size of the facility, to define three categories of TSF for which varying levels of detailed study and justification of design, operating procedures and rehabilitation measures are required. Rigorous and technically based justification is required for:

- TSF embankments which are any artificial barrier or levee, whether temporary or permanent, which do or could impound, divert or control water, silt, debris or liquid borne materials, together with its associated works, with an anticipated maximum embankment height of 15 m or more; or
- TSFs of any height which can be classified as posing Significant or High hazards using the rating system given in Table 1.

The matrix for defining the three categories of TSFs is shown in Figure 1.

TABLE 1: HAZARD RATINGS – MINE TAILINGS STORAGE FACILITIES (After DoIR-QLD, 1995a)

TYPE OF EFFECT	HAZARD RATING		
	High	**Significant**	**Low**
Uncontrolled releases of seepage			
Loss of human life	Location such that contamination of a water supply likely to be used for human consumption and consumption of the contaminated water is expected.	Location less critical but contamination of a water supply likely to be used for human consumption and consumption of the contaminated water is possible but not expected.	No contamination of a water supply likely to be used for human consumption expected.
Loss of stock	Location such that contamination of a water supply is likely to be used for stock consumption and consumption of the contaminated water is expected.	Location less critical but contamination of a water supply likely to be used for stock consumption and consumption of the contaminated water is possible but not expected.	No contamination of a water supply likely to be used for stock consumption expected.
Environmental damage	Location such that damage to an environmental feature of significant value is expected.	The significance of the environmental feature is less or damage is possible but not expected.	No environmental features of significance or no damage expected.
Embankment failure			
Loss of human life	Loss of life is expected because of community or other significant developments.	No loss of life expected, but the possibility recognised. No urban development and no more than a small number of habitable structure down stream.	No loss of life expected.
Direct economic loss	Severe economic loss such as serious damage to communities, industrial, commercial or agricultural facilities, important utilities, mine infrastructure, the storage itself or other storages downstream.	Appreciable economic loss, such as damage to secondary roads, minor railways, relatively important public utilities, mine infrastructure, the storage itself or other storages downstream.	No significant economic loss, but possible limited damage to agricultural land, minor roads, mine infrastructure etc.
Indirect economic loss	Storage essential for services and repairs not practicable.	Repairs to storage practicable.	Repairs to storage practicable. Indirect losses not significant.

Figure 1: Hazard Rating/Height Matrix to Derive TSF Categories

TSF CATEGORIES				
HAZARD RATING *		**HIGH**	**SIGNIFICANT**	**LOW**
Maximum Embankment Height †	>15m	1	1	1
	5-15m	1	2	2
	<5m	1	2	3

* Hazard Ratings are assigned on the basis of potential impact on human life, economic loss and the environment as per Table 1. All cross-valley facilities, or facilities which block or significantly impede the flow in natural drainage lines, are to be considered as Category 1 TSF regardless of embankment height.

† In-pit TSFs are to be classified assuming an embankment height of less than 5m. For central thickened discharge (CTD) facilities maximum stack height may be used instead of the maximum embankment height.

5. DESIGN AND OPERATING STANDARDS

The height and hazard rating system mentioned above recognises that, due to the varying environmental and safety hazards posed by TSFs of different size and design, there will be differing on-going design and operating requirements to ensure the safety and adequate rehabilitation of such facilities.

The three categories of TSFs weight these differences and provide a basis for decisions on the level of technical input and quantitative justification required for the design and operating procedures.

The requirements listed in Table 2 and the sections below cover the essential criteria for each category of TSFs. Owners and operators of TSFs in all categories must complete a tailings storage data sheet (Appendix A) which forms the basis for registration of all operating, disused, abandoned, proposed and rehabilitated TSFs in Western Australia. These data sheets should be updated periodically to reflect the changing storage statistics, and be submitted with periodic audit reports.

The Department of Environment and Conservation (DEC) may require additional information to be provided in support of specific proposals. This will be determined in conjunction with the proponents of individual proposals, by discussion and agreement. The recommended operational standards for TSFs are discussed in Appendix G.

5.1 Category 3 Facilities

TSFs with a Low hazard rating and classified as Category 3 facilities are generally exempt from the design detail required for facilities classified as having significant or high hazard ratings.

Requirements for Category 3 facilities are given in Table 2. These requirements include the completion of a Notice of Intent document in the format given in the “Guidelines to help you get environmental approval for mining project in Western Australia” (DoIR). Guidelines for the design of Category 3 TSF are presented in Appendix D in this document. A suitably experienced contractor with or without specialist supervision may construct a Category 3 facility. However, during operation, a geotechnical or engineering specialist should audit and review Category 3 facilities on a three-yearly basis. Guidelines on the technical issues to be covered during audit and reviews are given in Appendix F.

TABLE 2: DESIGN AND OPERATING REQUIREMENTS – MINE TAILINGS STORAGE FACILITIES

	CATEGORY 1	CATEGORY 2	CATEGORY 3
Completion of Tailings Storage Data Sheet	Yes	Yes	Yes
Design	Report prepared in detail by Geotechnical or Engineering specialist as outlined in Appendix E.	Report prepare by Geotechnical or Engineering specialist as in Appendix E.	Notice of Intent prepared as outlined in Appendix D.
Construction	Supervised by Geotechnical or Engineering specialist. Detailed construction report as outlined in Appendix F with as-built drawings.	Brief construction report as in Appendix F with as built drawings.	Constructed by a suitably experienced contractor.
During Operations	Annual inspection and audit by Geotechnical or Engineering specialist as outlined in Appendix F. Operation as per Appendix G.	Inspection and audit every 2 years by Geotechnical or Engineering specialist as outlined in Appendix F. Operation as per Appendix G.	Inspection and audit every 3 years by Geotechnical or Engineering specialist as outlined in Appendix F. Operation as per Appendix G.
Rehabilitation Phase	Inspection and decommissioning report by Geotechnical or Engineering specialist as outlined in Appendix F.	Inspection and decommissioning report by Geotechnical or Engineering specialist as outlined in Appendix F.	Inspection and decommissioning report by Geotechnical or Engineering specialist as outlined in Appendix F.
Provision of Emergency Action Plan	Yes	Yes	Yes
Routine daily inspection by site personnel	Yes	Yes	Yes

5.2 Category 1 and 2 Facilities

The design and operating requirements for Category 1 and 2 (as defined by the height/ hazard rating matrix Figure 1) TSFs are similar, and the specific differences in supporting documentation, design approach, construction control, and operating procedures are differences in the level of detail.

For Category 1 TSFs, considerably more detail is required. Both Categories 1 and 2 require design documentation and construction input from suitably qualified and experienced geotechnical and engineering specialists. Guidelines on the technical aspects to be covered at the design stage are given in Appendix E. Prescriptive requirements for these documents are not provided.

It is the responsibility of the geotechnical and/or engineering specialist involved in the design of Category 1 and 2 facilities to determine the level of geotechnical and other professional input appropriate to the specified rating of the site. This should include consideration of the most severe and unfavourable combination of static and dynamic loads, where appropriate.

Where a change in the mining operations occurs, eg the development of an underground mine adjacent to a previously mined open pit and existing TSF, which may affect the hazard rating of the facility, then the hazard rating of the structure must be reassessed to take account of the change.

Construction of Category 1 and 2 facilities should be performed under the supervision of a suitably qualified geotechnical or engineering specialist. The specialist should produce an as-constructed report to confirm that the construction met the design intent. During operation, a geotechnical or engineering specialist should audit and review Category 1 and 2 facilities on a yearly and two-yearly basis respectively. Guidelines on the technical issues to be covered during construction, and during audit and review are given in Appendix F.

6. ADMINISTRATIVE PROCEDURES

For all mining projects in Western Australia a Notice of Intent (NOI) document addressing the environmental issues should be submitted as per Section 5 of the “Guidelines to Help You Get Environmental Approval for Mining Projects in Western Australia” (DoIR). Figures 1, 2 and 3 of that guideline show the NOI assessment and approval process administered by DoIR and the Department of Environment and Conservation (DEC). DEC’s role with respect to the assessment and approvals of TSFs is summarised in Appendix I.

As part of the NOI, a TSF design report should be produced in accordance with the guidelines given in this document. The design should be based on the hazard rating and TSF category as outlined in Sections 3 and 4 of this document. A completed tailings storage data sheet (Appendix A) should be included in the design report. Construction and operation of a TSF should be based on the guidelines given in this document.

The inclusion of a duly signed Certificate of Compliance for TSF Design, as specified in Appendix B, may expedite DoIR assessment. Following the construction of the TSF or any additions thereto, a signed certificate of compliance for TSF construction, as specified in Appendix C, should be forward to DoIR.

The principal employer or manager of a mine must notify the District Inspector of the region, in which the mine is situated, of the commencement or suspension of mining operations (Section 42(1) Mines Safety and Inspection Act). The operation of a Prescribed Premises without a Licence may be an offence under the Environmental Protection Act, 1986.

For further assistance on geotechnical or environmental matters relevant to TSFs please contact:

Department of Industry and Resources
100 Plain Street, East Perth WA 6004.

Telephone: Geotechnical (08) 9222 3401 Environmental (08) 9222 3437
Facsimile: Geotechnical (08) 9222 3441 Environmental (08) 9325 2280

7. SUGGESTED FURTHER READING

- ANCOLD (1983). Guidelines for dam instrumentation and monitoring systems. Australian National Committee on Large Dams (ANCOLD), 88 pp.
- ANCOLD (1986). Guidelines on design floods for dams. Australian National Committee on Large Dams (ANCOLD), 42 pp.
- ANCOLD (1998). Guidelines on tailings dam design, construction and operation (Draft). Australian National Committee on Large Dams (ANCOLD), 59 pp.
- ANZMEC (1995). Security Deposit Systems for Minesite Rehabilitation. Australian and New Zealand Minerals and Energy Council (ANZMEC), Report No 95.01, 7pp.
- ARR (1987). Australian Rainfall and Runoff, A Guide to Flood Estimation, 2 volumes, third edition, 347 pp. 97 maps (The Institution of Engineers, Australia: Canberra).
- AS 1726-1993. Australian Standard, Geotechnical site investigations, 40 pp. (Standards Association of Australia: Homebush).
- DoIR(QLD) (1995a). Site water management, in Technical guidelines for the environmental management of exploration and mining in Queensland, January (Department of Industry and Resources: Brisbane).
- DoIR(QLD) (1995b). Tailings management, in Technical guidelines for the environmental management of exploration and mining in Queensland, January (Department of Industry and Resources: Brisbane).
- DoIR 1995. Report on a survey of the effects of Cyclone Bobby on Western Australian mines. Dept of Minerals and Energy Western Australia and the Chamber of Mines and Energy Western Australia, 21pp.
- DoIR 1998a. Guidelines to Help You Get Environmental Approval for Mining Projects in Western Australia (March 1998). DoIR 1998b. Guidelines on the Development of an Operating Manual for Tailings Storage (October 1998).
- DoIR 1998c. Guidelines for Preparation of Annual Environmental Reports on Mining and General Purposes Leases (March 1998).
- EPA (1996). Best Practice Environmental Management in Mining - Environmental Auditing. Environment Protection Agency (EPA), 64pp.
- Fell R, MacGregor P and Stapledon D (1992). Geotechnical Engineering of Embankment Dams. AA Balkema, Rotterdam, 675pp.
- ICOLD (1982). Manual on tailings dams and dumps. International Commission on Large Dams (ICOLD), Bulletin No. 45, 237 pp.
- ICOLD (1989). A Guide to Tailings Dam Safety. International Commission on Large Dams (ICOLD), Bulletin No. 74.
- ICOLD (1995). A Guide to Tailings Dams - Transport and Placement. International Commission on Large Dams (ICOLD), Bulletin No. 101.
- ICOLD (1996). Tailings Dams and Environment - Review and Recommendations. International Commission on Large Dams (ICOLD), Bulletin No. 103.
- ICOLD (1996). Monitoring of Tailings Dams - Review and Recommendations. International Commission on Large Dams (ICOLD), Bulletin No. 104.
- ICOLD (1996). A Guide to Tailings Dams and Impoundments. International Commission on Large Dams (ICOLD), Bulletin No. 106.
- MERIWA (1998). Research into Saline Tailings Disposal and Decommissioning. Minerals and Energy Research Institute of Western Australia, Report No 189, 595pp., Vols 1 & 2.

- Newson T A and Fahey M, 1998. Saline tailings disposal and decommissioning, Volume I Main Report. MERIWA Project No. M241, Australian Centre for Geomechanics, Western Australia.

ANCOLD and ICOLD publications are available from the Australian National Committee on Large Dams:

- Assistant Secretary
- Australian National Committee on Large Dams

Telephone: 02 9631 4717
Website: www.ancold.org.au

Other DoIR guidelines are available at this web site: http://www.doir.wa.gov.au/environment/

APPENDIX A
Tailing Storage Data Sheet

TAILING STORAGE DATA SHEET

Please complete a separate sheet for each tailings storage facility (TSF)

1. PROJECT DATA			
1.1 PROJECT NAME:		1.2 Date:	
1.3 TSF name:		1.4 Commodity:	
1.5 Name of data provider:*		Phone:*	
1.6 TSF centre co-ordinates (AMG)		m North	m East
1.7 Lease numbers:			
2. TSF DATA			
2.1 TSF Status: Proposed ❑ Active ❑ Disused ❑ Rehabilitated ❑			
2.2 Type of TSF:[1]		2.2.1 Number of cells:[2]	
2.3 Hazard rating:[3]		2.4 TSF category:[4]	
2.5 Catchment area:[5]	ha	2.6 Nearest watercourse:	
2.7 Date deposition started (mm/yy)		2.7.1 Date deposition completed (mm/yy)	
2.8 Tailings discharge method:[6]		2.8.1 Water recovery method:[7]	
2.9 Bottom of facility sealed or lined?	Y / N	2.9.1 Type of seal or liner:[8]	
2.10 Depth to original groundwater level	m	2.10.1 Original groundwater TDS	mg/l
2.11 Ore process:[9]		2.12 Material storage rate:[10]	
2.13 Impoundment volume (present)	x10^6 m^3	2.13.1 Expected maximum	x10^6 m^3
2.14 Mass of solids stored (present)	x10^6 tonnes	2.14.1 Expected maximum	x10^6 tonnes
3. ABOVE GROUND FACILITIES			
3.1 Foundation soils		3.1.1 Foundation rocks	
3.2 Starter bund construction materials:[11]		3.2.1 Wall lifting by: Upstream ❑ Downstream ❑ Centre line ❑	
3.3 Wall construction by:		3.3.1 Wall lifting material:[12] mechanically ❑ hydraulically ❑	
3.4 Present maximum wall height agl:[13]	m	3.4.1 Expected maximum	m
3.5 Crest length (present)	m	3.5.1 Expected maximum	m
3.6 Impoundment area (present)	ha	3.6.1 Expected maximum	ha
4 BELOW GROUND/IN-PIT FACILITIES			
4.1 Initial pit depth (maximum)	m	4.2 Area of pit base	ha
4.3 Thickness of tailings (present)	m	4.3.1 Expected maximum	m
4.4 Current surface area of tailings	ha	4.4.1 Final surface area of tailings	ha
5 PROPERTIES OF TAILINGS			
5.1 TDS mg/L	5.2 pH	5.3 Solids content %	5.4 Deposited density t/m^3
5.5 Potentially hazardous substances:[14]		5.6 WAD CN g/L	5.7 Total CN mg/L
		5.8 Any other NPI listed substances in the TSF?[15] Y / N	

* Not to be recorded in the database; for 1, 2, 3 etc see explanatory notes on the next page.

EXPLANATORY NOTES FOR COMPLETING TAILINGS STORAGE DATA SHEET

The following notes are provided to assist the proponent to complete the tailings storage data sheet.

1. Paddock (ring-dyke), cross-valley, side-hill, in-pit, depression, waste fill etc.
2. Number of cells operated using the same decant arrangement.
3. See Table 1 in the Guidelines.
4. See Figure 1 in the Guidelines.
5. Internal for paddock (ring-dyke) type, internal plus external catchment for other facilities.
6. End of pipe, (fixed), end of pipe (movable) single spigot, multi-spigots, cyclone, CTD (central thickened discharge) etc.
7. Gravity feed decant, pumped central decant, floating pump, wall/side mounted pump etc.
8. Clay, synthetic etc. 9 See list below for ore process method.
9. Tonnes of solids per year.
10. Record only the main material(s) used for construction eg: clay, sand, silt, gravel, laterite, fresh rock, weathered rock, tailings, clayey sand, clayey gravel, sandy clay, silty clay, gravelly clay, etc or any combination of these materials.
11. Any one or combination of the materials listed under item 11 above.
12. Maximum wall height above the ground level (not AHD or RL).
13. Arsenic, Asbestos, Caustic soda, Copper sulphide, Cyanide, Iron sulphide, Lead, Mercury, Nickel sulphide, Sulphuric acid, Xanthates etc.
14. NPI - National pollution inventory. Contact DEC for information on NPI listed substances.

ORE PROCESS METHODS

The ore process methods may be recorded as follows:

Acid leaching (Atmospheric)	Flotation
Acid leaching (Pressure)	Gravity separation
Alkali leaching (Atmospheric)	Heap leaching
Alkali leaching (Pressure)	Magnetic separation
Bayer process	Ore sorters
Becher process	Pyromet
BIOX	SX/EW (Solvent extraction/Electro wining)
Crushing and screening	Vat leaching
CIL/CIP	Washing and screening

APPENDIX B
Certificate of Compliance - Tailings Storage Facility Design

CERTIFICATE OF COMPLIANCE TAILINGS STORAGE FACILITY DESIGN

For and on behalf of ____

I, _________________________________ being a duly authorised officer of the above company and a current corporate member of

* (The Institution of Engineers, Australia)

(The Australasian Institute of Mining and Metallurgy), do hereby certify and confirm that the _____________________

____ Tailings Storage Facility at the _____________

____ mine site has been designed in accordance with the current edition of the Guidelines on the safe design and operating standards for tailings storages issued by the Department of Industry and Resources, Western Australia and the design is referenced as:

____ dated ______________________________

Signature of above person: ____

Signature of witness: ____

Name of witness: ____

Date: ____

* delete not applicable

APPENDIX C
Certificate of Compliance - Tailings Storage Facility Construction

CERTIFICATE OF COMPLIANCE TAILINGS STORAGE FACILITY CONSTRUCTION

For and on behalf of ____

I, ____Registered Manager), do hereby certify and confirm that the ____ Tailings Storage Facility at the __________________________________mine site has been constructed in accordance with the design prepared by________________________________ reference ____________________ dated________________. and the current edition of the Guidelines on the safe design and operating standards for tailings storages issued by the Department of Industry and Resources, Western Australia. For a category 1 tailings storage facility, an employee of the design organisation, being a current corporate member of * (The Institution of Engineers, Australia) (The Australasian Institute of Mining and Metallurgy) shall certify that the above storage facility has been constructed, as far as reasonably practical, in accordance with the design referenced above.

Signature of design consultant: ____

In addition, the above facility will be operated in accordance with the design intent.

Signature: ____ (Registered Manager)

Signature of witness: ____

Name of witness: ____

Date: ____

*delete not applicable

APPENDIX D
Design, Construction and Operational Aspects to be Addressed for Category 3 Tailings Storage Facilities

DESIGN, CONSTRUCTION AND OPERATIONAL ASPECTS TO BE ADDRESSED FOR CATEGORY 3 TAILINGS STORAGE FACILITIES

Category 3 facilities are defined as shown on the height/hazard rating matrix (Figure 1). The Notice of Intent proposal documentation should provide the following information:

1. SUMMARY

All proposals for TSF construction and operation in Western Australia submitted to DoIR should contain a detailed summary of the proposal and list of commitments. This summary and list of commitments, which should not exceed seven pages in total, will then be available for public search at all DoIR offices.

It is important that the contents of the summary be given careful consideration to avoid the need for amendments to be recorded during the assessment phase.

Suggested contents for the summary are location, tenements, brief outline of the project and statements that the local Council and pastoralist have been contacted, and a document provided to Council. A map is not to be included in the summary.

A list of commitments to safeguard the environment is to be included. This list is to state the commitments, and not to refer to Sections within the body of the document.

Confidential or proprietary information should not be included in the summary section. This information, where required, should be supplied separately so that it can be removed from the main document. Any such information should be clearly marked CONFIDENTIAL.

2. INTRODUCTION

A brief summary of the proposal and, if appropriate, its relationship to any existing operation should be provided. The following information is required:

- Location, including tenement details, AMG Co-ordinates and a suitably scaled plan
- Ownership and Management Structure
- Brief History - include history of approvals by other agencies if appropriate
- Existing Facilities - suitably scaled plans of lease and site as per Tailings Storage Data Sheet

3. GENERAL INFORMATION

- Process Type
- Rated throughput as dry tonnes/year
- Ore Type(s)
- Tailing Production Rate as dry tonnes/year
- Environmental performance to date (if existing operation)

A completed tailings storage data sheet (Appendix A) should be attached.

4. TAILING PROPERTIES

4.1 Mineralogy and/or composition

- Base metal content (Cu, Pb, Zn, Ni, As, etc)
- Residual Gold
- Sulphide content, as percentage of elemental sulphate

4.2 Residual process chemicals

- Total Cyanide ex-plant in ppm
- Total Cyanide in tailings return water in ppm
- Free Cyanide ex-plant in ppm
- Free Cyanide in tailings return water in ppm
- other process chemicals added and show amounts and fates
- Salinity of process water in mg/l
- Salinity of tailings return water in mg/l

- pH of slurry ex-plant
- pH of tailings return water

5. TAILINGS STORAGE STRUCTURE

- **Plan and section**: A detailed contour plan and section of the proposed storage should be provided.
- **Construction method**: A description of the site preparation and construction procedures including details of any supervision to be provided, test procedures, etc.
- **Area**: The total area of the structure and the functional area for tailings disposal at start-up, full production and at close of operations.
- **Height/depth**: Ultimate design height of tailings storage facility and number of lifts envisaged.
- **Capacity**: The volume of storage available for tailings and expected dry tonnes capacity, i.e. allowance for non-recovered water content must be made.
- **Wall angles**: Final outer wall angle (DoIR recommendation is a maximum of 20o from horizontal for any outer slope, but this depends on materials to be exposed, and their erodibility).
- **Decant/underdrainage system:** Provide details of design and expected performance of any decant or underdrainage (DoIR's objectives are to achieve maximum tailings density and water recovery for process plant recycling). Designs without a decant or underdrainage must be justified, and have sufficient surface area to achieve acceptable tailings density by evaporation between placement cycles. Designs which incorporate upstream wall lifts using tailings may not be permitted unless some form of central decant is employed.
- **Liners** Details of the liners (if used). Decant or return water sumps must be lined preferably using synthetic liners.

6. TAILINGS DENSITY

• Average slurry density ex-plant	)	Estimates for
• Estimated final tailings density	)	new operations;
• Estimated angle of internal friction	)	actual where
• Particle size distribution	)	Possible for
• Hydraulic conductivity and/or permeability	)	existing operations.

7. TAILINGS DISPOSAL SITE DETAILS

- General description of the site topography (including a plan)
- Description of soils
- Brief description of vegetation
- Sub-soil conditions and superficial deposits (provide details of any geotechnical investigations undertaken)
- Geological description (particular attention to mineral potential, rock types and fracture systems)
- Groundwater: data on depth, quantity and quality {analysis of pH, salinity, cyanide (free, WAD, total) and metals is required}
- Water resources (details of any surface or groundwater use in the vicinity of the TSF: the Water and Rivers Commission should be contacted for details of known water resources)
- Catchment area
- Runoff diversion. Details of any diversion structures needed to by-pass runoff including materials to be used and emplacement procedures. Indicate the design storm event.

8. TAILINGS DEPOSITION METHOD

Details of deposition procedures and approximate rate of rise of the tailings surface. Deposition should be such that tailings are fully dried between each cycle. Designs using upstream construction with tailings materials for wall lifts will be required to technically justify any proposed use of open ended pipe discharge techniques in preference to multipoint discharge techniques.

9. CLIMATIC CONDITIONS

The design must have a demonstrated ability to cope with both average and extreme event climatic conditions. For design purposes in routine cases, a minimum 50-year return period should be used for rainfall/runoff events during operations. For the assessment of flood capacity after decommissioning, a more seasonal approach to rainfall should be adopted, with a 100-year return period wet season being used.

10. MONITORING

The aims of monitoring are to provide a measure of actual performance against expected performance as described in the Notice of Intent for the project. In addition to conventional environmental monitoring for dust, gases and water, it is recommended that monitoring of such aspects as achieved tailings densities and properties, available storage volumes and deposition time remaining, should be performed on a regular basis to assist with management planning. The results of environmental trials for final rehabilitation, in addition to the performance of the facility during significant seasonal events, should also be considered as part of the facility monitoring to aid rehabilitation planning.

A description of all monitoring procedures is required. Details of the sampling locations, frequency and parameters should be provided. The detailed design for the TSF should address the measures to be taken to limit the extent and amount of contamination, and the monitoring program should provide the means to assess the effectiveness of the measures taken.

It is a DoIR requirement that all fauna deaths and any technical malfunction resulting in tailings or water escaping from the containment system be reported to the Regional Mining Engineer. All tailings pipe lines not equipped with automatic cut-outs in the event of pipe failure are to be buried, or located in a suitably bunded easement capable of containing any spill for a period equal to the time between routine inspections. Decant or return water ponds are to be fitted with a warning system that will alert plant operators to any possible overflow.

11. EMERGENCY ACTION PLAN

A detailed emergency action plan should be provided to include an assessment of the risk to life, property, and the environment downstream of the facility and details of any flood warning systems and emergency preparedness.

12. DECOMMISSIONING/REHABILITATION PROPOSALS

DoIR requires decommissioned TSF to achieve three outcomes. They must be safe, stable, and aesthetically acceptable. The following notes define, as near as practicable, DoIR's understanding of what the words "safe, stable, and aesthetically acceptable" mean.

12.1 "Safe"

Decommissioned TSFs must be left in a manner, which does not allow them to breach any of the embankments necessary for containing the tailings. Decant systems, if used, will be fully decommissioned and made safe so that when normal weather forces act on the TSF the decant systems will not be a cause of undermining the embankment. The embankment walls should be left in such a condition that they would not be heavily eroded by surface run-off from the structure. In particular, considerable attention should be paid to the probability of gullies developing on the wall and any capping of the wall to armour it against erosion should be specifically designed to minimise gully development. The outer walls or embankments should also be protected against the erosion effects of any surface run-off from around and upstream of the structure that could undercut the structure and cause it to collapse. Where across-valley structures have been built considerable attention must be paid to the interface between the natural topography and the TSF embankment to ensure this does not become a zone of excessive erosion.

A TSF is considered to be safe when the retaining embankment will not be breached and where the contents of the TSF are not able to pollute the surrounding areas. The ground water or the surface water should not be adversely affected as a result of either liquor or metals leaching from the structure. In order to achieve this safe condition, it may be necessary to have an extended decommissioning period to ensure any groundwater mound developed under the TSF is reduced significantly to largely eliminate any ongoing pollution.

12.2 "Stable"

All natural and human-made structures subject to weathering will be eroded to some degree. DoIR requires that the decommissioned TSF should not erode at an excessive rate. This generally requires that the outer batters of the TSF are constructed to shallow angles which will vary according to the material used in their construction. In addition, other erosion control methods such as limiting the length of the batter and constructing intercept and/or drop structures may be necessary. All structures should be left with an effective drainage management system that takes into account the long-term erosion impacts of rainfall, the consolidation of the structure and wind erosion. It is anticipated that the surface of the TSF will have an erosion resistance similar to that of the surrounding areas.

Considerable care should be exercised when capping is used as it must be sufficiently well engineered to resist the development of gullies in peak rainfall events and avoid the long term problems that may be caused by the materials used in such capping breaking down during weathering.

12.3 "Aesthetics"

While DoIR recognises that aesthetics are a largely subjective matter, it also believes that the TSF should blend into the landscape and the visible portions of the structure should be covered by a suitable self-sustaining vegetation. In the rare event that this cannot be achieved other options will be considered by DoIR on a case by case basis.

12.4 Proposals

As each TSF is unique in terms of mineralogy, process, management, design, climate and location, it is expected that rehabilitation solutions may also be unique to each facility. It is acceptable for the proponent to provide alternative decommissioning systems, especially for the surface of the facility, to DoIR for consideration and approval. Proposals for rehabilitation of the TSF should include descriptions of the following:

- the stage by stage plans to rehabilitate the TSF embankment and surface area;
- measures to control dust, water erosion, and contamination of surface and subsurface waters;
- proposals for decommissioning of any decant and under-drainage systems; Measures to provide long term wall stabilisation; DoIR recommendations are for final outer walls to be 20o or less overall and covered with an adequate waste rock layer and suitable drainage control measures to ensure that there is minimum potential for long term erosion; it is emphasised that slopes of 20o may not be suitable for fine grained, or highly erodible materials, without adequate armouring; where such fine grained or erodible materials exist at the surface, slopes of less than 20o may be required to minimise gully erosion.
- Measures to provide long term surface stabilisation; DoIR recommendations are to cover the top surface of the TSF with a minimum of 500 mm of suitable waste where saline process water has been used, followed by spreading of topsoil and seeding; those facilities which use potable quality water during ore processing may not require the top surface to be covered with waste, but should be ripped, seeded, and fertilised to encourage revegetation to reduce the erosion and dusting hazards.
- Measures to be taken to establish a self regenerating cover compatible with the surroundings; to achieve this, topsoil or a growth medium could be spread on all external surfaces and, where necessary, additional seed and fertiliser applied.
- Measures to be taken to minimise the possibility of uncontrolled release and erosion during flood periods, and endangerment to life; decant and underdrainage systems should be decommissioned, sumps refilled and a drainage control system developed to shed rainfall runoff from all external surfaces so as to minimise the possibility of erosion.

APPENDIX E
Design, Construction and Operational Aspects to be Addressed for Category 1 and Category 2 Tailings Storage Facilities

DESIGN AND OPERATIONAL ASPECTS TO BE ADDRESSED FOR CATEGORY 1 AND 2 TAILINGS STORAGE FACILITIES

The proposals for Category 1 and 2 TSFs should provide the information given in Sections 1, 2, 3, 4 and 6 of Appendix D to this guideline. In addition, proposals should address the following:

1. SITE SELECTION

A site for a TSF should be selected with due consideration of the impact of the facility on the surrounding infrastructure and environment, particularly in the event of an abrupt embankment failure, either during operations or after abandonment. Among the factors that should be considered in the selection of a TSF site are:

- the water tightness of the foundation material;
- the influence of the watershed draining into the TSF area - preferably this should be kept to a minimum;
- the proximity to major streams or creek systems and the potential impact of flooding; and
- the proximity to mine infrastructure, centres of population, operational mine sites (especially underground operations), or areas of environmental significance. A discussion should be presented on the considerations given to site selection.

2. HYDROLOGICAL AND HYDRAULIC ANALYSES

2.1 Design Floods

The design of Category 1 and 2 facilities must take account of the impact of storm flooding in terms of external toe erosion as well as internal flooding throughout their operating life. Rainfall in Western Australia can at times be extremely heavy, and this must be taken into account at all stages of the TSF development.

To obtain data for design flood estimation ARR (1987), Australian Rainfall and Runoff , is recommended as a reference. In general, there is little hydrological data in the remote mining areas of Western Australia that can be used as a basis for the estimation of probable maximum flood levels. In these situations, correlation with records from nearby areas with similar characteristics may be adopted. Care must be exercised, however, with this approach and resulting estimates must be checked during operations by specific field measurements of runoff, previous flood marks, etc.

If natural drainage diversion becomes necessary for the construction of a TSF, all safety issues arising from water diversion measures must be suitably addressed at the design stage. Special attention must be given to minimise the potential for flooding operating mines, residential areas and access roads due to a combined effect of extreme rainfall events and natural drainage diversion measures associated with the TSF. This is a legal requirement as per Regulation 4.11 of the Mines Safety and Inspection Regulations, 1995 (MSIR). Guidelines on the safe design and operating standards for tailing storages

Due to the arid climatic conditions and relatively flat topography in major mining areas of Western Australia, the potential for flood hazards may not be apparent unless a detailed 30 hydrological study is conducted for the area. Attention is drawn to DoIR's Report on a Survey of the Effects of Cyclone Bobby on Western Australian Mines, for recorded information on damage resulting from extreme rainfall events in the mining areas of Western Australia.

In the post-decommissioning phase, the requirement for passing flood discharges should be considered. In this situation, the approach to floods will need to be more of an examination of seasonal conditions, when ring-dyke (paddock) type facilities are being assessed. Individual storm events may not cause problems in terms of storage capacity, but the possibility of successive events in wet seasons when evaporation rates are low, will need to be considered.

2.2 Freeboard

The design of a TSF should be such that the embankment, irrespective of the method of construction, should maintain sufficient freeboard to store the maximum predicted event that may occur during the life of the facility, using a worst case situation assuming no decant, such as will occur after decommissioning. The purpose of freeboard is to provide a safety margin over and above all the estimated inflows of fluids from extreme natural events and operational situations, so that the risk of overtopping leading to embankment erosion and ultimate failure of an above ground TSF is minimised. The maintenance of an adequate freeboard on a TSF is important, particularly when the deposited tailings and/or fluid level reaches the embankment crest level. The freeboard should be sufficient to contain unforeseen increases in the level and movement of fluid within the facility caused by the following:

- Tailings spills or overflow from spigot malfunctioning;
- Back flow and overtopping as a result of mounding of tailings at discharge points;
- Outlet and/or recovery system failures;

- Uncertainties in design rainfall estimates;
- Uncertainties in design catchment and runoff estimates;
- Extreme wind effects such as wave runup and wind setup;
- Any other effects, such as seismicity, land slips etc. that may generate waves.

It is recommended that the freeboard should be specified according to the following, and as shown on Figure 1.

Case 1: For a TSF with a water pond normally located away from any perimeter embankment: Total Freeboard = Operational Freeboard + Beach Freeboard = 500mm with a sub-minimum of 300mm Operational Freeboard.

Case 2: For a TSF with a water pond normally located against a perimeter embankment but with no upstream catchment apart from the storage itself: Total Freeboard = Operational Freeboard = 500mm.

Case 3: For a TSF with a water pond normally located against a perimeter embankment but with an upstream catchment in addition to the storage itself: Total Freeboard = Operational Freeboard = 1,000mm.

Total Freeboard is defined as the vertical height between the lowest point on the crest of the perimeter embankment of the TSF and the normal operating pond level plus an allowance for an inflow corresponding to the 1:100 year 72-hour duration rainfall event falling in the catchment of the pond, assuming that no uncontrolled discharge takes place for the duration of the rainfall event. (Note: the Total Freeboard also corresponds to the sum of the "Operational Freeboard" and the "Beach Freeboard" as defined below.)

Operational Freeboard is defined as the vertical height between the lowest elevation of the perimeter embankment and the tailings beach immediately inside the embankment. The operational freeboard varies over the course of a deposition cycle as the storage is raised and fills with tailings. The operational freeboard becomes critically important at the end of a deposition cycle, particularly to minimise the potential for back flow and overtopping as a result of mounding of tailings at discharge points.

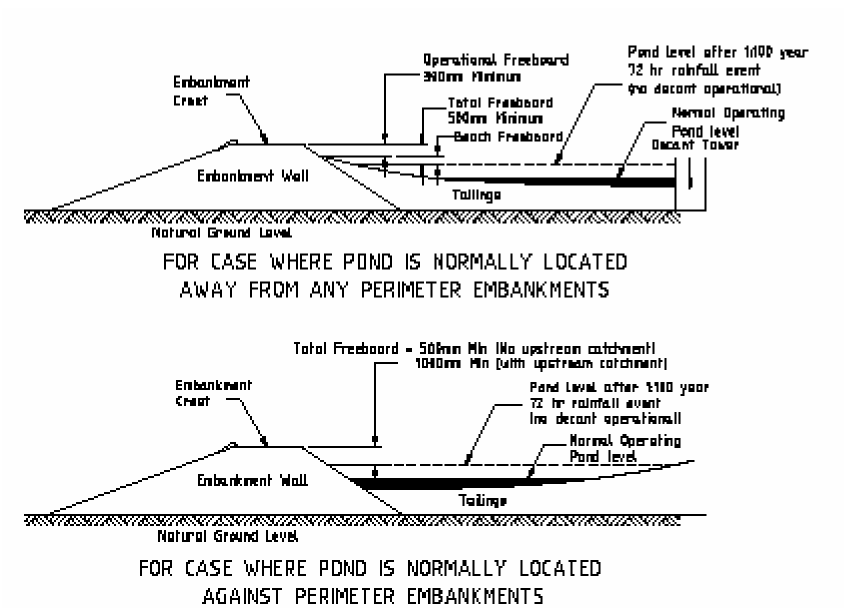

FIGURE 1: Definition of Freeboard

Beach Freeboard is defined as the vertical height between the normal operating pond level plus an allowance for an inflow corresponding to the 1:100 year 72-hour duration rainfall event falling in the catchment of the pond, assuming that no uncontrolled discharge takes place for the duration of the rainfall event, and the point on the beach where the wall freeboard is measured. The Beach Freeboard can vary significantly during the life of the storage and depends upon beach length, slurry/tailings characteristics, deposition methodology etc. Beach Freeboard is not applicable where the pond is normally located against a perimeter embankment.

Where relevant, the following information should be provided within the proposal:

- a topographic map of the catchment and description of the terrain including elevations;
- the area of the catchment and of each sub-area controlled by other TSFs or lakes;
- summaries of streamflow, flood flow or rainfall records on which the hydrological analyses are based;
- tables or curves of reservoir area and storage capacity versus water surface level;
- summaries, as applicable, of hydrological analyses leading to the determination of flood frequencies, probable maximum flood, reservoir capacity, outlet capacity, and freeboard above maximum flood level and capacity of flood diversion measures;

- estimated rates of production of tailings or industrial wastes to be stored;
- particulars of any proposal for reclaiming water from storage; capacity of return water pond(s) and automatic shut-off valves/mechanisms for decant outfall pipe and underdrainage collection pipes;
- particulars of any proposal for pumping or otherwise discharging excess water;
- assumptions as to loss of water by evaporation. Attention is drawn to the MERIWA Project No. M241, Saline tailings disposal and decommissioning (Newson T A and Fahey M, 1998) for estimating evaporation rates; and
- the minimum freeboard to be maintained at relevant stages of the tailings deposition cycle to minimise the potential for tailings spills (see section 2.2).

4. GEOTECHNICAL INVESTIGATIONS

The scope and extent of the geotechnical investigations required to justify the design of a TSF will vary depending on the following:

- the hazard rating and size of the proposed facility; and
- the complexity of local geotechnical conditions. Attention is drawn to Australian Standard AS 1726-1993, Geotechnical site investigations, as a basis for determining the level of detail and/or the extent of the geotechnical site investigations. The scope of the geotechnical investigation should be designed to cover the following aspects:
- the site geology of both the superficial and bedrock formations, including details of the soil and bedrock stratigraphy, giving information on the depth, thickness, continuity and composition of each significant layer as well as information on the history of deposition, erosion, and any diagenetic processes that may have altered the soil and rock materials;
- the hydrogeological properties of the site, including the determination of the potential aquifers and aquicludes, identification of the local and regional piezometric surfaces, and if necessary, the piezometric pressures within each aquifer, determination of hydraulic conductivity or permeability and the local and regional groundwater flow systems; groundwater chemistry (pH, TDS, CN and other substances as required by DEC);
- engineering properties of the foundation materials; a sufficient number of foundation exploration holes, pits, excavations, and other sub-surface investigations as well as adequate laboratory and in-situ tests will be required;
- the nature and extent of any proposed foundation treatment including provisions for drainage;
- the availability of natural or already existing materials suitable for use in embankment construction, and/or use in the treatment of the foundation area of the facility; the results of any laboratory testing should be included;
- the geotechnical properties of the construction material (soil, rock, and, if available, tailings material) and consideration of the manner in which these properties may have an impact on the design and operation of the structure;
- the requirement for specific measures to limit seepage either through the foundation material, the embankment materials, or any combination of these; and
- the requirement for any further specific testing of tailings materials to confirm design assumptions, if construction methods are such that these form part of the retaining structure for the final embankment.

By necessity, consideration of the geotechnical properties of the foundation and construction materials will include some measure of interpretation to reflect the inherent variability of geological and/or tailings materials.

5. CONSTRUCTION MATERIALS AND METHODS

5.1 Borrow Materials

For any earthfill, filter materials, transition materials, and/or rockfill the following information should be provided:

- approximate locations of proposed borrow areas and quarries and estimated volumes of reserves of each material;
- numbers of exploration holes, pits and excavations in each proposed borrow area and/or quarry; and
- summaries of results of laboratory tests for determining the engineering properties of each type of material, and the results of geological examinations and tests on rock materials, indicating the number of test samples and extreme as well as average values.

5.2 Tailings Materials

For TSFs proposed for upstream raising by either mechanical or hydraulic methods using tailings, the following information should be provided:

- the proposed methods of embankment construction;
- the engineering properties of the tailings to be incorporated in the embankment including impounded tailings where any contribution towards stability is assumed, indicating the methods used to derive the engineering properties; if estimates are used, the basis for the estimates must be presented;
- any anticipated or possible change in strength or other mechanical properties by chemical action which is assumed and/or depended upon for design purposes;

- provision for the extraction of excess water from tailings materials forming the embankment by drainage or other means; and
- construction procedures to be adopted to ensure that tailings materials used for construction are adequately dewatered and compacted, and achieve the design engineering properties; the implications for design of the construction procedures proposed (e.g. weak, saturated materials deposited in trenches excavated adjacent to the final walls, where excavators are employed for lift construction and borrowing tailings from beaches).

6. EMBANKMENT DESIGN AND STABILITY ANALYSIS

The detailed embankment design should include the following:

- summaries of the properties of natural or tailings materials in each zone of the embankment and the foundation adopted for stability analyses including density and shear strength parameters both as-placed and saturated; properties of impounded tailings should be presented where any contribution towards embankment stability is assumed;
- where appropriate, the basis for any estimates of the pore pressures in impervious zones adopted in the design;
- the assumed phreatic surface and justification of the geometry of the surface used in the analysis;
- particulars of the methods of stability analyses used, formulae used in the analyses or references thereto in technical literature, and the upstream and downstream water levels used in each design case (see Fell, MacGregor and Stapledon, 1992, chapter 10);
- minimum values of the factor of safety obtained for the design and the locations of the critical slope surface for each case drawn to a suitable scale on a crosssection of the embankment or results of any other method of assessment of the stability of the embankment; and
- where appropriate, the impact of possible seismic loadings, as a result of earthquake activity, on the stability of the embankment (see Fell, MacGregor and Stapledon, 1992, chapter 15).

7. OPERATING PROCEDURES

Details are required for operating procedures to cover:

- proposed discharge and reclaim facilities to be installed;
- methods proposed to maximise water recovery and minimise the volume of ponded water;
- procedures to minimise faunal access to the TSF area; and
- methods of managing pipelines and procedures to contain and/or provide early warning of pipeline leakage/failure.

It is not uncommon for major seepage from TSF to be related to tailings and water management. Seepage can often be minimised, and may be brought within acceptable limits, by the careful management of the facility to maximise water recovery and minimise the size and volume of ponded water.

8. GEOCHEMICAL CHARACERISATION

The full range of materials that will ultimately be processed through the mill, and later stored in the facility, may be unknown at the time of initial planning and construction. However, possible environmental issues relating to water quality, dust, revegetation, rehabilitation and closure requirements should be addressed by examination of the geochemistry of the known materials and their predicted behaviour in the particular environment, under the particular process selected.

The potential for sulphides present in the tailings material to generate acid rock drainage will need to be determined and appropriate measures put in place to ensure that seepage of acidic fluids from the facility do not present an additional hazard to the environment.

9. DAMBREAK STUDIES

Dependant on the public facilities or structures located close to the TSF, a dambreak study may need to be completed to show the impact of a failure of the embankment. The scope of the study should consider:

- the extent of potential flooding and/or tailings flow slides;
- likely flood or tailings flow travel times;
- likely flood or tailings flow velocities; and
- potential environmental effects of the dambreak.

The dambreak study should examine the case of storage to the maximum design level without the influence of a flood, and a similar situation under the influence of the worst case flood event considered probable during the life of the embankment.

10. INSTRUMENTATION AND MONITORING

Three categories of instrumentation and monitoring should be considered, namely:

- requirements prior to design;
- monitoring/instrumentation during construction and operation; and
- monitoring during the rehabilitation process.

Monitoring systems must be flexible enough to allow for possible changes from the expected conditions.

Attention is drawn to ANCOLD (1983), Guidelines for dam instrumentation and monitoring systems, for information of instrumentation and monitoring procedures that may be suitable for embankment dams. Similarly, attention is drawn to ICOLD (1996), Monitoring of tailings dams, which deals with the monitoring of TSFs during construction and operation.

Water seepage from a TSF is an inevitable consequence of the deposition of tailings slurries. TSF operators should address the issue of seepage even when every reasonable effort has been made to minimise it. If sufficient seepage occurs to be detected in monitoring bores or seepage interceptor drains required by DEC, or forms a plume in the groundwater down-gradient from the facility, it will be necessary to assess the impact on the environment, and in some situations to take action to recover the seepage to the extent that is practicable or necessary to limit the environmental impact.

It is probable that a well-designed and carefully executed monitoring program will either detect seepage, or at least strongly infer that it may have occurred. The relevant emergency action plan will then provide a framework for a rapid implementation of further investigations, and then if necessary the containment or remediation of the seepage plume.

The aims of monitoring are to allow a measure of actual performance against expected performance as described in the Notice of Intent. In addition to the conventional environmental monitoring, it is recommended that monitoring of achieved tailings densities and properties, available storage volumes and deposition time remaining, and water balances should be carried out on a regular basis to assist with management planning. The results of environmental trials for final rehabilitation, in addition to the performance of the facility during significant seasonal events, should also be considered as part of the facility monitoring to aid rehabilitation planning.

11. EMERGENCY ACTION PLANS

11.1 Key Issues

A TSF emergency action plan should address all relevant key issues including the following:

- an assessment of possible danger to life, property, and features of environmental significance in areas adjacent to and downstream of the facility;
- actions to be taken in a range of emergencies; as listed in section 11.2;
- information relating to any warning or emergency alarm systems proposed, with a description of proposed emergency procedures.

11.2 Possible Emergencies

The emergencies that may occur during the operation of TSF include the following:

- blocked decant structure, with or without the danger of overtopping of embankment walls;
- surface erosion of embankment faces with the development of significant gullies;
- seepage from the embankment face, with or without erosion of materials;
- shear failure or “breakaway” of part of the embankment face;
- tension cracks observed on the embankment outside face or crest;
- complete embankment failure with massive loss of contained material;
- groundwater seepage with or without vegetation distress;
- breaks or bursts in the tailings discharge pipe line; and • leakage from the decant pond or return lines.

12. DECOMMISSIONING/REHABILITATION PROPOSALS

Proposals for rehabilitation of Category 1 and 2 TSFs should follow the guidelines given in section 12 of Appendix D to this document.

APPENDIX F
Recommended Aspects to be Addressed in Construction Documentation, Periodic Audits and Reviews, and Pre-Decommissioning Reviews

RECOMMENDED ASPECTS TO BE ADDRESSED IN CONSTRUCTION DOCUMENTATION, PERIODIC AUDITS AND REVIEWS, AND PRE-DECOMMISSIONING REVIEWS

The following notes provide guidelines on the information that should typically appear in reports on TSF construction, periodic review and decommissioning review as shown in Table 2. As all TSFs are unique in their characteristics, not all features may be relevant to all operations.

The objective of all documentation pertaining to TSFs is to provide a permanent record of conditions or activities. This information should be primarily of interest to the TSF owner or operator, and act as a storehouse of data to assist with future planning and operational decisions.

1. CONSTRUCTION DOCUMENTATION

The construction documentation should be a record of conditions actually encountered, in contrast to what was expected during the design that is based on the site investigation. Frequently, design parameters are assumed as a result of insufficient data during the early planning stages. The construction phase presents a unique opportunity to view the actual foundation conditions and compare them with those assumed in the design. DoIR would expect the geotechnical specialists responsible for the design, or their representative, to be involved during the construction phase of the TSF to ensure that the construction meets the design intent.

Construction supervision should be carried out by suitably qualified personnel. The extent of supervision will depend on the complexity of the design, the size of the completed storage and the hazard rating of the facility.

The construction document should describe the following:

- foundation conditions as exposed: are they different from what was expected? what impact are these differences likely to have? were exploration and investigation boreholes and pits identified and backfilled and how? what foundation treatment was performed? how much topsoil was recovered and where was it stored or used?
- embankment building and lining materials: where did they come from? are they different from what was expected? what are their physical properties? how do these properties relate to the values assumed during the design phase?
- construction method and equipment; timing and duration of construction activities;
- construction quality control; methods used; if a method specification was adopted, what were the results of any roller compaction trials employed as the basis for the specification? what were the results of the soil testing performed? what check testing was performed (and how frequently, and by whom) to ensure that specifications were being achieved?
- variations from the proposed design; reasons and impacts; and
- locations and construction details of all monitoring bores.

The results of the quality control testing on the embankment should provide data for validation of the design that was outlined in the NOI documentation.

The report should be accompanied by as-constructed survey drawings showing the locations of buried pipework, the embankment profile, ground surface contours inside and outside the facility, and the locations and profiles of any borrow areas located within the facility.

2. PERIODIC OPERATIONAL AUDITS AND REVIEW

Periodic operational audits conducted by engineering or geotechnical specialists provide a status report of progress measured against NOI expectations. In addition to providing an on-going history of the facility which is vital on sites where frequent personnel changes occur, this information provides invaluable assistance with tailings management planning, wall lift scheduling, storage optimisation and improvements to general tailings management practices. The TSF operating company shall provide DoIR with a copy of the audit report and details of proposed actions that may be required to remedy any deficiencies identified during the audit.

Information that may be expected from an audit and review report includes:

- updated tailings storage data sheets (Appendix A);
- updated site plan (A3 size);
- current survey plan of the facility showing spot elevations along walls and across tailings beaches where possible;
- reconciliation of stored volume and calculated densities with expected values from the NOI; an assessment of available capacity remaining in terms of volume and time;

- assessment of in situ properties, including particle size distribution of currently mined materials; for Category 1 facilities which have reached, or exceed 15m in height, in situ strength, density and moisture properties, and the piezometric profiles within the walls and foundations;
- water balance studies with an approximate reconciliation of slurry volumes, solids content, decant recovery, site rainfall and evaporation; in conjunction with the contained moisture information, this may provide an indication of possible seepage losses;
- validation of TSF design, using input parameters derived from site measurements and testing; implications for future of the facility if present trends are continued; recommendations for any necessary operational or design modifications;
- presentation (tables and graphs) with interpretation by a suitably qualified hydrogeologist of monitoring results; proposals for additional monitoring of identified problem areas; implications of monitoring results (e.g. changed management practices or new works) and proposals for any necessary seepage recovery systems;
- general description of the complete facility, the tailings management practices and reclaim operations; their features, problems, failures and successes, and any alterations to the facility or operations that are proposed; and
- what wall lifts have been completed in the past year and how they were built, and what lifts are proposed for the coming year.

3. PRE-DECOMMISSIONING REVIEW

At the cessation of tailings deposition, it is a requirement to safely decommission and rehabilitate the TSF. Rehabilitation or decommissioning review conducted by engineering/ geotechnical specialists provides an engineering status report of the facility to assist with rational planning for safe, long term abandonment.

Some of the information that may be expected from a decommissioning review report includes:

- updated tailings storage data sheets (Appendix A); updated site plan (A3 size);
- current survey plan of the facility showing spot elevations along walls and across tailings beaches where possible;
- reconciliation of stored volume and calculated densities with expected values from the NOI;
- assessment of in situ properties, including particle size distribution of recently mined materials and complete geochemical characterisation of contained materials with its implications; the sources and properties of materials to be used as part of the rehabilitation stabilisation process should also be identified; construction techniques should be detailed;
- validation of TSF design for long term stability, using input parameters derived from site measurements and testing, and incorporating any rehabilitation stabilisation works;
- presentation (tables and graphs) with interpretation of groundwater monitoring results; proposals for on-going monitoring of identified problem areas; implications of monitoring results and proposals for any necessary seepage recovery systems;
- general description of the complete facility; discussion of all proposed rehabilitation stabilisation works and any requirement for on-going remedial works; and
- presentation of long-term flood management strategies for the mitigation of floods sourced from internal and external catchments.

APPENDIX G
Recommended Operational Standards for Tailings Storage Facilities

RECOMMENDED OPERATIONAL STANDARDS FOR TAILINGS STORAGE FACILITIES

1. INTRODUCTION

The use of appropriate operational standards for TSFs are vital to achieve the objective of safe, long term storage of fine grained mine or industrial waste with minimal environmental impact. The day to day management of TSFs can be a significant determining factor in achieving the above objective in the longer term. All people involved with the daily operation of TSFs must be fully conversant with sound operating practices. These notes present a summary of what may be described as sound TSF operating practice.

The main objective of daily tailings placement operations should be to ensure that the tailings material is deposited in such a manner as to stabilise as rapidly as possible. This can be best achieved by:

- separating process water from tailings as soon as possible;
- allowing tailings the opportunity to dry out (desiccate) and consolidate;
- preventing the formation of thick deposits of unconsolidated slimes.

Process water must be removed from the surface of settled tailings before desiccation can commence. During desiccation, the suction forces within the soil cause it to consolidate with increases in density. Density increases can also be achieved by normal consolidation, surcharging and mechanical compaction. Increasing the density of the tailings has two major advantages in that:

- the strength, stability and trafficability increase with increase in density, thus facilitating ease of rehabilitation; and
- the storage capacity of the facility increases with increased placement density, thus prolonging the life of the facility.

2. METHODS OF DEPOSITION

There are several methods for deposition of tailings. Deposition systems may involve the combination of several of these methods. The most suitable system will depend on the tailings characteristics, the tailings transport system and the local climate.

2.1 Cyclic drying (South African paddock rotation)

Cyclic drying (paddock rotation) comprises a system of ‘paddocks’ or ‘cells’ in which a thin layer of wet tailings is placed in one cell while previously discharged tailings in the other cells are drained and allowed to dry and consolidate before being covered by a subsequent layer of tailings. Generally stable high density tailings result. The system is only suitable in areas of high net evaporation. Dried tailings may be of use as a construction material for containment walls. This method is not used in WA at present, but can be adapted to semiarid climatic conditions in some mining areas of WA.

2.2 Subaerial deposition

Subaerial deposition is a generic term for the deposition of tailings on beaches or in deltas above the decant pond water level. The slurry is discharged onto a beach whereupon it forms shallow low velocity braided streams. The low velocities enable the tailings to settle out on the beach where they are hydraulically worked by the stream thus increasing their density. Excess water drains to decant areas. Away from the streams, the tailings dry out and consolidate.

2.3 Central thickened discharge

The Central thickened discharge (CTD) method involves thickening the tailings slurry to a higher percent solids than would otherwise be the case and then takes advantage of the natural beach slope formed by sub-aerially discharged tailings to create a stack with an essentially conical shape. The CTD method minimises the need for high retaining embankments and leads to considerable savings in construction costs. Operating costs are also reduced as there is no need to periodically raise and relocate the tailings delivery line.

2.4 Dry stacking

Dry stacking is an extreme form of subaerial deposition with little or no decant runoff. The slurry is thickened to a paste consistency by the use of a filter press or other similar equipment. Evaporation usually accounts for all process water discharged and decant facilities are not normally required. Dry stacking tailings can be handled soon after deposition by earth moving machinery for rehabilitation.

2.5 Subaqueous deposition

Subaqueous deposition is the pumping of slurried tailings into a water/liquor-filled containment. Sedimentation of the tailings through the water creates a normally or under consolidated low density settled tailings of low strength. It is not generally recommended for slimes and fine grained tailings since it produces an extremely weak tailings mud which is difficult to cap and rehabilitate. However, coarse and sand tailings can be successfully deposited this way.

A certain amount of subaqueous deposition occurs in the decant ponds associated with other methods (i.e. at the end of beaches). Movement of the decant ponds can prevent the build-up of thick slime deposits.

Some tailings may have to be discharged subaqueously to prevent adverse impacts on the environment, including acidification of high sulphidic residues and dust generation.

2.6 Co-disposal deposition

Co-disposal is the mixing of coarse and fine waste streams to produce another waste material with physical handling properties superior to either of the constituent wastes. For example, mixtures of coal washery tailings and coarse rejects have been successfully mixed at the washery plant and pumped as a slurry to disposal areas. It is possible to traffic the beach during deposition. The co-disposal method is suitable for most situations including backfilling of voids, disposal in or covering of conventional tailings storages and the construction of elevated waste heaps (provided a water containment system is in place).

2.7 Other disposal methods

Tailings may be disposed of through backfilling of voids, valleys in overburden stripping, stopes or other underground mined areas. Hydrogeological investigations should be conducted to ensure that groundwater or void water quality will not be affected.

Decommissioning of such sites should ensure that overflows of poor quality water will not occur.

3. DEPOSITION PRINCIPLES

While each method of deposition may not satisfy all desirable deposition principles, several of the methods can usually be integrated into a tailings storage system which can satisfy most requirements. A measure of adequacy of the storage system can be obtained by comparing system performance with the following desirable principles:

- Water should be removed from the tailings as soon as possible;
- Tailings should be deposited subaerially on beaches and deltas with rotation of discharge points;
- The decant pond should be minimal and just sufficient to settle tailings fines and/ or to provide a decant facility;
- Deposition of coarse tailings against embankment walls is advantageous particularly where wave action could erode such walls or upstream embankment raisings are envisaged;
- Water levels within tailings beaches should be lowered as far as practicable by the use of underdrainage, particularly where future upstream embankment construction is envisaged;
- Seepage through or beneath external embankments should be minimised as far as practicable;
- Seepage through designed permeable walls and bunds should be captured downstream by seepage containment structures which have been sized accordingly;
- The area of land used for tailings storage should be minimised by ensuring that such land has been used to its reasonable maximum capacity for waste disposal before rehabilitation;
- Tailings can be stored above the crest of the containment embankment provided:

    a) that the heaped tailings are drained and contained by structures which are stable under all conditions including earthquake loading,
    b) that the heaped tailings are stable and non-flowable under all conditions including earthquake loading, and
    c) that the arrangement complies with specified hydrologic emission criteria;

- TSF should not be used as ‘water storage facility’ for process water etc.;
- The catchment area of a TSF should be minimised;
- TSF should not be used to harvest surface runoff waters from external catchments;
- Thick deposits of hydraulically sorted slimes should be avoided;
- Long beaches with meandering tailings streams do not facilitate total drying and should be avoided;
- The use of internal bund walls for cyclic drying (South African paddock) areas for drying should be encouraged. Each can be filled in turn while the others dry out and consolidate; leaching of tailings and should be avoided;
- TSF should be designed having regard to the potential adverse chemical reactions within the tailings mass;

- The need for suitable lining/drainage to minimise and/or manage leachate should be assessed at the initial planning stage based on thorough hydrogeological studies;
- Fines should be removed from the process water by sedimentation and/or filtering prior to re-use or discharge of water.

4. OPERATING MANUALS

The daily operation of a TSF should be of appropriate standard to ensure that the tailings material is deposited in a manner to achieve the objective of safe, long-term storage with minimal environmental impact. To achieve this objective site-specific Tailings Storage Operating Manuals, which are tailored in content to suit a particular TSF, should be prepared for TSFs of all categories. A detailed list of operating manual contents is given in the “Guidelines on the Development of an Operating Manual for Tailings Storages” (DoIR). All personnel involved with the daily operation of TSFs must be fully conversant with the relevant operating practices and procedures outlined in the operating manual. The operating manual should be used as a basis for training operating personnel.

APPENDIX H
Recommended Aspects to be Addressed When Using in-Pit Methods of Tailings Storage Facilities

RECOMMENDED ASPECTS TO BE ADDRESSED WHEN USING IN-PIT METHODS OF TAILINGS STORAGE

1. INTRODUCTION

The following brief notes are intended to provide guidance on the issues that need to be addressed when considering in-pit method of tailings storage

The final rehabilitation of TSF must always be kept in mind when considering which tailings storage method is the most cost effective. Short term economic advantages of storing tailings in a mined-out open pit may be offset by very considerable monitoring and remediation works before rehabilitation can be done. Substantial rehabilitation costs may then be incurred once the pit is filled with material with, for example, a high liquid content and/or very low strength characteristics. In-pit tailings storage presents a number of difficulties not normally associated with the more conventional methods of tailings storage.

Successful rehabilitation generally requires a stable tailings surface that has sufficient bearing capacity for people and equipment to safely traverse the surface of the TSF and is resistant to wind erosion.

2. GROUNDWATER AND DEWATERING ISSUES

2.1 Location relative to groundwater table

There are basically two types of open pits that need to be considered, those:

- wholly above the groundwater table; or
- in contact with the groundwater table.

Both have their own unique challenges that must be considered before any decision is made to commit to in-pit tailings storage. Many open pits are considerably deeper than the depth to the groundwater table; hence the tailings will be in contact with groundwater. Tailings storage above the groundwater table is generally considered to present fewer difficulties than storage below the groundwater table.

The quality, quantity and potential use of groundwater resources need to be considered when assessing future adverse impacts on the groundwater resources. The presence of significant quantities of potable groundwater, in close hydraulic proximity to a proposed in-pit tailings storage, would require detailed hydrogeological investigation and licensing of the facility by the Department of Environment and Conservation.

It is strongly recommended that groundwater monitoring bores be installed around the open pit and regularly monitored prior to and during tailings deposition. This will facilitate long term monitoring of the potential for groundwater contamination. Appropriate capping and marking of the monitoring bores is required for their long term use.

2.2 In-pit dewatering considerations

Successful in-pit storage of tailings must be able to achieve an on-going and high level of dewatering during the process of tailings deposition in the open pit. Failure to give sufficient consideration to the dewatering requirements may result in a delayed and unnecessarily difficult and/or very costly rehabilitation phase.

The design phase of in-pit storage, above or below the groundwater table, requires careful consideration of the dewatering procedures to be adopted. Limited open pit access, via the haul ramp, to service and maintain pontoon mounted pumping equipment will mean that the decant pond must be kept in close proximity to the end of the haul ramp. Progressive filling of the open pit will require the decant pond to be moved to follow the end of the haul ramp as it traverses its way up the wall or walls of the open pit. This is different to from conventional TSF where the decant pond remains in an essentially fixed horizontal position around the decant tower.

Multi-point tailings discharge procedures are required to ensure that the decant pond is easily accessible at all times. Having to reach the dewatering pumps by travelling over saturated or partially saturated tailings is not considered a desirable operating procedure.

3. IN-PIT TAILINGS STORAGE METHODS

The options for in-pit tailings storage include:

- in-pit storage above groundwater table;

- in-pit storage near groundwater table;
- subaqueous storage; and
- combined in-pit and paddock (ring-dyke) storage.

3.1 In-pit storage above the groundwater table

Some open pits are excavated entirely above the natural groundwater level. If tailings are stored in these pits, the tailings water seeps into the ground and may come into contact with the natural groundwater. This may result in contamination of groundwater supplies, particularly if potable groundwater is present. However, consolidation of deposited tailings may be relatively faster when compared to the tailings storage below the natural groundwater table.

An abandonment bund wall would be required around the open pit as per the DoIR Guidelines if the pit is not filled with solid material up to its crest level.

3.2 In-pit storage near groundwater table

Often open pits are excavated well below the natural groundwater table.

If tailings are stored in open pits deeper than the groundwater table the position of the final tailings surface relative to the groundwater table needs to be recognised in advanced. If the final surface of the tailings is at or near the level of the groundwater table the saturation of the tailings surface may become an important rehabilitation issue. Other tailings storage options should be seriously considered before adopting this approach. If tailings are deposited to a level well above the groundwater table the effects of groundwater on rehabilitation may be less significant.

An abandonment bund wall would be required around the open pit as per the DoIR Guidelines if the pit is not filled up to its crest level with solid material.

3.3 Subaqueous tailings storage

The success of subaqueous storage of tailings requires the continuous presence of a sufficient depth of water above the tailings surface at all times. The Department considers there must be a minimum water depth of 5 metres above the surface of the tailings once the deposition of tailings is complete. This is required to ensure as far as practical that no person may be injured by striking, or becoming trapped in, the tailings material.

The ability to maintain a sufficient depth of water will depend on a number of factors, including:

- the net difference between rainfall and evaporation at the site; and
- the amount of groundwater inflow to the open pit.

With a bund wall around the open pit the amount of surface water runoff into the open pit should be minimal. Each of these hydrogeological and hydrological issues needs to be addressed to fully understand the water balance required to maintain a minimum depth of 5 metres of water above the tailings material.

An abandonment bund wall would be required around the open pit as per the DoIR Guidelines.

3.4 Combined in-pit and paddock storage

In this method the mined-out open pit is surrounded by an embankment similar to a ringdyke (paddock) type TSF. Once the open pit is filled with tailings, deposition continues to a pre-determined level above the natural ground surface. The end product of this approach should be similar to a conventional above ground TSF.

The final surface of the tailings, over the open pit, may be susceptible to higher levels of settlement due to long term consolidation of the tailings. Rehabilitation of the tailings surface may be extremely difficult as the tailings in the pit may continue to consolidate for a longer period long after the rest of the tailings have stabilised. This must be taken into consideration when using this type of storage. Regular survey pick-up of the completed tailings surface can provide a useful indication of the rate of settlement.

No abandonment bund wall would be required around the open pit as it has effectively ceased to exist.

4. REHABILITATION CONSIDERATIONS

The TSF rehabilitation options available to a mine will largely be determined by the conditions in the top several metres of material in the TSF. DoIR would prefer that all TSFs were re-vegetated with natural plant species endemic to the general mine site location.

The following general geotechnical issues must be considered when determining what rehabilitation is required:

- profile of the tailings surface;
- amount of surface settlement that is acceptable with time; and
- moisture content of the tailings surface.

There will be a range of chemical and biological issues that may also need to be addressed to ensure viable lasting rehabilitation of the site.

APPENDIX I
Additional Information on the Department of Environment and Conservation Requirements for Tailings Storage Facilities

ADDITIONAL INFORMATION ON THE DEPARTMENT OF ENVIRONMENT AND CONSERVATION REQUIREMENTS FOR TAILINGS STORAGE FACILITIES

The Department of Environment and Conservation's role

The Department of Environment and Conservation (DEC) is responsible for the assessment of projects that may have a significant impact on the environment. Relevant assessment and approval procedures are provided under the Environmental Protection Act, 1986. These procedures include provisions for environmental impact assessment of major proposals (Part IV of the Act) and provisions for works approvals and licences of prescribed premises (Part V of the Act).

The construction and operation of mine sites is generally subject to assessment by both DEC and the Department of Industry and Resources (DoIR). A memorandum of understanding (MOU) has been agreed between DoIR and DEC setting out arrangements for consultation on projects situated on conservation reserves and other environmentally sensitive land in Western Australia.

As described in Attachment B to the MOU, all operations defined as 'Prescribed Premises' within the Environmental Protection Act 1986, should be referred to the DEC for issue of a Works Approval and/or Licence. Some projects may be exempt from the works approval and licence provisions of the Environmental Protection Act if they meet the 'Environmental Protection (Gold Extraction Operations) Exemption Order 1992'.

Examples of prescribed premises are premises that include grinding and milling works, works with the potential to cause water pollution (e.g. cyanide from TSFs), works that discharge solid or liquid wastes (e.g. mine dewatering water) and works with significant storage of environmentally hazardous chemicals including fuel, oil or other hydrocarbons.

The applicant should note that a works approval for a new mining operation may not be limited to items such as TSF construction and operation, but may be developed (with legally binding conditions) to address environmental management issues for the complete project (e.g. dust and noise emissions). Similarly, Licences issued by the DEC generally include conditions for the project as a whole.

It is recommended that the proponent of any new mining project, or the operator of an existing project considering expanding of production capacity, contact DEC at:

Westralia Square
141 St George's Terrace
Perth
Western Australia 6000
Telephone: (08) 9222 7000
Facsimile (08) 9222 7099