

MINING IN ZAMBIA: ENVIRONMENTAL MANAGEMENT

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Abstract

The nationalized mining sector in Zambia has undergone virtually complete privatization since January 2000. Immediately prior to this, Zambian mines, while blessed with substantial copper and cobalt deposits, had been significantly undercapitalized¹, with little upgrading or funding for environmental protection. In the pre and post war era, legislation (in the then Northern Rhodesia) had been passed, due to the paramount concerns of the war and post war reconstruction efforts, that exempted mining companies from prosecution related to air quality- issues. This legislation persisted to the mid-1990s. Currently, air quality in areas of the Copperbelt Province and the aquatic habitat in the Kafue River, a tributary to the Zambezi River, are two of the more significant mining environment issues in Zambia. With the onset of privatization, new investors in the form of multinational mining companies, have adopted their corporate environmental policies in Zambia, which has placed increased pressure on the Environmental Program of the Zambian Mines Safety Department (MSD) of the Ministry of Mines and Minerals Development to review development plans as well as monitor and enforce environmental regulations related to mining. The Mining and Mineral Sciences Laboratories (MMSL-CANMET) of Natural Resources Canada under contract with the Canadian International Development Agency (CIDA), are working with MSD to accelerate the development of an increasingly functional environmental inspection program for mining, using Canadian experience and consulting expertise to facilitate this process. With a considerable Canadian mining presence already established in Zambia, it is anticipated that the project will help to establish a regulatory regime that will benefit new and existing Canadian mining companies in Zambia.

Project Location

Zambia (formerly Northern Rhodesia) is located on the vast plateau in central Africa. It is a landlocked country consisting of nine provinces covering approximately 750,000 square kilometres with a population of approximately 10 million people (Figure 1). In contrast to some of its neighbours, *Zambia is a stable and peaceful democratic republic*. Most of the current mining activity occurs in the Copperbelt Province

of Zambia (Figure 2). This part of Zambia is 12° south of the equator at an elevation of 1500m and borders on the South-eastern portion of the Democratic Republic of Congo (Zaire).

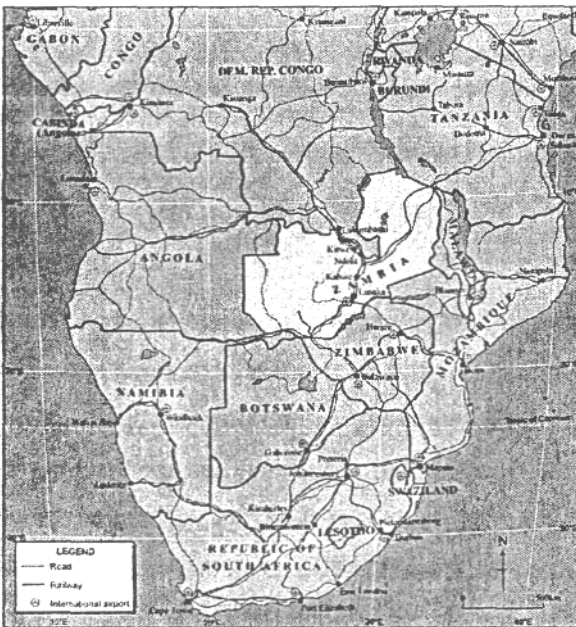


Figure 1 : General Map of Southern Africa.



Figure 2: Map showing Zambian Provinces.

The Copperbelt Province is almost entirely within the drainage basin of the Kafue River, a major tributary to the Zambezi River which passes over Mosi-o-tunya (Victoria Falls) and then flows east, forming the border with Zimbabwe (formerly Southern Rhodesia) and then through Mozambique to the Indian Ocean. The Kafue River ultimately receives all mine waste water and effluent from the Copperbelt, and it also supplies domestic-potable and mine process water. The continued release of suspended solids has resulted in extreme siltation and loss of aquatic habitat in sections of the Kafue River. One of the biggest challenges continues to be the ability to retain heavy metal species as solids behind the dams and to control pH, sulphate and metals levels in discharged water.

Background

Zambia has very substantial mineral resources with copper deposits grading over 6%. Cobalt is mined along with the copper, yielding by-products of gold, silver, antimony and selenium. There are tailings deposits with copper grades of up to 3% which are being re-mined. Emeralds are also mined in the Copperbelt Province with deposits southwest of Kitwe. The Kabwe lead-zinc mine, in Central Province just south of the Copperbelt, was commissioned in 1902 and operated until 1994. A reprocessing operation for the tailings which grade up to 9% zinc is planned. There are thermal-coal mines located in

the southern part of Zambia. The Country also has substantial hydroelectric generation.

The National Environmental Action Plan of Zambia (NEAP) is the guiding document for the Zambian government, international development agencies and other stakeholder activity in Zambia's environmental sector. The NEAP identifies five principal environmental problems facing the country: air pollution; water pollution and sanitation; land degradation; deforestation; and wildlife depletion.

Mining in Zambia has been a major contributor to air and water pollution, and land degradation. Sulphur dioxide and particulate emissions from smelting and refining activity in the Copperbelt region of Zambia are the leading air quality issues, while effluent from mill tailings and waste dumps draining into Zambia's major watershed, the Kafue River, is the country's primary non-urban water quality issue. Land degradation has occurred from poor mine reclamation practices, gaseous and particulate air emissions from smelting and refining, windblown erosion from very large tailing pond areas and waste dump sites, as well as relatively uncontrolled smaller scale mining activities.

The strategic and global importance of copper production during the war and post war reconstruction period resulted in an exemption of mining companies from prosecution for air emissions under the terms of the *Smoke Damage Prohibition Act*. This legislation was repealed in the mid-1990s. Although progressive environmental regulations related to mining were passed in the mid-1990s, environmental concerns, particularly air and water quality could not be addressed due to the financial constraints prior to and during the 5 year privatization process that took place between 1995 and 2000.

Sulphur dioxide and particulate emissions from smelting and roasting operations result in increased ground level concentrations during overcast or rainy conditions with resultant respiratory distress and vegetation damage. These issues are being addressed through more stringent legislation, including the introduction of sulphur dioxide emission penalties. Environmental Impact Assessments are underway in order to formulate environmental management plans to redress this matter.

Though the mining industry has a questionable environmental past, it contributes significantly to Zambia's economy. It is the largest industry in Zambia, producing approximately 80% of Zambia's foreign exchange and 10-12% of its Gross Domestic Product. From the early 1970s until 2000, the industry had been operated by Zambia Consolidated Copper Mines (ZCCM), in which the Zambian Government held a majority interest.

There has been a substantial decline in production from a peak in the mid-1970s to the mid-1990s (Table 1). In addition, there has been a substantial decline in commodity prices over this same period, which has had a very significant effect on the Zambian economy. Copper production results from ten underground and five open pit copper mines. The Nchanga Mine is the biggest producer in the commonwealth and began production in 1939. It is anticipated that the revitalisation of this industry can return production levels to near historical levels within a few years.

Table 1. Annual production levels of major commodities from Zambian mines.

| Commodity | Mid-1970s (metric tonnes) | Mid-1990s (metric tonnes) |
|------------------|--------------------------------------|--------------------------------------|
| Copper | 700,000 | 200,000 |
| Cobalt | 5,000 | 3,000 |
| Lead/Zinc | 7,600 | 0 |

Generally, mining at all locations has followed a similar pattern. Mined overburden has traditionally been placed in dumps in selected areas close to the mines. Concentrator tailings are disposed into valley dam impoundments away from the mines where suspended solids are retained and supernatant water overflows through a decant pipe or spillway into a nearby stream or river. Sulphuric acid is used for dissolving metals in acid leach operations. Lime is used to neutralize the waste water discharges at these operations, and results in the formation of copper and cobalt hydroxide precipitates, and dissolved solids mostly composed of calcium and magnesium sulphates, in the decant flow.

During the early years of mining on the Copperbelt, simple tailings impoundment dams were constructed close to the mines, but these areas had limited storage capacity and were quickly filled to capacity. In general, these early impoundments can now be characterized as fairly well-vegetated plateaus, with indigenous grasses and acacia trees as the dominant species present. However, where steep slopes exist, vegetation is generally scanty, and heavy wind and rain erosion gullies have developed, resulting in high sediment loads to the Kafue River. Underground mining methods now employ a cut a fill technique which has reduced the volume of tailings being generated.

The Zambian mining industry is now undergoing comprehensive privatization and entering a period where conditions are appropriate for wholesale adoption of modern environmental practices. A new modern *Mines and Minerals Act* was passed in 1995 which reflects current environmental management requirements. International mining companies are returning to Zambia either to acquire brownfield sites or to take up new exploration licenses. Anglo American Plc has become a significant participant through its recent acquisition of major shareholdings in the Konkola, Nchanga, and Nampundwe operations. A

Canadian company, First Quantum Minerals Ltd. now controls three pre-existing operations, the Bwana Mkubwa tailings re-milling project, the Nkana Mine, concentrator and cobalt plant and the Mufulira mine, concentrator and smelter.

The new private sector owners are responsible for recapitalizing infrastructure and introducing environmentally sound technologies and practices to their acquired operations. A grace period, referred to as the 'Stabilization Period', has been granted to allow the new owners to complete this, although the time frames have been individually negotiated as the issues are very site specific. The Zambian government, through its wholly owned ZCCM Investment Holdings Plc, has retained responsibility for all environmental and safety issues associated with abandoned and defunct facilities as well as for the facilities not yet privatized.

While financing of the recapitalisation for infrastructure and the introduction of environmentally sound technologies are the responsibility of private sector owners, environmental protection is regulated by government legislated standards with which companies must comply by the end of the negotiated stabilization periods. It is therefore important for the government institutions having responsibility for permitting and monitoring of mining operations; in Zambia to be familiar with international environmental management capabilities and practices.

Exploration activity is increasing in Zambia in response to efforts to promote foreign investment. Enhanced administration and management capacity is important to ensure the benefits of the increased activity are captured through environmental and social issues management.

With the privatization of mining properties, more foreign companies are entering the Zambian mining industry. This has resulted in the introduction of new mining and environmental technologies and practices consistent with individual corporate commitments to environmental protection. However, knowledge of modern environmental management practices in mining remains weak within the various statutory institutions making it difficult for those institutions to effectively assess environmental effects, monitor industry performance and enforce regulatory compliance. The Government of Zambia and the industry are both aware of this and the need to raise the level of knowledge of the statutory agencies in order to promote a meaningful dialogue between industry and government. An informed dialogue will ensure responsible environmental management practices are implemented within the mining sector of Zambia in a timely fashion.

The Government of Zambia has expressed the will to implement and enforce the Environmental Protection and Pollution Control Act and to promote and adopt internationally accepted standards and practices of environmental management in mining. Canada is well positioned to provide development assistance in this regard. Canada is recognized as a world leader in the development and application of environmentally sustainable and clean technologies in the minerals and metals sector.

Project Description

Given the socio-economic importance of the mining sector in Zambia and the effect that it has had on the Zambian environment, it is expected that Canadian assistance in addressing environmental mining-management issues in Zambia will result in far-reaching benefits for all of Zambia.

The Mining and Mineral Sciences Laboratories (CANMET-MMSL) of Natural Resources Canada is the executing agency for a capacity development project entitled *Environmental Management in the Mining Sector of Zambia (EMMS)*. The project has been developed in partnership with CIDA and the Government of the Republic of Zambia (through the Ministry of Mines and Minerals Development).

The goal of this four year project is to improve environmental management practices and performance in the mining sector in Zambia. The project purpose is to strengthen the technical and managerial capacity of the Mines Safety Department of the MMMD and other key mining sector institutions in Zambia such as the Environmental Council of Zambia, ZCCM-IH and the universities to execute statutory mandates to regulate, monitor, enforce and/or implement appropriate environmental management practices in the mining sector. The major partner in the project is the Mines Safety Department (MSD) of the Ministry of Mines and Minerals Development (MMMD). Secondary partners include the Environmental Council of Zambia (ECZ), ZCCM Investment Holdings Plc (ZCCM-IH), the Universities of Zambia and the Copperbelt and representatives of the mining industry. While MSD is the main project stakeholder, in order to be truly successful, it is imperative that the project address the needs of all stakeholders. To accomplish this, the EMMS project is working in conjunction with a parallel project financed through the World Bank.

The MSD was created in 1957 to ensure that mining companies comply with national health and safety requirements. More recently, MSD has also been tasked with providing environmental expertise to ECZ on behalf of the MMMD. This is a new field for the department, and MSD has established its Environmental Unit to review Environmental Impact Assessments, environmental plans and audit reports

submitted by the industry. The unit will require a substantially enhanced range of expertise in this regard. The project will provide the information and training required to develop this new expertise within MSD. Field monitoring of industry performance against commitments and standards is also an important MSD function that will be addressed by the project.

The ECZ was created in 1990 and is responsible for implementing environmental policy and ensuring the country's compliance with environmental regulations, standards, and guidelines as per the 1990 Environmental Protection and Pollution Control Act. The Council was set up to co-ordinate the environmental management activities of all government organizations and agencies; to establish and nurture closer institutional linkages; and play a co-ordinating role in the preparation and implementation of cross-sectoral programs of consequence to the environment. The ECZ is also responsible for final approval of environmental impact statements/plans, the issuance of permits and licenses, enforcement and prosecution, advising the Minister on environmental policy and the effect of development, as well as providing input into the development of environmental regulations. At the present time, an amendment to the Environmental Protection and Pollution Control Act is being presented to Parliament to strengthen the enforcement mechanisms. The ECZ has a staff of approximately 70 persons, who are involved in all sectors of activity. ECZ relies on competent sectoral authorities to implement and enforce regulations in the field, including MSD as the competent authority for the mining sector.

ZCCM Investment Holdings Plc, is the company established by the government of Zambia to manage its residual holdings in the privatized operations and the rehabilitation of defunct sites and facilities which remain under government ownership. As part of this mandate, the company will need to develop environmental plans related to closing and decommissioning the sites and to their rehabilitation. A World Bank project is providing significant funding for this initiative.

The School of Mines of the University of Zambia was established in 1973. It offers a five-year program in geology, mining engineering and metallurgy/on; processing, with graduates receiving a Bachelor Degree in Mineral Sciences. While some environmental management courses are already included in the various programs, in order to ensure that graduates enter the workforce with the environmental management skills required by the minerals and metals industry, the project will attempt to expand and strengthen the existing student curriculum with regard to environmental management in mining.

The Copperbelt University delivers Technical Diplomas and is expected to benefit from this program in a similar fashion to the University of Zambia.

It is very important that MSD in particular, find a means of generating and retaining sufficient operating funds to effectively fulfil its mandate. Currently, a mining inspector working for government (MSD) receives several times less than industry employees with similar education and experience. This disparity makes recruitment and retention of trained, experienced staff difficult. An analysis of resource requirements and potential for revenue generation is included in the project workplan, as a means of assisting the Government of Zambia in developing a solution that will allow MSD to effectively fulfil its mandate.

In summary, the project is quite timely, with events taking place in Zambia that will provide a fertile ground in which to introduce and/or improve environmental management practices in the mining sector, including:

- 1) Enactment of a modern, progressive Mines and Minerals Act (1995) and Environment Protection and Pollution Control Act (1990);
- 2) Recent changes in government institutions to raise the profile and emphasis on environment, including the establishment of a Ministry of Environment and Natural Resources and the Environmental Council of Zambia;
- 3) Recent privatization of ZCCM assets;
- 4) Increasing foreign interest and investment in mining in Zambia;
- 5) Public sector reform, with increased emphasis on efficiency, capacity building and client orientation;
- 6) Pressure for improved environmental performance from the international community.

MSD and the other stakeholder agencies are enthusiastic and committed to increasing their specialized environmental management knowledge, techniques and expertise through additional training, in order to effectively perform their duties.

Activities for the current year include reciprocal visits for Zambian and Canadian mining sector regulators, to exchange information on approaches to various issues. As well, working sessions on reviewing Environmental Impact Assessments and the acquisition and use of diverse field assessment equipment is planned. The project is expected to strengthen the capacity of Zambia to perform its environmental management roles and functions in an effective fashion and to manage the environmental sustainability of the development of its very substantial mineral resources to the benefit of the country and its people.