Water Resources Management Plan for Mining Industries – A Guidance Model

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Abstract

Water resource management is an essential process for industries whose production relies on water consumption. Mining plants processes demands water for diverse ends, such as, ore washing, beneficiation, transport, dust control, among others. Based on the necessity of granting an efficient and sustainable Water Resources Management Plan (WRMP) and the lack of a literature dedicated to this topic, this study proposes a guidance model that encompasses technology, standardization, risk management, intelligent data analysis, continuous improvement and integrated management of water resources that goes beyond the regulated and legal tools for water management. The preparation of the guidance model of water resource management plan for mining industries was based on 4.0 industry guidelines, all of 10 International Council on Mining and Metals - ICMM Mining principles and performance standards. The WRMP must be a written document available for consultancy by any employee of the enterprise and environmental agency, and it requires a compilation of all the information on water resources and wastewater treatment of the plant, encompassing: complete description of processes (production chain, grant water system, wastewater treatment), basin characteristics, water safety plan (monitoring and risk management programs), action plan for contamination, water resources indicators, consumption and reuse of water (sources and techniques of reuse) and 4.0 industry opportunities for monitoring process. The WRMP provides a holistic view of how water is managed and if the management process is efficient, it also compilates enough information that will facilitate the continuous improvement process, besides, it is an essential tool to grant the sustainable use of water resources in diverse industries.

Keywords: Water resources, Mining, Bauxite mining, Water management, Guidance model.

1. Introduction

The maintenance of environmental quality is essential for human's well-being, socioeconomic development, preservation, and diversity of ecosystems. In Brazil, for example, the Federal Constitution of 1988, in Article 225, states that "Everyone has the right to the ecologically balanced environment, asset of common use of the people and essential to healthy quality of life, being imposed to the Public Power and the community the duty to defend it and preserve it for the present and future generations" [1].

The Brazilian mineral sector is an important segment for the country's economy due to its vast reserves and good positioning in the world trade in mineral commodities, representing for Brazilian GDP about 3.19% and 3.18% in 2019 and 2020, respectively [2]. Therefore, it is important to keep under control the impacts that this activity causes in the physical and biological environment, to provide an adequate environment for future generations, as well as to ensure the maintenance of operations in this sector.

Both for the environment and for the maintenance of the quality of life of the world population,

water assumes a role of great importance in various uses, products and services from which man takes advantage [3].

Water is present throughout the mining process, from exploration to processing. According to Minera Jr. [4] the sources of water used in mining can be surface, underground and recyclable. According to the Water Resources Conjuncture Report 2017 [5], mining was responsible for the catchment of 1.6% of water in the country, which corresponds to 1.024 billion cubic meters per year.

It is evident that mining operations, due to their physical influences and water use through processes of extraction, beneficiation, transport, and operational discharges, can impact the water dynamics of a hydrographic basin. On the other hand, mining companies are also affected by the physical and socioeconomic dynamics of the basin [6].

The characteristics of the watershed area, such as: water availability, quality and extraction rates, can impact mining operations. Although these dynamics seem obvious, they are complex and require a relatively sophisticated understanding of the multiple and competing pressures exerted on water resources by its users [7]. Social pressures, development priorities, and changes in national, regional, or local policies can also impact the operation, so water management is essential to raise awareness on the complex nature of risks related to water resources and identify response options in cases where risks arise, such as action outside the mine's operational borders [7].

The Water Resources Management Plan is a strategic instrument that consists of an integrated planning process that considers both short-term and long-term needs, incorporating environmental, economic, and social considerations within the sustainability principles [8].

Given the above, it is notorious that mining is fundamental for social, technological, and economic development, but the environmental management of these enterprises is still a great challenge for professionals working in the area. Based on this statement, this work aims to develop a technical guide for professionals, who work in mining enterprises or any medium and large enterprise, to develop a management plan of water resources, whose methodology generated from the experience acquired by the authors in the daily routine of a bauxite mine located in the municipality of Paragominas, Pará State, Brazil. At the end, a block diagram containing a summary of all procedures and guidelines necessary to provide professionals and managers with conditions to improve the management of water resources in their enterprise will be presented.

2. Experimental

To achieve the objectives of this work, consultations were carried out with works of Brazilian literature (university book, technical guides from the Brazilian National Water Agency), national legislation, technical works carried out by specialized consulting companies and environmental studies that were prepared in the of the mining company's environmental licensing. In addition, it is important to highlight that the experiences obtained by the authors in the management of the working daily routine in the enterprise was the point of greatest contribution in the methodology applied to achieve the results of this work.

The work was carried out at Mineração Paragominas S.A., located in the municipality of Paragominas, Pará State, Brazil (Figure 1). The deployment and installation of the project took place in June 2003 and lasted until December 2005. The project started its activities with a production target of 4.5 million tons per year (Mtpa) in November/2006. The commercial operation began in February/2007. In 2009, there was an expansion to production of 9.9 Mtpa. Currently, the company produces approximately 11 Mtpa.

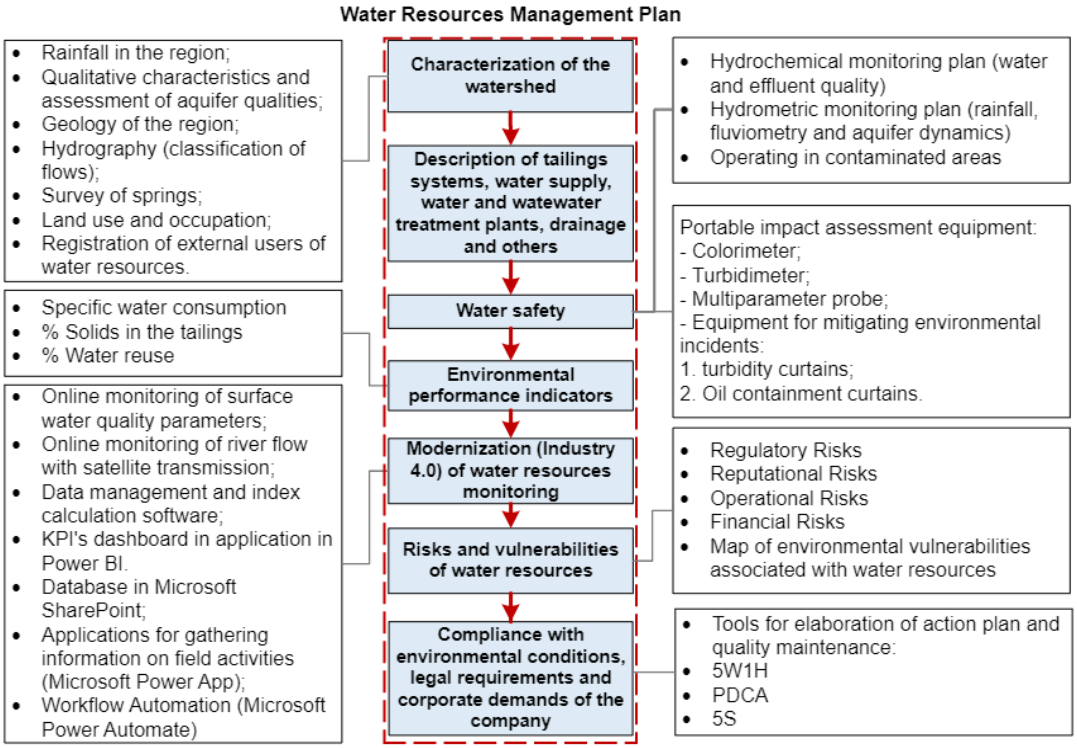

Figure 3. Diagram of blocks of management of water resources in enterprises.

4. Conclusions

This technical guide can be used by engineers, environmental technicians, employees in general and other professionals willing the adoption of environmental management practices or environmental practices focused on water resources. It will also help those professionals who seek the increase of efficiency for their processes, and reduce impacts on the environment, in an integrated and preventive way. The dissemination of these good practices in the management of water resources in small, medium, and large companies can contribute to the promotion of sustainable development in the industrial and mineral sector.

The work presented different techniques, methodologies, indicators, technologies, good practices applicable to the implementation of a water resources management system in mining enterprises, and briefly exposed a successful case implemented in Mineração Paragominas. Therefore, the information contained in this document may help management teams to identify the main environmental aspects associated with their activities and to seek the best ways to mitigate them, in addition to encouraging the adoption of an active behavior in relation to environmental issues.

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