Assessment of rehabilitation completion criteria for mine closure evaluation

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1. Introduction


- Properly planned closure provides opportunities (DEHP 2014).

- Flexibility of mine closure plan and associated cost estimates (ICMM 2011, DIT 2006a, IIED/WBCSD 2002).
2. Completion criteria, performance indicators

Mine completion criteria (DIT 2006a, DTI 2013, ANZMEC/MCA 2000, Brearley 2003):

- End land use objective
- End point: objective, target level or value
- Numerical value, by measurement of performance indicators
- Standard to be met to have a successful rehabilitation outcome
- Achieve each phase of rehab before proceeding to next phase
- Approved by appropriate regulatory body
2. Completion criteria, performance indicators

Performance indicators (DIT 2006a, DTI 2013, ANZMEC/MCA 2000, Brearley 2003):

- Measure progress of the completion criteria/objectives
- Biophysical environment, e.g. pH, biomass, slope, topsoil depth etc.
- Location and ecosystem specific
- Track progress, negative changes and trends of sustainable ecosystems
- Measured and audited
3. International leading practice

- Canada
- United States of America
- European Union and Member States
3. International leading practice

- Discussion paper ‘MMSD+10: Reflecting on a decade of mining and sustainable development’ (Buxton 2012).
- Financial institutions
• Canada


- Ownership of natural resources
- Responsible for policies, regulations and guidelines
- Certified Closure Plan needed
- Financial Assurance
- Progressive rehabilitation
• United States of America

National environmental laws - Responsibility on a State level (UN 2011, OSMRE n.d.)

- State-specific laws, regulations, technical requirements and guidance
- Closure permit: detailed assessments of conditions during operations + predicted post-closure conditions
- Closure plans required for “Approval to Operate”
- Financial assurance: estimates of closure costs
- Closure approval: conditions after closure, plans for long-term monitoring
• European Union


Obligations of EU Member States / mining companies:
- Bring legislation into force
- Submission of waste management plan
- Financial guarantee
- Inspections by the competent authority
4. Australian completion criteria

Australian Commonwealth

- State/Territory specific Mining law and EPA guidelines
- Leading Practice Sustainable Development Program for the Mining Industry (DIS n.d., DIT 2006a, DIT 2006b)

States:

- LPSD program as guideline
- Learning from each other!
- Criteria set through Lease agreement, Mining Operation Plan, Closure Plan
- Difference between Performance Indicators and Completion Criteria
- Emphasis on monitoring
- Financial assurance / bonds (calculation tool)
- Progressive rehabilitation
### 4. Australian completion criteria

<table>
<thead>
<tr>
<th>Australian State/Territory</th>
<th>Closure and Rehabilitation Documentation</th>
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<tbody>
<tr>
<td>Queensland</td>
<td>Rehabilitation Requirements for Mining Resource Activities - EM1122 (DEHP 2014)</td>
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<tr>
<td>New South Wales</td>
<td>ESG3: Mining Operations Plan (MOP) Guidelines (DTI 2013)</td>
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<tr>
<td>Northern Territory</td>
<td>CA7-011 Mine Close Out Objectives - Life of Mine Planning Objectives (DME 2006)</td>
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<td>AA7-019 Information Sources for Mining Management Plan Preparation (DME 2011)</td>
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<td>AA7-026 Exploration Operations Mining Management Plan Structure Guide (which includes a Template Document as well) (DME 2010a)</td>
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<td>AA7-027 Extractive Operations Mining Management Plan Structure Guide (includes a Template Document) (DME 2010b)</td>
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<td>AA7-030 Template for the Preparation of a Mining Management Plan (includes a Template Document) (DME 2013)</td>
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<tr>
<td>South Australia</td>
<td>MG1 Guidelines for Miners: Mining Approval Processes in South Australia (PIRSA 2009)</td>
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<td>MG2 Guidelines for Miners: Preparation of a Mining Lease Proposal or Mining and Rehabilitation Program (MARP) in South Australia (PIRSA 2011)</td>
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<td>MG12 Guidelines for Miners: Preparation of a Mine Operations Plan (MOP) (MITRE 2012a)</td>
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<td>MG6 Guidelines for Miners: Preparation of a Program for Environment Protection and Rehabilitation (PEPR) for Extractive Mineral Operations in South Australia (MITRE 2012b)</td>
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<td>MG8 Guidelines: Program for Environment Protection and Rehabilitation (PEPR) for Low Impact Mineral Exploration in South Australia (MITRE 2013)</td>
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<tr>
<td>Tasmania</td>
<td>Decommissioning &amp; Rehabilitation Plan (DRP) – A guideline for the Tasmanian mining industry (EPA TAS 2011)</td>
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<tr>
<td>Victoria</td>
<td>Rehabilitation Plans &amp; Other Environmental Aspects of Work Plans Guidelines for Environmental Management in Exploration and Mining Minerals and Petroleum Division (DEER 2004)</td>
</tr>
<tr>
<td></td>
<td>Code of Practice for Mineral Exploration, Standards, procedures and practical guidance under the Mineral Resources (Sustainable Development) Act 1990 (DSDBI 2014)</td>
</tr>
<tr>
<td>Western Australia</td>
<td>Guidelines for Preparing Mine Closure Plans (DMP &amp; EPA 2015)</td>
</tr>
</tbody>
</table>
• NSW completion criteria

NSW regulatory objective: “to promote a culture of environmental protection and best practice environmental management in the exploration, mining and petroleum industries” (DRE n.d., DTI 2013)

− NSW Trade & Investment, Department of Resources and Energy (DRE)
− NSW Environment Protection Authority (EPA)
• NSW Mining Operations Plan


• Detailed table/reporting template for each phase of rehabilitation and domain
  ✦ performance indicators
  ✦ completion criteria

• Monitoring
• Financial bonds
• Progressive rehab

Table: ‘Rehabilitation Table’ example page from the NSW Mining Operation Plan guidelines (DTI 2013)
Figure: NSW rehabilitation Phases with Post Mining Land Use Goal – Native plant ecosystem (DTI 2013)
Define Sustainable End Land Use

Figure: NSW rehabilitation Phases with Post Mining Land Use Goal – Native plant ecosystem (DTI 2013)
Contaminated materials / Removals of infrastructure / Define infrastructure to be retained

Decommissioning

Figure: NSW rehabilitation Phases with Post Mining Land Use Goal – Native plant ecosystem (DTI 2013)
Figure: NSW rehabilitation Phases with Post Mining Land Use Goal – Native plant ecosystem (DTI 2013)
Texture / Structure / Overburden / Topsoils / Soil Chemistry / In situ soils / Ameliorants

Growth Medium Development

Figure: NSW rehabilitation Phases with Post Mining Land Use Goal – Native plant ecosystem (DTI 2013)
Ecosystem and Landuse Establishment

Reproductive cycling of flora / Recolonistaion by macroinvertebrates / Pest animal and weed species management and control / Habitat augmentation / Establishment of Flora / Relevant land capability and Agricultural suitability / Economically Feasible / Align to LEP / Optimal carrying capacity / Stocking rate

Figure: NSW rehabilitation Phases with Post Mining Land Use Goal – Native plant ecosystem (DTI 2013)
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5. Comparative assessment

International leading practice on mine closure
- Mine closure regulated per state /province
- Financial assurance / Bonds
- Progressive rehabilitation and Monitoring

Australian comparison
- WA, NSW and Qld most elaborate guidelines
- Leading Practice Sustainable Development Program for the Mining Industry (DIS n.d.)
- Need for stronger guidance and key requirements
6. Conclusions

- Minimal specification of Completion Criteria or Performance Indicators
  - Up to the company to develop, justified
  - Approval of closure plan and conditions by the regulatory body

- Unclear, certification of surrender or relinquishment

- Unclear, defined rules and regulations
6. Conclusions

Issues with Australian mine closure guidelines

− Currently lease and bond relinquishment, difficult or even unattainable.
− Gaps between regulatory guidance and successful relinquishment.

• Need for clearer standards by regulators for rehabilitation and relinquishment to proceed.

• Need for more uniform and realistic set of requirements to be applied nationwide in Australia.

• Thus need for clearer guidelines on performance indicators and completion criteria and clearer (quantifiable) relinquishment criteria

➢ Quantitative framework for mine closure evaluation
References


Brearley, D., 2003. Developing completion criteria for rehabilitation areas on arid and semi-arid mine sites in Western Australia. Curtin University of Technology.


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