

ÖkoRess III

Pilot Screening of Environmental Hazard Potentials of Mine Sites

Factsheet:

Sishen

Anglo American , South Africa

ID: 14

Note

The qualitative assessment of Environmental Hazard Potentials (EHPs) in this factsheet was conducted according to the method developed in the precursor project ÖkoRess I “Discussion of the environmental limits of primary raw material extraction and development of a method for assessing the environmental availability of raw materials to further develop the criticality concept”¹ (Dehoust et al. 2017a). The measurement instructions applied here are described in Dehoust et al. 2017b. The method is tested and further developed within this project (ÖkoRess III).

The information in this factsheet refers exclusively to publicly available, designated sources that have been classified as serious by the authors. It is specifically pointed out that no statement is made about the implementation and quality of agreements or standards that are applied. The implementation of agreements through memberships, certifications, etc. is the responsibility of the companies.

The surface extension of each mine area has been estimated based on publically accessible satellite images as official land-use plans from the public authorities or mine operators are not consistently available. It therefore only corresponds to the apparent area where mining, processing facilities, heaps, etc. and related infrastructure are clearly identifiable.

The fact sheets make no claim to completeness of all relevant voluntary standards. Mentioning a membership in one of the listed voluntary standards does not imply an assessment of the suitability of the standard in itself, nor does it make any statement about the member's success in implementation.

¹TEXTE 87/2017 <https://www.umweltbundesamt.de/publikationen/discussion-of-the-environmental-limits-of-primary>

Sishen

Iron ore

General information	
Indicator or criteria	Description and values
Name of mine	Sishen
Description of mining area	<p>Sishen is a hematite ore deposit and produces around 68 % of Kumba's (a unit of Anglo American) annual iron ore production. The mine produces a hematite ore, which is fully beneficiated at its own plant, using e.g. a dense medium separation (DMS). A second modular plant was commissioned for Sishen in November 2018 (Kumba 2019).</p> <p>Sishen hosts a high-grade hematite ore that is extracted from specific stratigraphic units belonging to the Palaeo-Proterozoic (~ 2400 million years (Ma)) Transvaal and (~ 2070 Ma) Olifantshoek Supergroups, respectively. The ore body has four types of hard iron ore: massive, laminated, conglomerated and brecciate (Shangoni 2017).</p>
Surface extension	186.83km ² 186.83 km ² (Image date: 25.12.2018; Viewing height: 26.05 km) (Google Earth)
In operation since	1953 1953 (Anglo American 2010)
Operator	Kumba Iron Ore
Owner	Anglo American
Closest town	Kathu is very close to the Sishen mine (10km away) and its existence and expansion are linked to that of the mine. The mine is 280 km north west of Kimberly. The mine also has its own airstrip, operating daily chartered flights (Shangoni 2017).
Province	Northern Cape
Country	South Africa
Longitude	23.002599°



Latitude	-27.746849°
Altitude	1213 m a.s.l. 1213 m a.s.l. (Google Earth)
Main product and by-products	Main product: Iron Ore (lump 72% fine 28%); by-product: none
On-site processing stages	The iron ore is beneficiated on site, using dense media separation & jig technology to produce high grade lump and fine iron products (Kumba 2019)
Annual production	29.2 Mt iron ore (Kumba 2019).
Proven Reserves	323 Mt of Hematite (including ROM stockpile) – 58.7 % Fe (Anglo American 2019b)
Probable Reserves	221.6 Mt of Hematite (including ROM stockpile) – 55.6 % Fe (Anglo American 2019b)

Geology



Indicator or criteria	Description and values	Explanation	Assessment result	Data quality
Preconditions for acid mine drainage (AMD)	The absence of sulphates in waste streams and the alkaline nature of the ore and wastes indicate AMD is not applicable to Sishen (Anglo American 2018).	As environmental impact reviews have tested and established the lack of sulphates in the ore, a Low EHP rating is given.	Low	A = high, can be derived directly from available data
Paragenesis with heavy metals	Of the two type of wastes produced by the mine/processing unit, tests indicate that none of the constituents exceed leachable limits of arsenic, barium, cadmium, antimony and fluoride, exceed total limits. The material is noted to be slightly alkaline (Anglo American 2018).	As environmental impact reviews have tested and established the leachability limits to be within acceptable levels, a Low EHP rating is given.	Low	A = high, can be derived directly from available data

Paragenesis with radioactive components	No specific information on Sishen obtained.	In accordance with the measuring instructions, iron ore deposits are evaluated with a medium EHP, if no other information is available (Dehoust et al. 2017b)	Medium	B2 = medium, classified according to measurement instructions
Deposit size	Starting production in 1953, the mine is estimated to have produced in excess of 1 billion tonnes of iron ore. Its reserve life in 2018 was noted to be a further 14 years (Kumba 2019).	Given the life of the mine and ore extracted over its production, the deposit size is classified as large resulting in a high EHP.	High	A = high, can be derived directly from available data
Ore grade	64.6 % Fe (Kumba 2019).	In line with Priester et al. iron ore with grades above 60 % is classified as high-grade (Priester et al. 2019). Therefore, the EHP resulting from the ore grade is low.	Low	A = high, can be derived directly from available data

Technology



Indicator or criteria	Description and values	Explanation	Evaluation result	Data quality
Mine type	Conventional drill, blast, truck and shovel open-pit operations (Kumba 2019).	Open-pit mines are usually limited to an area that is only slightly larger than the projection of the deposit body to the surface. Accordingly, the EHP resulting from the mining method is medium.	Medium	A = high, can be derived directly from available data

Use of auxiliary substances	The processing unit employs DMS, which uses ferrosilicon as dense medium (Mare et al. 2015).	The processing unit does produce waste slurry and a heavy media separation technique is employed. Thus, according to the measuring instructions a Medium EHP is awarded.	Medium	A = high, can be derived directly from available data
Mining waste	There is a waste rock as well as a tailings storage facility from the processing unit (Anglo American 2018). Off-grade ore is stockpiled around the mine site. The tailings produced by the processing plant are sent from the processing plant thickener dams to the tailing's storage facility. The dam height of the tailings storage facility is 35 meters. There is a landfill associated specifically with the mine, on its licence area (Shangoni 2017).	The tailings storage facility qualifies as a large dam according to ICOLD definition. Accordingly the EHP resulting from waste management is high.	High	A = high, can be derived directly from available data
Remediation measures	The nature of the top soil and that it was only started to be stockpiles in 1982, suggests that Sishen will be constrained when it comes to rehabilitation. The mine closure plans takes into consideration the decommissioning and disposal of the processing plant and infrastructure on the mine site (Shangoni 2017).	No details for parallel remediation measures could be identified for Sishen. Adequate financial costing appears to have been undertaken under the mine closure plans. Therefore, a Medium EHP is provided.	Medium	B2 = medium, classified according to measuring instructions

Framework conditions natural environment



Indicator or criteria	Description and values	Explanation	Evaluation result	Data quality
Accident hazard due to floods, earthquake, storms, landslides	The rating system for the 4 sub-indicators uses georeferenced data from publicly available risk maps (see measurement instructions (Dehoust et al. 2017a)). Metrics are directly taken from the given risk assessment. The indicator total is determined by the highest hazard level of the sub-indicators.	The EHP for all sub-indicators are low (earthquakes, landslide, tropical storm, arctic region) except for floods which is high leading to an overall high EHP.	High	A = high, can be derived directly from available data
Water Stress Index (WSI) und desert areas	The WSI by Pfister et al. (2009) provides characterization factors on the relative water availability at watershed level. Absolute water shortages in dry areas is supplemented by desert areas. The highest hazard level of the sub-indicators determines the total result.	The water stress for the mining area is low but it is situated in a desert area, which results in a High EHP.	High	A = high, can be derived directly from available data
Protected areas and AZE sites	Georeferenced data for designated protected areas are used to assess hazards posed by mining extraction. The metric to evaluate EHPs corresponds to the method first described in the draft standard of the Initiative for Responsible Mining Assurance (IRMA 2014).	The mining area is not situated in designated protected areas and AZE sites, which results in a low EHP.	Low	A = high, can be derived directly from available data

State Governance

Indicators

WGI 1 -Voice and Accountability	70.44 ^{ooo}
WGI 2 -Political Stability and Absence of Violence/ Terrorism	36.19 ^{ooo}
WGI 3 - Government Effectiveness	66.35 ^{ooo}
WGI 4 -Regulatory Quality	61.54 ^{ooo}
WGI 5 - Rule of Law	50.96 ^{ooo}
WGI 6 -Control of Corruption	57.21 ^{ooo}
EPI (Environmental Performance Index)	44.73
EITI membership	No
International Agreements	
ILO 176	Yes - in 2000
Others	OECD Member
Legal framework	

Areas of Law: Environment	<p>The legal framework for environmental assessments and environmental protection in South Africa has been undergoing reform for several years. In 2015, the government published the National Environmental Management Laws Amendment Bill for public comment and in November of 2015 promulgated the Financial Provisioning Regulations (FP Reg.), which apply to prospecting, exploration and mining or production operations. The on-going legislative reform is part of the 'One Environmental System' effort, which aims to bring the mining industry within the scope of the environmental management system that has applied to other industries for many years, as well as to streamline the overall environmental permitting process. As a result of the on-going reform the EIA process, and more generally the requirements for environmental protection and management, are in a continuing state of flux in South Africa. The system is highly burdensome, complex and reportedly inconsistently applied and enforced by the government.</p> <p>At present, a wide variety of environmental legislation is pertinent to the mining sector including: the National Environmental Management Act 1998 (NEMA), as amended by the National Environmental Management Amendment Act 2008 (NEMAA) and the National Environmental Management Laws Amendment Act 2014 (NEMLAA); the Mineral and Petroleum Resources Development Act 2002 (MPRDA) as amended by the Mineral and Petroleum Resources Development Amendment Act 2008 (MPRDAA); the Mineral and Petroleum Resources Development Regulations 2004 (MPRDA Reg.); the National Environmental Management Waste Act 2008 (Waste Act); the Regulations Regarding the Planning and Management of Residue Stockpiles and Residue Deposits from a Prospecting, Mining, Exploration or Production Operation 2015 (Mining Residue Regulations); and the EIA Regulations 2014. In addition, the FP Reg. mentioned above apply to applicants and holders of mineral rights and regulate financial provisions for the management, rehabilitation and remediation of environmental impacts, which arise from mining activities and operations (see s. 2 FP Reg.) (MineHutte 2019).</p>
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<p>Areas of Law: Occupational Health and Safety (OHS)</p>	<p>Based on the recommendations of a commission of inquiry into health and safety in the mining industry in 1995, South Africa enacted the Mine Health and Safety Act in 1996 (MHSA). The MHSA and its accompanying regulations continue to provide the regulatory framework for health and safety issues in South Africa - with various amendments taking place over the last 20 years. Under the terms of the MHSA, employers are responsible for providing conditions for safe operations and must maintain a working environment in which, as far as is practicable, workers are not exposed to hazards. Employers are also charged with ensuring that persons who are not employees, but may be directly impacted by a mine, are not exposed to hazards to their health and safety. The MHSA also contains requirements relating to health and safety policies, codes of practice and employee training. It is the responsibility of the CEO of the mine to ensure that the obligations of the employer under the MHSA are met and though these responsibilities may be delegated the onus still ultimately falls on the CEO. The MHSA established a Mine Health and Safety Inspectorate and provided for the appointment of a Chief Inspector of Mines – who is responsible for ensuring companies comply with the terms of the MHSA and its accompanying regulations (MineHutte 2019).</p>
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Corporate Social Responsibility (CSR)

Voluntary Standards

<p>Aluminium Stewardship Initiative (ASI): Is the mine owning company a member?</p>	<p>Not applicable Not applicable</p>
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Aluminium Stewardship Initiative (ASI): Is the mine certified?	Not applicable Not applicable
International Council of Mining & Metals (ICMM): Is the mine owning company a member?	Yes Yes – The parent company Anglo American is a member (ICMM 2019)
Towards Sustainable Mining (TSM) Is the mine owning company a member of the Mining Association of Canada (MAC)?	No No (MAC 2019)
Towards Sustainable Mining (TSM) outside Canada: Are TSM standards implemented*?	No No (MAC 2019)
Initiative for Responsible Mining Assurance (IRMA): Is the mine owning company a member?	Yes Yes (IRMA 2018)
Initiative for Responsible Mining Assurance (IRMA): Is the mine certified?	No No (IRMA 2018)
Responsible Copper (RC): Is the mine owning company a member of RC?	Not Applicable Not Applicable
Responsible Copper (RC): Is the mine certified?	Not Applicable Not Applicable
Responsible Mining Index (RMI): Has the mine been rated?	No No (RMI 2018a)
Responsible Mining Index Company indicator „Working conditions“	0.788 0.788 /1.00 (RMI 2018b)
Responsible Mining Index Company indicator „Environmental sustainability“	0.669 1. 669 /1.00 (RMI 2018b)
Responsible Steel (RS): Is the mine owner a member of the RS?	No No (Responsible Steel 2019)
Responsible Steel (RS): Is the mine certified?	No No (Responsible Steel 2019)

Australian Steel Stewardship Forum (ASSF): Is the owner a member of the ASSF?	No No (Australian Steel Stewardship Forum 2019)
Australian Steel Stewardship Forum: Is the mine certified?	No No (Australian Steel Stewardship Forum 2019)
ISO and CSR reporting	
ISO 14001 (ISO 14004): Is the mine ISO 14001 certified?	Yes Yes (Kumba 2019)
CSR-directive 2014/95/EU: Does the mine owning company have its headquarters in an EU country?	Yes Yes (UK)
OECD Guidelines: Does the company have its headquarters in a signatory state?	Yes Yes (UK)
ISO 26000: Does the mine implement ISO 26000?*	No information obtained Not indicated in company documents.
Banking Standards	
WB Standards / IFC Performance Standards: Is the mine financed to a major extend by the world bank?	No information obtained No information obtained
Equator Principles (EP): Is the mine financed to a major extend by a bank adherent to the EP?	No information obtained No information obtained

*by companies own account.

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A Glossary

Table 1 Legend

Environmental hazard potential



low



medium



high

Data quality



low



medium



high

- No concrete information, no general specifications of the measurement instructions, expert estimation.
- Assessment not possible due to lack of data at the site, as there is also no evidence for an assessment and there are no generalized assessment rules.

- Assessable on the basis of available information.
- Generalized classification according to measurement instructions.

- Can be derived directly from available data.

B Abbreviations

EHP	Environmental hazard potential
FY	Financial year
kt	Kilo tonnes
m a.s.l.	Meters above sea level
Mt	Million tonnes
OHS	Occupational Health and Safety
t	tonnes
TSF	Tailing Storage Facility
WGI	World Governance Indicators
WHS	Work Health and Safety

C Imprint

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- Öko-Institut e.V. (Institute for Applied Ecology)