



MINE CLOSURE STUDIES

From regulatory requirement to business decision-making

Managing the technical pathway to a defensible closure plan

Mine closure planning is often presented as a logical technical process:

define the objectives, commission the studies, develop the designs, estimate the cost and progressively reduce uncertainty.

In reality, it is rarely that orderly.

Closure studies compete for time and budget with production, sustaining capital, project development and operational priorities. Mine plans change. Technical investigations are delayed. Some studies are undertaken because a regulator requires them, while others are needed because the business requires a clearer understanding of its future liability, execution risk and funding requirements.

Those drivers do not always align.

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What will it actually take to close this operation - and what is it likely to cost?

That distinction matters.

Regulatory cost is not necessarily execution cost

Regulatory closure and financial assurance frameworks serve an important purpose. They provide a mechanism for demonstrating closure obligations and ensuring that adequate financial provision is available if those obligations ultimately need to be delivered.

But regulatory estimates and internal closure estimates do not necessarily answer the same question.

Internal estimates need to support:

- business planning
- liability forecasting
- capital allocation
- project evaluation
- mine planning
- closure scheduling
- contractor strategy
- execution planning
- long-term financial decision-making

As closure planning matures, the internal estimate can therefore become more detailed - and often more conservative - than the regulatory figure.

A compliant closure estimate is not necessarily an execution-ready closure budget.

This is particularly important where increasing the assessed closure liability also has a direct financial consequence for the business.

In Queensland, for example, rehabilitation and closure obligations interact with the Estimated Rehabilitation Cost and Progressive Rehabilitation and Closure Plan frameworks. While the regulatory process has its own purpose, the business still needs to develop a realistic internal understanding of what closure is likely to cost under actual site conditions.

The danger is when the regulatory number gradually becomes the accepted business assumption simply because it is the number most regularly reported.

Closure does not start at closure

The most effective closure planning occurs while the operation still has choices.

That means closure needs to be considered during:

- feasibility and project design
- mine planning
- waste-rock placement
- tailings facility planning
- infrastructure layout
- water-management design
- material movement
- progressive rehabilitation
- sustaining-capital decisions
- operational planning
- contractor procurement
- major project execution

Decisions made during operations can either reduce future closure liability or lock additional cost into the final closure program.

A waste-rock landform designed only around short-term haul efficiency may become expensive to reshape later.

Growth media placed where it cannot be practically recovered may need to be replaced.

Infrastructure constructed without considering demolition access or contamination risk may make closure more complex.

Tailings deposition strategies can materially influence eventual closure options.

Drainage, water storage and pit-lake outcomes may be influenced decades before final closure.

By the time cessation of mining is approaching, many of these options have already disappeared.

The role of closure studies

Closure studies should therefore be used to support decisions - not simply to produce documents.

A mature closure program may require technical work across:

- hydrogeology
- geochemistry
- pit lakes
- surface-water management
- landform design
- erosion and stability
- cover systems
- tailings closure
- contaminated land
- rehabilitation and revegetation
- infrastructure demolition
- hazardous materials
- waste disposal
- social transition
- post-closure monitoring
- closure costing and liability assessment

The challenge is not commissioning every possible study. The challenge is determining what uncertainty matters, what decision it affects, when that decision needs to be made, and what level of technical confidence is actually required at that point in the mine life.

Managing uncertainty rather than pretending it does not exist

Closure plans will always contain uncertainty. Ore reserves change. Mine lives extend. Commodity prices influence operating strategy. Technology changes. Regulatory expectations evolve. Environmental conditions may not perform exactly as predicted.

The objective is not to eliminate every uncertainty. It is to identify the uncertainties that could materially change closure outcomes, regulatory acceptance, execution methodology, schedule, cost or long-term risk.

Those uncertainties can then be progressively reduced through studies, monitoring, field trials and operational experience.

From trials to better decisions

Rehabilitation trials are a good example. A successful trial undertaken early enough in the mine life can establish practical information on ripping, growth-media depths, erosion controls, species establishment, equipment productivity, material quantities and actual unit rates.

That information is far more useful to a future closure estimate than relying indefinitely on generic assumptions. The same principle applies to cover trials, geochemical characterisation, water modelling and landform performance.

Someone needs to manage the pathway

Closure study management is not about personally undertaking every specialist investigation. It is about ensuring the technical work collectively answers the questions the operation and the business need answered.

That requires someone to:

- establish the closure basis and key assumptions
- identify material knowledge gaps
- prioritise studies according to risk and decision timing
- develop scopes and manage specialist consultants
- ensure assumptions are consistent between disciplines
- challenge technical recommendations where necessary
- integrate outcomes into mine planning and operational decisions
- maintain the connection between closure design and closure cost
- identify opportunities for progressive execution
- update liability as the closure basis matures
- maintain traceability between commitments, designs, evidence and costs

Without that integration, it is easy to accumulate a library of technically competent reports while still lacking a practical closure pathway.

The practical lesson

The strongest closure plans are not necessarily the ones with the most studies. They are the ones where technical work has influenced actual decisions.

Closure therefore needs to move beyond being an environmental compliance activity undertaken periodically to update a regulatory document. It should form part of the operating and investment conversation throughout the life of the mine.

That means asking closure questions while there is still time to change the answer.

- Can this landform be constructed closer to its final closure geometry?
- Can rehabilitation be brought forward?
- Can material be placed once rather than moved twice?
- Can closure infrastructure be incorporated into current capital works?
- Can a trial now remove uncertainty from a much larger future liability?
- Can an operating decision today materially reduce the eventual closure cost?

These are business questions as much as environmental ones.

From planning liability to reducing liability

The best closure plan is not simply the document produced at the end of a study. It is the series of operational and investment decisions made throughout the life of the mine that progressively reduce uncertainty, liability and execution risk.

Closure needs to commence well before closure. It should be embedded in project design, mine planning, rehabilitation programs, sustaining capital, technical studies and everyday operational decision-making.

NG Mining Environmental

Client-side support for closure planning and studies - defining the work, managing specialist inputs, challenging assumptions, integrating technical outcomes and translating closure requirements into practical operational and business decisions.

Because closure is easier to manage while the operation still has choices.

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