

D3 – Management of slope geotechnical hazards

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Direct linkages to other relevant Policies, standard, procedures or guidance notes: Rio Tinto Risk Management Standard (2019), Rio Tinto HSEC Management System Standard, Safety Performance Standards, Environment Performance Standards, Tailings and water storage facility management standard, Closure Standard.			
Document purpose: This standard covers the management of geotechnical hazards associated with natural slopes, and temporary or permanent slopes which are excavated or constructed in relation to mining activities or associated supporting infrastructure. It does not cover the design and management of tailings and/or water storage facilities.			

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D3 – Management of slope geotechnical hazards

Scope and intent

This Safety Standard applies to all Rio Tinto projects, business units and managed operations, including new acquisitions (for the purposes of this standard, these will be collectively referred to as “sites”). It covers all development phases, from exploration through planning, construction, operation to closure and, where applicable, post closure.

The intent of this standard is to provide a framework for the identification, assessment and management of slope geotechnical hazards and risks in support of safety and business performance.

This standard covers the geotechnical hazards associated with both engineered and natural slopes. It does not cover the design and management of tailings and/or water storage facilities.

Definition of Slopes under the D3 Standard

Engineered Mining Slopes¹: Slopes that are constructed as a consequence of geotechnical investigation and analysis, which can be either temporary or permanent. These slopes can include those that are constructed as a result of excavation processes or those that are a result of direct placement of material (examples: open pit walls, trenches and adits, box cuts & portals, stockpiles and waste dumps).

Natural Slopes: Slopes formed by natural processes that are sufficiently close to mining/business activities or infrastructure such that they could present a hazard to a business.

Slopes affected by external influences outside of excavation processes or natural processes also need to be considered if these are present. These would specifically relate to influences such as underground workings or tunnels on either engineered or natural slopes.

Slopes that fall outside of the D3 Standard are non-mining slopes that have been designed specifically by civil, structural or mechanical engineers. These are typically associated with plant and/or infrastructure and are often partly constructed from man-made materials such as concrete and steel. The performance of these slopes is frequently not governed by soil and/or rock mechanics.

Sites should establish a register of slopes that are subject to management under the D3 Standard. A register of non-mining slopes not included the D3 slope register should also be maintained. These registers would be evidence of good practice in slope management.

The project, business unit or managed operation must comply with prevailing mining laws, and legislation, including relevant mining title license conditions, in the country or state in which it operates.

Clarification of terminology used in this standard is presented in the Management of slope geotechnical hazards Group Procedure.

¹ Referred to as “Engineered Slopes” in remainder of this document

Control requirements

Requirements in this standard are in addition to those defined in the Rio Tinto Risk Management Standard, Management System Standard and Safety and Environment Performance Standards.

Nominated Roles under the D3 Standard

The following roles are required under the D3 Standard, and each incumbent must understand and acknowledge their responsibilities:

D3 Nominated Manager: Accountable for the implementation and conformance to the intent of the D3 Standard and Group Procedure.

Qualified Individual: Responsible for engineered slope designs and natural slope geotechnical hazard management processes.

Independent Reviewer: Responsible for overall review of slopes inclusive of design and slope performance.

Responsible Person: Responsible for ensuring engineered slope designs and natural slope geotechnical hazard management processes are implemented as intended, as well as coordinating slope conformance and slope performance monitoring.

Slope Performance Monitoring Representative: Responsible for monitoring and assessing slope performance and behaviour.

Slope Conformance Monitoring Representative: Responsible for verifying and ensuring slope conformance to the required design specifications.

1. Planning

- 1.1. Each operation with an engineered or natural slope which could represent a hazard to a business must appoint a D3 Nominated Manager who is accountable for the implementation of this Standard and associated Group Procedure.
- 1.2. The D3 Nominated Manager must appoint a Qualified Individual as defined in the control requirements.
- 1.3. Risks associated with both engineered and natural slopes must be identified, assessed and included in a risk register. Slope geotechnical risks that are material for a site as defined by financial and non-financial consequence thresholds must be included in the site risk register.

2. Documentation

- 2.1. The D3 Nominated Manager must arrange for development of documentation that comprises a Slope Management Plan (SMP), a Dump Management Plan (DMP) for engineered slopes and a Geotechnical Hazard Management Plan (GHMP) as necessary to address identified natural slope hazards. The SMP, DMP and GHMP may be combined into a single document.
- 2.2. The documentation (inclusive of the SMP, DMP and GHMP) must capture the site accountabilities and processes for managing slope geotechnical risks.
- 2.3. The SMP and DMP must document how engineered slopes are designed, constructed and monitored.
- 2.4. The GHMP must document how natural slope geotechnical hazards are assessed and managed.
- 2.5. The SMP, DMP and GHMP must document the slope management review process.
- 2.6. The SMP, DMP and GHMP and risk register documentation must be reviewed and approved by a Qualified Individual every two years, or more frequently as determined by risk assessment, monitoring outcomes or significant geotechnical event.

3. Design

- 3.1. Engineered slope designs and slope geotechnical hazard assessments must be based on Ore Body Knowledge (OBK) including geological, geotechnical and hydrogeological data. A formalized and rigorous QA/QC process must be in place to ensure data integrity and spatial coverage.
- 3.2. Engineered slope designs must meet, or exceed, specified minimum stability criteria using industry accepted design techniques.
- 3.3. Designs and slope management processes for engineered slopes as well as geotechnical hazard management processes for natural slopes must be reviewed by an Independent Reviewer and/or expert panel at least every two years, or more frequently as determined by risk assessment, monitoring outcomes or significant geotechnical event.
- 3.4. Management of change processes must be employed if material changes are made to engineered slope designs, or to natural slope geometries.

4. Implementation and operation

- 4.1. The Nominated Manager must appoint a Responsible Person to coordinate the slope management processes across the site. The Responsible Person may be appointed in situations including where the Qualified Individual is an external consultant, the Qualified Individual is located remotely from the site, or to assist the Qualified Individual in the coordination of site geotechnical management processes.
- 4.2. All engineered slopes must be excavated or constructed using industry accepted techniques and operating procedures.
- 4.3. All personnel accessing slopes must be authorized, and be trained and assessed as competent in slope geotechnical hazard awareness, required responses and communication procedures.
- 4.4. All instances of slope instability must be recorded and investigated. Incidents meeting the definition of a Geotechnical Incident should be reported (internally and externally as required) and mitigated.

5. Monitoring

- 5.1. Natural slopes must be assessed using industry recognized geotechnical hazard management systems, and outcomes ranked for either management or mitigation.
- 5.2. Suitably qualified and experienced site representatives must be appointed by the Nominated Manager to be responsible for slope performance monitoring and slope conformance measurement. The requirements of these roles may be performed by the Qualified Individual or Responsible Person, depending on the scale/complexity of the slope exposures for a site.
- 5.3. A slope performance monitoring process based on risk assessment must be developed and implemented (inclusive of both engineered and natural slopes).
- 5.4. A slope conformance measurement process must be developed and implemented for engineered slopes.
- 5.5. Engineered slope performance and conformance data must be routinely reconciled against design, and the latter updated as necessary.
- 5.6. A procedure to verify that slope footprints do not encroach upon permit / mine lease boundaries must be documented and implemented.

Revision history

Version No.	Effective Date	Prepared by	Reviewed by	Authorized by	
1	January 2012	Martyn Robotham	BU & T&I geotechnical practitioners	Suresh Rajapakse	
Revision number	Revision date	Revised by	Reviewed by	Authorized by	Reason for change
2	July 2015	Martyn Robotham	BU & T&I geotechnical practitioners	ExCo	Update to address issues identified by RTKC Manefay failure investigation and to add consideration of natural slope hazards following IOC rail slope failure.
3	December 2019	Rob Parker / Marnie Pascoe	Surface Mining Geotechnical Working Group, G&I and PG geotechnical SMEs		Update to reflect changes resulting from 2017 GIA Major Slope Geotechnical Event audit findings and response, and to meet the 3 year revision requirement.