Mining Energy newsletter #7

Groundwater Strategy 2010

Newsletter # 8: Groundwater For The Mining And Energy Sectors

Introduction

Mining and power generation are closely tied to each other and to water. All South African power stations need water for cooling - with the evaporative process leading to loss from the atmosphere, and salinisation. While power generation is always a consumer of water, mining (not only of coal, but all minerals) frequently intercepts useable groundwater – sometimes more than it would require for its own operations – with this water too often flooding mine workings and resulting in acid mine drainage.

Mining and power generation are also both critical to the national economy. Power generation is a key strategic activity, with the assurance of supply of water to coal-fired power stations planned at 99.5%. Mining is expected to compete with other water users, but the role of the sector in the economy, its ability to leverage funds for water trading or to pay for infrastructure development and, in the case of coal, its importance to the energy sector, does result in advantage.

Since surface water supplies are nearly fully allocated, both the mining and energy sectors are drivers for increased groundwater development and use. This newsletter addresses the role groundwater can play in meeting the needs of these two sectors.

Groundwater And Mining

Key issues are:

- Water as a requirement
- Water as a liability
- The availability of water to support mining
- The licensing of mine water use
- The impact of mining on water quality

Regulation and Licensing

Increasing requirements for water to meet growth, improved standards of living (water and sanitation), ecosystem requirements, and equity are difficult to meet in a water scarce country. Legislation related to the licensing of mining activity is discussed in the Groundwater Strategy. The Department of Water Affairs is responsible for the water use licence that must accompany any mining licence. Water uses, as defined in section 21 of the National Water Act (Act 36 of 1998) include the taking or storage of water (for use) and the discharge or disposal of wastewater. The use of a limited resource, impacts on groundwater quality, and the prospect of acid mine drainage are deeply important considerations in mine water licensing.

While mining does not have any special privileges with regard to water allocation, the importance of the sector to the national economy is recognised and water infrastructure, such as the De Hoop Dam on the Steelpoort River (Olifants River catchment) and the Lephalale pipeline [Mokolo and Crocodile (West) Water Augmentation Project (MCWAP)] out of Gauteng and the Crocodile West River, are strongly driven by the needs of mining.

The provision of water for mine operations through the drilling and abstraction of groundwater in the immediate vicinity prior to mining, should lead to many win-win licence applications. Advantages should be not only the supply of water, but also a reduction to the threat of mine flooding and acid mine drainage. The water licensing authority (DWA) would need to agree that this groundwater is indeed “available” to the mine, and that its abstraction and use does not harmfully reduce the volume of water available to other users, or have other opportunity costs.

Acid Mine Drainage

Acid Mine Drainage is a groundwater problem … and prevention is far better than cure. It is never too late to try and prevent or reduce the ingress of water. Mine water decant, once it has become polluted, is wastewater and will be subject to wastewater discharge charges – but the much bigger problem is the environmental damage and the impact of pollution on downstream users, with cumulative impacts rendering water resources unfit for use. Large volumes of water are involved – and treatment and re-use should get more research and application investment.

Groundwater And The Energy Sector

What role can groundwater play in supplying the energy sector?

Nuclear Power

While coal-fired power stations are sited as close as possible to their energy source, nuclear stations do not have this constraint and are located or planned for coastal sites where seawater can be used for cooling. Groundwater is not an issue.

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Turning A Liability Into An Asset

South Africa’s geology means that most of the country is for the most part underlain by fractured hard-rock aquifers, although large dolomitic aquifers are prevalent on the West Rand, and occasionally to the north and east. Fractured rock aquifers usually yield low volumes of water, but there is inevitable leakage into mines as these create voids, and as horizontal rock layers, which previously impeded inflows, are further fractured to allow ingress into the actual mines (as happens in coal longwall mining). The result is to turn what could have been an asset (fresh groundwater) into a liability (water flooding the mines, now also polluted).

One approach has been to grow trees to intercept and evaporate rainwater. Another is to sink boreholes and drain the mining area, preferably in advance of mining activity – using the water provided to sustain both the actual mining and associated processing activities. Where workable this would reduce the demand on other (external) fresh water resources and reduce the contamination of water.

Groundwater can sometimes meet all the direct needs of the mining sector – although the requirements of associated growth and development (and especially of power stations) are usually beyond the means of the local resource.

The re-use of mine water

Many collieries, and other mines, are flooded by more water than they need for their own operations. This excess water (groundwater ingress), the poor quality of the water, and the lack of assimilative capacity in the Olifants

Wind and solar energy

Wind energy generation does not require cooling. Solar thermal energy production, however, has cooling requirements similar to coal or nuclear power stations, therefore requiring equivalent cooling water. Upington has been identified as the best site for a solar thermal station, for which water would be taken from the Orange River. Groundwater is scarce in this region and, given the volume required, does not offer a practical alternative.

Coal-fired power stations

The energy sector requires fresh water primarily for the cooling of coal-fired power stations. The existing grid of power stations has enormous water requirements (many are older wet-cooled power stations) that cannot possibly be met through groundwater sources. Requirements have historically been provided for from surface water sources. As water becomes more scarce, distant, and expensive it is important to re-look at groundwater options.

Lephalale, in the Mokolo catchment

Lephalale, in the Mokolo catchment, is expected to grow very rapidly as the centre of new coal mining and power generation activity. There are massive reserves of coal that could supply four or five new power stations in addition to the existing 3600MW Matimba power station. Medupi (4800MW) is already under construction. Although dry-cooled, each power station will require about 12 million m^3 of water per annum so as to allow for water-intensive scrubbing of sulphur emissions. A coal-to-liquid fuel plant would use 80 million m^3 of water per annum, dwarfing the power station demand. The mines supplying these users will each also require in the order of 3-5 million m^3/a to operate. Additionally, surrounding towns and villages are sure to grow dramatically.

There is not enough surface or groundwater locally, and water will have to be transferred in. The Mokolo and Crocodile Water Augmentation Project combines the optimal utilisation of local water resources and the transfer of surplus return flows from the Crocodile West and Vaal River catchments. Groundwater remains an important additional and conjunctive source. A feasibility proposal indicates that a well-field of eight boreholes could supply Lephalale with 1.4 million m^3/a. Further development of the Waterberg aquifer could make an additional 4 - 7.5 million m^3 available although this would have some impact on other users of the alluvial aquifer.

These groundwater sources will provide water at a far lower cost than that of imported water, but groundwater cannot possibly supply the entire development.

The questions that arise are:

- Who gets to use the locally supplied groundwater – which will be both cheaper and cleaner?
- Which users will be required to take and pay for the surface water brought from the Crocodile West?
- Should the cost of all sources be combined or should existing local users be passed the full benefit of existing local water?
- Is it a matter of 'first come first served'?
- Should the conjunctive sourcing and supply of groundwater be used in such a way that it not only augments surface water supplies, but also adds to water security in the event of, for example, pipeline failure?

The Vele coalfield

There have been recent attempts at mining coal from the Vele coalfield near Musina. Whilst this has been at least temporarily halted due to environmental considerations, water is a key issue. The water would either have to come from trading with existing agricultural users (who would be using groundwater) or through additional groundwater boreholes - as in the case of the Venetia diamond mine. In the Limpopo River valley this water source is closely connected to the river system and South Africa's international obligations to ensure flow requirements in the Limpopo to Mozambique preclude further new abstraction. This would be a particularly critical limitation if there were ever any plans to construct a power station on this coalfield.

River to accept discharges of mine water, has led to the implementation of water treatment facilities.

Collaboration amongst the mines has led to the construction of the 25 Mℓ/d (9.1 million m^3/a) Emalahleni Mine Water Reclamation Plant. The mine water is treated to potable standard and supplied to Emalahleni Municipality under contract.

The plant has been constructed in modules so that treatment capacity can be added to accommodate further water from adjacent mines, ensuring enough water to Emalahleni for the future.

A similar plant is being built in the vicinity of Hendrina, and will supply potable water to the town.

(Source: Integrated Water Resource Planning for South Africa – a Situation Analysis, DWA 2010)

Power stations in Botswana

Botswana is currently constructing the Morupule B power station, adjacent to the existing Morupule (A) power station, near Palapye, 280 km north of Gaberone. This will be a dry-cooled station generating 600 MW. The combined water use of Morupule A&B is estimated at two million m^3 per annum. Botswana, with a long history and experience in the use of groundwater has looked at the necessary well-fields to supply these water requirements.

The Paje wellfield, 50 km to the northwest, has been investigated and can supply Morupule, but this would result in drawdown of the aquifer by 30% over 20 years, impacting on some cattlepost boreholes and seeps in the Motlouse River. This is in the Limpopo Basin but unlikely to have a direct impact on the Limpopo River. As a consequence of the expected impact on the aquifer the primary supply will be the North-South Carrier (NSC), bringing surface water from the Dikgatlhong dam - with the wellfield developed as a conjunctive backup source.

Some Principles Applicable To Groundwater And Mining

From the preparation of the Groundwater Strategy, and groundwater inputs into the Water for Growth and Development Strategy (both Department of Water Affairs initiatives), a number of principles may be distilled:

- Mining cannot claim priority as a water user, but the value of the sector does make it a strong competitor
- Licensing and regulation of water use by the mining sector are essential in protecting both the sector and other users
- Contaminated mine water is a potential liability, but there is often potential for it to be managed as an asset
- It is far better to use local groundwater before this enters the mines and becomes polluted
- Mining requires water – but this water can often be generated on site through pre-emptive drilling and abstraction. In this way the mining sector can reduce its impact on water resources (quantity and quality)
- Acid mine drainage is a groundwater problem. Water decanting from mines should be addressed as a groundwater issue
- The treatment and re-use of mine water should be encouraged and facilitated.

Your feedback

The Soutbansberg coal basin (Makhado)

The town of Makhado (Louis Trichardt) is already struggling with water supply, with transfers from Albasini Dam and now also from the new Nandoni Dam. Groundwater is the one remaining option for Makhado. Water trading and groundwater are also the only options for the possible development of the Soutpansberg coalfield. Supplies are not that plentiful, and availability would have to be ascertained through a detailed investigation, particularly again, were a power station to be involved.

Your inputs on this topic, or any other aspect related to the future of Groundwater in South Africa, would be much appreciated.

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Archives

- Groundwater Strategy Newsletter #6: Artificial Recharge
- Groundwater Strategy Newsletter #5: Groundwater Availability