NSW Resources
Resources Regulator

March 2025

Targeted assessment program

Guidance note: Landform establishment

Purpose of this guidance note

> Important: The information provided is intended as guidance only and is not intended to be relied upon as a comprehensive list of all controls that may apply to risks associated with mine site rehabilitation. Mine operators must undertake risk assessments and implement controls relevant to the risk profile of their mining operation.

The Resources Regulator manages the risks to rehabilitation as part of a risk-based and outcomes-focused approach to compliance and enforcement. The Regulator's risk-based intervention includes the ongoing identification and verification of risk profiling, incorporating risk control measure verification and targeted assessments focussing on critical risks and the critical controls required to mitigate these risks.

Further details are available on our website at www.resources.nsw.gov.au/resources-regulator/mine-rehabilitation/rehabilitation-compliance

An important part of the Regulator's compliance and enforcement strategy involves implementing a scheduled and targeted assessment program for mines. The Regulator has developed targeted assessment programs (TAPs) around identified critical controls.

The primary aim of a TAP is to assist industry with continual improvement in rehabilitation outcomes. The TAPs comprise inspections across NSW mine sites to determine whether measures have been identified and implemented to facilitate sustainable rehabilitation outcomes.

The TAPs proactively assesses how effectively a mine controls risks and implements the preventative and mitigating controls that are critical in planning for and implementing mine site rehabilitation. Each TAP focuses on the implementation of a specific critical control.

The landform establishment TAP comprises a targeted assessment of how a mine site is establishing the final approved landform to achieve sustainable rehabilitation outcomes. The TAP involves both documentary and on-site assessment, to draw conclusions and make recommendations for continual improvement.

This guidance note may help mine operators understand the range of issues that are assessed by the Regulator as part of the decommissioning TAP.

Assessment objectives

The standard conditions of mining leases set out in Schedule 8A of the Mining Regulation 2016 require lease holders to rehabilitate land and water in the mining area that is disturbed by activities under the mining lease as soon as reasonably practicable after the disturbance occurs. The key requirements set out in the standard conditions can be summarised as follows:

- To rehabilitate land and water in the mining area that is disturbed by activities under the mining lease as soon as reasonably practicable after the disturbance occurs (clause 5).
- To ensure rehabilitation of the mining area achieves the final land use. In other words, rehabilitation achieves the final landform and land use as set out in the rehabilitation objectives statement, the rehabilitation completion criteria statement and (for large mines) the final landform and rehabilitation plan (clause 6).
- To conduct a rehabilitation risk assessment and implement the identified control measures to eliminate, minimise or mitigate the risks to achieving the final land use (clause 7). This includes undertaking a risk assessment whenever a reasonably foreseeable hazard is identified that would present a risk to achieving the final land use (clause 7(3)(c)).
- To prepare a forward program that includes the requirement that rehabilitation of land and water disturbed by mining activities under the mining lease must occur as soon as reasonably practicable after the disturbance occurs (clause 13(1)(c)).
- To ensure the forward program includes a schedule of mining activities and the spatial progression of rehabilitation through its various phases for the next 3 years (clauses 13(1)(a) and (b)).
- To prepare and implement a rehabilitation management plan (clause 10), including implementing matters within the timeframes specified in the forward program (clause 10(4)).
- To prepare an annual rehabilitation report that describes the rehabilitation undertaken over the annual reporting period and demonstrates progress made through the phases of rehabilitation provided for in the forward program (clauses 13(2)(a) and (b)).

The TAP comprises a targeted assessment of landform establishment to ensure measures have been identified and implemented to facilitate sustainable rehabilitation outcomes. The objectives of the TAP include:

- ensuring the range of risks associated with landform establishment are identified and appropriate controls are in place to facilitate sustainable rehabilitation outcomes.
- ensuring selective handling and management of mine materials (e.g. overburden, tailings, reject materials etc.) to address potential geochemical and geotechnical constraints for rehabilitation.
- ensuring design and management measures to construct the final landform over reject emplacement areas and tailings dams will be to a condition/capability that supports the final land use
- ensuring the design of final landform takes into account long-term stability and surface water management considerations to address impacts from erosion/scour/water movement
- identifying opportunities to adopt geomorphic design principles to achieve natural landform and improvements to long-term final landform stability and visual amenity

- ensuring control measures are validated via monitoring and inspections are recorded to enable risks to be appropriately addressed
- ensuring the mine site has engaged the appropriate skills and experience in relation to landform establishment
- ensuring landform establishment and rehabilitation are integrated into mine planning systems
- ensuring techniques and measures have been developed and implemented to achieve the final landform
- ensuring that rehabilitation compliance obligations are identified and actively managed - including the requirement for rehabilitation to occur as soon as reasonably practicable after disturbance and achieve the final land use.

It should be noted that the specific need to implement the above controls will be based on the risks as well as scope of activities being undertaken on a mine site.

Documents and records to be reviewed

The desktop assessment component of the TAP will include a review of the following types of documents and records (as relevant). This is not an exhaustive list and other documents may be identified during the site inspection.

- Rehabilitation risk assessment
- Rehabilitation management plan (RMP)
- Annual rehabilitation report
- Forward program
- Final land use and rehabilitation plan
- characterisation analysis of the materials to be used in rehabilitation (i.e. a geochemical and geotechnical analysis of materials).
- stability assessments (geotechnical)
- waste/reject material or ‘waste rock’ management plan
- acid mine drainage (AMD) management plan
- spontaneous combustion management plan
- capping design and construction plans
- landform design plans, including any associated landform evolution modelling (LEM) that may have been undertaken to address long- term erosion and stability risks
- rehabilitation methodology records
- rehabilitation monitoring records, specifically evaluating the long-term stability of rehabilitated landforms and effectiveness of associated controls
- quality assurance program and associated records
- ‘as built’ surveys of rehabilitated landform.

Details of the assessment

The TAP involves both documentary and on-site assessment. A summary of the assessment objectives and the assessment considerations for the landform establishment TAP is provided below. It is relevant to note that not all assessment considerations will be relevant to all mines.

Rehabilitation risk assessment

To ensure the range of risks associated landform establishment are identified and appropriate controls are in place to facilitate sustainable rehabilitation outcomes.

The site rehabilitation risk assessment(s) provides for the following scope:

- Identifies, assesses and evaluates the risks that need to be addressed to achieve the rehabilitation outcome documents.
- The risk assessment identifies site specific risks associated with landform establishment.
- The risk assessment identifies suitable controls and strategies to treat the identified risks (Note that the observations made in the remaining sections of the TAP will inform the adequacy of the risk assessment).
- The risk assessment is relevant to current mining operations.
- The assessment identifies how the effectiveness of risk control measures will be assessed.
- The risk assessment was produced by a team of appropriately skilled and experienced people from the workforce with responsibilities for mine rehabilitation.
- The controls or validation of the controls has been assigned to a responsible and suitably qualified position.
- Where multiple risks assessments have been conducted, there is a centralised document (e.g. risk register) that links all assessments to the Schedule 8A requirements.

Waste materials are characterised (geochemical & geotechnical)

To enable the selective handling and management of mine materials (e.g. overburden, tailings, reject materials etc.) to address potential geochemical and geotechnical constraints for rehabilitation.

A strategy for characterisation analysis considers the following scope:

- Characterisation analysis conducted and geochemical and physical properties of waste materials are understood.
- Where relevant, an appropriate geological model has been adopted to determine source of problematic material – typical for AMD. Typically block models are utilised for metalliferous mines while regular verification testing would be appropriate for coal.
- Ongoing sampling program is in place to identify potential changes in material properties
- Strategy / procedure/ management plan has been developed for selective handling and management of problematic materials for tailings storage facility (TSF) construction material (e.g. potentially acid forming material)

- Characterisation analysis outlined in the RMP – Section 6.2.1 (f) (g) (h) (i)

Emplacement strategy: Management of geochemical problematic material

To ensure constructed landform is stable and limit the generation of contaminants from emplaced waste/reject material.

A strategy to manage geochemical unstable materials considers the following scope:

- Modelling of emplacement construction method options for gas transport/ acidity production.
- Placement method to reduce likelihood of depositional layering or high permeability zone 'rubble zone' - base-up via 'paddock dump' rather than 'end tipping'.
- Treatment during placement to reduce oxygen supply (engineered layers – vertical gas management, encapsulation, oxygen consuming materials, sulphide passivation).
- If liner is specified in the containment design: liner type, performance and quality assurance program is specified.
- If seepage control drainage is specified in the containment design: drainage type, performance and monitoring program is specified.
- A monitoring program in place to determine emplacement strategy effectiveness, including a trigger action response plan (TARP).
- Management of geochemical problematic material is outlined in the RMP – Section 6.2.1 (f) (g) (h) (i) and Section 6.2.3.(b) (c)

Capping strategy

To ensure sufficient suitable material is available to provide a final barrier to contain waste/reject emplacement, control gas and seepage transport (where applicable) and to support final land use.

A capping strategy considers the following scope:

- Capping function identified (e.g. 'rainfall shedding', 'store and release') and design takes into account final land use (including vegetation requirements or exclusion).
- Capping design defined (materials, thickness).
- Engineering requirements understood e.g. requirements for capillary break
- Performance requirements to control gas (oxygen flux) and seepage identified (if applicable).
- Where relevant, use of water balance modelling to determine likely seepage post closure
- Capping material type, source and quantity required has been identified.
- Methods to quarantine adequate quantities of capping material have been specified and implemented.
- Emplacement capping is outlined in the RMP – Section 6.2.1 (d) and Section 6.2.3.(c)

Final landform: geotechnical stability

To ensure constructed landform is stable. Limit the generation of contaminants from emplaced waste/reject material.

A strategy for final landform geotechnical stability considers the following scope:

- High risk stability landforms identified: high walls and steep slopes, emplacement areas.
- Stability assessment undertaken on high risk areas.
- Stability assessment takes into account the present of low strength and/or dispersive materials present in the landform.
- Stability design criteria for high risk areas nominated for landform construction for both temporary operation/mining phase and long term post closure for final landform.
- Stability design criteria for high risk areas at closure takes into account final land use and other sensitive features in the final landform.
- Other controls proposed where a final landform is not able to achieve the stability design criteria (for instance, landforms with stabilities FoS[1]<1.5). Verification that these landforms are sustainable for the proposed land use and sensitive landform features.
- Consideration of mine subsidence for the stability of surface landforms, and strategy for management and monitoring.
- Consideration of geotechnical stability during placement, including methods to promote compaction/consolidation during construction.
- Geotechnical stability strategy is outlined in the RMP – Section 6.2.1 (l) and Section 6.2.3.(b)(c)(d).
- Final landform must be consistent with the final landform and rehabilitation plan (FLRP).

Final landform: erosion stability

To ensure rehabilitated landform is protected from scour/erosion from water movement resulting from rainfall. Adopt geomorphic design principles to achieve a long term stable landform

A strategy for final landform erosion stability considers the following scope:

- A landform that is commensurate with surrounding natural landform and where appropriate, incorporates geomorphic design principles.
- Appropriate use of landform design stability principles of reduced slope length and surface water management structures.
- Landform strategy is outlined in the RMP – Section 6.2.1 (j) and Section 6.2.3. (a) (b) (c) (e)
- Final landform must be consistent with the approved FLRP
- Use of the ‘blue book’ principles where appropriate as a short-term measure, noting limitations of reliance on engineering solutions (e.g. contour banks) for long-term stability without ongoing maintenance.
- Potential for settlement and how this will be accounted for in the design (especially differential settlement).
- Survey control is in place to verify final landform, capping and water management structures comply with design parameters.

[1] FoS = factor of safety.

Specific considerations for erosion models (including landform evolution modelling – LEM):

- Where relevant (large complex landscapes and/or high risk emplacements) erosion modelling (including LEM) is utilised to demonstrate the long-term stability of the landform. This should be done pre-construction and verification post-construction.
- Use of erosion models to optimise the landform design and identify high-risk areas for further controls/treatment (e.g. rock armouring).
- Models use appropriate parameter inputs – preferably field parameter data collected from the materials to be used in rehabilitation.
- Modelled erosion rates are consistent with what would be considered a stable landforms and use of stable analogue sites (i.e. 5-20 t/yr/ha based on literature).

Specific considerations for surface water management:

- The design and location of significant surface water management structures.
- Design of structures takes into account catchment size and modelled significant rainfall event to determine design to manage volume of water and scour protection from water velocity (note ANCOLD and Global Tailings Standard nominate rainfall events up to probable maximum flood (PMF) need to be considered for TSFs).
- Consideration of rock competency for use in water management structure armouring i.e. weathering properties of rock exposed at surface.

Assessment stages, reporting and feedback to industry

TAPs are managed in 3 stages:

Stage 1: pre-arrival arrangements, review and information exchange

At least 2 weeks before a TAP, participant sites will receive notification of the forthcoming TAP. This notification will include:

- assessment visit schedules
- assessment team composition
- focus areas for the assessment (e.g. a specific critical control or compliance priority)
- resources required by the assessment team, including the necessary site personnel (e.g. technical experts) that will be required to be interviewed and participate in the site inspection
- tools to be used in the assessment.

Stage 2: on-site assessment

This site visit will be looking for a demonstration that:

- the range of risks to rehabilitation have been identified
- the mine site has implemented appropriate systems, procedures and controls to facilitate sustainable rehabilitation outcomes
- systems, procedures and controls are functional in practice and effective at controlling the risks

- the workforce is competent and confident about the risk controls relevant to their area and level of responsibility
- based on monitoring, the effectiveness of controls are evaluated and the risks are reviewed to facilitate continual improvement.

Stage 3: Findings, recommendations, follow-up

The assessment team will conclude whether, and to what extent, the mine site has demonstrated:

- compliance with legislative requirements
- how relevant components of the rehabilitation management system comply with the minimum legislative requirements
- how well the rehabilitation management and monitoring plans are being implemented
- satisfactory performance in achieving sustainable rehabilitation outcomes on the ground.

The assessment team will debrief site management on their preliminary findings at the completion of the site assessment. An assessment finding letter and/or a notice under section 240 of the *Mining Act 1992* may also be issued to the mine following completion of the site assessment.

A report providing an overview of the findings and recommendations of each of the completed TAPs will be prepared and published on our website as a learning resource.

A follow-up site inspection may also be conducted to:

- verify the progress made by the mine on actioning the recommendations outlined at the initial debriefing
- verify progress made on addressing any matters outlined in any assessment finding letter
- verify compliance with any directions outlined in a section 240 notice
- investigate any potential alleged breaches identified as part of the TAP.

How to prepare for a TAP

Review your strategy and capacity to control risks and managing compliance with the preventative and mitigating controls that are critical in planning for and implementing mine site rehabilitation. Sites should ensure measures have been identified and implemented to facilitate sustainable rehabilitation outcomes and that practices are in line with:

- requirements under the *Mining Act 1992*
- conditions of the mining lease(s), specifically Schedule 8A of Mining Regulation 2016
- carrying out rehabilitation progressively, that is, as soon as reasonably practicable following disturbance
- commitments outlined in the forward program and rehabilitation management plan
- achieving the approved final land-use(s)
- available guidance material.