

# Analysis of the Current Legal Framework Protecting the Health of Communities Near Gold Mine Tailings in South Africa

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## Abstract

South Africa has a robust legal framework to ensure that mine tailings do not become a health hazard. This notwithstanding, this article will show how a lack of effectiveness with regard to implementation and compliance has led to a situation where the health and safety of people living in communities near gold mine tailings are constantly threatened. This health hazard is exacerbated by human settlements being developed too close to mine tailings, a consequence of poor monitoring, planning and control. The authors explain how the problem could be remedied through effective implementation and compliance with the legal framework and concerted efforts between the government, mining companies and affected communities. Similarly, the establishment of exclusion zones is key to limiting exposure to pollution. At the same time, awareness campaigns will ensure that community members are equipped with the knowledge to safeguard themselves against health hazards caused by gold mine tailings.

**Keywords:** Gold mine tailings; health; pollution; communities; legal framework; implementation; enforcement

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## Introduction

Gold mining has a positive as well as negative impact on society. While contributing significantly to the economy of South Africa,<sup>1</sup> the financial gains from the extraction of mineral resources come at a price—namely the pollution caused by large quantities of waste material.<sup>2</sup>

South Africa has been a mining country for more than a century<sup>3</sup> and over time, mine wastes have become a significant cause of pollution.<sup>4</sup> For many decades, large volumes of waste material—generally the unwanted and uneconomic by-products of mining<sup>5</sup> located on or around mine sites<sup>6</sup>—have been accumulating across the country. Such sites often contain high levels of heavy metals that are likely to be toxic, corrosive and/or radioactive.<sup>7</sup> These lead to high levels of air pollution and contamination of land and water sources, especially around mine sites.<sup>8</sup> Such high levels of pollution are, in turn, a permanent threat to the health of communities living close to mine dumps.

A major contributor to this problem is the high prevalence of abandoned mine sites, where no owner or responsible party can be identified. On such sites, mine wastes typically go unattended.<sup>9</sup> As a result, there are close to 6 000 abandoned and unrehabilitated mines across the country.<sup>10</sup> There are also hundreds of mine tailings still awaiting remediation across South Africa.<sup>11</sup> Consequently, communities in several parts

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- 1 Stats SA, 'Mining: Production and sales' in *Statistical Release P2041 8* (Stats SA, 2019) <<https://www.statssa.gov.za/publications/P2041/P2041June2022.pdf>> accessed 27 October 2022; Nadine Wenzel, Bill Freund and Olivier Graefe, 'Surviving in the BRICS: The Struggle of South African Business in Coping with New Partners and Investors' (2019) 33 *International Review of Applied Economics* 51, 54.
  - 2 RK Tiwary, 'Environmental impact of coal mining on water regime and its management' (2001) 132 *Water, Air, and Soil Pollution* 185, 185–186.
  - 3 Lochner Marais, Stuart Denoon-Stevens and Jan Cloete, 'Mining Towns and Urban Sprawl in South Africa' (2020) 93 *Land Use Policy* 9.
  - 4 Lorren Kirsty Haywood, Benita De Wet, Willem de Lange and Suzan Oelofse, 'Legislative Challenges Hindering Mine Waste being Reused and Repurposed in South Africa' (2019) 6 *The Extractive Industries and Society* 1079, 1080.
  - 5 These include rock, sediment, tailings, metallurgical wastes, dusts, ash, and processing chemicals.
  - 6 Karen Hudson-Edwards, 'Tackling Mine Wastes' (2016) 352 *Science* 288, 288.
  - 7 *ibid.*
  - 8 Abraham Albertus Jacobus Naudé, 'A Methodology to Quantify the Groundwater Impacts of Mega-Tailings Dams for the Gold Mining Industry, South Africa' (MSc Thesis, North-West University 2016) iii.
  - 9 David Laurence, 'Optimisation of the Mine Closure Process' (2006) 14 *Journal of Cleaner Production* 285, 286.
  - 10 Herman Cornelissen, Ingrid Watson and Tshepo Malefetse, 'Challenges and Strategies of Abandoned Mine Rehabilitation in South Africa: The Case of Asbestos Mine Rehabilitation' (2019) 205 *Journal of Geochemical Exploration* 1 <<https://doi.org/10.1016/j.gexplo.2019.106354>>
  - 11 Muibat Omotola Fashola, Veronica Mpoke Ngole-Jeme and Olubukola Oluranti Babalola, 'Physicochemical Properties, Heavy Metals, and Metal-Tolerant Bacteria Profiles of Abandoned Gold Mine Tailings in Krugersdorp, South Africa' (2020) *Canadian Journal of Soil Science* 218, 219.

of South Africa are struggling with health issues such as respiratory and cardiovascular diseases, associated with gold mine dumps<sup>12</sup>—most of which are located in Gauteng.<sup>13</sup>

This article analyses the legislative framework governing gold mine tailings in South Africa, to identify existing gaps therein. It is asserted that the problem exists, at least partially, due to legislative failure. The main question of how and why law and policy fail to protect the health of communities living near gold mine dumps in South Africa is addressed as well as the necessary steps that should be taken by relevant stakeholders to remedy the problem.

In the next section of the article the legal framework relating to the management of the effects of mine tailings on people's health in South Africa, to establish its strength, will be examined. This will be followed by the current health issues caused by gold mine tailings, while highlighting the correlation between such issues and the legal framework's failure to protect the community effectively. Finally, the measures necessary for the better protection of community health and the role to be played by relevant stakeholders will be discussed. A conclusion is then drawn to establish the main outcomes of the article.

## Legal Framework Regarding the Health Impact of Gold Mine Tailings

Experience has shown that an inclusive legal framework on a given issue can become the key solution to that issue if properly implemented and complied with.<sup>14</sup> Therefore, this section analyses the potential of the South African legal framework to avert mine-related health issues prevalent in communities close to or around gold mine tailings. The analysis focuses on three main themes or lines of enquiry to discuss the health-related regulatory reliefs offered to mining communities in South Africa. These are environmental rehabilitation, health and safety, and human dignity.

### **Environmental Rehabilitation**

Preserving the environment ensures that society in general and communities living close to mine tailings, in particular, exist in safe spaces. It is in line with this argument that section 24 of the South African Constitution of 1996 (Constitution)<sup>15</sup> advocates, among

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12 Vusumuzi Nkosi, 'Association Between Dust from Gold Mine Dumps Respiratory Symptoms and Diseases among Adolescents and the Elderly in Gauteng and North West Provinces South Africa' (Doctoral Dissertation, University of Pretoria 2016) 38.

13 Frank Winde, Emile Hoffmann, Carolina Espina and J. Schüz, 'Mapping and Modelling Human Exposure to Uraniferous Mine Waste using a GIS-supported Virtual Geographic Environment' (2019) 204 *Journal of Geochemical Exploration* 167, 167–168.

14 Malgosia Fitzmaurice, 'Environmental Compliance Control' (2018) 8 *Wroclaw Review of Law, Administration & Economics* 372, 375.

15 'Environment  
Everyone has the right –  
to an environment that is not harmful to their health or well-being; and

others, for the prevention of environmental pollution<sup>16</sup> and for measures to ensure that economic development, in particular, does not occur at the expense of societal well-being.<sup>17</sup> Hence, the section provides for the establishment of legislative measures to promote the right to a healthy environment for both present and future generations.<sup>18</sup>

In the South African mining context, the above constitutional vision of environmental protection is given effect and promoted across various instruments on specific aspects of environmental pollution. First, in terms of soil quality, the National Environmental Management: Waste Act of 2008 (NEMWA) provides for national norms and standards to be in place for the proper management of different types of waste.<sup>19</sup> In addition, the Act provides for the establishment of national norms and standards for the ‘remediation of contaminated land and soil quality.’<sup>20</sup> Towards that goal, the National Norms and Standards for the Remediation of Contaminated Land and Soil Quality in the Republic of South Africa (National Norms and Standards) were published<sup>21</sup> in 2014<sup>22</sup> to provide a reliable benchmark to determine levels of contamination in susceptible areas.<sup>23</sup> The aim is to provide the ‘most appropriate criteria and method’ applicable to the evaluation of contaminated land.<sup>24</sup> Significantly, the norms and standards aim to determine a threshold for the assessment of ‘necessary environmental protection measures’ for the remediation of contaminated areas.<sup>25</sup>

When screening contaminated sites concerning land,<sup>26</sup> the National Norms and Standards apply once a site assessment report is necessary. This happens when there is a declaration of an area identified for investigation in accordance with the National Environmental Management Act (NEMA) of 1998.<sup>27</sup> The National Norms and Standards provide minimum benchmarks,<sup>28</sup> including, for example, that the concentrations of arsenic in the soil should not exceed 5.8 mg/kg.<sup>29</sup> These contaminants

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to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that –  
 prevent pollution and ecological degradation;  
 promote conservation; and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.’

16 The Constitution, s 24(b)(i).

17 *ibid* s 24(b)(iii).

18 *ibid* s 24(b).

19 NEMWA s 7.

20 *ibid* s 7(2)(d).

21 By the then Minister of Water and Environmental Affairs.

22 See Government Gazette 37603, National Norms and Standards 2014.

23 *ibid* 2(a).

24 *ibid* 2(b).

25 *ibid* 2(c).

26 *ibid* 4(2)–(3) and 5.

27 NEMA s 36; National Norms and Standards 4(1).

28 Though such are neither ‘absolute minimum values’ nor ‘default remediation values.’ See the National Norms and Standards 4(3).

29 *ibid* 5(1).

include metals and metalloids, a health hazard for which soil screening values are provided in table 1 of the National Norms and Standards.<sup>30</sup> Values provided in the table seek to ensure that levels of heavy metals, for instance, in the soil, do not prevent an alternative and healthy use of the land around gold mine tailings, including remediated land.<sup>31</sup>

To eliminate the health threat posed by polluted water, such as acid mine drainage resulting from gold mine tailings, water quality in communities around such tailings must be monitored, measured and reported periodically. This is in line with standards regarding drinking water quality set out by the South African National Standards (SANS).<sup>32</sup> The instrument sets the acceptable standard limit of contaminants generally found in drinking water. Further, the instrument sets the standard limit, for example, of arsenic and cadmium concentration in drinking water at ten and three  $\mu\text{g/L}$ , respectively.<sup>33</sup> Such contaminants are among the heavy metals and metalloids associated with mining activities and mine wastes.<sup>34</sup>

Guidelines<sup>35</sup> for water quality in South Africa serve as a ‘basis for developing materials to inform water users about the physical, chemical, biological and aesthetic properties of water.’<sup>36</sup> The guidelines provide criteria for water quality, targeted water quality and support information.<sup>37</sup> They seek further to ensure acceptable and safe water quality, among others, for domestic,<sup>38</sup> agricultural,<sup>39</sup> recreational,<sup>40</sup> industrial<sup>41</sup> and aquaculture<sup>42</sup> purposes through the support information and especially the treatment

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30 *ibid* 5.

31 Muhammad Amjad Khan, Sardar Khan, Anwarzeb Khan and Mehboob Alam, ‘Soil Contamination with Cadmium, Consequences and Remediation Using Organic Amendments’ (2017) 601 *Science of the Total Environment* 1591, 1592.

32 SANS 241:2015.

33 *ibid*.

34 H Eijssackers, FA Swartjes, L van Rensburg and MS Maboeta, ‘The Need for Attuned Soil Quality Risk Assessment for Non-Western Humans and Ecosystems, Exemplified by Mining Areas in South Africa’ (2014) 44 *Environmental Science & Policy* 174, 176–177.

35 South African Water Quality Guidelines.

36 Unknown, South African Water Quality Guidelines, <[http://www.waternet.co.za/policy/g\\_wq.html#top](http://www.waternet.co.za/policy/g_wq.html#top)> accessed 21 September 2020.

37 Support information includes the occurrence of constituents in aquatic environments. It also includes the effects of the constituents on water uses and how such effects should be mitigated or eliminated through available treatment options.

38 South African Water Quality Guidelines, Domestic Water Use (Vol 1).

39 *ibid* Irrigation Water Use (Vol 4).

40 *ibid* Recreational Water Use (Vol 2).

41 *ibid* Industrial Water Use (Vol 3).

42 *ibid* Aquacultural Water Use (Vol 6).

options. The guidelines also promote acceptable water quality for livestock watering<sup>43</sup> and aquatic ecosystems.<sup>44</sup>

Measures to resolve the air pollution problem that results mainly from mine tailings are also promoted within the current legal framework. The Air Quality Act was enacted as a response to ambient air quality in parts of South Africa not being conducive to a healthy environment.<sup>45</sup> Concerning mining specifically, the Act provides that where it is determined that mining operations are likely to cease within a period of five years, the minister responsible for environmental affairs must be notified promptly in writing by the owner of such a mine.<sup>46</sup> In addition, the owner is also required to notify the minister of plans in place or being planned for: '(i) the rehabilitation of the area where the mining operations were conducted after mining operations have stopped; and (ii) the prevention of pollution of the atmosphere by dust after those operations have stopped.'<sup>47</sup> It is believed that such plans should include the management or prevention of dust from mine tailings, often a major source of air pollution in mining areas.

Further, national or provincial departments responsible for preparing environmental implementation plans or environmental management plans and municipalities preparing integrated development plans, must include an air quality management plan.<sup>48</sup> This is to identify and mitigate the negative impact of poor air quality on human health.<sup>49</sup> Also, priority areas may be declared in places should the minister responsible for environmental affairs, or a member of the Executive Council deems the ambient air quality standards to exceed or are likely to exceed acceptable limits.<sup>50</sup> The declaration of priority areas can also be made where a situation that causes or is likely to cause a significant negative impact on air quality exists, or where the 'area requires specific air quality management action to rectify the situation.'<sup>51</sup> To this effect, the Highveld Priority Area Air Quality Management Plan and West Rand District Municipality Air Quality Management Plan were declared.<sup>52</sup> These priority areas cover some of the places where issues with mine dust are most prevalent. As discussed in the next section, the provisions and standards discussed so far are meant to ensure societal well-being, including safety and health.

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43 *ibid* Livestock Watering (Vol 5).

44 *ibid* Aquatic Ecosystem (Vol 7).

45 National Environmental Management: Air Quality Act 39 of 2004, Preamble.

46 *ibid* s 33(a).

47 *ibid* s 33(b).

48 *ibid* s 15.

49 *ibid* s 16(1)(a)(iii).

50 *ibid*, s 18(1)(a).

51 *ibid* (a)–(b).

52 2007 and 2009 respectively by Department of Environmental Affairs and the West Rand District Municipality.

## Health and Safety

In its definition of ‘mining area’, the Mineral and Petroleum Resources Development Act of 2002 (MPRDA) acknowledges health as one of the factors to be taken into account in connection with mine tailings and land adjacent to mining areas,<sup>53</sup> including community land. Thus, regarding mine closure and wastes, the MPRDA provides that holders of mining rights must take necessary measures to remediate health issues associated with their projects in terms of their environmental authorisation or as directed by the minister responsible for mineral resources.<sup>54</sup> This is in line with the NEMA, which provides that ‘everyone has the right to an environment that is not harmful to his or her health or wellbeing,’ and those responsible for health issues must cover the cost of remedying such.<sup>55</sup> Similarly, the NEMWA advocates, amongst others, for avoidance, minimisation, treatment of waste and prevention of pollution to protect health and wellbeing.<sup>56</sup> The Act also provides that people be made aware of the impact of waste on their health and well-being.<sup>57</sup> This enables community members to familiarise themselves with the diseases that mine tailings expose them to in the short and long term.<sup>58</sup> Where there are reasonable grounds to believe that waste poses a threat to health and wellbeing, the minister responsible for environmental affairs may declare that waste as a ‘priority waste.’<sup>59</sup> This means waste that requires specific management measures to improve or reduce health impacts.<sup>60</sup>

The above provisions for health protection in the mining context coincide with other provisions not explicitly designed for the management of mine tailings and their health effects. Mindful that the well-being of communities affected by mining is generally the responsibility of local governments, the Constitution mandates such governments to ‘promote a safe and healthy environment.’<sup>61</sup> This requires local governments to ensure that the local population, especially mining communities, whose health is likely to be compromised by pollution caused by mine tailings, are afforded a living environment

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53 MPRDA, ‘mining area’ (b)(i) and (iii).

54 *ibid* s 43.

55 NEMA, preamble and ss 2(p) and 30(3)(b).

56 *ibid* ss 2(a) (16)(1).

57 *ibid* s 2(b).

58 E Zhakata, SR Gundani, V Chauke and KO Odeku, *A Critic of NEMA: Waste Act 59 of 2008, So Many Promises, Little Implementation and Enforcement* (SAAPAM Limpopo Chapter 5th 228 Annual Conference Proceedings 2016) 234.

59 NEMWA s 14(1).

60 *ibid* s 14(1)(a) and (b).

61 The Constitution s 152(6).

that guarantees their well-being.<sup>62</sup> This also entails collaborating with provincial and national governments, which are more resourced, for the same goal.<sup>63</sup>

In addition, and specifically in the context of mining, the Mine Health and Safety Act 29 of 1996 (MHSA) advocates for community health and safety. While the MHSA is mainly concerned with establishing the obligations of mining companies to ensure a safe working environment, it also requires such companies to ensure that non-employees are not exposed to any health and safety hazards.<sup>64</sup> To this end, mining companies must develop a policy of which the objective is to protect non-employees who are affected or likely to be affected directly by mining activities.<sup>65</sup> In that regard, the MHSA provides for fire prevention, noise management and control, blasting, vibration and shock management control. The MHSA Regulations provide, for example, that reasonable measures must be taken to ensure that vibrations, shock waves and or fly material are limited during blasting.<sup>66</sup> These are required to be limited to ‘such an extent and at such a distance from any building, public thoroughfare, railway, power line or any place where persons congregate to ensure that there is no significant risk to the health or safety of persons.’<sup>67</sup> Similarly, with regard to radioactivity in and around gold tailings storage facilities, the National Nuclear Regulator Act, 47 of 1999 (NNRA) provides for safety standards and regulatory practices regarding the protection of persons. Hence, the NNRA provides that organs of state must cooperate with regard to the monitoring and control of radioactive material to ‘ensure the effective monitoring and control of the nuclear hazard.’<sup>68</sup> Also, any person who has caused the contamination of a site with radioactive material may be required by an inspector to rehabilitate such site to a state that complies with safety standards.<sup>69</sup>

The mining-related framework promoting the health and well-being of communities situated close to mine tailings in South Africa supports the objectives of the National Health Act of 2003 (NHA). The NHA’s objectives include the endeavour to make policy and take ‘measures necessary to protect, promote, improve and maintain the health and wellbeing of the population.’<sup>70</sup> These objectives are meant to respond to the constitutional mandate of human dignity, as explained in the following section.

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62 Julie Middleton and others, ‘Environmental Management and Llocal Government’ (2011) PDG Occasional Paper 1, 2 and 5.

63 Carel Schoeman, ‘The Alignment Between Spatial Planning, Transportation Planning and Environmental Management Within the New Spatial Systems in South Africa’ (2015) *Town and Regional Planning* 42, 53.

64 MHSA s 5(2).

65 *ibid* s 8(1)(c).

66 *ibid* reg 4.7.

67 *ibid*.

68 NNRA s 6(1)(a).

69 *ibid* s 41(4)(g).

70 NHA s 3.



## Human Dignity

The constitutional right to dignity, as enshrined in the Bill of Rights, seeks to guarantee everyone in South Africa the 'inherent dignity and the right to have their dignity respected and protected.'<sup>71</sup>

According to Beyleveld and Brownsword, human dignity is a fundamental value to which all humans are entitled.<sup>72</sup> This implies that the concept of human dignity embodies people's right to their dignity and physical integrity as humans, as well as the right to conditions that enable such dignity to flourish.<sup>73</sup>

Consequently, protecting the right to human dignity in the mining context requires the appropriate management of health issues associated with mine tailings. The continual pollution in various forms, caused by mine tailings has adverse effects on the dignity of the members of communities located in its close proximity.<sup>74</sup>

The constitutional right to human dignity with regard to the health effects of mine tailings can be realised if the provisions applicable to environmental rehabilitation and health (discussed in the previous section) are properly implemented. However, despite the existence of those provisions of the legal framework applicable to the mining industry and its related health impacts, several challenges associated with the protection of health persist in communities close to mine tailings.

## Current Health Issues Associated with Gold Mine Tailings

In most parts of the world, mining operations take place in remote areas that are sparsely populated. In South Africa, the environmental, ecological and human health effects associated with mining and mining waste have been a concern for many years. For example, gold mining in South Africa has resulted in considerable amounts of waste material deposited for over a century in densely populated urban areas and mainly in the form of mine tailings storage facilities (MTSFs). These MTSFs are interspersed within and around human settlements, and in 2001, gold mining waste was estimated to account for 221 million tons or forty-seven per cent of all mineral waste produced in South Africa.<sup>75</sup> A wide variety of toxic metals, including uranium, lead, mercury, cadmium, arsenic and particulate matter have been reported to be present in

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71 The Constitution s 10.

72 Deryck Beyleveld and Roger Brownsword, 'Human Dignity, Human Rights, and Human Genetics' (1998) 61 Mod L Rev 661, 667.

73 *ibid* 670–671.

74 Tobias Thobile Poswa and Theophilus Clavell Davies, 'The Nature and Articulation of Ethical Codes on Tailings Management in South Africa' (2017) 7 Geosciences 101, 1–2.

75 Department of Water Affairs and Forestry, 'Waste Generation in South Africa' in *Water Quality Management Series* (Pretoria, Department of Water Affairs and Forestry (DWAF) 2001).

communities living near MTSFs.<sup>76</sup> These are potential health hazards that affect millions of residents in nearby communities, including poor and vulnerable citizens.<sup>77</sup>

Human exposure to these elements may occur through multiple pathways, including inhalation of mine tailing dump dust and both inadvertent and deliberate ingestion of tailings through the hand-to-mouth activity of children, and the practice of geophagia (mostly in pregnant women).<sup>78</sup> Other primary pathways by which contamination could enter the environment from a mine site are: an airborne pathway, where radon gas disperses outwards from mine sites; a waterborne pathway, either via ground or surface water or due to direct access; external irradiation after unauthorised entry to a mine site; residing in settlements directly adjacent to mines; and in some cases, in settlements on the contaminated footprints of abandoned mines or MTFs.<sup>79</sup>

Taking into consideration that some communities practice subsistence farming, the risk to human health and food security is dire. Toxic metals can be accumulated and transferred to plants when grown in metal-contaminated soils and irrigated with water from contaminated sources. This is often due to a lack of government monitoring and awareness about ways to avoid exposure to toxic environments, as provided in the legal framework.

Similarly, a lack of proper planning policies and improper environmental controls have led to the development of human settlements close to the MTSFs. In South Africa, approximately 1.6 million people live in informal and formal settlements on or directly next to the MTSFs. During a dry, windy season, there is high metal pollution in such surrounding communities.<sup>80</sup> This situation generally results in a high risk of metal exposure spread over a wider geographical area affecting a greater number of individuals.<sup>81</sup>

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76 Samuel J Cobbina, Abudu B Duwiejuah, Reginald Quansah, Samuel Obiri and Noel Bakobie, 'Comparative Assessment of Heavy Metals in Drinking Water Sources in Two Small-scale Mining Communities in Northern Ghana' (2015) 12 *International Journal of Environmental Research and Public Health* 10620.

77 S Schonfeld and others, 'Health Effects in Populations Living Around the Uraniferous Gold Mine Tailings in South Africa: Gaps and Opportunities for Research' (2014) 5 *Cancer Epidemiology* 38, 628–632; F Winde and E Hoffmann, 'Virtual Geographical Environments as a Tool to Map Human Exposure to Mining-related Radionuclides' (International Uranium Mining and Hydrogeology Conference (UMH VII) September 2014, Freiberg, Germany).

78 Angela Mathee and others, 'A Cross-sectional Analytical Study of Geophagia Practices and Blood Metal Concentrations in Pregnant Women in Johannesburg, South Africa' (2014) 104 *South African Medical Journal* 568.

79 MW Sutton, 'An Environmental Risk Assessment of Gold Mine Residue Deposits (MRDs) and Reclaimed Footprints in the East Rand, South Africa' (Third International Seminar on Mine closure October 2008, Johannesburg, South Africa).

80 ME Ojelede, HJ Annegarn and MA Kneen, 'Evaluation of Aeolian Emissions from Gold Mine Tailings on the Witwatersrand' (2012) 3 *Aeolian Research* 477.

81 *ibid.*

An exposure assessment study conducted in the MTSFs of Johannesburg, South Africa, showed that air pollution levels could be several times higher than the twenty-four-hour limit value set by the South African Department of Environmental Affairs ( $180 \mu\text{g}/\text{m}^3$ ).<sup>82</sup> Communities residing downwind of mine dumps experienced higher dust concentrations than those located upwind.<sup>83</sup> Residential developments foot of the mine dumps, caused elevated exposure to particulate matter and toxic metals.<sup>84</sup> Dust deposits affect visibility, fabrics, buildings, skin, eyes, and water tanks.<sup>85</sup>

Heavy metals exposure is known to have adverse health impacts on human physiological systems, including the nervous, skeletal, respiratory, excretory and digestive systems. Children are especially vulnerable to the health effects of heavy metals exposure; the health consequences include mental retardation, neuro-cognitive disorders, behavioural disorders, cancer, respiratory and cardiovascular diseases. The International Agency for Research on Cancer, an international scientific organisation of the World Health Organisation, published a series of monographs on the evaluation of carcinogenic risks to humans. Heavy metals found in the MTSFs are classified into groups 1 and 2. Research studies have shown that heavy metals are toxic to human cells, even at very low concentrations. They cause damage to cells through the induction of mutagenesis, carcinogenesis and teratogenesis. In addition, they cause: alterations in cell differentiation and proliferation; the induction of chromosomal aberrations and sister chromatid exchange; and the mediation of increased cellular tyrosine phosphorylation, which is associated with uncontrolled cell growth and cancer development.<sup>86</sup> An exposure assessment study conducted in communities close to gold mine dumps in South Africa showed that they have very high levels of uranium, and their estimated doses have a high potential to cause cancer.<sup>87</sup> Although several studies have investigated the health effects of a single isolated contaminant, less is known about the impact associated with simultaneous exposure to a combination of metals. Because humans are rarely exposed to a single metal, specifically in a situation of environmental exposure to mine tailings, it has been postulated that the toxic effect of metals can be

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82 Olusegun Oguntoke, Matthew E Ojelede and Harold J Annegarn, 'Frequency of Mine Dust Episodes and the Influence of Meteorological Parameters on the Witwatersrand area, South Africa' (2013) 2013 International Journal of Atmospheric Sciences 1–10.

83 L Wallace, 'Personal Exposure to Ultrafine Particles' (2011) 1 Journal of Exposure Sciences and Environmental Epidemiology 20–30.

84 Oguntoke and others (n 81).

85 CY Wright and others, 'Risk Perceptions of Dust and its Impacts Among Communities Living in a Mining Area of the Witwatersrand, South Africa' (2014) 24 Clean Air Journal 22.

86 WHO International Agency for Research on Cancer, 'IARC Monographs on the Identification of Carcinogenic Hazards to Humans' (12 August 2022) <<https://monographs.iarc.who.int/agents-classified-by-the-iarc/>> accessed 31 October 2022.

87 Pius Fasinu, and Orish E Orisakwe, 'Heavy Metal Pollution in Sub-Saharan Africa and Possible Implications in Cancer Epidemiology' (2013) 6 Asian Pacific Journal of Cancer Prevention 3393–3402.

modified by concurrent exposure to other metals.<sup>88</sup> Table 1: summarises the toxic metals and particulate matter found in the MTSFs and their impact on human health.

**Table 1:** Toxic Metals and Particulate Matter and their Impact on Human Health

Toxic Metals and Particulate Matter	Health Outcomes
Uranium	lung and liver cancer, and kidney damage
Cadmium	kidney, liver and nervous systems diseases
Lead	nervous systems, cardiovascular, immunological and renal diseases and behavioural disorders
Arsenic	complications of the nervous, cardiovascular, respiratory, endocrine, immune, renal and hepatic systems.
Particulate matter	respiratory and cardiovascular diseases

The persistence of the mine-related health issues discussed above indicates a lack of proper implementation and compliance with the legal framework and the poor monitoring of mine tailings and their effects on nearby communities.

### Improving Health Protection for Communities Living Near Gold Mine Tailings

South Africa's widespread problems with unrehabilitated MTSFs and health concerns in mining communities, show a clear failure of implementation and compliance. As a result, those responsible for remediating the impacts of mine tailings on people's health and well-being do not (or cannot) meet the aims of the legal framework. Reasons for poor implementation and non-compliance include ineffective monitoring and enforcement, all of which can be improved in various ways.<sup>89</sup>

The need for residential housing, especially that within easy reach of employment and infrastructure have resulted in a sharp increase in housing developments at the base of mine dumps over the last fifty years.<sup>90</sup> As a result, the more than one million people living in these settlements are at constant risk of contracting a disease and succumbing to premature death. Hence, the authors call for the strengthening of the implementation of the environment and health-based mandatory standards for exclusion zones between MTFs, active mines and human settlements as part of a broader strategy to protect the

88 MA Armienta, O Talavera, O Morton, and M Barrera, 'Geochemistry of Metals from Mine Tailings in Taxco, Mexico' (2003) 2 *Bulletin of Environmental Contamination and Toxicology* 387–393.

89 Thabo Madihlba, 'The Fox in the Henhouse: The Environmental Impact of Mining on Communities in South Africa' in DA McDonald (ed), *Environmental Justice in South Africa* (Ohio University Press 2004) 156, 161.

90 Melanie Anne Kneen, ME Ojelede and HJ Annergarn, 'Housing and Population Sprawl near Tailings Storage Facilities in the Witwatersrand: 1952 to Current' (2015) 12 *South African Journal of Sciences* 1–9.

public against exposure to mining-related toxic substances as per requirements of the MHSA.<sup>91</sup> However, due to previous numerous complaints from the public that MTFs are creating problems for nearby communities and mines complaining that the residents are encroaching onto the mines or of MTFs, the Department of Mineral Resources and Energy put in place a rule to extend the prescribed 100 metres to 2 000 metres. However, this is not a blanket rule, but a case-based rule. For example, in some parts of the country a ‘best-case scenario’ of 1 000 metres and a ‘worst-case scenario’ of 500 metres are adopted.<sup>92</sup> The legal argument is that this rule, although it is intended to serve as a precautionary rule in terms of health and safety matters, remains inferior to the regulations. Exclusion zones would also avoid communities falling victim to tailing dam collapse, as was the case in the Kopanong Local Municipality (Free State), where the collapse of the Jagersfontein’s tailings dam led to the death of one person, caused severe damage to property and infrastructure, and displaced many people.<sup>93</sup>

Also, dumps management must be improved as a matter of urgency. Occasionally, two strategies are implemented to reduce pollution from mine dumps. Such strategies include the spraying of mine tailings dumps with water and rehabilitation through planting grass. However, these strategies are often deemed ineffective since grass withers during dry seasons and sprayed water is rapidly absorbed or evaporated. Therefore, a multi-stakeholder approach between the mining companies, affected communities and the government is recommended to find sustainable, innovative strategies to mitigate pollution in the affected areas. Involving affected communities specifically could be critical in addressing the issue of mitigating efforts. These efforts are, however, being delayed and frustrated by informal mining activities occurring on sites where rehabilitation is in progress.<sup>94</sup> As argued by various authors, and proposed by the Department of Mineral Resources and Energy’s Artisanal and Small-Scale Mining Policy of 2022, one approach would be to bring such activities within the bounds of the law to control its activities.<sup>95</sup> The more profound step, however, would be to query why health issues caused by mine tailings persist and to establish their root causes.

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91 MHSA ss 17(6) and (10).

92 Kerry Bobbins and Guy Trangoš, ‘Mining Landscapes of the Gauteng City-Region’ (Wits, 2018) 70 *GCRO Research Report # No. 07* <<https://wiredspace.wits.ac.za/handle/10539/23829>> accessed 13 February 2023.

93 Dieketseng Maleke, ‘Foundation Calls for Exclusion Zones Around Mine Tailings Facilities’ (*IOL*, 2022), <<https://www.iol.co.za/business-report/companies/foundation-calls-for-exclusion-zones-around-mine-tailings-facilities-a8cf01d0-335f-4ee0-a36e-540dff8d9237>> accessed 26 October 2022.

94 Sphiwe E Mhlongo and others, ‘The Impact of Artisanal Mining on Rehabilitation Efforts of Abandoned Mine Shafts in Sutherland Goldfield, South Africa’ (2019) 11 *Jambá: Journal of Disaster Risk Studies* 1, 2.

95 *ibid* 2; Laura-Anne Wilson, ‘Unshackling South African Artisanal Miners: Considering Burkina Faso’s Legislative Provisions as a Guideline for Legalisation and Regulation’ (LLM Thesis, University of Cape Town, 2018) 106; Janet Love, ‘Report of the SAHRC Investigative Hearing: Issues and Challenges in relation to Unregulated Artisanal Underground and Surface Mining

Compliance is another area where steps in the right direction must be taken. Once mining operations have been closed, mining companies must adhere to the legislation by ensuring that the environment is properly rehabilitated. The facts in *Harmony Gold Mining Company Ltd v Regional Director: Free State Department of Water Affairs and Others*<sup>96</sup> revealed that some companies have little interest in remediating the effects of their activities.<sup>97</sup> In so doing, such companies might ignore their legal responsibilities pertaining to environmental management.<sup>98</sup> Hence, the Department of Mineral Resources and Energy must monitor and provide oversight on rehabilitation processes as part of its enforcement mandate.

Similarly, there is an urgent need for the Department of Forestry, Fisheries and the Environment, Department of Mineral Resources and Energy, and the Department of Water and Sanitation to tighten their monitoring roles regarding mine owners. The issues highlighted above demonstrate that the monitoring of health issues associated with mine dumps is ineffective. Therefore, proper monitoring is vital to ensure effective compliance with the legal framework on mine waste management, as demonstrated in the *Harmony* case.

Finally, the authors call for an awareness campaign to educate the affected communities about the dangers of exposure to dust from MTSFs, its contents, and resulting health outcomes. While the NEMWA provides for communities to be made aware of health risks associated with mine tailings, such awareness exercises seldom happen. Therefore, awareness campaigns must be promoted and enhanced to guide community members on how they can reduce exposure to health hazards such as mine dust both indoors and outdoors, especially for children and the elderly.

## Conclusion

Mine tailings dumps are a hazard to living organisms—plants and animals alike, and a grave threat to human health.<sup>99</sup> South Africa has enacted a robust legal framework to mitigate such threats to people's health and provide affected mining communities with a sense of human dignity. However, the effectiveness of the said legal framework is contradicted by the current health issues confronting communities living in or around

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Activities in South Africa' (SAHRC, 2015) <<https://www.sahrc.org.za/home/21/files/Unregulated%20Artisanal%20Underground%20and%20Surface%20Mining%20Activities%20electronic%20version.pdf>> accessed 20 November 2020. 96 (971/12) [2013] ZASCA 206.

97 Tracy-Lynn Humby, 'The Spectre of Perpetuity Liability for Treating Acid Water on South Africa's Goldfields: Decision in *Harmony II*' (2013) 31 JERL 453, 460–461.

98 As per, eg NWA s 19; NEMA s 28; NEMWA s 37.

99 Innocentia G Erdogan, Elvis Fosso-Kankeu, Seteno KO Ntwampe and others, 'Management of Metalliferous Solid Waste and its Potential to Contaminate Groundwater: A Case Study of O'Kiep, Namaqualand South Africa' in Elvis Fosso-Kankeu, Christian Wolkersdorfer and Jo Burgess (eds), *Recovery of Byproducts from Acid Mine Drainage Treatment* (Wiley 2020) 10–12.

close proximity to MTSFs.<sup>100</sup> These issues have arisen because of poor implementation and compliance. Even the best-conceptualised laws and most sophisticated legal frameworks are worthless in the face of the well-known defect of legal systems, such as poor monitoring, enforcement, and implementation.<sup>101</sup> These weaknesses defeat the best intentions and comprehensive legal frameworks, as demonstrated by this article.

Poor rehabilitation of mine tailings and the prevention of resulting pollution are the causes of several diseases highlighted above, affecting mostly children and the elderly. This article also finds that exposure to pollution and diseases can be attributed to the development of human settlements close to the MTSFs because of poor planning. All these issues are a result of failed monitoring, implementation, and enforcement.

As a way forward, the authors have argued that the solution to health issues caused by mine tailings would start with the establishment of exclusion zones between MTFs, active mines and human settlements to limit exposure to pollution. In addition, the government must improve its implementation and monitoring and enforcement efforts. Similarly, mining companies must take the requisite steps to comply with guidelines on managing and rehabilitating mine waste. Finally, a case is made for awareness campaigns to be conducted to enable affected communities to play a part in protecting themselves against the health issues caused by MTFs.<sup>102</sup>

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100 See s 3 above.

101 Bernard Kengni and Hanri Mostert, 'Regulation and Remediation of the Impacts of Mine Wastes on Land and Water in South Africa' (2022) 40 Journal of Energy & Natural Resources Law 337, 359.

102 See s 4 above: How to Improve Health Protection in Communities Living Near Gold Mine Tailings

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