Project Summary

Organization:
Roy Hill Iron Ore

Location:
Pilbara, Australia

Project Objective:

- Reduce costs for Australia's largest iron ore mining facility by implementing optimal water infrastructure.
- Meet the varying demands of multiple end users while preserving limited good quality groundwater.

Products used:
WaterGEMS

Fast Facts

- Roy Hill Iron Ore is implementing Australia's largest mining facility, including water supply and dewatering operations covering 300 square meters.
- To reduce operational expenditures, Roy Hill's water management team is using WaterGEMS to model the entire integrated network under greatly varying conditions over the LOM.
- Using the hydraulic model for scenario analysis enabled the team to optimize pipeline sizes, and other factors to minimize costs amid changing mine network.

ROI

- WaterGEMS ensures uninterrupted mining operations, saving potential lost revenue of approximately AUD 20 million per day.
- Reducing operating pressure allowed for the use of smaller pipes in 80 percent of the system, decreasing the environment footprint of the mine, and contributing to saving AUD 1.6 million within the first two years, and AUD 16 million over the LOM.
- With a targeted 20 percent reduction in fuel, Roy Hill would save AUD 2.4 million in burnt diesel over the LOM, the equivalent of taking 2,100 vehicles off the road for 12 months.

Roy Hill Iron Ore Optimizes Water Infrastructure Design and Operations for AUD 10 Billion Mining Facility

WaterGEMS® Hydraulic Model to Save Millions over 20-Year Life of Mine

An Evolving, Flexible Dewatering and Water Supply Network

In the Pilbara region of Western Australia, 1,200 kilometers northeast of Perth, Roy Hill Iron Ore (Roy Hill) is developing an open pit, bulk mining facility capable of processing 55 megatons of iron ore annually. Set to be the country's largest iron ore mining operation, the AUD 10 billion project includes a water supply and dewatering network spanning 300 square kilometers that needs continuous adapting to meet the changing mining and ore processing requirements over the 20-year life of the mine (LOM).

Roy Hill's engineering services department's water management team is responsible for planning, design, construction, and operations of the site's raw water supply and dewatering system. The team is challenged to meet consumer requirements, preserve good quality water, and ensure dewatering and dust suppression objectives are met, while minimizing any surplus water disposal in a rapidly fluctuating mining environment. With iron ore prices drastically falling over the past several years from an all time high of AUD 180 per ton in 2011 to AUD 55 in 2016, Roy Hill faces increasing pressure to reduce capital and operational expenditures through optimal water management.

"Water management is so important on-site that it was listed as number two on a list of 47 conditions that funding lenders put together," commented Craig Nelson, engineer in water planning, Roy Hill. The integrated water infrastructure at the mine currently includes 24 high water quality production bores for final ore processing and potable purposes, six lower water quality separate bores for ore processing make-up and dust suppression supplies, and 49 dewatering bores. Over the LOM there will be two distinct dewatering systems, raw and saline, with the raw dewatering system estimated to peak at 105 active bores, and the saline network estimated to peak at 75 bores. With no permanent power supply system, the bores all operate on diesel generators and during peak operations there will be an estimated 220 kilometers of HDPE pipeline ranging in diameter up to DN800.

With an AUD 500 million initiative to reduce costs over the 20-year LOM, the water management team aims to optimize the design of future systems to reduce the potential size and rating of infrastructure elements on the capital expenditure side, and reduce fueling and servicing costs on the operational side. To implement a cost-effective water supply and dewatering system that ensures the water table always remains at least 1 meter below the pit floor amid the highly dynamic mining environment, without any impact or delay to the mine plan and operations, the team required a comprehensive water distribution and analysis solution.

Integrated Hydraulic Modeling Solution

Using WaterGEMS, the team designed a fully integrated, mapped hydraulic model that provides a detailed representation of the water system, containing all key items including bores and pipework, both as-constructed and to be constructed in the field. The interoperability of WaterGEMS enabled the team to import aerial imagery and reference data from other internal departments and generate proposed layouts in compatible formats for on-site engineers and operators responsible for running of the system, facilitating information mobility and streamlining decision making. Having a collaborative model provides a full understanding of the dynamic nature of the network from system expansion to changing yield and quality characteristics of the bores over time. Moreover, modeling the entire dewatering network in an integrated environment accelerates information mobility and allows informed decision making.

WaterGEMS' What-if Scenarios Optimize Design

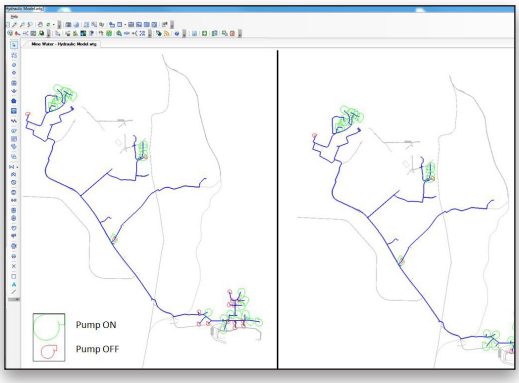
The water management team completes all system planning and design using the hydraulic model to run specific what-if scenarios. By modeling current and future scenarios, the team optimizes pipeline sizes, pressure ratings, and other factors to meet changing operational requirements at minimal cost. Using WaterGEMS enables the team to quickly turnaround design information to meet imposing deadlines for development of dewatering processes ahead of mining operations and ensure operations remain uninterrupted.

Fully modeling the current and future scenarios enabled Roy Hill to install 80 percent of all pipelines with a low pressure rating, PN6.3 or PN8, which largely contributed to a savings

"Bentley's WaterGEMS software is the cornerstone to successfully delivering an evolving, effective, efficient, and flexible dewatering and water supply system for the Roy Hill mine site."

— Simon Windsor, Superintendent, Water Infrastructure, Roy Hill Iron Ore

of AUD 1.6 million in capital expenditures during the first two years of operation. Moreover, this design approach helped the project team eliminate any design conservatism that the industry typically uses to account for varying conditions in the future. "Over a 20-year LOM, that has a potential to be about AUD 16 million, mainly due to the way we've designed the system," explained Nelson.



Modeling current and future scenarios in WaterGEMS optimized pipeline sizes, pressure ratings, bore pump run time, and other factors to meet changing operational requirements at minimal cost.

Real-time Simulations

Faced with a need to reduce operational expenditures, the water management team relied on running extended period simulations (EPS) in WaterGEMS to simulate the day-to-day running of the network. The team created on-site system controls and demands within the model for selected periods of time, and used the modeling results to identify inefficiencies. For example, simulating operations of the bores led to the identification and removal of inefficiencies in control logic, resulting in a reduction in the number of bore pumps required to maintain supply tank levels.

The EPS simulations also optimized water quality, which is a big driver, especially from feed to processing at the mining facility. With water sourced from different parts of the site, water qualities vary. The team checked the effects of mixing the water from the varied sources to ensure the water supplied to the processing plant met required standards. Nelson added, "This is particularly useful. We didn't have to build expensive treatment or disposal facilities; we can offset costs for a while just using what we have." Additionally, the team set an alarm within the hydraulic model to indicate when water quality exceeds the maximum allowable supply.

With WaterGEMS' Darwin Scheduler, the team initiated efforts to optimize the running of the water network to achieve the lowest energy consumption while maintaining water supply requirements. This function in WaterGEMS uses genetic algorithms to run numerous operating conditions to determine the best combinations within preset criteria. Typically the Darwin Scheduler benefits water utility companies aimed at optimizing pump operations based on an energy tariff charged by an energy provider. However, given that Roy Hill uses diesel generators rather than contracting with an energy company for its power supply, the team had to manipulate the data based on optimization against a fuel burn rate of the diesel generators at each bore.

Roy Hill loaded the fuel burn rate for each bore into the hydraulic model for different bore sites, with different pump and generator sizes. From that, the team developed a conceptual control philosophy based on building different demand points into the model and, using Darwin Scheduler, output the best three scenarios, which were checked using EPS to prove the minimum tank levels were maintained. Running Darwin Scheduler on a periodic basis aligned with changing on-site water demands or dewatering network expansion. Then, issuing the output to the site for implementation into the daily operations of the system provided the basis for optimizing operations with a targeted 20 percent savings in operational expenditures.

Proof of Concept Promises Savings

Although the processing facility is still in an implementation phase, the team conducted a proof-of-concept trial with dummy values to represent dewatering and processing activities. It used an average of the highly variable demands within the model in a given month, and an estimated average fuel burn rate for the diesel generators based on the size of the generator and associated pump from manufacturer supplied data. WaterGEMS' Darwin Scheduler determined the most energy-efficient method to fill the main processing pond and the output was then compared against the actual average pump run data. This optimized proof-of-concept scenario identified the potential to save AUD 3,500 per month in fuel and servicing costs, reducing the number of utilized pumps by 50 percent, total average daily run hours across the bore field by 7 percent, and the total average fuel burn by 5 percent. As these savings are estimated against average data as a proof of concept, the team anticipates that with further refinement, better results can be achieved. Based on a targeted 20 percent savings, that would equate to approximately AUD 2.4 million in fuel and servicing costs over the LOM.

Uninterrupted Operations

With ore prices consistently falling, cost savings is a huge driver for the Roy Hill Iron Ore facility. However, the worst thing water management can cause is a delay in mining operations. While it is estimated that optimizing the water network can save AUD 16 million in capital expenditures and potentially AUD 2.4 million in operating costs over the LOM, causing a delay in mining operations for just one day can cost close to AUD 20 million.

WaterGEMS enabled the team to optimize the water infrastructure, avoiding pipe bursts and over pressure activity resulting in uninterrupted mining operations. "From an operational water supply and dewatering point of view, we've had no delays to mining operations whatsoever," stated Nelson.

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