

Consolidated report

Ground or strata failure – coal underground outbye areas – stage 3

July 2023 to August 2024



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Executive summary

A crucial part of the Resources Regulator’s incident prevention strategy for mines and petroleum sites involves:

- targeted assessments and planned inspection programs – focusing on assessing an operation’s control of critical risks by evaluating the effectiveness of control measures in the mine’s safety management system
- priority programs – proactively assessing a topic that is an emerging risk throughout the industry, which is determined primarily from incident data as well as evolving industry trends. Although these topics may also be contained within the Regulator’s planned inspection programs, the aim of compliance priority programs is to gather further information and knowledge about how the industry is managing and controlling a specific issue.

The planned inspection program for ground or strata failure in underground coal mine outbye areas stage 3 was conducted between July 2023 and August 2024.

Outbye areas are underground roadways not located within a designated face zone. The designated face zone is an area within 200m outbye of a longwall face or for a panel where mining is carried out by a continuous miner the most inbye completed line of cut-throughs.

Ground or strata failures in outbye areas of underground coal mines have the potential for serious consequences affecting mining operations including a loss of access and egress to and from active mining areas, mine ventilation restrictions or total blockages and destabilisation of supporting pillars. Serious injury or death may result if mine workers are directly impacted by outbye ground and strata failures, potentially causing crush injuries and asphyxia.

As part of the planned assessment activities, Regulator inspectors attended 19 underground coal mines with a focus on the critical controls including ground support, ground support life cycle management and control access to unsupported ground.

This planned inspection program was part of an ongoing effort by the Regulator to reduce the potential risks of ground or strata failure in outbye areas of underground coal mines.

This report provides information on assessment findings and recommendations for underground coal mine operators.

In summary, of the 19 underground coal mines assessed, resulted in 13 compliance notices issued to 10 of the 19 underground coal mines. Nine of the 13 compliance notices issued related specifically to ground or strata failure.

Explanatory notes on the assessment system are listed in Appendix A.

Assessment criteria for all assessments

Assessment threats and consequences, critical controls and control supports were identified by the Regulator in a bowtie to review how mine operators manage the material unwanted event (MUE) of unplanned ground or strata failure in an underground mine.

A tabulation of the assessment criteria for unplanned ground or strata failure underground is provided in Table 1.

Table 1. Threats-consequence, critical control & control supports for unplanned ground or strata failure - underground

Threat/Consequence		Critical control	Control support
Threat	1. Ground conditions	PC1.6 Ground support	02. Acceptable performance and condition of ground support has been established. Conversely, unacceptable performance and condition of ground support may have been established.
	3. Pillar overload		
	4. Seismic event		12. Verify by physical inspection that the condition and performance of ground support meets established requirements.
	1. Ground conditions	PC1.7 Ground support life cycle management	01. Confirm that documented quality assurance and quality control activities are completed as required by the nominated people.
			03. The requirements for monitoring the conditions and performance of ground support have been established.
			04. Monitoring device concentration and data collection frequency is selected in a risk-based process.
			05. Monitoring instrument data is collected at the required intervals and interpreted and actioned to established procedures (e.g. TARPs).
			06. There is a system in place for recording ground support defects and deteriorating ground conditions.
			07. Verify the monitoring devices are measuring within the manufacturer's tolerances.
			08. The monitoring device readout displays can easily be read by reviewing a sample of them in the field.
			09. People accountable for recording monitoring device data can read them correctly.
			10. People conducting the physical inspections of the condition and performance of ground support can explain the inspection schedule requirements.
			11. People conducting the physical inspections of the condition and performance of ground support can explain the conditions that warrant action.

Threat/Consequence	Critical control	Control support
Consequence 1. Crush injuries 2. Impact injuries 3. Asphyxia	MC1.1 Control access to unsupported ground	13. Confirm that identified controls include controlling access to unsupported ground using a hierarchy of controls approach. 14. Confirm that procedures establish unsupported ground access control. 15. Confirm that work methods have been designed to prevent exposure to unsupported ground. 16. People in the work area can explain the controls restricting access to unsupported ground applicable to their work. 17. Controls restricting access to unsupported ground are implemented as required. 18. Supervisors understanding of hazards and required controls aligns with documented expectations.

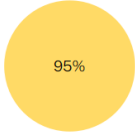
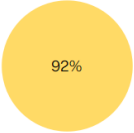
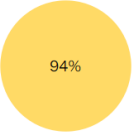
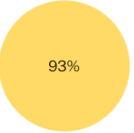
Assessment findings for underground coal mines

Overall, the assessment findings for underground coal mines were:

- 19 underground coal mines were assessed
- 342 individual findings for the assessed criteria,
- 28 assessment findings with enforcement action recorded,
- 13 compliance notices were issued to 10 of the 19 underground coal mines assessed

Figure 1 provides a summary assessment of the overall results by critical control.

Figure 1. Summary assessment findings of overall results by critical control

Threat		Consequence		Grand Total
1. Ground conditions 3. Pillar overload 4. Seismic event	1. Ground conditions	1. Crush injuries 2. Impact injuries 3. Asphyxia		
PC1.6	PC1.7	MC1.1		
Ground support	Ground support life cycle management	Control access to unsupported ground		
 95%	 92%	 94%	 93%	

- Green (=100%)
- Yellow (>= 80% and <100%)
- Orange (>= 65% and <80%)
- Red (<65%)

In summary, the overall assessment findings by critical control were assessed in total as 93%.

The assessment overall findings by critical control ranged from 92% to 95% (all assessments findings were within the yellow colour category).

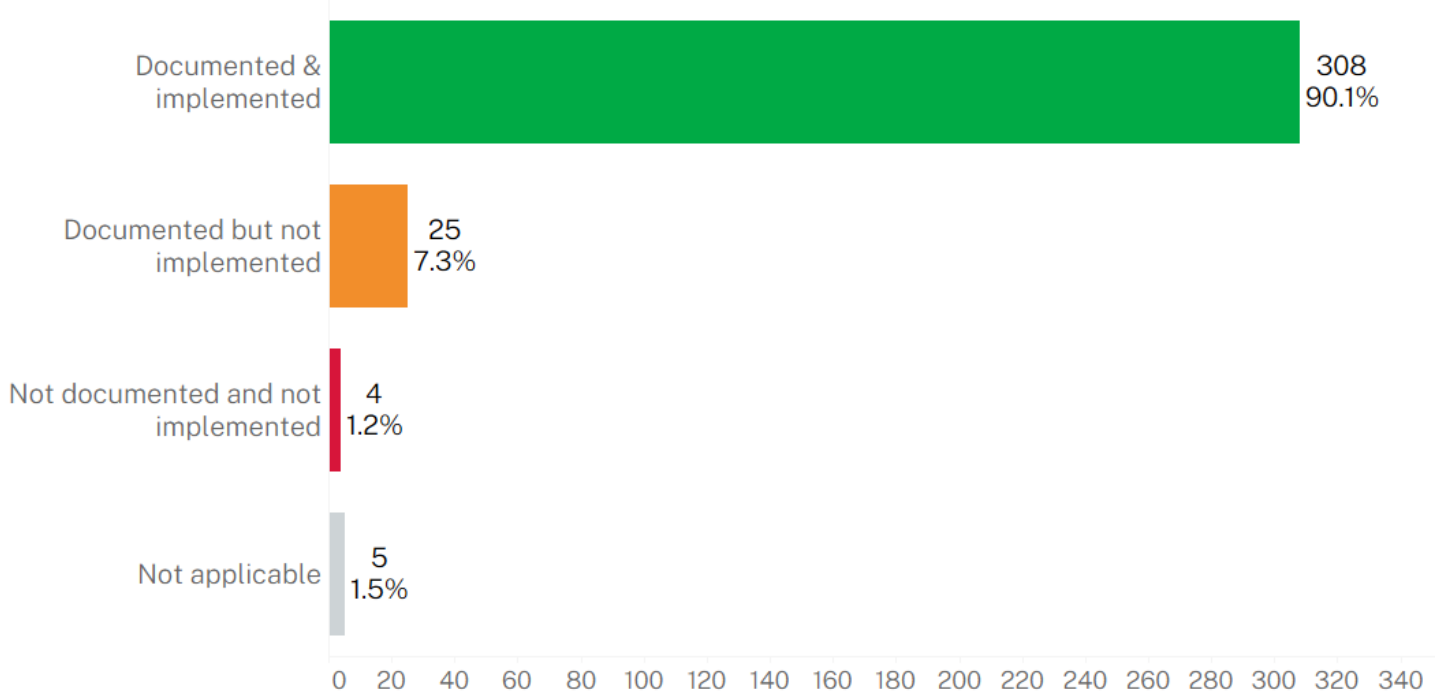
Assessment overall ratings for underground coal mines

In summary the overall assessment ratings for underground coal mines were:

- 90% rating for documented and implemented finding
- 7% rating for documented but not implemented finding
- 1% rating for not documented and not implemented finding
- 1% rating for not applicable finding

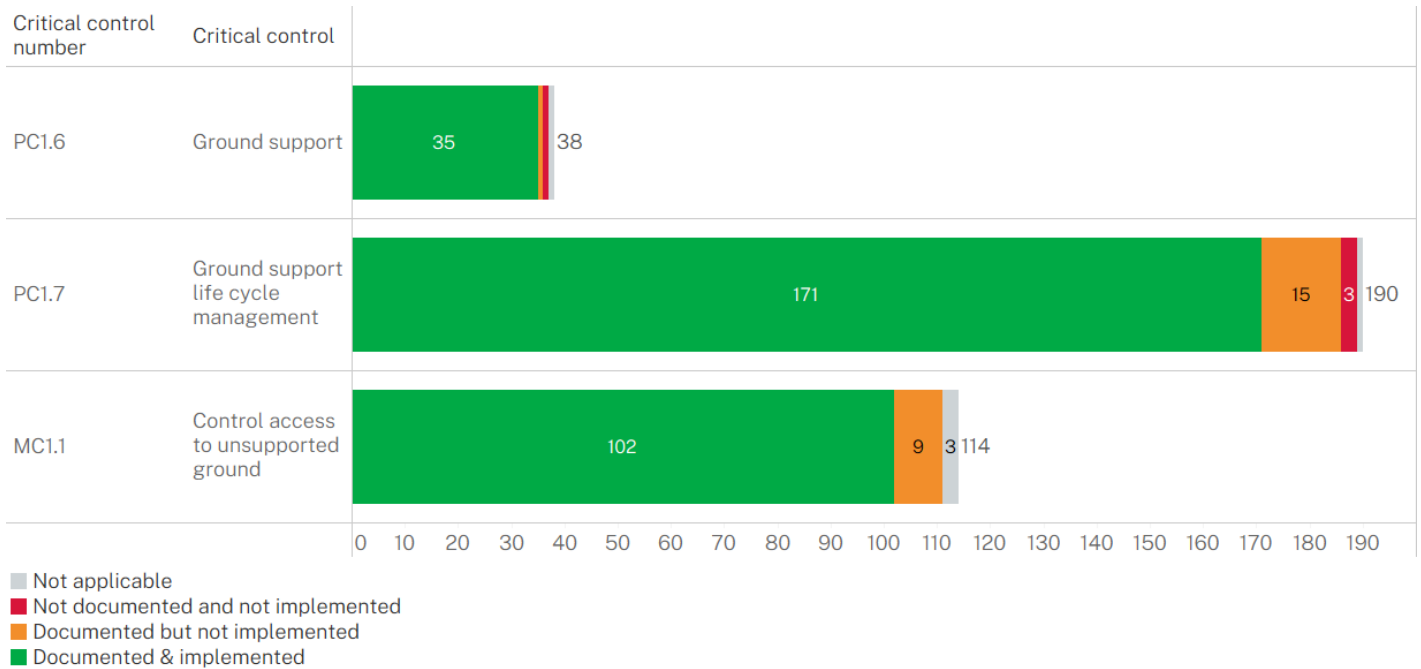
The overall assessment findings ratings for underground coal mines is shown in Figure 2.

Figure 2. Overall assessment findings ratings for underground coal mines



The overall assessment findings ratings by critical control for underground coal mines is shown in Figure 3.

Figure 3. Overall assessment findings ratings by critical control for underground coal mines



Notices issued to underground coal mines

In total, 19 assessments were conducted at underground coal mines.

In summary, there were 13 compliance notices issued to 10 of the 19 underground coal mines assessed comprising:

- 3 x section 191 improvement notices
- 10 x section 23 cause for concern notices.

Note: 9 of the 13 compliance notices issued related specifically to ground or strata failure.

Four of the 13 compliance notices issued related to other identified non-compliance issues.

The compliance notices issued for underground coal mines were reviewed and Table 2 lists the notices issued by type and number.

Table 2: Notices issued for underground coal mines

NOTICE TYPE	TOTAL ISSUED	NUMBER OF SITES
s.191 improvement notice	3	2
s.23 notice of concern	10	9
Total	13	10

Note: some mine sites were issued multiple notices

Recommendations for underground coal mines

Based on the findings outlined in this report and in relation to the numbers and types of compliance notices issued during the assessment of unplanned ground or strata failure in outbye areas of underground coal mines it is recommended that the following topics should be reviewed by operators of underground coal mines:

Review of the site principal hazard management plan for ground or strata failure, in particular:

- Strata monitoring:
 - maintain accurate and consistent reading and recording of outbye strata monitoring devices and provision for inspection comments to be included in strata monitoring reports
 - maintain an auditable management system for collation of roadway inspection reports and ongoing strata defect management action and closure reporting
 - ensure strata borescope monitoring density and locations are appropriate for the assessed strata risks in roadways
 - provide appropriate training for people engaged in reading and recording strata monitoring devices for consistency of data recording and reporting.
- Geotechnical assessment:
 - ensure availability of geo-technical competent person/s for the assessment and reporting on underground roadways.

- No-road barricade standards
 - provide no-road barricade standards for long term closure of a roadway due to strata instability to prevent un-authorized access.

Further information

For more information on safety assessment programs, the findings outlined in this report, or other mine safety information, please contact the Regulator.

CONTACT TYPE	CONTACT DETAILS
Email	cau@regional.nsw.gov.au
Incident reporting	To report an incident or injury call 1300 814 609 or log in to the Regulator Portal
Website	www.resources.nsw.gov.au
Address	Resources Regulator 516 High Street Maitland NSW 2320

Appendix A – Assessment criteria rating

Each assessed criteria is rated from one to 4 based on evidence supporting the expected control supports identified at the mine site.

Evidence supporting expected control supports

Expected control supports	Rating	Evidence supporting rating / comments				
	<table border="1"> <tr> <td>4</td> <td>3</td> </tr> <tr> <td>2</td> <td>1</td> </tr> </table>	4	3	2	1	
4	3					
2	1					

Assessment findings results are calculated based on the total points allocated to the assessed ratings as a percentage of the maximum possible points for each criteria group, and any findings rated as ‘Not applicable’ were excluded from the calculation.

Criteria assessed ratings and points

Assessed as	Rating	Points
Documented & implemented Compliant	4	4
Implemented but not documented Improvement needed	3	2
Documented but not implemented Significant improvement needed	2	1
Not documented and not implemented Non compliant	1	0
Not applicable (N/A)		

Findings results (points) with colours assigned as follows:

- Green (=100%)
- Yellow (>= 80% and <100%)
- Orange (>= 65% and <80%)
- Red (<65%)
- Not applicable