



**NSW
Resources
Regulator**

DISCUSSION PAPER

PROPOSED NEW STATUTORY FUNCTION: GEOTECHNICAL ENGINEER – UNDERGROUND COAL MINES

Prepared on behalf of the Mining and Petroleum Competence Board

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Foreword

On behalf of the Mining and Petroleum Competence Board (the Board), the NSW Resources Regulator is seeking comment from stakeholders on a proposal to introduce a new statutory function of geotechnical engineer for underground coal mines.

The Board is a statutory board established under the *Work Health and Safety (Mines and Petroleum Sites) Act 2013* (WHS(MPS) Act) responsible for advising the Minister and the Regulator on the:

- setting of competence standards
- standards for assessing competence, and
- requirements for the maintenance of competence

for statutory functions at a mine or petroleum site that impact on the health and safety of any person.

In the NSW mining industry, statutory functions are identified under Schedule 10 of the *Work Health and Safety (Mines and Petroleum Sites) Regulation 2014* (WHS (MPS) Regulation).

The CFMMEU Mining and Energy Division believes operators of underground coal mines are not receiving sound and robust advice on geotechnical issues because of an absence of a statutory function with responsibility for this area of mining engineering. The board agreed that the proposal should be subject to public consultation before making a recommendation.

On behalf of the Board, the Resources Regulator is seeking feedback from interested parties.

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Introduction

The CFMMEU Mining and Energy Division has formally requested the Mining and Petroleum Competence Board (the Board) consider a new statutory function of geotechnical engineer for underground coal mines. The CFMMEU believes operators of underground coal mines are not receiving sound and robust advice on geotechnical issues because of an absence of a statutory function with responsibility for this area of mining engineering.

The Board requested the Resources Regulator undertake a public consultation process on its behalf seeking comments from interested parties and provide that feedback to it for consideration. The Resources Regulator has prepared this discussion paper on behalf of the Board. The paper is not an endorsement of the Resources Regulator's position on the proposal.

Have your say

The Resources Regulator is seeking written submissions on behalf of the Board about this discussion paper from interested parties.

You can make an individual submission or contribute to a joint submission through your employer, union, professional association, work health and safety group or committee or another forum.

You are invited to respond to some or all the questions below (please outline the reasons supporting your view):

1. Is a new statutory function for geotechnical engineering warranted?
2. If the function is warranted, what qualifications and experience are appropriate?
3. If the function is warranted should it be a key statutory function?

Please provide your submission to rr.feedback@planning.nsw.gov.au by 19 October 2019.

Submissions on this discussion paper will be considered by the Board before it makes a final recommendation.

Submissions or summaries may be published on the Resources Regulator's website. Please advise us if you do not want your submission to be published or if you wish to keep parts of your submission private, such as your name and contact details.

Existing statutory functions underground coal mines

The Work Health and Safety Mines and Petroleum Sites (WHS (MPS)) legislative framework requires certain safety critical roles known as statutory functions (Schedule 10 WHS (MPS) Regulation 2014) to have competent people to perform them.

There are currently 13 statutory functions required in an underground coal mine as outlined in the table below.

SUPERVISION	ELECTRICAL	MECHANICAL	MINING
Undermanager	Electrical engineering manager	Mechanical engineering manager	Mining engineering manager
Deputy	Qualified electrical tradesperson	Qualified mechanical tradesperson	Ventilation auditor
			Ventilation officer
			Dust explosion control measures auditor
			Fire officer
			Roadway dust sampler
			Mining surveyor

What is a geotechnical engineer?

A geotechnical engineer uses principles of soil mechanics and rock mechanics to:

- investigate subsurface conditions and materials
- determine the relevant physical/mechanical and chemical properties of these materials
- evaluate stability of natural slopes and man-made soil deposits
- assess risks posed by site conditions.

Refer to Appendix A for more detailed analysis on the role of a geotechnical engineer and Appendix B for information on how geotechnical engineering fits into the operational structure at a mine.

Possible qualifications and experience

The Australasian Institute of Mining and Metallurgy (AUSIMM) and Engineers Australia both accept geotechnical engineers as members of their professional bodies and seek varying qualifications and experience. AUSIMM provides an avenue for ‘chartered’ status and Engineers Australia offers a society that any interested individual can join.

Following consideration of the above possible qualifications and experience the following qualifications and experience options are proposed for consideration:

- A four-year degree in geotechnical engineering **and** three years’ experience working in an underground coal mine

- OR**
- A degree in either geology, geophysics or mining engineering with a one-year postgraduate qualification in geomechanics or geotechnical engineering **and** three years’ experience working in an underground coal mine.

Possible role of geotechnical engineer statutory function

In keeping with other statutory functions in Schedule 10 of the WHS(MPS) Regulation, the role of the geotechnical engineer statutory function would be to:

Control and manage geotechnical activities and standards forming part of the mining operations at the mine.

This role may relate to geotechnical issues associated with principal hazards such as:

- ground or strata failure (including coal burst)
- inundation or inrush
- gas outburst.

The above role appears to be a subset of the mining engineering manager area of responsibility

The role of the mining engineering manager statutory function is to develop, supervise, monitor and review the mining engineering standards and procedures forming part of the mining operation at the mine (Schedule 10, Part 2 (3) WHS(MPS) Regulation). The mining engineering manager is a key statutory function at an underground coal mine.

Mining engineering standards apply to the following principal hazards:

- ground or strata failure (including coal burst)
- inundation or inrush
- gas outburst.

An analysis (Appendix A) of the role that geotechnical engineers at mines undertake shows the activities all fall under the responsibility of the mining engineering manager. The NSW Code of Practice: *Strata control in underground coal mines* (February 2015) describes the task allocations for different roles (Appendix B).

The information in Appendices A and B demonstrate that the mining engineering manager is responsible for strata control and draws on information from several specialist professionals to undertake this role. In a complex system, such as an underground coal mine, it is impossible for one person to have expert knowledge on all important areas and completely understand the socio-technical system that operates a mine safely.

Is there a need for it to be a key statutory function?

The following matters should be considered in relation to whether the geotechnical engineer should be classified as a key statutory function:

- If a statutory function is not a key statutory function it means that more than one person can carry out the function at a mine or number of mines (cl 136 WHS(MPS) Regulation 2014). This would enable different expert perspectives and exposure of geotechnical engineers to different situations.
- Mines should have the ability to use geotechnical advice across different sites. As the mining engineering manager is responsible for supervising, monitoring and reviewing activity at the mine, the geotechnical engineer would not be required to have a full-time presence or have an individual nominated as would be required if it was a key statutory function (cl135 & cl137 (4)(a) WHS(MPS) Regulation 2014).

Examination of the evidence of the case for a new geotechnical engineer statutory function

Geotechnical information on ground and strata mechanics relate to number of principal mining hazards. The critical safety function that develops, supervises, monitors and reviews the standards is the mining engineering manager.

Analysis of data collected through the Regulator’s Activity Compliance and Enforcement System (ACES) and major investigation information (Appendix C) shows there has been:

- eight fatalities and nine major investigations relating to ground and strata management since 1998.
- 10 dangerous incident reports and 29 high potential incidents notified to the Regulator between March 2018 and March 2019.

This emphasises the importance of suitable integration of geotechnical information into principal hazard management plans (PHMPs). However, it must be understood that in a whole-of-mine approach, it is the role of the mining engineering manager for matters such as:

- design and development of PHMPs and their implementation such as strata control, spontaneous combustion and outburst
- important developments including ventilation systems, shafts, pillars and road ways, and
- roof and rib support.

Cases for and against introducing a geotechnical engineer statutory function

CASE FOR	CASE AGAINST
<ul style="list-style-type: none"> ■ Mining methods such as ‘board and pillar’ are becoming more popular and the geological environment more complex ■ Sets a minimum standard for qualifications and experience ■ Holds the individual performing the function to account for the advice provided ■ Ensures access to suitably qualified personnel on site ■ Provides a verification process for the mining engineering manager to support due diligence ■ There are regular incidents relating to strata failure in NSW 	<ul style="list-style-type: none"> ■ Underground coal mines already have access to geotechnical expertise either through direct employment or contract arrangements with consultants ■ Does not foster an approach where different perspectives are sought, and therefore overcome potential for a repetitive approach to risk management ■ On-site expertise may not be regularly exposed to different conditions ■ The Regulator undertakes Targeted Assessments to monitor mine site compliance with PHMP supported by a strata management Code of Practice ■ Multiple fatalities due to strata failure in Australia are rare

Appendix A: Analysis of geotechnical engineer role

There is a range of mining methods used in underground coal mining and the core geotechnical parameters and criteria that affect the choice or application of the mining methods.

Geotechnical engineering can be applied to:

- mine entry systems (drifts, shafts etc.)
- pillar mechanics and design procedures
- geomechanics of longwall mining
- caving mechanics, periodic weighting, windblasts
- outbursts and rock bursts/bumps
- pillar extraction
- mine subsidence mechanics and design
- geotechnical equipment considerations and mine planning considerations, and
- geotechnical design methodologies (methods, excavations, pillars etc).

Geotechnical engineers have a role at underground coal mines and should be involved in the principles of rock reinforcement, that is:

- active/passive support
- support requirements for different excavation types and mining methods
- load and displacement-controlled support response
- types of ground support/reinforcement hardware and related systems
- design of support systems for the lifetime of a roadway
- interaction of mining method, layout and reinforcement systems
- ground support installation and quality assurance
- time effects on ground support systems and remedial options

Appendix B: Strata control PHMP Code of Practice

The following information is taken from the NSW Code of Practice: *Strata control in underground coal mines* (February 2015) (p 52 Appendix B - example task allocations). The mining engineering manager has overarching responsibility for tasks undertaken by several professional disciplines that contribute to mining engineering standards. These include the technical services manager; geotechnical engineer; geologist and mine surveyor.

Strata Control PHMP Roles			
Mining engineering manager (mine manager)			
<ul style="list-style-type: none"> Approve the PMHMP for strata failure, its updates and associated standards and procedures Establish that all individuals with functions and responsibilities under this plan are trained and competent to carry out those responsibilities Establish that all workers are aware of, and understand their responsibilities as stated in the plan, and that these responsibilities are included in their position descriptions Establish that training material is developed and provided for all functions of the plan Establish that any systems and procedures are developed and implemented in accordance with the requirements of the plan Establish that the plan is monitored, audited, reviewed at intervals not exceeding 12 months, or if a specific event occurs as defined in the plan. Any changes should be conveyed to the workforce Establish that all risk-assessment processes are formally documented 			
Geotechnical Engineer <ul style="list-style-type: none"> Ensure a geotechnical model is maintained Develop and maintain geotechnical database that is relevant to strata control Maintain a program of data collection to enable an assessment of strata control requirements Provide support designs based on an appropriate geotechnical hazard 	Technical services manager <ul style="list-style-type: none"> Facilitate the implementation of the principal mining hazard management plan for strata failure, and ensure it is updated and modified as necessary Assist the underground mine manager in identifying the resources required to meet the requirements of this plan Ensure that other hazard plans are prepared prior to the commencement of mining in the relevant sections of the mine 	Mine surveyor <ul style="list-style-type: none"> Ensure surveying of underground roadways is undertaken Check that the roadways are driven to design and in relation to orientation and dimensions Ensure surveys are carried out and transferred onto suitable plans for filing and reference purposes and roadways are plotted as constructed 	Geologist <ul style="list-style-type: none"> Ensure exploration data is obtained and interpreted to provide an assessment of the geological conditions and threats to mining Review and issue a statement confirming the sealing status of all surface boreholes in the hazard plan area Maintain the geological database

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<p>assessment. This includes remedial support work</p> <ul style="list-style-type: none"> • Provide geotechnical analysis of changes to the mine plan or operation, ground support equipment, materials and systems • Prepare TARPs, monitoring plans and hazard plans • Confirm quality control (regular testing of support elements) and monitoring schedule is maintained • Ensure the reported defects are effectively managed 	<ul style="list-style-type: none"> • Liaise with the technical experts such as geologists and geotechnical workers regarding any additional information or investigation that may be warranted for the compilation of the hazard plans • Review the system before the mining of any new section of the mine along with a review at the completion of the section • Oversee intermediate reviews as required • Oversee compilation of the support plans as detailed in the principal mining hazard management plan for strata failure • Determine the nature, location and frequency of monitoring. • Organise internal/external reviews 	<ul style="list-style-type: none"> • Ensure all boreholes are shown on section hazard plans • Comply with any other requirement of the principal mining hazard management plan for strata failure for this function 	<ul style="list-style-type: none"> • Assist management in the preparation of section hazard plans • Ensure underground geological mapping is conducted and potential structures defined and recorded on the hazard plan • Ensure exploration boreholes (as necessary) are grouted to a specification upon completion • Comply with any other requirement of the principal mining hazard management plan for strata failure for this function
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Appendix C: Resources Regulator data

High potential and dangerous incidents

As outlined in the tables below, there were 29 high potential incidents and 10 dangerous incidents in underground coal mines in NSW between March 2018 – March 2019.

HIGH POTENTIAL INCIDENT CLAUSE 128 (5)		COUNT
(c)	an unplanned fall of ground, roof or sides that impedes passage, extends beyond the bolted zone or disrupts production or ventilation	16
(d)	a failure of ground support where persons could potentially have been present	12
(e)	the burial of machinery such that it cannot be recovered under its own tractive effort	1
(f)	progressive pillar failure or creep	0
(g)	a sudden pillar collapse	0

DANGEROUS INCIDENTS CLAUSE 179		COUNT
(a) (viii)	the collapse or failure of an excavation or of any shoring supporting an excavation	1
(a) (ix)	the inrush of water, mud or gas in workings at an underground excavation or tunnel	1
(a) (xvi)	a failure of ground, or of slope stability control measures	4
(a) (xvii)	rock falls, instability of cliffs, steep slopes or natural dams, occurrence of sinkholes, development of surface cracking or deformations or release of gas at the surface, due to subsidence	1
(d)	any initial indication that any underground part of a coal mine is subject to windblast, outbursts or spontaneous combustion	1
(j)	a coal burst or rock burst at an underground mine	2

Eight fatalities since 1998 relating to strata failure

DATE	FATALITY
17 July 1998	Continuous miner operator fatally injured when roof fell during pillar extraction at the Awaba Colliery.
20 December 2000	One worker fatally injured and a second severely injured when the roof fell during recovery of a continuous miner from unsupported roof during pillar extraction at the Bellambi West Colliery.
6 March 2001	Worker fatally injured when unsupported rib spalled during roof bolting at Wollemi Colliery.
12 September 2001	One worker fatally injured and second worker seriously injured when unsupported roof at the longwall face fell while undertaking loading of holes in face floor for shotfiring at the Baal Bone Colliery.
28 May 2004	Worker fatally injured when roof fell during erecting roof support (roof bolting) for pillar split at the Dartbrook Mine.
3 June 2011	Mine worker received fatal crush injuries when a slab of coal fell from the rib while the worker was operating a continuous miner during pillar extraction at Chain Valley Colliery.
15 April 2014	Two mine workers fatally crushed by a major rib pressure burst in a longwall development roadway at the Austar Coal Mine.

Nine major investigations relating to ground and strata management since 1998

MAJOR INVESTIGATION	PRINCIPAL HAZARD	GEOTECHNICAL ISSUES	WOULD GEOTECHNICAL OFFICER STATUTORY FUNCTION ASSIST IN CONTROL
Awaba Colliery 17 July 1998	Ground and strata	Poor roof conditions – mudstone instead of conglomerate Change in pillar extraction from total to partial – coal pillar stook stripped resulting in poor roof support	Yes
Bellambi West Colliery 20 December 2000	Ground and strata	Unsupported roof – pillar extraction Setting prop in goaf past last line of bolts	Maybe/Yes
Wollemi Colliery 6 March 2001	Ground and strata	Fall (spall) of rib during roof bolting – rib not bolted Mine history of rib failure – thick claystone band in coal seam expands when exposed to atmosphere and moisture, thereby creating tensile forces in the adjacent coal and causing it to split	Yes
Baal Bone Colliery 12 September 2001	Ground and strata	Unsupported roof and face on longwall Floor heave of 0.5 m near tailgate – tailgate chocks ‘iron bound’ Shale roof – weak roof in places and roof flaking, rib spall along BSL and rock falling between chocks	Yes
Dartbrook Mine 28 May 2004	Ground and strata	Fall of roof past last line of roof bolts – no temporary roof support	No

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MAJOR INVESTIGATION	PRINCIPAL HAZARD	GEOTECHNICAL ISSUES	WOULD GEOTECHNICAL OFFICER STATUTORY FUNCTION ASSIST IN CONTROL
			No person to enter area of unsupported roof
Beltana 14 August 2010	Ground and strata	Unsupported roof – longwall face – fall of strata ply	No No person to enter area of unsupported roof
Chain Valley Colliery 3 June 2011	Ground and strata	Pillar extraction: increased loading onto ribs failure and fall (spall) of unsupported rib coal	Yes
Austar Coal Mine 15 April 2014	Ground and strata	Pressure burst due to relief of stress within the rib strata High levels of pre-mining vertical stress due to the depth of mining (> 500 m) Potential additional stress contributions (in both magnitude and direction) due to the presence of disturbed structural geology in the region, and variable thickness massive sandstone units in the near roof overburden. Floor geology could also have been a factor, with evidence of massive sandstone and conglomerate units present in the floor, near the Greta Seam in this region of the mine	Yes
Clarence McFadden 4 July 2018	Ground and strata	Strata failure – rib spall during cutting of development headings Investigation ongoing	Yes