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Complying with water quality limits set out in water-use licences (WULs) is imperative for mines, industrial organisations and other authorised South African water users. However, there are good reasons for taking a broad view when considering the option of treating water.
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The environmental impacts of water treatment

Among the responsibilities of public sector water regulators is the maintenance of water resource quality in rivers, streams and other natural water bodies. WUL holders must generally comply with quality limits set for water discharged into natural water courses. These limits are specified within the terms of a WUL.

Stricter limits and other water treatment triggers

Many users, both mining and industrial, may now be faced with the need to meet more onerous water quality obligations. For example, if a new ecological reserve, including resource quality objectives is published, this might affect the quality limit specified in the WUL. The resource quality objectives are a set of limits and requirements published by government for rivers and their tributaries. It provides pollutant concentrations that should not be exceeded in that river system, to protect both aquatic ecosystems and people.

Some WULs state that once the ecological reserve is published, any resource quality objectives (limits) will apply in place of the original WUL limits. In many cases, that means there are far more stringent water quality limits for those water

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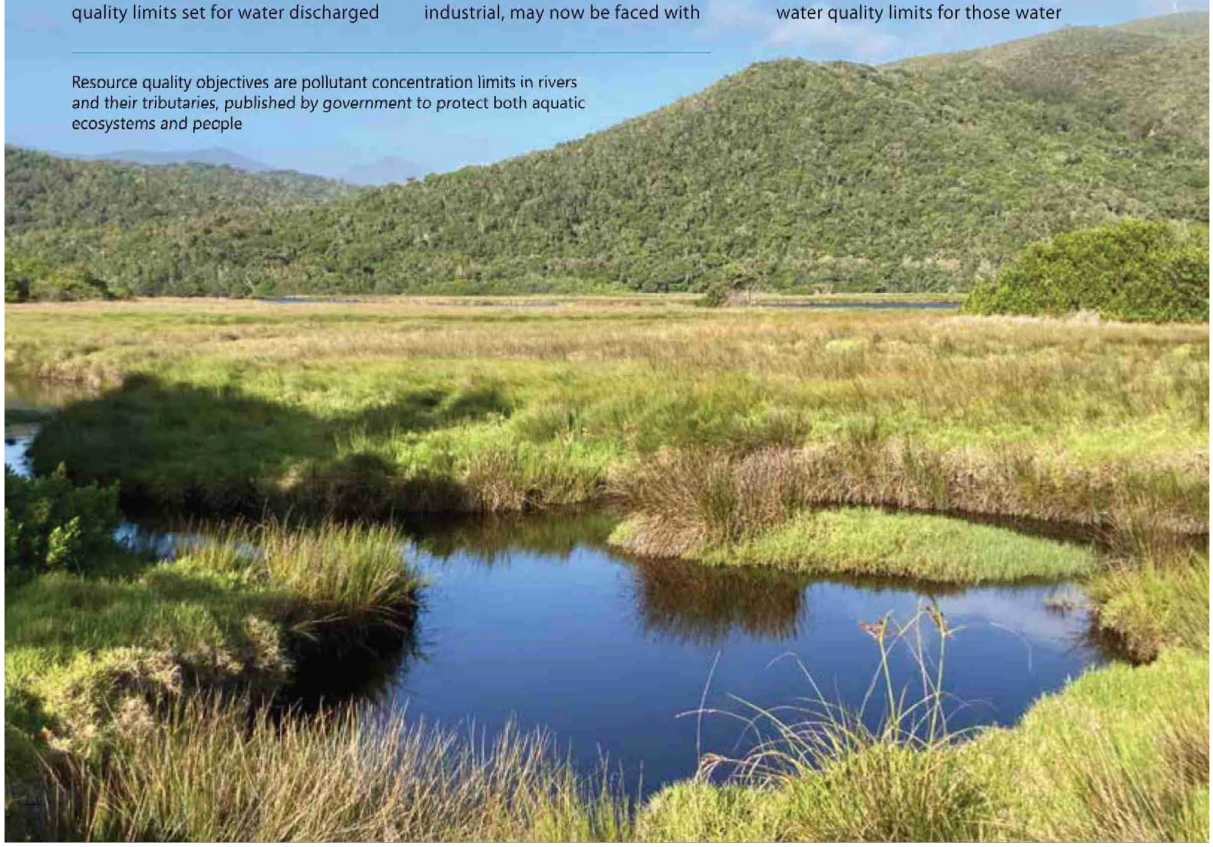

Resource quality objectives are pollutant concentration limits in rivers and their tributaries, published by government to protect both aquatic ecosystems and people

Water treatment options need to be assessed in terms of their full range of environmental impacts

users. Other licences implicitly require consideration of the ecological reserve – by stating that users need to assess impacts in terms of the ecological reserve. Organisations should read their WULs carefully and consider the implications if such clauses are included.

Even where the ecological reserve does not apply, the question of how to meet quality limits might be new territory for users as they navigate stricter enforcement by authorities. Others might be grappling with previously overlooked discharges such as a polluted groundwater plume that seeps into a wetland. Mines nearing closure also face increased water quality obligations as they cease dewatering – and inundated open pits begin decanting to rivers.

Whether a company is looking to meet stricter limits or improve the quality of its discharge, one of the first decisions it will need to make is usually related to possible treatment options for the water it discharges. This is where a broader approach is valuable, because few water treatment options are completely free of environmental impact.

The trouble with treatment

Treatment processes will successfully generate cleaner water, but most also produce by-products or side effects that pose their own potential risks to the environment and community.

Photo credit: Harry Shelton

Reverse osmosis (RO), for example, is well accepted, not only for seawater desalination, but also for the removal of salts and metals that are common pollutants in mining and industrial discharge waters. However, the RO process emits carbon and produces brine. While there are defined processes for capturing and disposing of the residual brine, it is still a process that needs to be competently managed or it can become risky – and it nearly always has environmental impacts.

Many people understand that most treatment processes create waste; but the practical reality is difficult to appreciate until one calculates that, as in one real-world example, 27 trucks would be required each day to transport the brine to a hazardous waste facility. For such large volumes, transporting off-site would be unlikely but that does not lessen the waste burden. Even if brine is concentrated via crystallisation, the process will emit carbon and still produce a waste, albeit in lower volumes. On-site disposal facilities for brine, or other waste products, are another option – especially for remote mines – but these present their own problems. The waste is stored permanently, thus sterilising a piece of land and presenting an ongoing risk of leakage, especially as the facility ages.

When truly considering treatment, the key question quickly becomes whether the risk and impacts outweigh the benefits, and each case needs to be carefully assessed on its merits.

Alternatives to treatment

An early mentor once told me, to my great disappointment as a budding treatment engineer, "The first rule of water treatment is to avoid water treatment." A kernel of truth exists in that statement.

Given the downsides of many water treatment options, companies should make sure that all other – less problematic – solutions are in place before turning to treatment. These alternatives might include additional source controls, such as further stormwater controls, which would prevent on-site water from becoming contaminated in the first place. Passive treatments, such as artificial wetlands, with non-toxic waste products, such as nitrogen gas, can also be considered.

Amending WULs

If treatment is the only solution, then its unintended impacts need to be recognised. These impacts could even form the basis for an amendment to the water quality limits contained in a WUL – if the risk of the by-products to the environment, even with appropriate management in place, outweighs the risk of the untreated water or partially treated water being discharged to the natural water resource and downstream users.

To be clear, the aim of considering these broader aspects is not to reduce water quality limits by avoiding treatment through WUL amendments, but rather to ensure that any proposed solution is optimal to the environment and society. This is very much in keeping with the Department of Water and Sanitation's own recent improvements to its water-use licence application (WULA) process.

To weigh up the impacts of treatment versus partial or no treatment, an options analysis is typically undertaken. Such an analysis should incorporate non-water impacts such as carbon emissions, waste disposal and site-specific quality limits.

Considering the options

Options analyses, while sounding relatively simple, are rather more of an iterative process than most water users expect. In fact, a good options analysis should raise difficult questions because that is the reality of minimising the impacts. Those difficult questions are usually around trade-offs between different types of environmental impacts. For example, is it better to prevent ongoing mild ecological damage in a river where metals-contaminated groundwater is surfacing or is it better treat the impacted water and deal with the risk of: first, very concentrated waste from the treatment process spilling into that same river; second, carbon emissions that might later affect the river via climate change; and third, the instalment of a permanent disposal facility that damages terrestrial ecology?

Options analyses do not necessarily lead to treatment being discarded and a WUL amendment application. Some confirm treatment as the optimal solution and others lead to a combination of traditional treatment, passive treatment (such as wetlands), and a WUL amendment application to request the easing of water quality limits. There is a great deal of learning along the way in an options analysis, and investigations frequently expose not only unexpected costs and complications, but also other opportunities – some of them perhaps potentially innovative.

For example, a site-catchment-specific reserve – based on specialist scientific input by an aquatic ecologist – could be sought. Site-specific reserves can sometimes be more lenient than the ecological reserve if site conditions differ significantly from the broader catchment. If so, the site-specific reserve can form the basis of a WUL amendment application and decrease treatment obligations.

Experimental treatments are frequently investigated in options analyses, some with the potential to provide useable or inert waste products. Understandably, there may be resistance by authorities or companies themselves, as the real results usually take some time to be proven. However, technological advancement remains an imperative in the quest for environmental sustainability. This requires a commitment by all stakeholders to encourage scientific endeavour, which is based on sound principles and research.

To treat or not to treat

In short, a good strategy for WUL holders considering treatment is, first, to understand fully the regulatory limits that apply in their WUL. If complying with limits through treatment will generate significant impacts, then water users should invest in a broader study to answer the question of whether or not to treat. The answer may be something in-between, but if the study is rigorous, it will result in a net positive for the environment. 3S