

Mine closure & rehabilitation challenges:

Mining company perspectives

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Presentation Overview

- ▶ Industry Context & Materiality of closure risk/liabilities
- ▶ Overview of closure function within a Mining Company, & its multidisciplinary nature
- ▶ Some mine closure & rehabilitation challenges:
 - ▶ Building/Maintaining internal closure competencies
 - ▶ Closure cost estimation & communication
 - ▶ Interdisciplinary collaboration in closure planning
 - ▶ Agreeing post closure land uses & completion criteria
 - ▶ Management KPIs

Industry Context



- Closure costs are frequently under-estimated (scope and cost accuracy)
- Stakeholder expectations are increasing
- Industry's licence to operate relies on improved closure performance
- Industry aims to leave a positive post closure legacy

Closure: A multi-faceted business risk

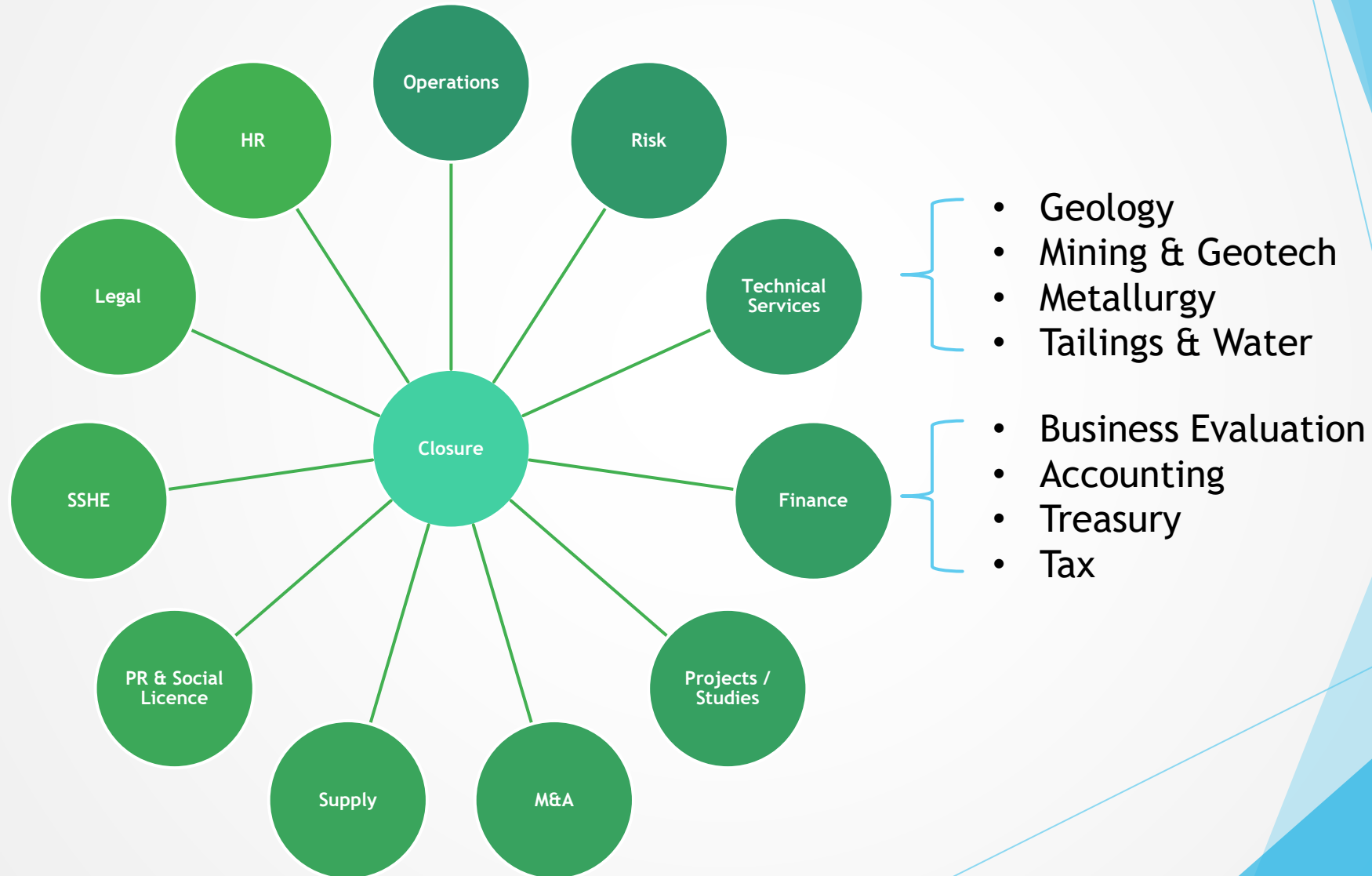
Environment	Social	Employees	Regulatory	Investors	Board & Executives	Risk areas
In-perpetuity management costs	Poor outcomes for social investments and community programmes	Talent management lacks focus on necessary skills for closure	Increased mine closure security / financial provision requirements	Reduced market value of a company due to high closure liability	Director liability (possible fine / imprisonment)	High
Environmental contamination clean-up costs	Loss in social license to operate resulting in reputational damage and difficulty in getting future approvals	Maintaining key talent as closure approaches and costs associated with maintaining staff	Unable to achieve closure and relinquishment	Reputational risks impacting on future business opportunities through loss of investor confidence	Reputational risks from poorly managed closure	Medium
Unidentified or un-costed liabilities			Complex and multiple regulatory compliance requirements		Reduced asset value during the operational period due to increasing closure liability	Medium
Failed site rehabilitation resulting in increased costs	Health impacts from contaminated water, soils and air	Job losses more likely to result in reduced livelihoods and conflict	Fines and legal action		Unable to implement closure measures due to inadequate financial provisioning	Low
			Lack of regulatory framework for post closure alternatives			Low

High
↑
Priority
↓
Low

Mining Company Closure Function

- ▶ Supports a site's strategy & business plan delivery through:
 - ▶ Effective functional assurance of material risk critical controls
 - ▶ Meeting budget & strengthening the balance sheet, through minimising closure liabilities and rehabilitation bank guarantees
 - ▶ Growing assets through LoM planning and projects, and embedding integration/optimisation of closure costs
 - ▶ Supporting growth through M&A due diligence, permitting and land access processes
 - ▶ Enhancing licence to operate, via progressive rehabilitation, closure execution and implementing SDGs

Closure - Internal Interfaces



Mine Closure: A multidisciplinary technical/financial function



Areas that inform closure planning

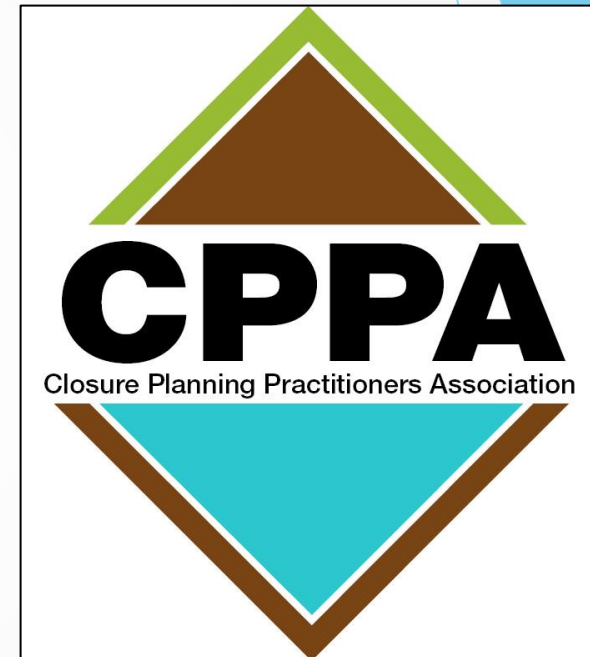
- ▶ Closure strategy & planning, permitting obligations and lease relinquishment pathway
- ▶ Geology & geochemistry
- ▶ Hydrology & hydrogeology
- ▶ Mining engineering
- ▶ Geotechnical engineering
- ▶ Tailings and metallurgy
- ▶ Soil science and geomorphology
- ▶ Landform & river diversion design
- ▶ Revegetation, restoration ecology and biodiversity
- ▶ Contaminated sites, hazardous materials & waste management
- ▶ Water treatment technologies
- ▶ Cultural heritage, socio-economic impacts and social performance
- ▶ Closure readiness, care & maintenance, demolition
- ▶ Environmental and revegetation monitoring
- ▶ Landform and rehabilitation maintenance
- ▶ Field data acquisition, trials, academic research and scaling up of results
- ▶ Project management/execution
- ▶ Cost estimation and cashflow scheduling
- ▶ Risk analysis and ranging

Challenge: Building/Maintaining Internal Closure Competencies

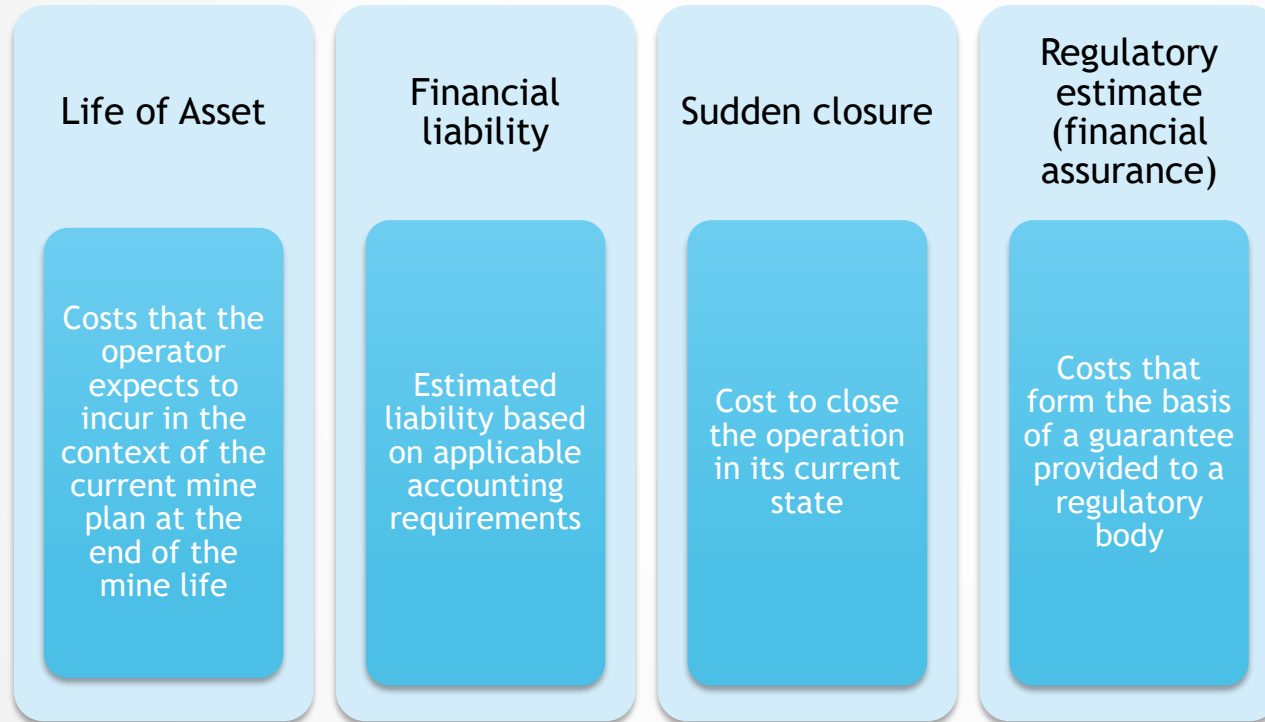
- ▶ There is a dearth of closure knowledge outside of experienced closure practitioners - in miners, consultants, regulators and other stakeholders.
- ▶ A framework has been developed by the CPPA with the aim of defining the required capabilities and competencies to plan and deliver effective closure work.
- ▶ This can assist the business to identify opportunities for development of the closure roles, talent management, career planning and personal growth of individual employees.
- ▶ Will also help ensure we have a pipeline of personnel with the necessary qualifications, skills and experience to undertake our future closure work.

CPPA Closure Competency Framework

- ▶ CPPA Vision:
 - ▶ To promote global leading practice skills in closure within Australia by representing and engaging with closure planning practitioners to develop and build professional capacity
- ▶ Have published their own Closure Planning Practitioners Competency Framework.
- ▶ Training courses available – AusIMM, CRC TIME, BRIMM etc
- ▶ <https://cppa.asn.au/>



Challenge: Closure cost estimation & communication



Challenge: Closure cost estimation & communication

- ▶ Closure costs miscalculation is a financially material business risk
 - ▶ accurate cost estimates and expenditure projections are essential to keep the business appropriately informed
- ▶ Costs are driven by scope, which is generally dictated by local laws and environmental approval/permit conditions, and typically include:
 - ▶ The removal of all unwanted services and infrastructure associated with an operation; and
 - ▶ The return of disturbed areas to a safe, stable, non-polluting and self-sustaining condition; consistent with an agreed post-mining land use(s).
- ▶ Communication these costs internally is always a major challenge

5 stages of closure...

5 stages of closure...

THE **5** STAGES OF GRIEF



Denial



Anger



Bargaining



Depression



Acceptance

5 stages of closure...

THE ~~5~~ STAGES OF GRIEF

CLOSURE



Denial



Anger



Bargaining



Depression



Acceptance

Challenge: Closure cost estimation & communication

- ▶ Opportunities to reduce the closure costs/liabilities, usually focus on challenging assumptions relating to:
 - ▶ Scope of rehabilitation obligations (what work is legally required)
 - ▶ Proposed execution methodology (how should the work be done)
 - ▶ Quantities utilised (volume of work - accuracy of survey, GIS etc)
 - ▶ Unit rates utilised (cost of the work, contractors proposed etc)
 - ▶ Timing of the proposed works (how much discounting)
 - ▶ Discount rate selection
- ▶ These are constantly challenged by unenlightened colleagues internally

Challenge: Interdisciplinary collaboration

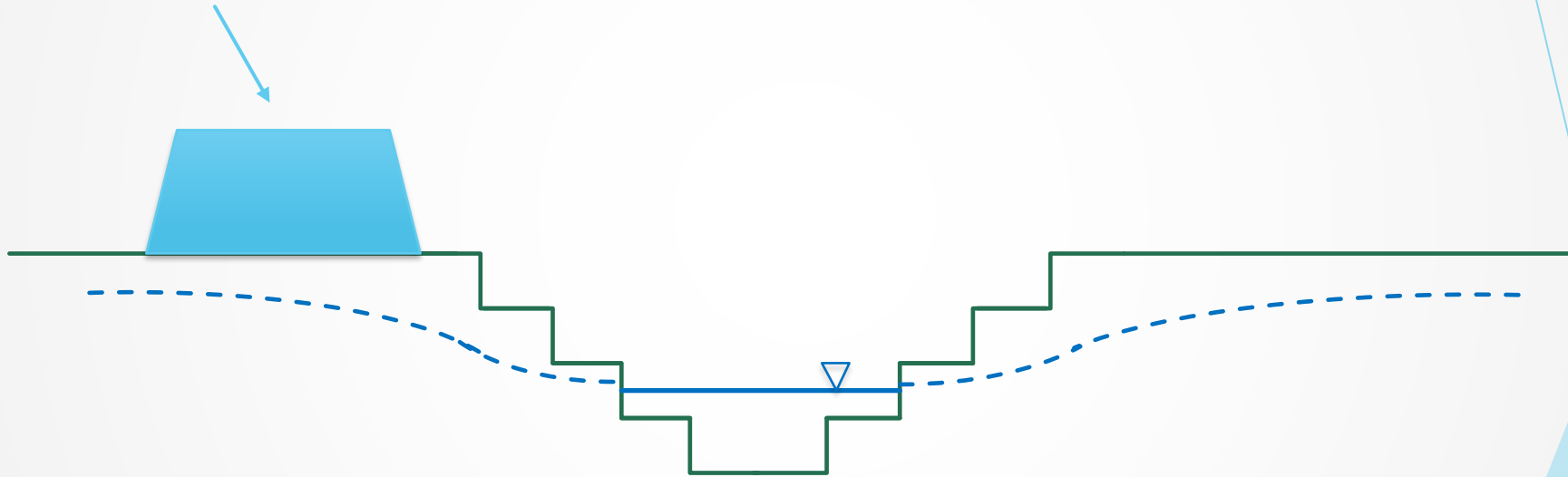
- ▶ Essential for effective closure planning and delivery
- ▶ Landform cover systems are a great example, as requires:
 - ▶ geochemistry,
 - ▶ soil science / unsaturated zone hydrology,
 - ▶ geotech (TSF drain down, stability of tailings/WRDs, synthetic liner performance, cover installation methods),
 - ▶ geomorphology (erosional stability / landform evolution)
 - ▶ hydrogeology & hydrology (pathways to downgradient receptors)
 - ▶ botany (root penetration, transpiration),
 - ▶ zoology (burrowing and foraging animals)

Interdisciplinary collaboration



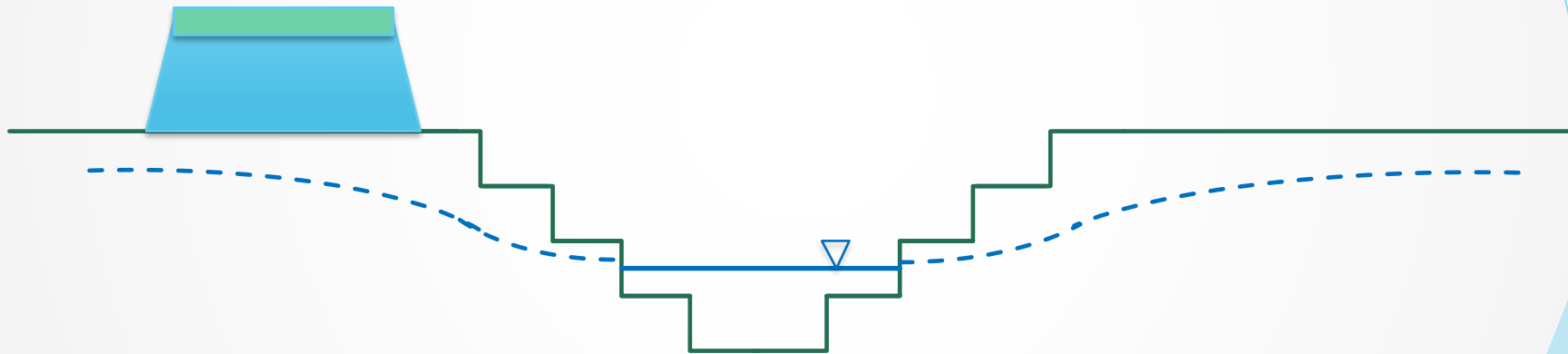
Interdisciplinary collaboration

PAF dump



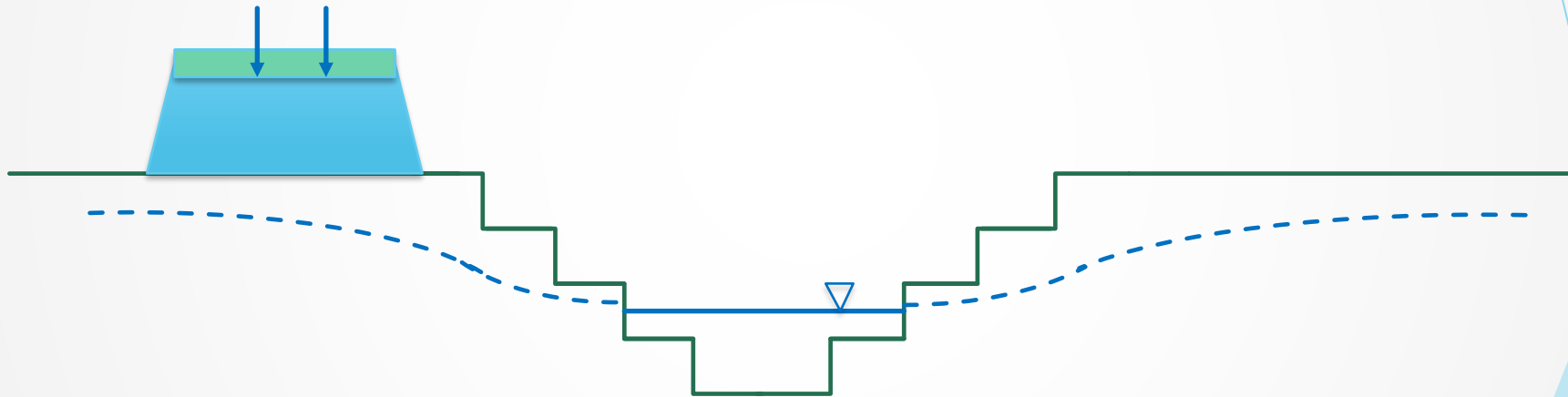
Interdisciplinary collaboration

PAF dump - need to cover it.

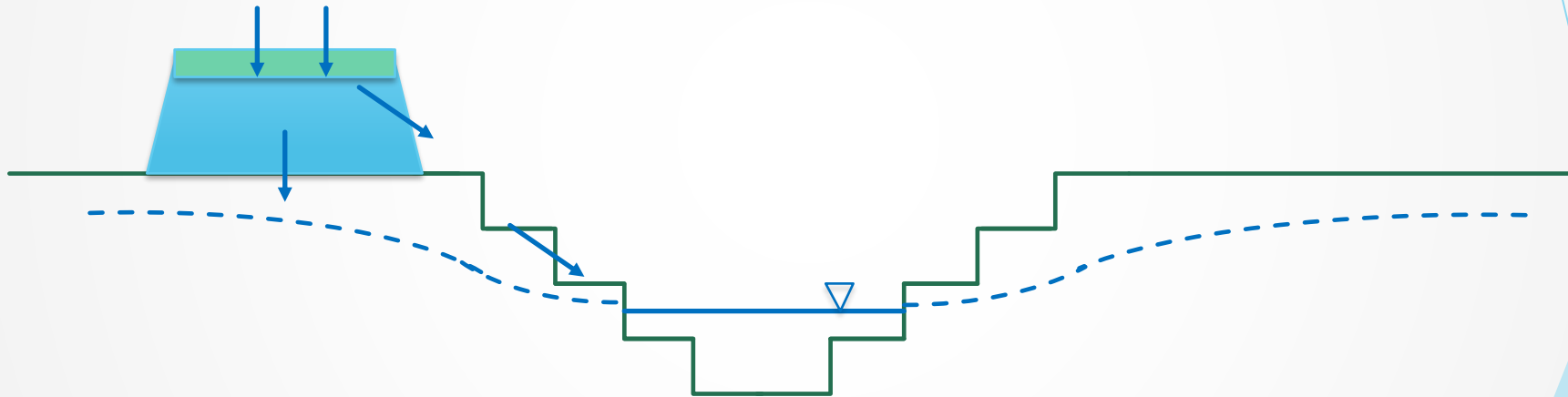


Interdisciplinary collaboration

% net percolation reduced?



Interdisciplinary collaboration



Groundwater and pit lake water quality impacts?

Challenge: Agreeing Post closure land use & completion criteria

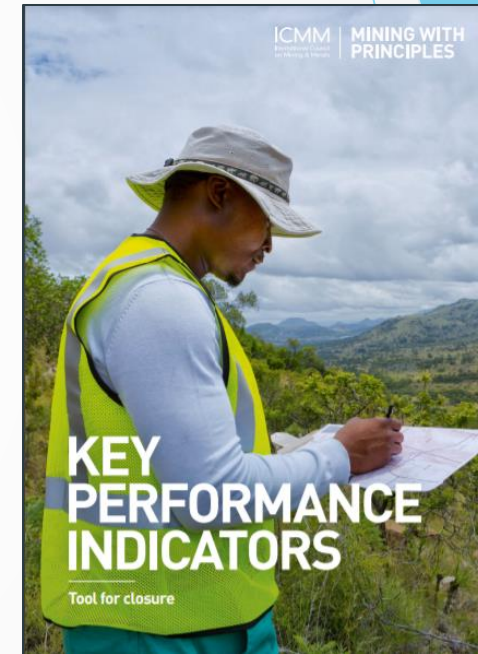
- ▶ A wide variety of potential alternative land uses - very site specific
- ▶ Often, mined lands are expected to be returned to the pre-mining land use.
- ▶ But who is the post closure landholder?
 - ▶ Are they comfortable accepting any residual risks?
 - ▶ Do they have the financial means to manage any residual risks?
 - ▶ Should/can the mining company provide financial assistance to facilitate lease relinquishment to them?
- ▶ Assess repurposing opportunities - may have greater economic and social benefit?

Challenge: Agreeing Post closure land use & completion criteria

- ▶ Uncertainties in setting/agreeing closure completion criteria:
 - ▶ Length of post closure phase (typically decades)
 - ▶ Landform engineering design life and factors of safety
 - ▶ Climate change impacts?
 - ▶ Ecological succession and resilience
 - ▶ Water quality criteria? At what location(s)?
 - ▶ Changing community expectations & regulatory reform
- ▶ These uncertainties can make it problematic for a business to make decisions on capital allocation for closure/progressive rehabilitation.
- ▶ Requires an adaptive management process

Challenge: Management KPIs

- ▶ Internal Management Key Performance Indicators (KPIs) are needed to drive positive closure outcomes.
- ▶ But they are not always in place, or are in place too late in the mine life.
- ▶ Without KPIs, it can be difficult to influence decision makers, which requires more effort developing the business case for closure (& progressive rehabilitation).
- ▶ Need to stop making stupid decisions basically - but need a carrot (and perhaps a stick...).



Summary

- ▶ Closure is a financially material ESG risk (but includes opportunities), and has many challenges
- ▶ Closure is a multidisciplinary technical & financial discipline, & interdisciplinary collaboration in closure planning is essential for improved outcomes
- ▶ Building closure competencies is vital to assist industry personnel in improving our closure planning and delivery - same for regulators and consultants
- ▶ Closure costs are large, and can cause a lot of grief...
- ▶ Adaptive management mechanisms for post closure land uses & completion criteria are essential
- ▶ Internal Management KPIs are essential to drive improved closure outcomes

Thanks

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