Integrated Mine Water Management: Innovative Design to address Challenging Environments

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Extended Abstract

Extreme geophysical and water environments found at many mine sites can present unique challenges in controlling the quantity and quality of mine impacted water. Our poster will explore the difficulties presented in designing a complex water management system at a mine site (open pit, process plant and tailings management facility) proposed for the extraction of a low grade auriferous deposit. Issues which had to be overcome included a steeply sloped site with limited natural water storage areas; operating in close proximity to a superficial aquifer used for potable water supplies; operating adjacent to a protected river; challenging regulations; and patterns of extreme rainfall events.

The Feasibility level design of the water management facilities had been based on a high level understanding of the annual water balance at the site and did not allow for the temporal separation of high evaporation and high runoff generation periods. Resolving this issue at the detailed design stage required expansion of water storage facilities despite the steep topography and limitations imposed by European dam regulations; this required a novel approach tailored to the local restrictions. In parallel to the volume management issue, water quality regulations limited the ability to remove excess contact water from the system. In order to address these restrictions, the relative hydraulic performance of lining and capping systems had to be interrogated, and the likely environmental impacts assessed. A sophisticated, probabilistic water management model of both water quantity and water quality throughout the water management system was built to drive the design with the model results predicting "zero operational discharge" for the life of mine.

Some of the key improvements in Mine Design included:

- Water Management Dam embankment height was reduced while increasing overall capacity through the adoption of a dual storage approach;
- Careful separation of mine water streams (contact vs non-contact) meant that a large proportion of the contact water generated on site could be utilised for operational and environmental purposes and not just constrained to supplying the process plant;
- A thorough understanding of the system performance across a wide range of likely operating conditions was gained through use of probabilistic water balance modelling;
- Enhanced evaporation techniques:
- Critical design parameters of a mandated water treatment plant was optimised using the probabilistic model.

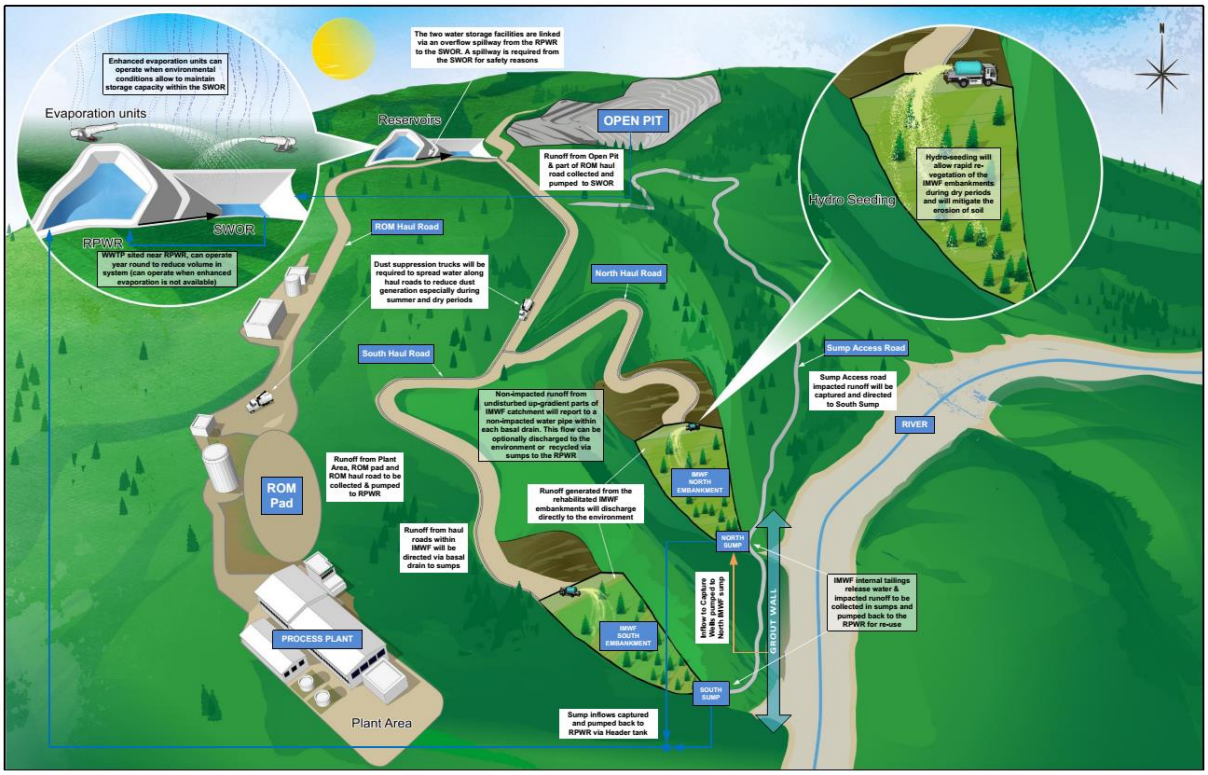

Figure 1: *Schematic illustrating the challenging site water management*

Some of the techniques used during the detailed design stage of the mine have clear applications within the wider mining industry. The particular approach taken to dual storage and judicious separation of water streams increases the efficiency of operational water management while optimising the cost of water treatment, providing both financial and environmental incentives for developers. The application of Monte-Carlo [1] simulation tool allows for transparent and sensible risk assessments to appraise differing water management strategies under a wide range of conditions. The integrated approach to mine water management focused on water recycling whilst limiting the volumes of generated mine impacted water and its release to the environment under normal operating conditions. Operators should be encouraged to develop sophisticated water management tools much sooner in the mine design process to avoid unnecessary regulatory restrictions and reduce costs.

Key words: Mine water, modeling, water balance, mass balance

References

[1] GoldSim Technology Group LLC (GTG).2011. GoldSim Pro Version 11.1.