

# Energy supply depends on water; water supply depends on energy

Water is critical to mining operations and effective water management has long been a focus for miners as they work to improve usage efficiency, reduce environmental impacts and support local community development. There is a direct relationship, or nexus, between water and energy at a mine with profound implications for the bottom line and also for ESG considerations.



The eMalahleni water plant in South Africa

23 June 2020

Author: [Paul Harris](#)

In *Environmental Governance in Latin America* (2016), Cristian Parker et al observed, "a struggle for legitimacy going on between conflicting discourses", between the company view that mining can be sustainable and those who are affected by mining activity who argue it is not due to concerns about the availability of water for agriculture and populations, and the potential for pollution.

The authors described the conflict as a Gordian knot: an intractable problem.

"From the perspective of environmental governance, the positions ... point at disagreement," they wrote.

"They will be a great source of conflict to the extent that some defend the thesis of economic growth, taking ecological factors into account only as secondary externalities. Others take an alternative stance, proposing an ecological perspective that focuses on avoiding economic growth and overconsumption in the neo-extractivist Third World."

In a January 2020 open letter, BlackRock CEO Larry Fink spoke about how anthropogenic climate change would alter how the giant firm invested as it placed sustainability at the centre of its approach, making it integral to portfolio construction and risk management, and exiting investments that presented a high sustainability-related risk.

"In the near future - and sooner than most anticipate - there will be a significant reallocation of capital," Fink said.

"Given the groundwork we have already laid engaging on disclosure, and the growing investment risks surrounding sustainability, we will be increasingly disposed to vote against management and board directors when companies are not making sufficient progress on sustainability-related disclosures and the business practices and plans underlying them."

## ***"This one risk will shift and change how capital is allocated and how assets are priced"***

Fink said sustainability was "the new way to manage because climate change is recognised as one of the biggest long-term risks, they require companies to address", Victoria Gosteva, marketing lead for global mining and thought leadership at Black & Veatch, an employee-owned engineering, procurement, consulting, and construction firm, told Mining Journal.

"This one risk will shift and change how capital is allocated and how assets are priced."

With ESG issues related to climate change becoming fundamental investment criterion for mining sector investors such as BlackRock, sustainability is a growing mantra among many miners, with most, if not all roads leading to the Rome of the issues and challenges surrounding water and energy.

The two are often flashpoints for community and government stakeholders and they are fundamentally intertwined with the financial performance and viability of an operation.

The task at hand for miners is increasingly reaching a balance between the pursuit of profitability and environment and social needs in order to have a legitimate corporate mining activity. "Everything is rooted in our journey through the United Nations Sustainable Development Goals and into sustainable mining. That is the compelling factor for all major multinational miners, the ICMM principles of sustainable mining and individual policies of mining companies," Jim Spenceley, SVP mining, governance at Black & Veatch told Mining Journal.

Spenceley believes sustainable mining has three core aspects: tailings management, energy and reducing greenhouse gas emissions (GHG) and carbon footprint towards carbon neutrality, and water sustainability. "There are three technical streams being actively managed and there is a nexus between the three of them," he said.

What ups the ante from the miners viewpoint is that this is occurring against a backdrop of declining ore grades. "This means that to produce an equivalent amount of metal you have to mine and process more material which puts upwards pressure on the amount of water you consume and the amount of energy you use. All these technical, business and political forces are coming together to put pressure on miners to redefine what sustainable development means," Spenceley said.

Mining needs a lot of energy and a lot of water and the two are entwined, hence the nexus.

Effecting meaningful change and improvement means changing the traditional way that miners tackle what are often seen as technical challenges, and looking beyond what may be the obvious solutions. Miners often have limited energy options due to the remote location of mines, which means they either have to use the energy supply available locally or install their own power capacity. As such, energy for mining often comes from fossil fuels such as coal, natural gas and diesel due to cost and reliability factors. That straightforward reasoning is increasingly difficult to reconcile with investors and their view on GHG.



The 2,500lps desalination plant for Escondida in Chile

Miners often see water and energy as technical problems and hold faith that innovation will deliver appropriate solutions. But taken in isolation, solving one problem such as the development of a seawater desalination plant or the implementation of filtered dry stack tailings, only creates another in terms of higher capex, opex and power consumption. "About 60% of global energy for mining is diesel as not that many mines are on the power grid, and those which are usually on coal-fired grids. Coal-fired energy has a major water cycle because of its steam cycle. Only 20% of mines are non-fossil fuel," Dr Hubert Fleming, previously head of water management at Anglo American and co-chairman ICMM Water Working Group, told Mining Journal.

At the mine level, water is often a bone of contention with local stakeholders with concerns about water availability and quality.

In arid regions, such as northern Chile, the government has imposed restrictions on the use of continental or ground water, forcing miners to seek alternatives to reduce water usage, increase water recycling and installing seawater desalination plants. BHP, for example, has invested more than US\$4 billion in desalination facilities for the Escondida copper mine in Chile to significantly reduce its groundwater usage and secure a sustainable water supply. It now has a 2,500lps desalination plant. Spence will begin using desalinated water from mid-2020 upon completion of a 1,000 litre per second desalination plant. "Some 70% of mines sites are now water short and the projection is that 85% of new sites will be water short, which means there will be a pipeline to bring it in from somewhere else or desalination and thus an energy problem to desalinate and pump it. The last thing you want to do is build a desalination plant as they are expensive and energy inefficient," said Dr Fleming.

### ***"The tailings dam failures in Brazil and Canada were water-related so there is a big push to get water off tailings storage facilities, which means reducing it and reusing it"***

Too much water is also a problem and one that can have more immediate catastrophic implications such as the tailings storage facility failures at Mt Polley in Canada and Samarco and Brumadinho in Brazil. The largest contact water resource at a mine site is often the TSF. "The tailings dam failures in Brazil and Canada were water-related so there is a big push to get water off tailings storage facilities, which means reducing it and reusing it," said Dr Fleming.

The response has been a shift towards the use of filtered dry stack tailings disposal to get water out of tailings and TSF to make them safer, and also (in arid regions) to reduce evaporation so more of the water is available for reuse. Getting water out of tailings has a cost in terms of increased capital investment and greater energy consumption, and the recycling of water can also drive-up concentrations of chemical contaminants in process water, which may impact the performance of the processing circuit. "Driving more water out of tails is going to allow you to recycle more but there is an energy cost to that, so it needs a mindset to look at the whole problem," said Spenceley.

Contact water and mine dewatering planning is often not given sufficient thought.

"It is more expensive to pump water from a pit than to intercept it as it migrates towards the mine. A lot of people say we will manage it when it comes into the mine, but wet ore is also an additional cost as it decreases blasting efficiency and accelerates wear on machinery. If you spend a little more in capex to intercept water before it comes into the mine and is contact water you can reuse it or discharge it with fewer permitting requirements. Once it is in the mine it will have contaminants from blasting and operations," Patrick Williamson, principal hydrogeochemist at Intera, told Mining Journal.

Solving water issues often rapidly raises the question of how to do it without energy costs spiralling out of control? "This is the absolute crux question, and this is where wanted to go with the SME CTMF panel," said Spenceley.

For Williamson, a focus on capex often results in more expensive solutions being employed. "People don't look at energy consumption which is hidden in the opex. They don't look at the energy cost of moving water, only the capital cost of putting in a well. The cost of putting in a well-designed well will be recovered several times by the energy efficiency," he said.

There will also perhaps be a scramble to tie-up with limited renewable energy sources to improve carbon footprint with the larger companies prevailing and monopolising local resources. In October 2019, BHP announced it had negotiated four new power contracts for its Escondida and Spence copper mines in Chile from 100% renewable energy sources by the mid-2020s with power to be supplied from solar, wind and hydro sources. This will virtually eliminate all of its scope 2 emissions and displace up to 3 million tonnes of CO2 annually compared to the fossil fuel contracts they replace, some 70% of the company's total greenhouse gas emissions in the Americas. The contracts will also reduce the operations' power costs by 20%. "These new renewable energy contracts will increase flexibility for our power portfolio and will ensure security of supply for our operations, while also reducing costs and displacing CO2 emissions," Daniel Malchuk, president of BHP Minerals Americas, said in a statement.

Up until relatively recently water, tailings and energy were still largely viewed independently and looked at as requiring their own unique oversight with someone in charge of water, someone in charge of energy and so on, with decisions taken on that basis in response to different drivers. This group think or parochial approach has seen initiatives fail due to a lack of an overriding unified approach to tackling water and energy issues and sub-optimal solutions advanced.

Spenceley argues the development of solutions needs to have the nexus front and centre.

If not, a solution may improve one aspect but worsen another. "If you look at optimising water and do it independently of energy you may not get the right answer because you have to use energy to move water around: they are co-dependent," he said.

The increasing focus on ESG, and the investor push for this to happen, is effecting change and driving leadership to burst bubbles in the corporate structure to overcome the technical silo approach and consider the water-energy nexus in ways which are arguably long overdue.

"Tails are driven by the health and safety perspective: are they inherently safe and how can I make them safer? There is a water benefit to that, as water is about using less and using it more sustainably. In the energy space, it is about scope 1 and 2 emissions, so the driver is to reduce GHG emissions and doing that in the most cost-effective way. It needs just a minor tweak to bring teams together and highlight the synergies. Unfortunately, mining company structures and the deep technical tracks people are on means there is a lack of cross pollination," said Spenceley.

Communities being sensitive about water is a given, but there is often little thought as to why, beyond human consumption and agricultural factors. The investor focus on ESG may see that start to change as cultural aspects related to water resonate with the 'S' and the 'G'. "People are very sensitive about water, especially if water is part of their culture. We see this in the Highland culture around the Pachamama in Peru where water is considered a communal good and with indigenous communities in Brazil and Oaxaca, Mexico. Cultural aspects have to be managed in addition to local water scarcity. Colombia, despite its apparent abundance of rain and run off, has water shortages as so much water is contaminated. Many communities depend on surface water. Not because a shortage but because of quality," Spenceley said.

## **Mining's glasnost moment**

Miners are starting to seek exogenous solutions to problems they share with other miners ushering-in an age of collaboration and openness; an entente cordial or Sunshine Policy is replacing the traditional isolationist approach to business.

"Collaboration between miners is starting to increase," said Dr Fleming.

"It makes sense for them to share infrastructure to reduce the environmental footprint and costs. Forward-looking governments in Chile, the US, Australia and Canada are being supportive of this."

Spenceley said miners were collaborating among themselves and with manufacturing and consulting firms such as his to evaluate "what the technical landscape looks like and what is out there in R&D that can be brought in, for the next phase of development".

"We are seeing increased collaboration and partnering as our mining clients recognise they have to tackle these problems differently as the easy problems have been solved. All that are left are the difficult problems," he said.

Broadening the scope of a challenge and potential solutions is producing answers that can deliver greater value to a mine and its host community. Rethinking the water supply and disposal issue is yielding alternative solutions beyond the gateposts of a mine.

"Miners are looking at alternative water sources such as municipal treated effluent. This is becoming a big deal in Chile, South Africa and Australia. Using wastewater as source water for miners is a big step," said Dr Fleming. An example of this is RIO2 Mining which has an agreement with local water utility Aguas de Chañar in Copiapo, Chile to use treated wastewater which it will truck to supply its Fenix gold project. Similarly, the beneficial reuse of waste mine waste is increasing, such as turning it into agricultural water or even potable water. Anglo American invested almost US\$100 million in the eMalahleni water reclamation plant in South Africa to treat underground water from its mining operations in the Witbank coalfields in Mpumalanga. The plant treats 25-30 million litres a day which then supplies 12% of the city's daily water needs.

Another approach is virtual water or a water swap.

"This is where you build a desalination plant at the coast and exchange the water it generates for rights to groundwater in the mountains," said Dr Fleming.

Partnerships with academic, other industrial sectors and tech start-ups are also increasing to develop solutions. For example, in 2018 Rio Tinto formed Elysis in partnership with Alcoa and Apple for an evolutionary carbon free aluminium smelting process, and in Australia, where there is strong regulatory support for the use of hydrogen fuel, Fortescue Mining has partnered with a technology innovator to develop hydrogen technology.

Rethinking the water problem is also yielding new possibilities "The holy grail is to be able to recover the purest possible water at the lowest possible cost. Interesting new technology is emerging without using the traditional approach of thermal evaporation but instead cooling to freeze water in the contaminant stream into ice or using organic solvents to pull water out of the pollution rather than the other way around," Courtney Pretorius, director of mine water management at Black & Veatch, told Mining Journal.

Miners are experiencing a glasnost moment, being more open and disseminating information beyond the corporate veil. In addition to helping find solutions for challenges, openness is also helping to redefine what some of the challenges actually are. Miners have been under the spotlight from communities and non-governmental organisations for years over their environmental impacts, in part

because of a lack of data in the public domain. Absence of data also leads to government policy being shaped by the precautionary principle which often clips miners' wings, such as shutting-off access to water, just in case.

In Chile, the precautionary principle has been advanced to prohibit mine development near glacier fields and it is possible the adoption of a similar strategy could have implications for all the seawater desalination plants the copper mines employ. The plants pump vast amounts of concentrated brine into the ocean, but the impacts are largely unknown—although fishing communities say they make the ocean around the discharge outlets unable to sustain life—and unregulated as sea discharge is not covered by environmental laws. The water shortage in northern Chile means that its miners also face the prospect of having their desalinated water declared a public good. These various issues and implications highlight how water and power issues extend beyond the mine.

Miners are rising to the challenge and increasingly generating and sharing data to facilitate integral water basin or eco-system management. "Technology like remote satellite sensing is being used to identify and delimit sub-surface water sources. By identifying and quantifying them, miners can have a discussion with a regional government about the aquifer, about what they need and how to divide it on a regional basis. Governments often don't have the resources to get the knowledge of a whole basin and manage it in a regional way," said Dr Fleming.

With investors pushing for greater ESG transparency, miners are signing up to codes of conduct and measurable commitments towards global sustainability goals. "Miners realise their balance sheets are at risk, so they are taking the lead with water stewardship programmes. Some have goals for zero liquid discharge," said Dr Fleming.

Anglo American, for example, has adopted a catchment-based approach to water management to contribute to regional water conservation. "As part of FutureSmart Mining, our ultimate vision is to develop the waterless mine in water-scarce regions; that is, a mine that uses no external freshwater beyond ramp up," it said in its 2018 sustainability report. Its FutureSmart Mining vision is aligned to the United Nations 2030 Sustainable Development Goals, which also sees the company commit to reduce GHG emissions by 30% against a 2016 baseline and achieve a 50% net reduction of water take in water-scarce regions.

Similarly, BHP has a five-year water target to reduce freshwater withdrawal by 15% in 2022 from 2017 levels as part of a longer-term goal to collaborate to enable integrated water resource management in all catchments in which it operates by 2030.



**Patrick Williamson, PG, QP** has 33 years of experience in managing geochemical and hydrogeologic investigations for mining projects, including water balances, water resource evaluation and development, waste rock characterization, mine dewatering, and permitting studies for due diligence, Preliminary Economic Assessments, Feasibility Studies, operations, and closure. His areas of professional interest include water footprinting and basin level water management, with a focus on community water impacts, as well as improving the efficiency of mine water management. Patrick was raised in Colombia and Venezuela, and has extensive expertise in mining projects in Latin America, including managing consulting practices in Mexico for Schlumberger Water Services and SRK Consulting.

*\*The energy-water nexus was due to be a panel topic at the Current Trends in Mining Finance conference organised by the New York branch of the Society for Mining, Metallurgy and Exploration, which was cancelled. This feature was inspired by the panel and it includes interviews with two of the panellists.*