

Chapter 2

The Global Context of AMD

2.1 Introduction

In many regions of the world, there is now a failure to invest adequately in water services. These services include the treating and reusing of water efficiently, ‘mainly because policy-makers and economic planners do not fully appreciate the importance of water’. This is now increasing the issue of water shortages in many parts of the world. This will contribute to a situation within 20 years, when the global demand for water will be far greater than the supply (Creamer 2015, p. 3). The world’s population tripled in the twentieth century, while the use of renewable resources has increased six times; in the next 50 years, the world’s population is expected to increase by another 40–50 %, and therefore water resources will be under severe pressure (Creamer 2015, p. 4). These concerns will continue to increase due to the growing population and the impacts on water systems. Therefore, water stress is not only unique to South Africa, but it is a global problem, with many countries experiencing the same impacts.

The purpose of this brief chapter is to look at AMD from a global perspective and to understand that AMD-related issues are not unique to South Africa but are being experienced in several parts of the world. Due to the challenges that South Africa faces with regard to AMD, ‘we have the opportunity to up our game in the acid mine drainage arena and become a leading producer of acid mine water and salinity solutions’ (Naidoo 2014, p. 24). This chapter therefore looks at the negative impacts of AMD on the water systems in other countries to identify the similarities or differences in the issues concerning AMD that are experienced.

‘Acid mine drainage is a significant and costly environmental impact of the mining industry worldwide’ (Coetzee et al. 2010, p. 4). The effects are seen in surface and groundwater resources long after mining activities have stopped and are a known global problem in many abandoned mine sites.

Abandoned mines are sites where ‘advanced exploration, mining or mine production ceased without rehabilitation being implemented at all or completed. They are found virtually in all regions with a history of mining’ (IIED 2002, p. 3).

The reason why mines—throughout history—were left abandoned is because it became the norm to abandon the mine site when there were no longer minerals to extract. On the other hand, according to the Environmental Mining Council of BC (2006, p. 2), ‘once a mine is in operation, water protection must remain the highest goal of the company, even if it means reduced mineral productivity. Adopting this common-sense ethic is the only way we can ensure that the golden dreams of mining do not turn into the nightmare of poisoned streams’. This hasn’t been the case in the past in those regions where abandoned mines have had negative effects on their water systems. In the late twentieth century, it was realised that abandoned mines were a threat to the environment and needed to be addressed (IIED 2002, p. 10). The issue has extended to what it is today because countries that had a long history of mining—at the time—did not consider the negative impacts that mining would bring in the future, and environmental regulations of mining activities in most cases were not implemented. Therefore, the biggest problem that we have with abandoned mines is acid mine water (IIED 2002, pp. 10–12).

South Africa has many abandoned mines, including gold, coal, copper and 134 abandoned asbestos mines (including 400 abandoned asbestos dumps) known to create health hazards (IIED 2002, p. 9). In South Africa, abandoned mines are controlled under the Water Amendment Act 58 of 1997. This act protects water and limits waste discharge by the industry. However, before the Water Act 54 in 1956, many mines were abandoned without implementation of sufficient pollution control measures (IIED 2002, p. 9).

AMD is not a phenomenon only found in South Africa. Abandoned mine sites in countries such as Australia, Canada and the United States of America (USA) also experience similar environmental challenges. In order to develop an appreciation for the global context of AMD in relation to the situation in South Africa, its prevalence in a few other countries is explored in the next sections.

2.2 AMD in Australia

Australia is known to be rich in minerals which have significantly contributed to the country’s economy. According to Australian government sources (2007), coal was discovered near Newcastle in New South Wales (see the map in Fig. 2.1 for orientation) in the 1700s and later in the south and west of the settlement. The first metal mined in Australia was lead in South Australia in the mid-1800s. Gold was first discovered in New South Wales in the early 1800s. The gold rush of the 1850s enabled the Australian colonies to become famous for their mining. Australia was producing almost 40 % of the world’s gold at that time. A few years later, Australia became an important producer of tin with the discovery of the metal in Tasmania (see the map in Fig. 2.1). In the late nineteenth century, copper and gold mines were established in Queensland (see Fig. 2.1), lead and zinc in New South Wales, gold in Western Australia and iron ore in South Australia. In the early twentieth century, mining activity in Australia began to decline despite the rise in the value of mineral



Fig. 2.1 Map of Australia (Source: Maps of World n.d)

production, and only lead, zinc and copper deposits were the major finds. With the discovery of new metals such as aluminium, nickel, tungsten, uranium, oil and natural gas, the country became a renewed interest for their mineral resources and is a nation that is known to be one of the world leaders in mineral resources. Companies like BHP Billiton and the Rio Tinto group have become associated with the main mining activities in Australia. With the Chinese economic boom in the 2000s and its demand for mineral commodities, Australia's geographical proximity to it counted in its favour to increase its exports to China.

Due to the fact that the country is so prominent in mining, because of its minerals, it makes one aware that management of water resources needs special attention, because mining is a large consumer of water.

The management of water resources in Australia is said to be an intricate process. As a federal union, this process differs between the Australian states and territories. Water management in Australia includes water pricing and economic regulations, water planning and management, water markets, water supply and services and water quality management (WRC 2016, pp. 2–3).

There is no nationwide inventory of abandoned mines in Australia, and it is therefore the responsibility of the federal states and territorial governments to obtain this data (IIED 2002, p. 5). In Western Australia, the Department of Minerals and

Energy is developing a database of abandoned mines by identifying outstanding risks and then seeing which sites are a priority with regard to safety and environmental harm. This programme commenced in July 1999, and at that time the Northern Territory had not yet undertaken similar measures to establish a database of abandoned mines but was planning to complete it by 2002 (IIED 2002, p. 6). In Australia an indication of the devastating environmental effects of mining is that large areas of dry forest that were exposed in the gold rush in the 1860s still have not yet recovered (IIED 2002, p. 12).

In the late 1990s, the Australian state and territorial governments took steps to require mining companies to be proactive in their management of potential and current acid-generating wastes (Harries 1997, p. 6). Governments are increasingly aware that AMD can become a liability where the state and territory governments will be responsible for remediation of mine sites due to not having proper and effective mechanisms in place. In 1996, the Queensland Department of Mines and Energy adopted a policy combating AMD, but it noted that there would be disagreements on what would be the best practice among experts.

The management of acid-generating wastes and methods used in Australia depend on the properties of the waste, the climate conditions and how sensitive the receiving environment is (Harries 1997, p. 5). Some of these strategies that are used for management of potentially acid-generating wastes to control the environmental impacts are isolation of the potentially acid-generating material so that it is enclosed above and on the sides by low hydraulic conductivity material, selective placement of potentially acid-generating tailings under non-acid-generating tailings, placement of water covers to reduce ingress of water and oxygen, placement of soil multilayer covers use of specific waste dumps for isolation of potentially acid-generating wastes, mixing of wastes with acid neutralising material to increase the acid neutralisation, establish surface water controls and construction of water treatment facilities to ensure water meets discharge criteria and use of bactericides to reduce bacterial activity in acid-producing materials (Harries 1997, p. 5).

The Australian mine sites use several methods to monitor the effectiveness of waste management strategy used for sulphidic wastes such as monitoring seepage water quality and volumes and measurement of water balance to name a few (Harries 1997, p. 5). The sites that had acid-generating material were managed according to waste characterisation and water quality.

2.3 AMD in Canada

According to the Government of Canada (2016, p. 2), Canada is one of the top destinations for exploring and mining investment. Canada is a supplier of over 60 minerals and metals. The key commodities include primary aluminium, cobalt diamonds, gold, nickel, platinum group metals, salt, tungsten and uranium (Government of Canada 2016, p. 2).



Fig. 2.2 Map of Canada (Source: Martin's AP Human Geography 2012)

Major mining regions have been developed throughout various provinces in Canada. These include the Labrador Trough on the Quebec, Newfoundland and Labrador border where iron ore, is developed, the Abitibi gold belt in Quebec and Ontario, and nickel and copper platinum group element mines of the Sudbury region in Ontario (see Fig. 2.2). Uranium mines are found in Saskatchewan (province in Canada), the metallurgical coal and copper–gold mines in British Columbia (province in Canada) and diamond mines in the Northwest Territories (Government of Canada 2016, pp. 2–3). In summary, Canada is also a producer of more than 60 mineral and metals and more than 200 producing mines. The total value of mineral production in Canada reached C\$45 billion. This shows that mining has significantly contributed to the economy and provided immense employment opportunities (Government of Canada 2016, p. 6).

With the economic growth due to the mineral wealth in Canada, federal, provincial and territorial governments also have legislative frameworks that include an environmental assessment process prior to mineral exploration approval and all mine development proposals (Government of Canada 2016, p. 14).

The Canadian Mine Environment Neutral Drainage (MEND) programme was established by mines and provincial, territorial and federal government agencies in 1989 in response to the recognition that AMD is the core environmental issue.

The mines in Canada were required to establish trust funds to cover the costs of AMD effects caused by mine wastes. A survey conducted showed that there were immense amounts of waste rock that were potentially acidic that came from metal mines and industrial mineral tailings (Coetzee et al. 2010, p. 4). The Canadian mineral industry generates one million tonnes of waste rock and 950,000 tonnes of tailings per day, which adds up to 650 million tonnes of waste per year (Environmental Mining Council of BC 2006, p. 3). In Canada, 'there are an estimated 351 million tonnes of waste rock, 510 million tonnes of sulphide tailings and more than 55 million tonnes of other mining sources which have the potential to cause AMD' (Environmental Mining Council of BC 2006, p. 3). Acidic drainage is identified as the largest environmental liability facing the Canadian mining industry, and to clean up these acid-generating mines will cost between \$2 billion and \$5 billion (Jennings et al. 2008, p 4).

A survey done on abandoned mines in Canada indicated two mining-related elements that occurred to create the legacy of abandoned mines: (1) economic elements (unexpected closure of mines leaving mining companies bankrupt) and (2) national security elements (mines that operated in Canada during the Second World War immediately closed with the Lend-Lease Act of 1941 and not much was done to rehabilitate these mines) (IIED 2002, p. 3). There are many other contributing elements to the legacy of abandoned mines which included the following: regulation, whereby no measures were in place to provide governments with financial security in the event of mine closure due to bankruptcy, therefore no rehabilitation could take place; ineffective government enforcement arising from a lack of capacity; the loss of mine data due to information not being stored adequately; political unrest leading to unplanned closure of a large number of mines; the impact of small-scale mining led to no control over illegal mining which resulted in the site being abandoned when mining activities ceased.

Abandonment of mines is unexpected and sudden in most instances. 'Closure and rehabilitation costs must be directly or indirectly born by the state' because it is the communities who are effected in the end and the environmental impacts are detrimental (IIED 2002, p. 4). More than 10,000 abandoned mines are on the inventory in Canada and only 60 % have been physically assessed. There also are other provinces in Canada that have inventories but they are not accessible (IIED 2002, p. 6). These abandoned mines generate acid-producing wastes, and MEND developed indicative costs of managing the wastes by using a range of treatments which include collecting and treating seepage water from waste rock and tailings, placing a water cover on tailings, placing a soil cover on tailings and transporting of waste rock to the pit (Harries 1997, p. 16). The estimated cost to treat AMD was extremely high, and in order to reduce these costs, an independent costing analysis sponsored by MEND was prepared (Harries 1997, p. 16).

2.4 AMD in the USA

Mining activity is said to contribute to the economic activity in every state in the USA. The USA is known for its minerals such as coal, copper, gold, iron, silver, uranium and zinc, as well as its production of oil and natural gas. Ten states with the largest contribution of mining to the gross domestic product (GDP) are Wyoming, 20 %; West Virginia, 17.3 %; Nevada, 8.7 %, Montana, 6.1 %; Arizona, 5.8 %; Kentucky, 4.8 %; Utah, 4.2 %; New Mexico, 3.5 %; Idaho, 3.2 %; and Alaska, 3.1 % (see Fig. 2.3) (NMA 2014).

Despite being known for the mining activity in each state, the USA has a large number of abandoned mine sites where AMD is an extensive issue (IIED 2002, p. 7). These problems are mainly due to coal mining in the eastern states ‘where over 7000 km of streams were considered to be seriously affected by acid drainage from coal mines’ (Harries 1997, p. 18). Hard rock mines in the western USA (Idaho and Colorado) are found to have water quality problems. According to Harries (1997, p. 18), the US Forestry Service estimated that 8000–16,000 km of streams in the USA were affected by AMD from active and inactive mines and waste rock piles.

Due to the liability associated with AMD caused by abandoned mine sites, conservative control strategies and payment of large performance bonds are assisted upon. Numerous abandoned coal mine sites in south west Pennsylvania were reclaimed between 1980 and 1992, and wetlands were constructed on 11 sites to reduce AMD through the use of soil cover (Harries 1997, p. 19).



Fig. 2.3 Map of the USA (Source: Maps of World n.d)

2.5 Conclusion

It is evident that AMD is not only an issue that is unique to South Africa, but in many parts of the world where mining activity has taken place, there will be the risk of an abandoned mine site and therefore the risk of AMD. It is clear that the occurrence and impact of AMD in all the countries where it is predominant happened for the same reasons. This is firstly due to the fact that no clear policies were in place to prevent it from happening or to assure that the mining industry, which is ultimately responsible for the damage caused, pay for the clean-up. What is unique to all the cases where AMD is seen is that there are treatment mechanisms in place to ensure that the problem is dealt with.

Water is one of the resources that is most often polluted by abandoned mines. What is important to account for is the social, economic, environmental and political implications that follow. These social impacts are similar to the ones discussed in Chap. 6 of this book. These impact directly on the people in terms of employment and health hazards, for instance. The economic implications include the large funds required for the rehabilitation of the abandoned mine sites which the government and the people have to provide. The environmental impact is the harm to water resources first and foremost. The political impacts stem from who must take responsibility for the damage done. All these impacts are also common to South Africa and will be discussed later.

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