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Page: 4

WORLD WATER DAY

Deep-level mines must get smarter about water

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FOR South Africa to achieve both economic resilience and responsible water stewardship, we must move beyond static control models and embrace adaptive, demand-driven approaches where feasible.

Water is one of the most critical resources in the world, and its scarcity is becoming ever more prominent. In South Africa, where infrastructure instability and recurring shortages already strain communities and industry alike, water wastage in any sector should concern us all.

Deep-level gold mining is no exception.

While few South Africans ever see what happens kilometres beneath the surface, vast volumes of water circulate through underground mines every day. In these environments, water is essential. It cools workplaces maintaining safe temperatures, keeps equipment from overheating, and acts as an energy carrier for hydraulic tools. Without a reliable supply, production slows or stops altogether.

Yet studies suggest that as much as 30% of the water supplied to deep-level mines may be lost through leaks and system inefficiencies. In a water-scarce country, that figure should give us pause.

The implications reach beyond the resource itself. Water wasted underground must ultimately be pumped back to the surface to avoid flooding. Dewatering systems in deep mines can account for up to 40% of a mine's total energy demand. While the adoption of renewable energy is increasing, coal-fired power still dominates. Consequently, water wastage translates directly into higher energy consumption and greater carbon emissions.

With mining contributing roughly 6% to South Africa's GDP in 2025, sustainable water management in deep-level mines is not merely an operational concern – it is an economic and environmental imperative.

Challenge

Managing water networks in deep mines is inherently complex. Current practice focuses on leak detection and repair, pressure control during low-demand periods, optimising networks, operational accountability to reduce unnecessary consumption, and more recently, smart management concepts.

Repairing leaks remains the most effective long-term solution. However, underground infrastructure stretches across vast and difficult-to-access areas. Fixing leaks also requires specialised labour, considerable resources, and often temporary production stoppages. These constraints mean that leaks may remain unresolved for extended peri-

ods. To limit losses in the interim, mines typically rely on pressure-control valves that reduce supply during scheduled low-demand periods. The difficulty is that mining operations, like any human enterprise, rarely follow schedules exactly. Delays occur, overtime becomes necessary, and equipment failures interrupt routines.

The key insight from our research is that water management systems in deep-level mines are largely static, while the environment they serve is inherently dynamic. When actual demand deviates from planned schedules, static control systems cannot adapt.

The fundamental challenge is therefore one of a supply and demand mismatch.

Smarter approach

Other sectors have addressed comparable challenges by adopting smart systems that respond to real-time human activity. By using operational data to approximate demand, these systems adjust supply dynamically and reduce unnecessary consumption.

A similar opportunity now exists underground.

GPS signals cannot penetrate rock, making conventional tracking impossible underground. However, many South African mines now use zone-based tracking systems known as Missing Persons Locator networks, required under the Mine Health and Safety Act

29 of 1996. These systems are designed to improve safety by enabling the location of workers during emergencies and providing real-time information about underground occupancy.

By integrating occupancy data with existing automated valve infrastructure, it becomes possible to approximate real-time water demand and adjust supply dynamically. When workers are present and active, supply can be maintained. When no one is present in a given area, supply can be reduced, limiting wastage while repair efforts continue.

Importantly, this approach does not replace maintenance and repair. It complements it by mitigating negative impacts during the often-lengthy repair process.

Sustainability, safety and growth

World Water Day, marked on March 22 each year, serves as a timely reminder that responsible resource management is a shared obligation.

Water wastage in deep-level mining has cascading impacts: higher energy requirements, increased carbon emissions, rising operational costs, and added strain on a scarce national resource. At the same time, mines cannot simply restrict water indiscriminately as water is critical for production and safety. Any intervention must therefore balance sustainability with productivity and worker safety.

The integration of underground tracking technologies and established control infrastructure presents a promising opportunity. Systems originally implemented purely for safety can now support sustainability and efficiency.

This alignment between safety, engineering and environmental stewardship is precisely the kind of integrated thinking South Africa needs. The mining industry does not need to abandon proven long-term solutions such as leak detection and repair. These remain foundational.

However, going forward, mining companies should adopt a mindset in which sustainability, safety and growth are engineered together rather than treated as competing priorities. Emerging technologies are making it progressively more possible to design systems that reduce resource wastage without compromising productivity.

Water is life, both above and below ground. How we manage it matters.

Gerber, Schutte, Gous and Van Laar are affiliated with the Department of Industrial Engineering at Stellenbosch University. This article is based, in part, on the paper 'Water Wastage Management in Deep-Level Gold Mines: The Need for Adaptive Pressure Control', published in Mining recently.