



# Capability Statement

As specialist Mining Geotechnical Consultants we deliver practical and innovative geotechnical solutions to the mining industry.

Practical &  
**Innovative.**  
Geotechnical  
**Solutions.**



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”  
Geotechnical  
Innovation  
“



# About Cartledge Mining and Geotechnics

Cartledge Mining and Geotechnics (CM&G) provide geotechnical solutions for your project life-cycle from advisory services through to construction support. Our team have worked on and managed geotechnically and commercially complex, large civil projects in residential and mining environments, consistently delivering positive outcomes for all stakeholders involved.

Our team have worked for large multi-disciplinary and small boutique consultancies, multi-national mining houses and R&D roles across the globe, providing a valuable blend of practical and technical experience.

Our team have global experience having worked in:

- America
- Argentina
- Australia
- Brazil
- Canada
- Chile
- China
- Colombia
- England
- Indonesia
- Kazakhstan
- Madagascar
- Mongolia
- Papua New Guinea (PNG)
- Scotland
- Solomon Islands
- South Africa
- Suriname
- Turkey
- Wales
- Zambia
- Zimbabwe



Exploration to  
Closure: Geotechnical  
Excellence



Your Specialist Mining  
**Geotechnical Consultants** ”

## Our History

Since 2015 CM&G has delivered practical and innovative technical solutions to global mining companies.

From advisory services through to construction support, CM&G understands all the risk and benefit complexities of your project and can support you to successfully manage and deliver across the lifecycle of your mine asset.

# Our Specialties

We deliver practical and innovative geotechnical solutions to the mining industry. Our team brings a diverse range of experience from world-class projects around the globe. From pit-to-port and exploration to mine closure, we deliver mining solutions for mining problems.

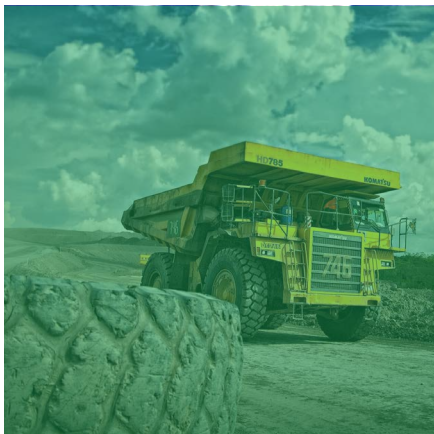
## Advisory

- Geotechnical Advisory
- Geotechnical Risk Management
- Knowledge Advancement



## Engineering

- Tailings Dams
- Infrastructure Ground Engineering
- Operational Support Geotechnical Engineering



## Lifecycle

- Mine Closure Geotechnics



## Research

- Research and Development (R&D)
- Innovation



## Expertise

- Experience in diverse mining markets and methods

# Our Markets

We have experience in all underground and surface mining methods for both deep and shallow deposits. The commodity markets our team have worked in include:

- Bulk commodities, including coal, iron ore and potash
- Base metals
- Platinum group metals
- Precious metals
- REE's.

If you're looking for a geotechnical consultant, a geotechnical engineer or even expertise in tailings dams, we can help.

An aerial photograph of a large-scale mining operation. The image shows a massive, terraced hillside with multiple levels of excavation. The slopes are covered in a mix of grey and reddish-brown soil, indicating different geological layers or stages of erosion control. A network of dirt roads winds through the site. In the lower-left quadrant, a small yellow vehicle is visible on one of the roads. The bottom right corner shows a large, circular area that appears to be a tailings pond or a processing area, with a complex network of pipes and structures. The background shows a rugged, mountainous landscape with sparse vegetation.

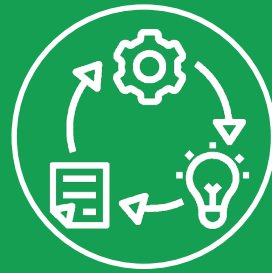
Global Expertise,  
Local Solutions:  
Unearthing  
Success with  
**Cartledge Mining  
and Geotechnics**



# Our Values



**Alliance**  
One team



**Innovation**  
Above, Below and  
Beyond



**Excellence**  
Expert Driven  
Solutions



**Integrity**  
Rock Solid



**Family**  
In It Together

# Why Choose Us

As projects become more complex and delivery times shorten, understanding the ground conditions is critical to developing successful projects. Cartledge Mining and Geotechnics provide geotechnical solutions for your project life-cycle from advisory services through to construction support.



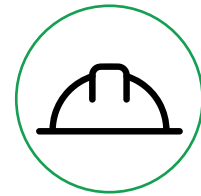
## COMPREHENSIVE SERVICES

End-to-end geotechnical solutions for seamless project delivery.



## GLOBAL EXPERIENCE

Valuable insights from working in various worldwide locations.



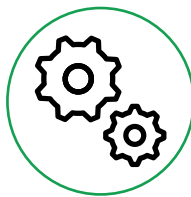
## INDUSTRY EXPERTISE

Proven track record in complex residential and mining projects.



## DIVERSE BACKGROUNDS

Unique blend of practical and technical experience from varied roles.



## TAILINGS DAM PROFICIENCY

Specialised expertise for your project's specific needs.



## ADAPTIVE APPROACH

Timely and efficient results, adapting to changing requirements.

# Professional Bodies



Board of  
Professional  
Engineers of  
Queensland



AUSTMINE  
Smart Mining



Bowen Basin &  
Hunter Valley Open  
Cut Geotechnical  
Society



ISRM

International  
Society for Rock  
Mechanics and  
Rock Engineering



METS IGNITE



Western Australia  
Ground Control  
Group



ENGINEERS  
AUSTRALIA

National  
Engineering  
Register



ENGINEERS  
AUSTRALIA

CHARTERED

Engineers  
Australia



The Australasian  
Institute of Mining  
and Metallurgy



# Geotechnical Advisory

Our business has a proven track record in delivering strategies and processes that have measured significant benefits for clients. CM&G is propelled by a team with extensive hands-on experience and rigorous technical oversight. Who understand all the geotechnical-dependent mine design and mine operation options and decisions that deliver safety and value to an active mine asset or project. Our team will work to critically assess each operating site or project in identifying ground-related pitfalls and opportunities towards optimising resource extraction value.

## **Our capabilities include:**

- Due-diligence and project valuations
- Pre-feasibility, feasibility and concept studies (surface and underground mines)
- Strategic and independent third-party design reviews (RPEQ assessment and approval)
- Auditing and developing principal hazard management policies and processes
- Auditing geotechnical systems and standards
- Forensic geotechnical engineering analysis
- Geotechnical assurance auditing
- Ensuring statutory compliance with regulatory frameworks relevant to ground control
- Developing and managing best practice feasibility studies and outcomes
- Providing geotechnical oversight to operations and engineering project teams
- Supporting advice in directional studies and the planning of growth options
- Coordinating requirements for mine studies and life-of-assets.



# Tailings Dams Engineering

CM&G provides leading practical solutions that balance tailings governance, tailings associated risk and critical controls management, safety, and commercial mining requirements. Our expert team will work with you to deliver a bespoke approach to the design, construction and risk-profiling of tailings storage/disposal facilities. CM&G understands the critical nature of tailings dams stability and associated governance and mine-waste management protocols, and will guide you through all process stages enabling performance-based (and risk-informed) decision-making.

## **Our capabilities include:**

- Routine and comprehensive inspections
- Dam safety reviewing
- Third-party reviewing and due-diligence
- Design of tailings dams and appurtenances
- Tailings disposal and storage facility monitoring and surveillance
- Construction and operational site support
- Site investigations and appraisals
- Dam break studies, Failure Mode Effects Analysis (FMEA)
- Breach analysis and inundation mapping (or Failure Impact Assessments)
- Qualitative and Quantitative Risk Assessments (QRA)
- Tailings dam risk profiling and consequence category classification
- Tailings governance audits.



# Infrastructure Ground Engineering

CM&G closely examines your mining infrastructure function and designs detailed approaches to optimising your material use and construction methodologies. Our team of experts go further in identifying the availability of materials on-site that might appear redundant but could in fact greatly enhance efficiencies and deliver real cost savings. CM&G can deliver project solutions relating to infrastructure including foundations, haul-roads, rail, dams, levees, drains, ROM pads, lay-down areas, retention systems, embankments, and cuttings.

## **Our capabilities include:**

- Concept development studies of ground engineering solutions
- Civil slope stability and foundations design and analysis
- Optimisation of materials and construction methodologies
- Sourcing already available run-of-mine waste/pre-strip materials and developing efficient designs that achieve project savings
- Minimising the importation of unnecessary materials
- Undertaking site inspections and interpreting/analysing results into report findings and recommendations
- End-to-end project management (including construction sequencing and oversight)
- Construction QA/QC
- RPEQ oversight and approval
- Assurance of design and construction certification (in line with government regulation).



# Operational Support Geotechnical Engineering

CM&G can provide clients with short and long-term geotechnical operational support through site deployment or remote advisory. Working with your team, CM&G will offer flexible options that assess available data and resources and design modelling and procedural frameworks that minimise risk, enhance safety and drive cost-savings back to your business.

## Our technical services include:

- Designing and reviewing QA/QC face mapping and core logging procedures that capture structural data
- Collection, analysis, integration and reporting of data in meeting design standards
- Validating and interpreting geological, geotechnical, structural and hydrogeological data
- Structural and geotechnical scoping, modelling and procedural design
- Determining protocols that build, improve and maintain existing structural models
- Analysing mining-induced stresses and deformations
- Delivering geotechnical discipline, competency and performance leadership modules
- Monitoring geotechnical systems performance
- Reviewing and analysing mine development plans, slopes, and drilling designs
- Ground stability analysis and design of stable excavations in rock
- Rock mass and surface characterisation (scanning and mapping)
- Geotechnical design and inspections
- Geotechnical-based selection and design of mining methods (Sublevel Stopping, Sublevel Caving, Cut and Fill, Drift and Fill, Tabular Narrow Stopping, Block Caving, etc.)
- Stability analysis of open pit slopes and underground excavations
- Ground monitoring systems design and response analysis
- Ground support management (design and planning)
- RPEQ oversight, assessment and approval
- Regional stability design and analysis (pillar design)
- QA/QC and paste fill design
- 2D and 3D numerical modelling and analysis.



# Geotechnical Risk Management

CM&G evaluates risk throughout your mine asset's lifecycle. Our subject matter experts collaborate with you in assessing geotechnical hazards and risk management procedures. Our thorough investigation and analysis provide assurance in the design, safety, and integrity of your mining assets and projects.

## **Our capabilities include:**

- Identifying and managing geotechnical hazards and related risks in mining operations
- Developing systems for geotechnical risk assessment, monitoring, and management
- Investigating rock fall events, ground control incidents, and analysing rock-related risks
- Advising site teams on concerns and solutions related to rock hazards
- Reviewing and communicating work practices to reduce injury risk
- Promoting safety culture through awareness programs for rock-fall hazard identification and elimination
- Developing and maintaining risk registers
- Creating and implementing ground control management plans per guidelines and best practices
- Developing site standards for ground control, mining methods, extraction sequencing, stress, seismicity, and re-entry
- Monitoring rock mass response, ground deformation, stress buildup, and seismicity
- Assessing ground support and reinforcement systems performance
- Monitoring large ground deformations, subsidence, and mining-induced surface expressions, and devising mitigation options
- Ensuring robust, fit-for-purpose engineering systems design and installation aligned with best practice.





# Mine Closure Geotechnics

The preparation of sustainable environmental practices in the event of your mine closure should be considered as critically as all operational elements during the ‘working’ life of the mine. CM&G experts can work with you in appraising all aspects of the mine closure in delivering long-term ground stability and ground-related hazard management solutions.

## **Our capabilities include:**

- The characterisation of site materials and properties including above and below cover layers and structural layers
- Investigating and determining long-term geotechnical risks and design of mitigating solutions
- Stability appraisals of legacy waste disposal facilities including rock pile, storage receptacles, dumps, leeching pads and dams
- Providing risk-ranking advice regarding dam safety and recommendations
- Advising long-term approaches to monitoring legacy mine sites
- Advising geotechnical-dependent environmental impact assessments associated with closure.



# Knowledge Advancement

CM&G is committed to continuous education and proudly offers a comprehensive cache of training modules, information resources and access to subject matters experts. Education resources address proactive and responsive industry needs and focus on the development of practical skills amongst geotechnical engineers and their affiliated mining networks. All training programs have been designed in consultation with industry experts in achieving practical outcomes for participants.

## **Our education and learning offer includes:**

- In-house geotechnical hazards awareness training programs for technical and mining operators
- Specialist geotechnical design courses for site engineers
- Programs for developing structural modelling of discontinuous rock masses
- Guest lecturing and course development advice for universities and education bodies – CM&G provides in-kind support by delivering geomechanics course lectures at the University of Queensland and University of New South Wales
- Developing and implementing mentoring opportunities on geotechnical and rock engineering practices on mine sites
- Coaching, coordinating and reviewing activities undertaken by early-experienced engineers
- Programs for continuous learning towards developing geotechnical engineering subject matter experts.



## R&D and Innovation

The preparation of sustainable environmental practices in the event of your mine closure should be considered as critically as all operational elements during the 'working' life of the mine. CM&G experts can work with you in appraising all aspects of the mine closure in delivering long-term ground stability and ground-related hazard management solutions.

### **Our capabilities include:**

- Analysing and recommending new technologies that improve structural modelling processes
- Managing the end-to-end development and deployment of technology innovations for rock mass characterisation and rock mass response
- Strategising and managing interdisciplinary collaborations and stakeholder engagement in technology development, and through to deployment
- Collaborating with research, technology, and innovation stakeholders as part of technology development teams
- Identifying, planning and delivering continuous improvement projects
- Designing and delivering technical site instrumentation and the commissioning of data logging and telemetry systems
- Ongoing analysis and recommendations in the improvement of safety systems that balance cost performance
- Ongoing advice for the advancement of technical excellence in developing strategic mining designs and innovative technologies
- Continuously prospecting divergent approaches to optimising mining operation
- Advising on technology transformation strategies and frameworks for the development and delivery of integrated geo-scientific data acquisition and processing solutions interfacing with geotechnical-based mine designs.

# Our Recent Projects

## **Project:** Geotechnical site support for open-cut coal mine

Foxleigh | Middlemount South, Bowen Basin (QLD)

**Value delivered:** CM&G has been a proud partner of Foxleigh for more than 5 years and has provided geotechnical support that promotes safe mining operations in challenging periods including during unstable wall conditions.

CM&G has worked with Foxleigh to improve their systems and procedures, including PHMP, GCMP, design process and data collection.

## **Project:** Due diligence for coal mines

RPMGlobal | Australia and Canada

**Value added:** CM&G has supported RPMGlobal on multiple due diligence studies for coal mines throughout Australia and Canada.

Our advice and delivery on a number of world-class operations has seen us become a trusted partner of RPMGlobal.

## **Project:** Feasibility study of underground and open-cut mine

Wilson Minerals | Croydon Gold Mine, Central North (QLD)

CM&G provided design advice for underground and open-cut options. Optimisation of the open-cut design allowed Wilson to steepen their slopes which in turn reduced their mining costs and increased reserves.

## **Project:** Dam safety reviews and rehabilitation capping design

Peabody Energy | Wambo Coal Mine, Hunter Valley (NSW)

CM&G undertook a comprehensive dam safety review which included stability analysis (tailings facilities), failure modes and effects analysis (FMEA), and dam break and inundation. The studies provided a status on the site's tailings management and compliance in accordance with the GISTM, along with local and national regulatory requirements. CM&G designed the rehabilitation capping plan for Wambo Mine, implementing the displacement method.

## **Project:** Independent technical review (slope failure and contributing cause/s)

Harmony | Hidden Valley Gold Mine, PNG

**Value added:** CM&G was engaged to complete an ITR on an unexpected slope failure. We identified gaps in the existing geotechnical model and design processes that allowed the failure to be missed. Further, we provided practical advice to support the robust assessments of geotechnical hazards, their Design Acceptance Criteria (DAC), and how it might affect their mine plans. This system included a risk-ranking of identified potential failures and assessing these against the mine plan and DAC to more accurately understand the risk to their schedule.

## **Project:** Underground and open-cut site support

Glencore Metals | Ernest Henry Mine, North Queensland

**Value added:** CM&G provided site support to the mine which included reviews of their existing systems and processes, and audit of their underground, open-cut, and tailings infrastructure.

## **Project:** Issued for construction (IFC) geotechnical design

Aarvee Associates | Carmichael Rail Project, Galilee Basin (QLD)

**Value added:** CM&G partnered with Aarvee Associates to provide specialist geotechnical solutions for the Carmichael Rail Project.

Through this partnership, CM&G succeeded in delivering IFC geotechnical designs, drawings, and specifications for the Carmichael Rail Project, following unsuccessful previous attempts by other third parties.

# Our Recent Projects

## **Project:** Re-design of surface water drain

Glencore Coal | Clermont Coal Mine, Bowen Basin (QLD)

**Value added:** Clermont mine approached CM&G to provide a remediation design of a major drain.

We worked with the Technical Services Department to develop the plan which drew upon the mine's own equipment and waste materials which minimised costs by eliminating the need to import expensive quarried materials and civil contractors.

## **Project:** Technical support for resumption of mining

Capricorn Copper | Gunpowder, North Queensland

**Value added:** CM&G undertook a significant body of work spanning the numerical modelling of stresses, the creation of geotechnical risk mitigation strategies, and advising onsite engineers to incorporate the recommendations.

This resulted in the previous directive to hold production to be lifted, and the mine recommencing activities after months of inoperability.

## **Project:** Pre-feasibility study for underground mining project

Bolkar Mountains | Madenkoy, Turkey

**Value added:** CM&G created the pre-feasibility study (PFS) submission for the project, validating the geotechnical-based designs, identifying gaps, and proposing additional work that was required to complete a valid, bankable PFS.



## **Project:** Technical oversight of manganese mine expansions

SOUTH32 (multiple projects) | Wessels Mine, Hotazel and Kalahari sites (South Africa)

**Value added:** CM&G has supported the South32 projects team in preparing, and substantiating, the technical submissions for the future expansions of their current mining operations.

CM&G also appraised the completeness of an existing pre-feasibility study that was required for investment purposes.

## **Project:** Vertical pit walls for final highwalls

Wilpinjong Mine | Western Coalfields, NSW

Wilpinjong mine approached CM&G to provide advice for non-standard design considerations for the final highwalls. The option was floated to cut vertical walls up to 50 m high for the final highwall.

CM&G provided kinematic analysis and numerical modelling to validate the option. The implementation of these final walls allowed for the recovery of an additional 850kt of coal per 100 m block.



**CARTLEDGE**  
MINING AND GEOTECHNICS

Visit our website



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