Thabazimbi Iron Ore Mine (Pty) Ltd: Thabazimbi Iron Ore Mine

Environmental Authorisation and Waste Management Licence Application for the proposed reclamation of the Discard Dumps and Slimes Dams
Environmental Impact Assessment Report and Environmental Management Programme Report

Report date: October 2020
Reference: LP30/5/1/3/2/1(45) and (47) EM

SHANGONI
Management Services (Pty) Ltd

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PART A

SCOPE OF ASSESSMENT AND ENVIRONMENTAL IMPACT ASSESSMENT REPORT

1 Details of project applicant and environmental assessment practitioner

1.1 Details of the project applicant

Name of operation	Thabazimbi Iron Ore Mine
Applicant	Thabazimbi Iron Ore Mine (Pty) Ltd
Postal address	Thabazimbi Iron Ore Mine Private Bag X534 Thabazimbi 0380
Responsible person	Heilet Hattingh
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Company registration no.	2006/034408/07

1.2 Details of the environmental assessment practitioner

EAP	Shangoni Management Services (Pty) Ltd.: Minnette le Roux
Tel No	(012) 807 7036
Fax No	(012) 807 1014
e-mail Address	minnette@shangoni.co.za

1.3 Expertise of the environmental assessment practitioner

Name and Surname	Qualifications and summary of experience
Minnette Le Roux	Minnette is a Principal Environmental Consultant with over 13 years consulting experience and obtained her B.Sc. Hons degree from the University of Pretoria. She is a registered Environmental Assessment Practitioner (EAP) and is a registered *Pr.Sci.Nat* in the fields of Environmental Science and Conservation Science. She has been project manager and

Name and Surname	Qualifications and summary of experience
	coordinator on a number of large environmental authorisations for predominantly industrial and mining clients. Minnette has extensive integrated environmental management experience, including amongst other; Environmental Impact Assessments, Scoping Reports, Basic Assessments, Environmental Management Plans, Environmental Management Programmes, Integrated Water Use Licence Applications, Integrated Water and Waste Management Plans, Waste Tyre Abatement plans, Biodiversity Action Plans, Screening Reports, Gap-Analysis, Due diligence reports, Waste Management Licence Applications, Mining and Prospecting Right Applications and various other Application forms as part of the Environmental Application Process. She also has experience in Environmental Management Programme Report Performance Assessments and Environmental Authorisation Compliance Audits, Legal Compliance Audits, Water Use Licence Compliance Audits, Regulation GN 704 Audits and Environmental Management Systems Audits (ISO 14001), Applications for exclusions exclusion of a waste stream or a portion of the waste stream from the definition of waste, Legal reviews, EMPr Peer reviews, and technical input and involvement in Legal Opinions and Reviews and Greenhouse Gas verification reports.
Marvin Grimett	Marvin holds an Honour's Degree in Environmental Science from the University of KwaZulu-Natal and has been actively involved in environmental management for the past 7 years. He has been project manager and coordinator on many large environmental authorisations for predominantly industrial and mining clients. Marvin has extensive integrated environmental management experience, including amongst other; Environmental Impact Assessments, Scoping Reports, Basic Assessments, Environmental Management Plans, Environmental Management Programmes, Integrated Water Use Licence Applications, Integrated Water and Waste Management Plans, Mining and Prospecting Right Applications and various other Application Forms as part of the Environmental Application Process

2 Description of the property

Table 1: Description of the properties applicable to the proposed activities

Fame name	**D1 – Old Plant Discard Dump** Remaining Extent of Portion 3 of the farm Wachteenbietjesdraai 350 KQ **D2 – Old Plant Discard Dump** Remaining Extent of Portion 2 of the farm Wachteenbietjesdraai 350 KQ **D3 – Supply Chain Discard Dump** Portion 10 of the farm Donkerpoort 344 KQ **Slimes Dams** Remaining Extent of Portion 2 of the farm Wachteenbietjesdraai 350 KQ
Application area (ha)	D1 – Old Plant Discard Dump - 1.5 ha D2 – Old Plant Discard Dump - 11.4 ha D3 – Supply Chain Discard Dump - 2.7 ha Slimes Dams - 34.5 ha
Magisterial district	The Thabazimbi Iron Ore Mine is situated in the Thabazimbi Local Municipality within the Waterberg District Municipality in Limpopo Province South Africa.
Distance and direction from nearest town	Thabazimbi is located 130 km north of Rustenburg, 140 km south of Lephalale (Ellisras), 140 km north-west of Brits, 130 km west of Bela-Bela (Warmbaths), and 220 km north-west of Tshwane (Pretoria).
21-digit Surveyor General code for each farm portion	**D1 – Old Plant Discard Dump** T0KQ00000000035000003 **D2 – Old Plant Discard Dump** T0KQ00000000035000002 **D3 – Supply Chain Discard Dump** T0KQ00000000034400010 **Slimes Dams** T0KQ00000000035000002

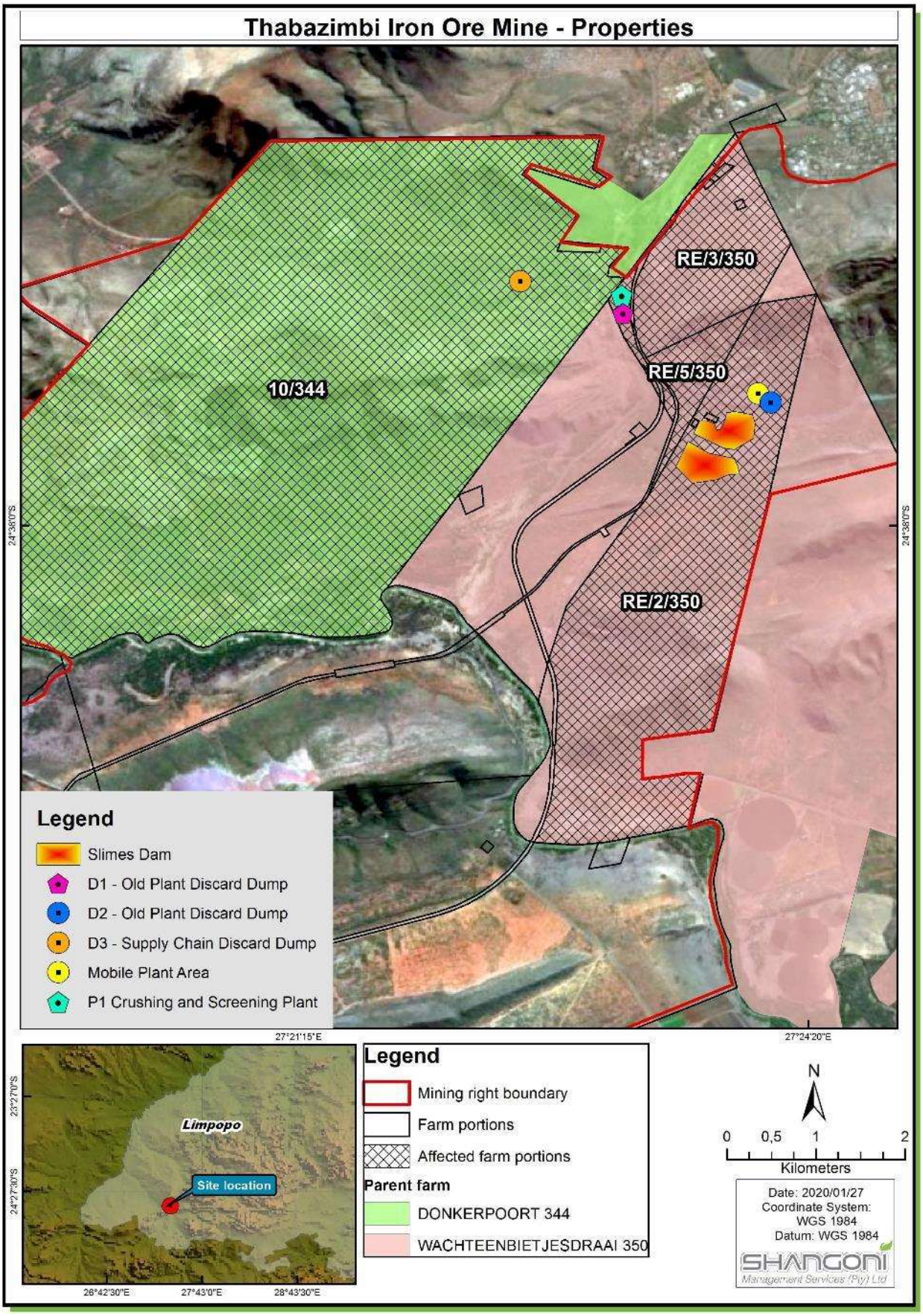


Figure 1: Properties associated with the Discard Dumps, Slimes Dams and the existing plants

3 Locality of the project

3.1 Magisterial district and administrative boundaries

Thabazimbi Iron Ore Mine falls within the administrative boundaries presented Table 2 below.

Table 2: Administrative boundaries associated with the Thabazimbi Iron Ore Mine

Province	Limpopo Province
District municipality	Waterberg District Municipality
Local municipality	Thabazimbi Local Municipality
Ward	4
Department of Mineral Resources and Energy ("DMRE") Local Office	DMRE (Polokwane)
Department of Human Settlements, Water and Sanitation ("DHWS") Local Office	DHWS (Polokwane)
Limpopo Department of Economic Development, Environment and Tourism ("LEDET")	LEDET (Modimolle)
Catchment Zone	Limpopo Catchment
Water Management Area	Crocodile (West) and Marico

3.2 Location of the mine

Thabazimbi Iron Ore Mine ("TIOM"), a full subsidiary of ArcelorMittal South Africa ("AMSA") is an established open pit operation, with ore processed through a single processing facility. The mine, which is owned and operated by AMSA, is located 220 km north-west of Johannesburg and 200 km north-west of Pretoria, in the Limpopo Province. The mine is situated in the town of Thabazimbi, which falls under the jurisdiction of the Thabazimbi Local Municipality ("TLM") and the Waterberg District Municipality ("WDM"), refer to Figure 2.

The Thabazimbi area is characterised by three prominent east-west trending mountain ranges and the majority of the mining operations take place in these mountains where the deposits occur. In the past the mine beneficiated ore in a plant situated close to the mining areas. Where the pits are far removed from the plant, ore was trucked to crushers located close to Donkerpoort pit or the Vanderbijl pit. The crushed material was transported by conveyor belt to a stockpile that feeds the plant. Eskom supplies electricity; water is obtained from boreholes on the mine's properties as well as from the local municipal supply if required.

Opencast mining took place at TIOM. Eight open pits (East pit, Buffelshoek East, Buffelshoek West, Bobbejaanwater, Donkerpoort West, Donkerpoort, Kwaggashoek East and Vanderbijl) are present on site. According to the Life of Mine plan, the inactive pits may be mined in the future. TIOM was operated through conventional opencast methods, including drilling, blasting, loading and hauling.

The pits were excavated with benches of 10-15 m and double benches at the final boundaries. Historically underground mining took place on site. These adits have been sealed where not used anymore.

3.3 Location of the proposed activities

The Slimes Dams are located on Remaining Extent of Portion 2 of the farm Wachteenbietjesdraai 350 KQ, the D1 - Old Plant Discard Dump is located on Remaining Extent of Portion 3 of the farm Wachteenbietjesdraai 350 KQ, the D2 - Old Plant Discard Dump is located on Remaining Extent of Portion 2 of the Farm Wachteenbietjesdraai 350 KQ and the D3 - Supply Chain Discard Dump is located on Portion 10 of the Farm Donkerpoort 344 KQ (indicated Figure 1). The material located at D1 – Old Plant Discard Dump and D3 – Supply Chain Discard Dump will be crushed and screened at the existing P1 – Crushing and Screening Plant indicated as item 14 in Figure 3. The D2 – Old Plant Discard Dump material will be crushed and screened at the existing crushing and screening plant at the Mobile Plant Area (item 12 of Figure 3). The processing of material from the crushing and screening plants and the Slimes Dams will take place at the existing Mobile Plant Area.

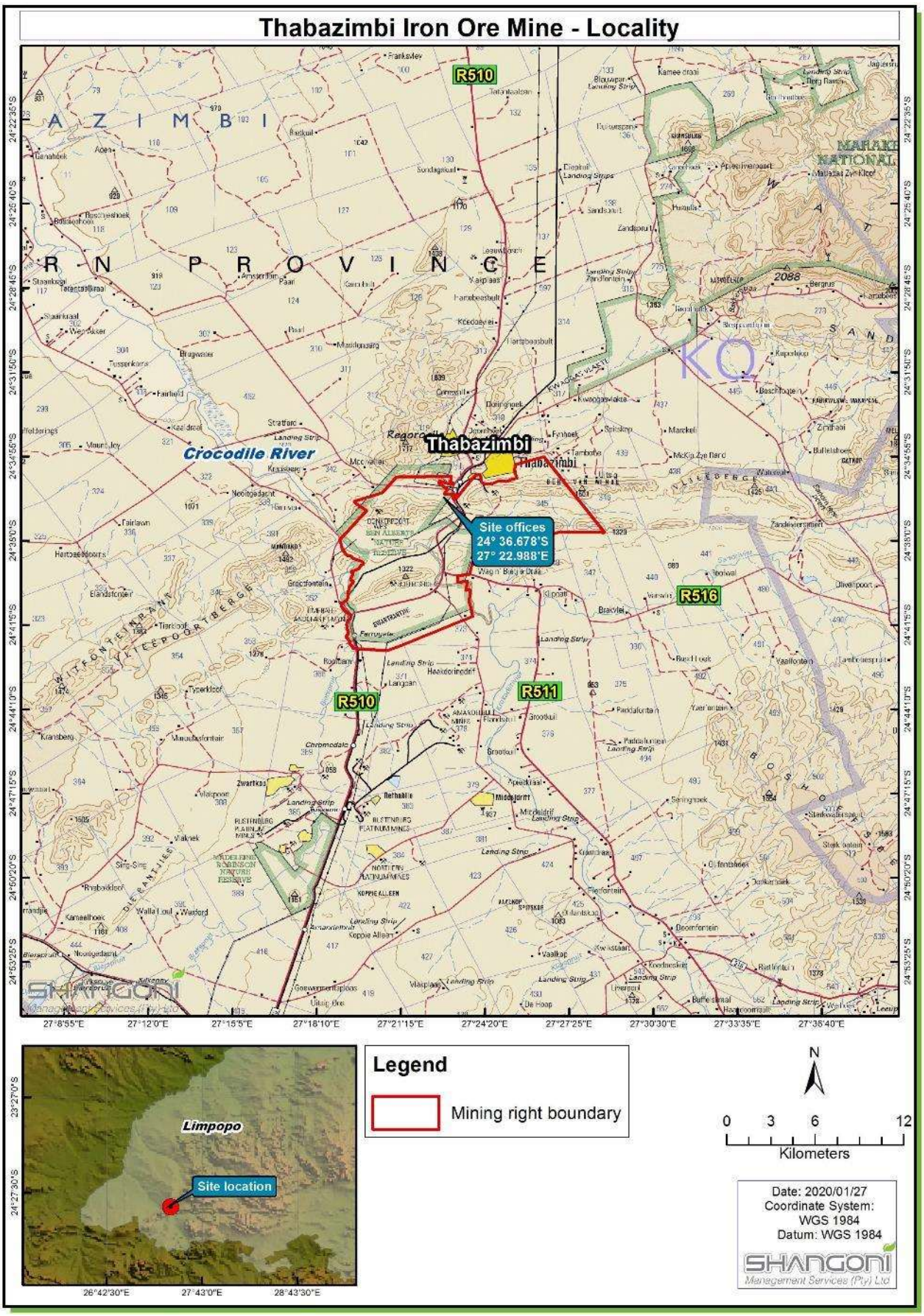


Figure 2: Locality of the Thabazimbi Iron Ore Mine

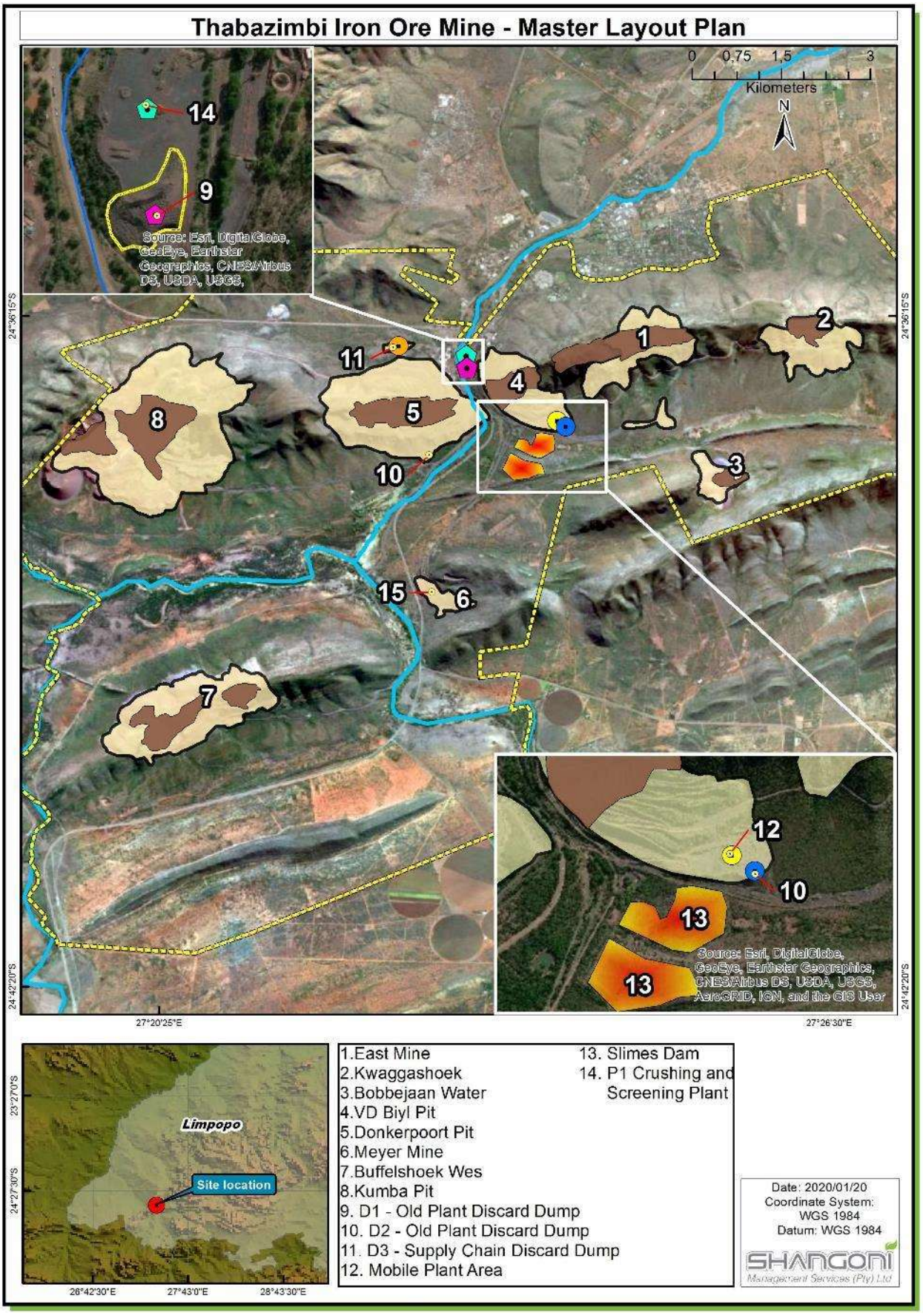


Figure 3: Layout map of the activities associated with the project

4 Description of the scope of the proposed activity

TIOM is pursuing to reclaim D1 – Old Plant Discard Dump, D2 – Old Plant Discard Dump, D3 – Supply Chain Discard Dump and the Slimes Dams, and processing the material at the existing P1 – Crushing and Screening Plant and the existing Mobile Plant ("the project").

4.1 Listed and specified activities applied for

The proposed reclamation of the D1 – Old Plant Discard Dump, D2 – Old Plant Discard Dump, D3 – Supply Chain Discard Dump and the Slimes Dams will trigger the following authorisations:

- An Environmental Authorisation ("EA") for listed activities contained in the Environmental Impact Assessment Regulations Listing Notice 1 of 2014 (GN R983 of 4 December 2014) ("GNR 984") and Environmental Impact Assessment Regulations Listing Notice 3 of 2014 (GN R985 of 4 December 2014) ("GNR 985"), as amended published in terms of Sections 24(2), 24 (5), 24D, 44 and 47(A) (1) (b) of the NEMA.
- Waste Management License ("WML") in terms of Section 19 of the National Environmental Management Waste Act (Act No. 59 of 2008) ("NEM:WA") and the List of Waste Management Activities ("GN R921") dated 29 November 2013, as amended.

For the EA and WML applications, a Scoping and Environmental Impact Assessment Report ("S&EIR") is required in compliance with the National Environmental Management Act, 1998 (Act No. 107 of 1998) ("NEMA") and the NEMA Environmental Impact Assessment Regulations, 2014 (GN R982 of 4 December 2014) ("GN R982"), as amended. Listed activities have been identified as associated with the proposed reclamation activities and the legal status of the plants have been provided in Table 3.

Table 3: Activities and listed activities associated with the project

Name of Activity	Arial Extent of Activity ha or m²	Listed Activity (Mark with X)	Applicable Listing Notice (GN R983, GN R984, GN R985)	Waste Management Authorisation (Mark with X)	Applicable Waste Activity (GN 921)	Legal Status
The reclamation of the D1 - Old Plant Discard Dump	15 388.86 m²	X	Activity 12 of Listing Notice 1 (GNR 983 of GG 40772 of 7 April 2017): *The development of—* *(ii) infrastructure or structures with a physical footprint of 100 square metres or more;* *where such development occurs—* *(c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse; —* Activity 14 of Listing Notice 3 (GNR 985 of GG 40772 of 7 April 2017): *The development of—* *(ii) infrastructure or structures with a physical footprint of 10 square metres or more;* *where such development occurs—* *(c) if no development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse.*	X	Category B: Activity 11: *The establishment or reclamation of a residue stockpile or residue deposit resulting from activities which require a mining right, exploration right or production right in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002).*	The proposed reclamation of the D1 – Old Plant Discard Dump will require an EA as it is located within 32 m of a watercourse. Furthermore, a WML will be required for the reclamation of the Discard Dump (a residue stockpile).
The reclamation of the D2 - Old Plant Discard Dump	31 284.85 m²		No listed activities were identified to be triggered.	X	Category B: Activity 11: *The establishment or reclamation of a residue stockpile or residue deposit resulting from activities which require a mining right, exploration right or production*	A WML will be required for the reclamation of the Discard Dump (a residue stockpile).

Name of Activity	Arial Extent of Activity ha or m²	Listed Activity (Mark with X)	Applicable Listing Notice (GN R983, GN R984, GN R985)	Waste Management Authorisation (Mark with X)	Applicable Waste Activity (GN 921)	Legal Status
					right in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002).	
The reclamation of the D3-Supply Chain Discard Dump	56 107.74 m²		No listed activities were identified to be triggered.	X	Category B: Activity 11: *The establishment or reclamation of a residue stockpile or residue deposit resulting from activities which require a mining right, exploration right or production right in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002).*	A WML will be required for the reclamation of the Discard Dump (a residue stockpile).
The reclamation of the Slimes Dams	411 036.72 m²		No listed activities were identified to be triggered[1].	X	Category B: Activity 11: *The establishment or reclamation of a residue stockpile or residue deposit resulting from activities which require a mining right, exploration right or production right in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002).*	A WML will be required for the reclamation of the Slimes Dams (residue stockpiles).
Dense Medium Separation Plant and the mobile	800 m²	N/A[2]	N/A	N/A	N/A	A mobile plant was approved by LEDET on 26 May 2015 by LEDET (12/1/9/2-W26) as part of the Infinity Project. After the authorisation was granted, a plant re-location trade-off

[1] Note that there is a drainage line between Compartment 1 and 2 and Compartments 3 and 4 of the slimes dams. The reclamation activities will be undertaken outside of the 32m of the edge of the watercourse. Should any activities be undertaken within the watercourse or 32 meter from the edge of the watercourse separate environmental authorisation and water use licence applications will be submitted.

[2] N/A: The listed activities associated with the activity does not form part of this application and has already been approved.

Name of Activity	Arial Extent of Activity ha or m²	Listed Activity (Mark with X)	Applicable Listing Notice (GN R983, GN R984, GN R985)	Waste Management Authorisation (Mark with X)	Applicable Waste Activity (GN 921)	Legal Status
High Density Medium DMS Plant ("Mobile Plant").						study was undertaken to identify a new site for the stand-alone plant. The trade-off study identified the site next to the D2 – Old Plant Discard Dump area as the best location for the plant. The relocation of the plant was approved by the then Department of Mineral Resources ("DMR") on 12 September 2019 (LP30/5/1/2/3/2/1 (45 & 47 EM). Therefore, the Mobile Plant is already authorised for the intended use.
P1 – Crushing and Screening Plant	570 m^2	N/A	N/A	N/A	N/A	The P1 – Crushing and Screening Plant will only be utilised for the crushing and screening of D1 – Old Discard Dump and D3 – Supply Chan Discard Dump. As part of the Authorisation granted by the DMRE on 12 September 2019, TIOM is authorised to process stockpiles at source. Therefore, the P1 – Crushing and Screening Plant is already authorised for the intended use.
Slimes Pipeline	200 m	N/A	N/A	N/A	N/A	TIOM has existing pipelines between the existing plant and the Slimes Dams. As the Slimes Dams are being reclaimed, a portion of the pipeline will need to be reconstructed. The Slimes pipeline is proposed to be constructed from the existing pipeline to the Slimes Dams. The proposed pipeline is approximately 200 m in length with a diameter of 0.1 m. As the proposed pipeline is less than 1000 m in length and the diameter less than 0.3 m, the proposed pipeline will not trigger a listed activity.

4.2 Description of the proposed activities

From studies undertaken by TIOM, it was discovered that the existing Discard Dumps and Slimes Dams have recoverable iron ore. The D1 - Old Plant Discard Dump, D2 - Old Plant Discard Dump and D3 – Supply Chain Discard Dump never formed part of the historical main production feed, due to high contaminants not blendable at the time, or not liberated sufficiently at previous ore sizes. One of the main characteristics of the Thabazimbi ore is the benefit achievable by crushing material down to -5 mm (Sinter feed size), and beneficiating this material at higher than previously achievable densities. The detrital ore bodies were considered to be insignificant in size, but issues regarding clay formations also prevented them from being treated in the old plant.

Referencing previous ore studies conducted by Kumba, discarding ideas of restarting the old plant and having a new critical look at the acceptable contaminant levels have opened up a potential business case for treating these old discard stockpiles and produce an acceptable ore to the AMSA Vanderbijlpark steelworks.

TIOM is pursuing the opportunity to process the existing D1 - Old Plant Discard Dump, D2 - Old Plant Discard Dump, D3 - Supply Chain Discard Dump and the existing Slimes Dams with the aim to supply product (high quality iron ore) to the ArcelorMittal South Africa (“AMSA”) Vanderbijlpark Steel Works and aggregate to the cement market.

4.2.1 Reworking Process Flow

4.2.1.1 D1 – Old Plant Discard Dump

The discard material from the D1 – Old Plant Discard Dump will be reworked utilising a front-end loader. Material from the D1 – Old Plant Discard Dump will be placed directly through the P1 – Crushing and Screening Plant. After the crushing and screening process, product material will be loaded onto a 30 tonne truck and transported to the Mobile Plant area, utilising the existing haul road, where the product material will be blended with material from the D2 – Old Plant Discard Dump. Any discard material from the D1 – Old Plant Discard Dump that is not suitable for blending at the Mobile Plant will be stockpiled back onto the D1 – Old Plant Discard Dump.

After the discard material is blended, the product material will be loaded onto 30 tonne trucks and transported to the existing stockpile area at Meyer’s Mine (refer to Figure 4). Discard material, after processing at the Mobile Plant area, will be disposed of on the D2 – Old Plant Discard Dump as final disposal.

4.2.1.2 D2 – Old Plant Discard Dump

The discard material from the D2 – Old Plant Discard Dump will be crushed and screening at source utilising a front-end loader to load the material into the crusher. After the crushing and screening process, any material that is not suitable for processing at the Mobile Plant will be stockpiled back onto the D2 – Old Plant Discard Dump. All material that is suitable for processing will be transported to the Mobile Plant Area where the material will be processed. Excess discard material after

processing at the Mobile Plant Area will be disposed of on the D2 – Old Plant Discard Dump as final disposal.

4.2.1.3 D3 – Supply Chain Discard Dump

The discard material from the D3 – Supply Chain Discard Dump will be screened and crushed at source. The material will be sold to external parties after being crushed and screened. The route that the external parties will utilise is shown in Figure 4. Excess discard material after crushing and screening will be disposed of on the D3 – Supply Chain Discard Dump as final disposal.

4.2.1.4 Slimes Dams

Material from the Slimes Dams will be reworked utilising front-end loaders. The slimes will be loaded onto 30 tonne trucks and transported to the Mobile Plant Area for processing utilising the existing haul road as shown in Figure 4.

It is proposed that after processing, any excess slimes that is not used for creating a product, will be deposited onto a proposed new Slimes Dam. It should be noted that the proposed new Slimes Dam does not form part of this application, and TIOM is required to apply for the various authorisations associated with the proposed new Slimes Dams separately.

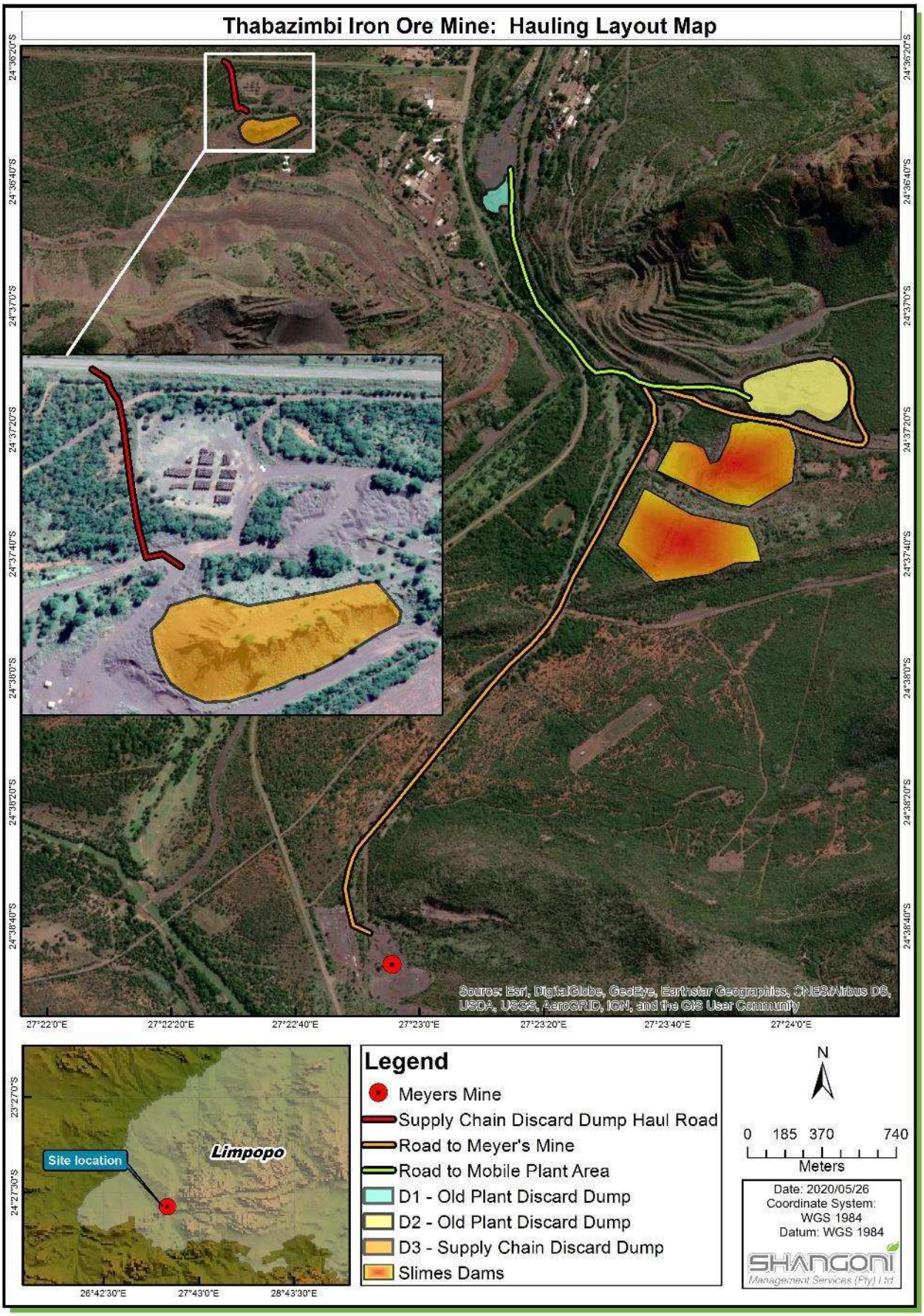


Figure 4: Layout Map of hauling routes associated with the project.

4.2.2 Characteristics and Classification of the discard and slimes material

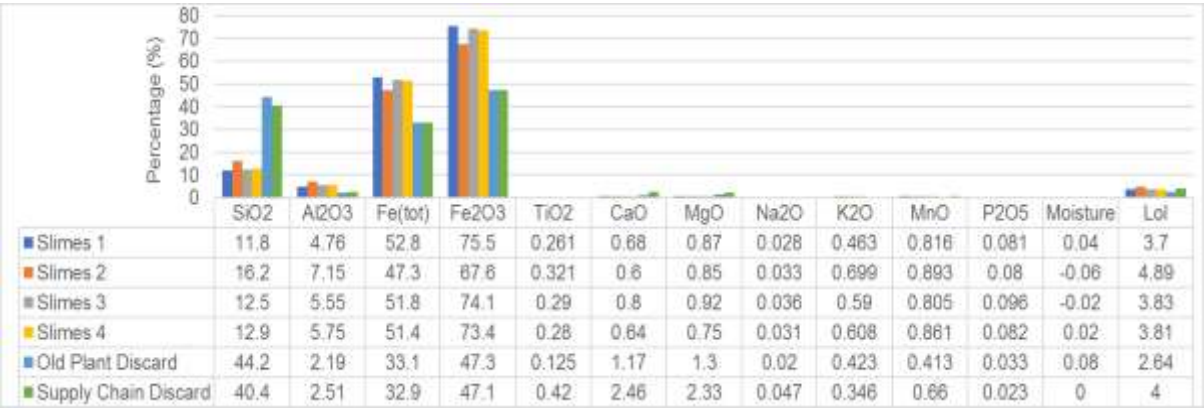
A geochemical investigation was undertaken to characterise and classify the materials from the discard dumps and the slimes in terms of its i) potential physical, human and environmental hazards (SANS 10234); and ii) a high-level human health and ecological risk assessment. The following information was obtained from the *Thabazimbi Iron Ore Mine (Pty) Ltd: A Subsidiary of ArcelorMittal South Africa Limited – Thabazimbi Iron Ore Mine SANS 10234 Classification for an application to exclude a waste stream or portion of a waste stream from the definition of waste, in terms of GN 715 of 18 July 2018*, dated April 2020 and compiled by Shangoni AquiScience.

Total concentrations

A geochemical investigation was performed to identify contaminants of concern ("CoC") and specific elements that will pose an environmental and leachate risk. Whole rock elemental analyses (aqua regia) including a leachate assessment (1:20 solid:distilled water) were performed. Although not relevant for this study, the results were, where available, compared to the National Norms and Standards for the Assessment of Waste for Landfill Disposal (GN R635).

A total of 35 samples were taken on 10 December 2019 from the 4 slimes compartments and 3 Discard Dumps. These were subsequently composited into 6 samples representing the various facilities. The samples were submitted to UIS Analytical Services and Biotox Laboratories, both SANAS accredited laboratories, located in Pretoria.

The results for the major elements as recorded in the whole rock analyses are displayed in Figure 5. Some differences exist between the slimes and the discard facilities but only with regards to contents of silica oxide (SIO_2), iron oxide/hematite (Fe_2O_3), total iron, calcium oxide (CaO) and magnesium oxide (MgO). The iron content is substantially greater in the slimes compared to the discard samples with Fe_2O_3 ranging between 68 % and 76 % and 40 % to 44 %, respectively. MnO and Al_2O_3 are also slightly more raised in the slimes samples. The discard samples are dominated by SiO_2 (40 % – 44 %), followed by Fe_2O_3 (~47 %), CaO and MgO (1 % – 2 %).



	SiO2	Al2O3	Fe(tot)	Fe2O3	TiO2	CaO	MgO	Na2O	K2O	MnO	P2O5	Moisture	LoI
Slimes 1	11.8	4.76	52.8	75.5	0.261	0.68	0.87	0.028	0.463	0.816	0.081	0.04	3.7
Slimes 2	16.2	7.15	47.3	67.6	0.321	0.6	0.85	0.033	0.699	0.893	0.08	-0.06	4.89
Slimes 3	12.5	5.55	51.8	74.1	0.29	0.8	0.92	0.036	0.59	0.805	0.096	-0.02	3.83
Slimes 4	12.9	5.75	51.4	73.4	0.28	0.64	0.75	0.031	0.608	0.861	0.082	0.02	3.81
Old Plant Discard	44.2	2.19	33.1	47.3	0.125	1.17	1.3	0.02	0.423	0.413	0.033	0.08	2.64
Supply Chain Discard	40.4	2.51	32.9	47.1	0.42	2.46	2.33	0.047	0.346	0.66	0.023	0	4

Figure 5: Whole rock analyses of major oxides, loss on material on ignition (LoI) and moisture content

The whole rock elemental analysis revealed certain elements to be present in the parts per billion ("ppb") and parts per million ("ppm") ranges (Table 4). The significance of these concentrations is directly related to the degree of toxicity that may result after exposure long- or short term. Therefore, threshold limits were established to "classify" waste materials (including mining related stockpiles or residue dumps) with reference to their potential environmental risk.

Table 4: Total trace element concentration results compared against the Total Concentration Threshold ("TCT") Limits of GN R635

Elements & Chemical Substances	Slimes 1	Slimes 2	Slimes 3	Slimes 4	Old Plant Discard	Supply Chain Discard	TCT0	TCT1
Ag, silver (mg/kg)	0.07	0.08	0.07	0.08	0.04	0.05	n/a	n/a
As, arsenic (mg/kg)	16.2	16.2	15.9	14.2	9.58	11.4	5.8	500
B, boron (mg/kg)	21.0	31.0	31.7	33.9	19.2	20.7	150	15000
Ba, barium (mg/kg)	154	209	181	180	86	129	62.5	6250
Be, beryllium (mg/kg)	2.96	3.31	3.22	3.12	1.75	1.85	n/a	n/a
Bi, bismuth (mg/kg)	0.28	0.31	0.26	0.28	0.16	0.28	n/a	n/a
Cd, cadmium (mg/kg)	0.15	0.17	0.15	0.14	0.07	0.11	7.5	260
Ce, cerium (mg/kg)	50.6	23.5	36.8	28.2	37.4	49.4	n/a	n/a
Co, cobalt (mg/kg)	18.5	23.7	20.3	21.3	11.7	14.9	50	5000
Cr, chromium (mg/kg)	96.9	105.4	97.6	93.2	46.3	87.5	46000	800000
Cs, caesium (mg/kg)	1.23	1.17	1.38	1.09	1.70	1.43	n/a	n/a
Cu, copper (mg/kg)	68.7	111	63.9	63.0	18.8	39.5	16	19500
Ga, gallium (mg/kg)	4.70	7.20	5.47	6.19	3.26	4.47	n/a	n/a
Ge, germanium (mg/kg)	2.30	1.89	2.44	1.88	2.66	2.56	n/a	n/a
Hf, Hafnium (mg/kg)	2.29	3.08	2.29	2.46	1.19	1.62	n/a	n/a
Hg, mercury (mg/kg)	0.05	0.04	0.06	0.05	0.01	0.03	0.93	160

Elements & Chemical Substances	Slimes 1	Slimes 2	Slimes 3	Slimes 4	Old Plant Discard	Supply Chain Discard	TCT0	TCT1
Ho, holmium (mg/kg)	0.58	0.52	0.55	0.54	0.45	0.50	n/a	n/a
La, lanthanum (mg/kg)	36.0	12.3	22.5	17.2	29.1	33.6	n/a	n/a
Li, lithium (mg/kg)	16.7	16.9	18.0	15.6	14.0	19.9	n/a	n/a
Mn, manganese (mg/kg)	6731	7334	6655	7079	3385	5468	1000	25000
Mo, molybdenum (mg/kg)	1.13	1.04	0.98	0.92	0.63	0.69	40	1000
Nb, niobium (mg/kg)	3.47	3.07	3.69	2.86	2.07	3.06	n/a	n/a
Nd, neodymium (mg/kg)	20.4	11.4	16.1	14.3	16.6	19.2	n/a	n/a
Ni, nickel (mg/kg)	82.7	100	86.6	84.5	46.1	64.4	91	10600
Pb, lead (mg/kg)	6.97	8.21	8.36	8.65	4.85	5.59	20	1900
Rb, rubidium (mg/kg)	12.2	3.28	7.61	4.02	12.3	10.2	n/a	n/a
Sb, antimony (mg/kg)	1.69	1.55	1.76	1.56	1.09	1.25	10	75
Sc, scandium (mg/kg)	3.85	6.30	5.36	5.43	4.58	4.29	n/a	n/a
Se, selenium (mg/kg)	0.08	0.13	0.02	0.12	0.02	0.09	10	50
Sn, tin (mg/kg)	1.05	1.20	1.08	1.03	0.86	1.27	n/a	n/a
Sr, strontium (mg/kg)	30.8	31.2	32.1	34.5	12.5	17.8	n/a	n/a
Ta, tantalum (mg/kg)	0.34	0.35	0.35	0.31	0.26	0.47	n/a	n/a
Te, tellurium (mg/kg)	0.05	0.06	0.06	0.05	0.04	0.08	n/a	n/a
Th, thorium (mg/kg)	14.3	9.34	9.74	9.49	12.6	11.3	n/a	n/a
Tl, thallium (mg/kg)	0.22	0.25	0.21	0.21	0.21	0.16	n/a	n/a
U, uranium (mg/kg)	3.70	4.09	3.90	3.81	2.23	2.13	n/a	n/a

Elements & Chemical Substances	Slimes 1	Slimes 2	Slimes 3	Slimes 4	Old Plant Discard	Supply Chain Discard	TCT0	TCT1
V, vanadium (mg/kg)	29.4	28.1	31.4	26.9	19.5	24.5	150	2680
W, tungsten (mg/kg)	3.17	1.78	2.69	1.92	2.73	3.09	n/a	n/a
Y, yttrium (mg/kg)	22.4	16.6	19.2	19.0	16.3	19.5	n/a	n/a
Zn, zinc (mg/kg)	57.4	69.1	63.5	57.1	33.1	50.2	240	160000
Zr, zirconium (mg/kg)	117	153	103	130	59.0	73.0	n/a	n/a
F^-, fluoride (mg/kg)	184	255	240	186	133	209	100	10000
Cr^{6+}, hexavalent chromium (mg/kg)	<5	<5	<5	<5	<5	<5	6.5	500

Certain elements recorded concentrations that exceed the TCT0 thresholds, but none were recorded to exceed the TCT1 threshold limits. The following elements exceed the TCT0 limits:

- Arsenic (As), barium (Ba), copper (Cu), manganese (Mn), nickel (Ni) and fluoride (F).

It must be stressed that the exceedances of these elements imply that only potential environmental risks or hazards are associated with the materials, since only the bioavailable fractions are potentially hazardous to the environment. Where the whole rock analyses become relevant is with regards to human health evaluations since constituents present in concentrations exceeding 1 % are used for classification in terms of potential health hazards.

Leachable concentrations

The results of the leachate assessments are shown in Table 5. The results, evaluated according to the GN R635 LCT limits, show low mobility of trace elements, most being in undetected ranges while major elements such as calcium (Ca), potassium (K), sodium (Na), magnesium (Mg), chloride (Cl) and silicon (Si) recorded in ppm ranges. The pH levels are circum-neutral to slightly alkaline and TDS levels are relatively low. Traces of nitrate (NO_3) were recorded for most samples, while F leached in ppm ranges for the Slimes Dams but was undetected in the discard samples. Sulphate (SO_4) was undetected in all samples. None of the elements that exceeded the TCT0 limits were detected in substantial amounts in the leachate assessment and these, including the remaining potentially hazardous elements, recorded well below the LCT0 limits and can be regarded as non-mobile and not bioavailable. The risk for bioaccumulation to occur is, therefore, low.

Table 5: Leachable inorganic concentration results evaluated according to the Leachable Concentration Threshold ("LCT") Limits

Elements & Chemical Substances	Slimes 1	Slimes 2	Slimes 3	Slimes 4	Old Plant Discard	Supply Chain Discard	LCT0	LCT1
Inorganics and anions								
pH	7.84	7.70	7.91	7.80	7.91	8.66	n/a	n/a
TDS (mg/ℓ)	62.0	122	46.0	76.0	40.0	46.0	1000	12500
EC (mS/m)	7.27	14.9	7.29	8.11	4.68	6.60	n/a	n/a
P Alk, carbonate alkalinity (mg/ℓ $CaCO_3$)	<0.6	<0.6	<0.6	<0.6	<0.6	2.40	n/a	n/a
M Alk, total alkalinity (mg/ℓ $CaCO_3$)	33.2	32.4	29.3	29.1	22.2	30.5	n/a	n/a
F, fluoride (mg/ℓ)	0.30	0.32	0.30	0.31	<0.1	<0.1	100	10000
Cl, chloride (mg/ℓ)	1.42	8.69	3.24	5.76	<0.25	<0.25	300	15000
NO_3, nitrate (mg/ℓ)	<0.1	0.72	0.40	0.10	0.38	<0.1	11	550
SO_4, sulphate (mg/ℓ)	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	250	12500
Chemical elements								
Ag, silver (mg/ℓ)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	n/a	n/a
Al, aluminium (mg/ℓ)	0.299	0.014	0.180	0.035	0.090	0.048	n/a	n/a
As, arsenic (mg/ℓ)	0.001	0.001	0.001	<0.001	<0.001	<0.001	0.01	0.5
Au, gold (mg/ℓ)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	n/a	n/a
B, boron (mg/ℓ)	0.079	0.030	0.027	0.027	0.045	0.042	0.5	25
Ba, barium (mg/ℓ)	0.188	0.075	0.074	0.079	0.127	0.120	0.7	35
Be, beryllium (mg/ℓ)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	n/a	n/a
Bi, bismuth (mg/ℓ)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	n/a	n/a
Ca, calcium (mg/ℓ)	10.3	16.7	9.88	11.2	7.00	8.27	n/a	n/a
Cd, cadmium (mg/ℓ)	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.003	0.15
Ce, cerium (mg/ℓ)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	n/a	n/a
Co, cobalt (mg/ℓ)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.5	25
Cr, chromium (mg/ℓ)	0.009	0.011	0.009	0.008	<0.001	0.001	0.1	5
Cs, caesium (mg/ℓ)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	n/a	n/a
Cu, copper (mg/ℓ)	0.002	0.005	<0.001	<0.001	<0.001	<0.001	2.0	100
Fe, iron (mg/ℓ)	0.24	0.01	0.09	0.01	0.04	0.02	n/a	n/a
Ga, gallium (mg/ℓ)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	n/a	n/a
Ge, germanium (mg/ℓ)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	n/a	n/a
Hf, hafnium (mg/ℓ)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	n/a	n/a

Elements & Chemical Substances	Slimes 1	Slimes 2	Slimes 3	Slimes 4	Old Plant Discard	Supply Chain Discard	LCT0	LCT1
Hg, mercury (mg/ℓ)	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.006	0.3
Ho, holmium (mg/ℓ)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	n/a	n/a
Ir, iridium (mg/ℓ)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	n/a	n/a
K, potassium (mg/ℓ)	2.21	3.99	1.99	1.79	0.48	0.55	n/a	n/a
La, lanthanum (mg/ℓ)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	n/a	n/a
Li, lithium (mg/ℓ)	0.001	0.001	0.001	0.001	0.001	0.002	n/a	n/a
Mg, magnesium (mg/ℓ)	2.17	4.0	2.14	2.44	1.32	1.47	n/a	n/a
Mn, manganese (mg/ℓ)	0.008	0.005	0.002	<0.001	<0.001	<0.001	0.5	25
Mo, molybdenum (mg/ℓ)	0.003	0.004	0.003	0.003	<0.001	<0.001	0.07	3.5
Na, sodium (mg/ℓ)	5.89	6.17	2.95	4.40	2.58	2.61	n/a	n/a
Nb, niobium (mg/ℓ)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	n/a	n/a
Nd, neodymium (mg/ℓ)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	n/a	n/a
Ni, nickel (mg/ℓ)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.07	3.5
Pb, lead (mg/ℓ)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.01	0.5
Pt, platinum (mg/ℓ)	<0.001	<0.001	<0.001	<0.001	0.001	0.001	n/a	n/a
Rb, rubidium (mg/ℓ)	0.001	0.001	<0.001	<0.001	<0.001	<0.001	n/a	n/a
Sb, antimony (mg/ℓ)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.02	1
Sc, scandium (mg/ℓ)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	n/a	n/a
Se, selenium (mg/ℓ)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.01	0.5
Si, silicon (mg/ℓ)	3.54	2.98	2.45	2.21	2.01	2.33	n/a	n/a
Sn, tin (mg/ℓ)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	n/a	n/a
Sr, strontium (mg/ℓ)	0.010	0.014	0.007	0.008	0.006	0.005	n/a	n/a
Ta, tantalum (mg/ℓ)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	n/a	n/a
Te, tellurium (mg/ℓ)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	n/a	n/a
Th, thorium (mg/ℓ)	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	n/a	n/a
Ti, titanium (mg/ℓ)	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	n/a	n/a
Tl, thallium (mg/ℓ)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	n/a	n/a
U, uranium (mg/ℓ)	0.0002	0.0002	0.0002	0.0002	<0.0001	<0.0001	n/a	n/a
V, vanadium (mg/ℓ)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.2	10
W, tungsten (mg/ℓ)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	n/a	n/a
Y, yttrium (mg/ℓ)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	n/a	n/a
Zn, zinc (mg/ℓ)	0.002	0.014	0.001	0.002	0.002	0.005	5	250
Zr, zirconium (mg/ℓ)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	n/a	n/a
Cr^{6+}, hexavalent chromium (mg/ℓ)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	6.5	500

Human health hazard (acute toxicity)

Three of the major elemental oxides recorded above the 1% cut-off limit for inorganics in the samples. These include oxides of Si, Al and Fe, while these including Ca and Mg (referred to as 'ingredients' for wastes containing 'mixtures') exceed the threshold of 1 % in the discard samples. Even though these elements are not included as hazardous species in the waste assessment criteria (GN R635), some toxicity data, although limited, are available for these "ingredients". The following acute toxicity data as in Table 6 is available for these 'ingredients'. Based on the SANS10234 Regulations, an ingredient in the ATE assessment can be ignored if the oral limit test does not show an acute toxicity at 2 000 mg/kg bodyweight.

Table 6: Relevant acute toxicity data (RTECS)

Type of test	Route of exposure	Species	Does data	Toxic effects
Acute Toxicity Data for Iron; Cas 7439-89-6				
TDL_0	Oral	Human - child	44 mg/kg	Behavioural irritability, Gastrointestinal-nausea or vomiting, Blood- Normocytic anaemia
LD_{50}	Oral	Human	200 mg/kg	Vascular- Shock, Liver- Hepatitis, Diffuse nutritional and Gross Metabolic acidosis
TCL_0	Inhalation	Rodent - rat	250 mg/m^3/6H/4W (intermittent)	Lungs, thorax or, Respiration- chronic pulmonary enema
TDL_0	Subcutaneous	Mouse	41.4 mg/kg/2W (Intermittent)	Reproductive- Spermatogenesis of genetic material, sperm morphology, motility and count
LD_{50}	Oral	Rodent-rat	750 mg/kg – lethal oral dose, 50% kill	Blood – changes in serum composition (e.g. TP, bilirubin, cholesterol) Biochemical -Enzyme inhibition, induction, or change in blood or tissue levels – transaminases.
Acute Toxicity Data for Aluminium; Cas 7429-90-5				
TCL0	Inhalation	Rodent - rat	206 mg/m3/5H/30D (intermittent)	Lungs, Thorax, or Respiration -fibrosis (interstitial), Endocrine – hypoglycaemia, Blood - changes in serum composition (e.g. TP, bilirubin, cholesterol)
TCL0	Inhalation	Human - man	4 mg/m3/1Y (intermittent)	Lungs, Thorax, or Respiration - cough Lungs, Thorax, or Respiration – dyspnea Nutritional and Gross Metabolic - weight loss or decreased weight gain
TDLo	Oral	Rodent - mouse	1260 mg/kg	Reproductive - Effects on Newborn – behavioural Reproductive - Effects on Newborn – physical Reproductive - Effects on Newborn – other postnatal measures or effects
TDLo	Unreported	Rodent - rabbit	67.5 mg/kg	Reproductive - Effects on Newborn – behavioural Reproductive - Effects on Newborn – delayed effects
Acute Toxicity Data for Silicon Dioxide; Cas 7631-86-9				
LD_{50}	Oral	Rat	10 000 mg/kg	Slightly hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Breathing crystalline silica dust can cause silicosis, which in severe cases can be disabling, or even fatal. The respirable silica dust enters the lungs and causes the formation of scar tissue, thus reducing the lungs' ability to take in oxygen.
LD_{50}	Dermal	Rabbit	5000 mg/kg	
Acute Toxicity Data for Calcium Oxide Cas 1305-78-8				
Not available	Not available	Not available	Not available	Repeated exposure of the eyes to a low level of dust can produce eye irritation. Repeated skin exposure can produce local skin destruction, or dermatitis. Repeated inhalation of dust can produce varying degree of respiratory irritation or lung damage.
Acute Toxicity Data for Magnesium Oxide Cas 1309-48-4				
Not available	Not available	Not available	Not available	Slightly hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation.

Because the acute toxicity for SiO_2 is reported to be >2000 mg/kg body weight, and absence of toxicity data (LD50) for Ca and Mg, only Fe and Al were used in the acute toxicity hazard classification.

Based on the ATE of the ingredients (average Fe and Al), and in terms of its acute toxicity/health hazard, the discard material is classified as a Category 5 hazard that is applicable to substances that

are of relatively low acute toxicity. However, under certain circumstances, it may pose a hazard to vulnerable populations.

Based on the toxicity data, the following hazard statements may, therefore, apply for the materials:

- May be harmful if swallowed (H303); and
- May be harmful if inhaled (H333).

Bio-toxicity assessments

Acute (and short-chronic) toxicity testing (as applied for this assessment) was applied by exposing biota to leachate obtained from the various materials in order to determine the potential risk to the biota/biological integrity of any relevant receiving water bodies. A risk category is determined based on the percentage of mortalities (or inhibition-stimulation) of the exposed biota. It is important to note that the hazard classification is based on the standardised battery of selected test biota and, therefore, represents the risk/hazard towards similar biota in the receiving aquatic environment. The toxicity hazard is, therefore, in terms of the aquatic biotic integrity and does in no way represent toxicology towards humans or other mammals.

Standard, internationally accepted methods and materials were applied in order to conduct acute and short-chronic toxicity testing and hazard classification based on 3 trophic levels (3 taxonomic groups, namely *Allivibrio fischeri* (bacteria), *Daphnia magna* (crustaceans) and *Selenastrum capricornutum* (micro-algae)) at each of the selected sites/samples. All tests were conducted in environmental controlled rooms using internationally standardized methods.

Toxicity test results classification system

A risk/hazard category was determined by application of the DEEEP[3] protocols as recommended by the then Department of Water Affairs ("DWA"), currently the Department of Human Settlements, Water and Sanitation ("DHSWS") and is broadly based on the hazard classification system of Persoone *et.al*. (2003). This risk category equates to the level of acute/chronic risk posed by the selected potential pollution source (water sample). After the determination of the percentage effect (EP)[4], obtained with each of the battery of toxicity tests performed, the sample is ranked into one of the following five classes as in Table 7, based on definitive testing protocols.

Table 7: Hazard classification system for definitive tests (Persoone et.al. 2003)

[3] DEEEP = Direct Estimation of Ecological Effect Potential. This is a battery of tests that can measure toxicity of complex mixtures based on a set of parameters stemming from the results of effects, even if all constituents are not known. A hazard class is determined based on the resulting parameters of the battery of tests

[4] EP (Percentage effect) = an effect measured either as a mortality rate or inhibition rate (depending on the type of test). A >10% effect is regarded as slight acute toxicity for Daphnia, while a >20% effect is regarded as slight short-chronic toxicity for *Selenastrum* and *Allivibrio*. A 50% effect is regarded as an acute/short-chronic toxicity for all of the tests (*Daphnia, Selenastrum* and *Allivibrio*)

Class I	**No acute/short-chronic environmental toxicity hazard -** none of the tests shows a toxic effect (i.e. an effect value significantly higher than that in the control)
Class II	**Slight acute/short-chronic environmental toxicity hazard -** the percentage effect observed in at least one toxicity test is significantly higher than in the control, but the effect level is below 50% (TU is <1)
Class III	**Acute/short-chronic environmental toxicity hazard -** the L(E)C50 is reached or exceeded in at least one test, but in the 10 fold dilution of the sample the effect level is less than 50% (1≤TU≤9,99)
Class IV	**High acute/short-chronic environmental toxicity hazard -** the L(E)C50 is reached in the 10 fold dilution for at least one test, but not in the 100 fold dilution (10≤TU≤99,99)
Class V	**Very high acute/short-chronic environmental toxcity hazard -** the L(E)C50 is reached in the 100 fold dilution for at least one test (TU is ≥100)

The criteria used to classify the materials with respect to aquatic toxicity were based on the hazard categories as per SANS10234 and those given by Persoone *et.al*. (2003) (refer to Table 7). Refer to Table 8 below for individual test results and overall hazard classification of the leachates of the different samples.

Based on the criteria by Persoone et al. (2003), leachate of samples Slimes 1 and the Old Plant Discard showed “no acute/short-chronic environmental toxicity hazard” (Class I). Leachates of samples Slimes 2, Slimes 3 and Slimes 4 were classified as having a “slight short-chronic environmental toxicity hazard” (Class II) based on the 20-34 % algal growth inhibition effects noted during testing (TU’s<1). Safe dilution factors ranging between 28 % and 53 % were calculated for these samples (e.g. 28 parts of Slimes 2 leachate, diluted with 72 parts of ‘unpolluted’ water should be sufficient to negate toxicity effects on these trophic levels, should it reach the natural environment). The leachate of the Supply Chain Discard sample showed a “short-chronic environmental toxicity hazard (Class III), based on the toxicity unit (“TU”) of 3.7 with a 55 % algal growth inhibition effect noted during testing. A safe dilution factor of <1 % was calculated for this sample (i.e. the toxic effect (EC≤20 %) could not be diluted out during the algal test, up to 0.2 % of the original leachate concentration).

Table 8: DEEP test results and risk classification for the TIOM leached samples

	Results	Composite 1	Composite 2	Composite 3	Composite 4	Composite 5	Composite 6
Water quality	Test date yy/mm/dd	2020/02/03	2020/02/03	2020/02/03	2020/02/03	2020/02/03	2020/02/03
	pH @ 25°C	8,0	7,9	7,8	8,0	8,0	7,8
	EC (Electrical conductivity) (mS/m) @ 25°C	11,5	26,2	14,4	18,0	8,9	10,3
	Dissolved oxygen (mg/l) (NA)	8,2	8,4	8,6	8,3	8,3	8,5
A. fischeri (bacteria)	Test started on yy/mm/dd	20/02/05	20/02/06	20/02/07	20/02/07	20/02/07	20/02/11
	%30min inhibition (-) / stimulation (+) (%)	19(F)	38(F)	43(F)	36(F)	115(F)	44(F)
	EC/LC20 (30 mins)	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
	EC/LC50 (30 mins)	nr.	nr.	nr.	nr.	nr.	nr.
	Toxicity unit (TU) / Description	<1	<1	<1	<1	<1	<1
S. capricornutum (micro-algae)	Test started on yy/mm/dd	20/02/04	20/02/04	20/02/04	20/02/04	20/02/04	20/02/04
	%72hour inhibition (-) / stimulation (+) (%)	-18(F)	-34(F)	-20(F)	-25(F)	-13(F)	-55(F)
	EC/LC20 (72hours)	n.r.	28	53	48	n.r.	0,2
	EC/LC50 (72hours)	nr.	nr.	nr.	nr.	nr.	27
	Toxicity unit (TU) / Description	<1	<1	<1	<1	<1	3,7
D. magna (waterflea)	Test started on yy/mm/dd	20/02/03	20/02/03	20/02/03	20/02/03	20/02/03	20/02/03
	%48hour mortality rate (-%)	0	0	0	0	0	-5
	EC/LC10 (48hours)	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
	EC/LC50 (48hours)	nr.	nr.	nr.	nr.	nr.	nr.
	Toxicity unit (TU) / Description	<1	<1	<1	<1	<1	<1
Estimated safe dilution factor (%) [for definitive testing only]		None required	28	53	48	None required	<1
Overall classification - Hazard class***		Class I - No acute/short-chronic hazard	Class II - Slight short-chronic hazard	Class II - Slight short-chronic hazard	Class II - Slight short-chronic hazard	Class I - No acute/short-chronic hazard	Class III - Short-chronic hazard
Weight (%)		0	33	33	33	0	33

*** Composite 1 – Slimes 1; Composite 2 – Slimes 2; Composite 3 – Slimes 4; Composite 4 – Slimes 4**

*** Composite 5 – Old Plant Discard; Composite 6 – Supply Chain Discard**

If the SANS10234 criteria are used, only the Supply Chain Discard material (Composite 6) recorded an EC/LC50 value of >10 to ≤100 for S. *capricornutum*, while the remaining tests recorded EC/LC values of >100 (*no relevancy*). As a result, all materials except for Supply Chain Discard (Composite 6) recorded a *low hazard category*. A moderate hazard category is assigned to the material from Supply Chain Discard.

No substantial difference exists between the geochemical results for the Supply Chain Discard material compared to the Old Plant Discard material. The reason for the hazard classification remains, therefore, unknown.

According to the GN R635 the materials were assessed to be Type 3 waste, which is considered to pose a low risk towards the environment. Low risk wastes have a low potential for contaminant release but do require some level of control and ongoing management to protect health and the environment.

Based on the Acute Toxicity Estimate of the ingredients, and in terms of its acute toxicity/health hazard, the discard material is classified as a **Category 5 hazard**, which is applicable to substances that are of relatively low acute toxicity but may under certain circumstances pose a hazard to vulnerable populations. No carcinogenic constituents were recorded to exceed the proposed threshold/cut-off value of >0.1%.

Therefore, according to the assessment and classification, the materials can be regarded as non-hazardous with respect to human health, the environment and ecotoxicity but long-term control and ongoing management are required to monitor performance and to protect health and the environment in every way necessary.

4.2.3 Processing of material

Primary and secondary crushing will be required and it is proposed that primary crushing be done using a jaw crusher. Crushing and screening of the D1 – Old Plant Discard Dump will be undertaken at P1 – Crushing and Screening Plant (item 14 of Figure 3), the crushing of the D2 – Old Plant Discard Dump will be undertaken at the Mobile Plant Area (item 12 of Figure 3) and the crushing and screening of the D3 – Supply Chain Discard Dump will take place at source. To minimise fines generation, a jaw crusher product will be scalped with the oversize feeding a cone crusher. The cone crusher product and screen undersize will then be combined to form a crushed product. As the material on the stockpiles does not contain an excessive amount of large rocks, it is proposed that a top size of 450 mm be used for design purposes. Measures will be put in place to ensure that there is minimum downtime due to blockages arising from oversize rocks. The product size from the primary and secondary crushing circuit will be nominally minus 25 mm.

Tertiary crushing will be required and the product from the primary and secondary crushing will be the feed for tertiary crushing. To minimise fines generation, the feed will be first be dry screened. The oversize will be the feed to the tertiary crusher.

The product from the tertiary crushing circuit is minus 5 mm. A maximum of 5 % oversize will be tolerated. Dry screening at 8 mm will be applicable to the plant discard stockpiles. Ore from these stockpiles must be dry screened using a double deck screen. The oversize from the top deck must be stockpiled and will be too coarse to load onto the existing plant discard conveyor and will have to be disposed of separately. The undersize from the top deck and oversize from the bottom deck can be loaded onto the existing plant discard conveyor. The undersize from the bottom deck must be stockpiled and will be fed to the dense medium plant. The double deck screen cut sizes will be 40 mm for the top deck and 8 mm for the bottom deck.

After the required crushing/screening of the stockpiles, the minus 8 mm / minus 5 mm material will be fed to a dense medium plant. The minus 0.5 mm material will be removed using a desliming screen and the screen oversize will be the dense medium plant feed. The minus 0.5 mm material will be dewatered and stockpiled for beneficiation at a later stage.

All the stockpiles will be beneficiated using dense medium separation. The feed to the dense medium plant will be deslimed at 0.5 mm. The minus 0.5 mm fraction must be dewatered in a separate circuit. The desliming screen oversize will be fed to a dense medium cyclone for separation. It is envisaged that a standard dense medium circuit design will be used. The only difference will be in the densification circuit, where a two-stage densification circuit is recommended due to the medium densities that will be used. The product and waste will be stockpiled prior to being moved to the loadout and discard conveyor. A plant yield of minimum 40 %, average 50 % and maximum 80 % is expected with a cut density between 3.8 and 4.2 t/m^3.

The minus 0.5 mm circuit will utilise the undersize from the desliming screen in the dense medium separation plant that will be pumped into a cyclone. The cyclone underflow will feed onto a dewatering screen to produce a dewatered product that will be stockpiled for later beneficiation. The screen undersize and cyclone overflow must be combined and sent to a thickener for water recovery. The overflow of the thickener will be routed to the process water tank. The thickener underflow will be pumped to the existing slimes dams. The screen oversize and dense medium plant floats will be routed to a discard stockpile from where it will be loaded and hauled to the D2 – Old Plant Discard Dump. Figure 6 below is a process flow diagram that illustrates the scope of primary crushing and screening.

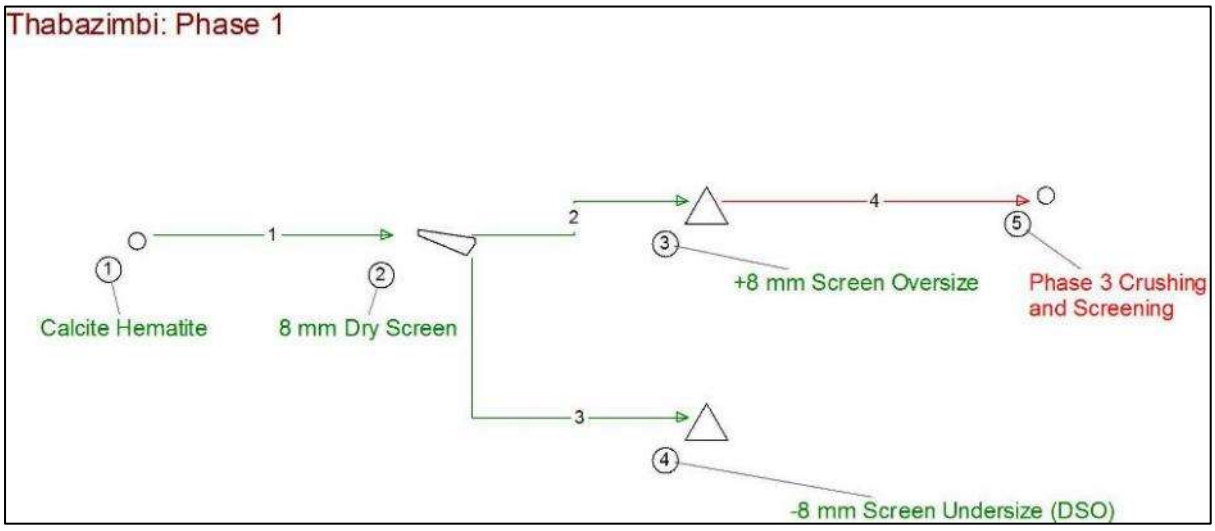


Figure 6: Primary crushing and screening

Figure 7 below is a process flow diagram that illustrates the scope of secondary crushing and screening.

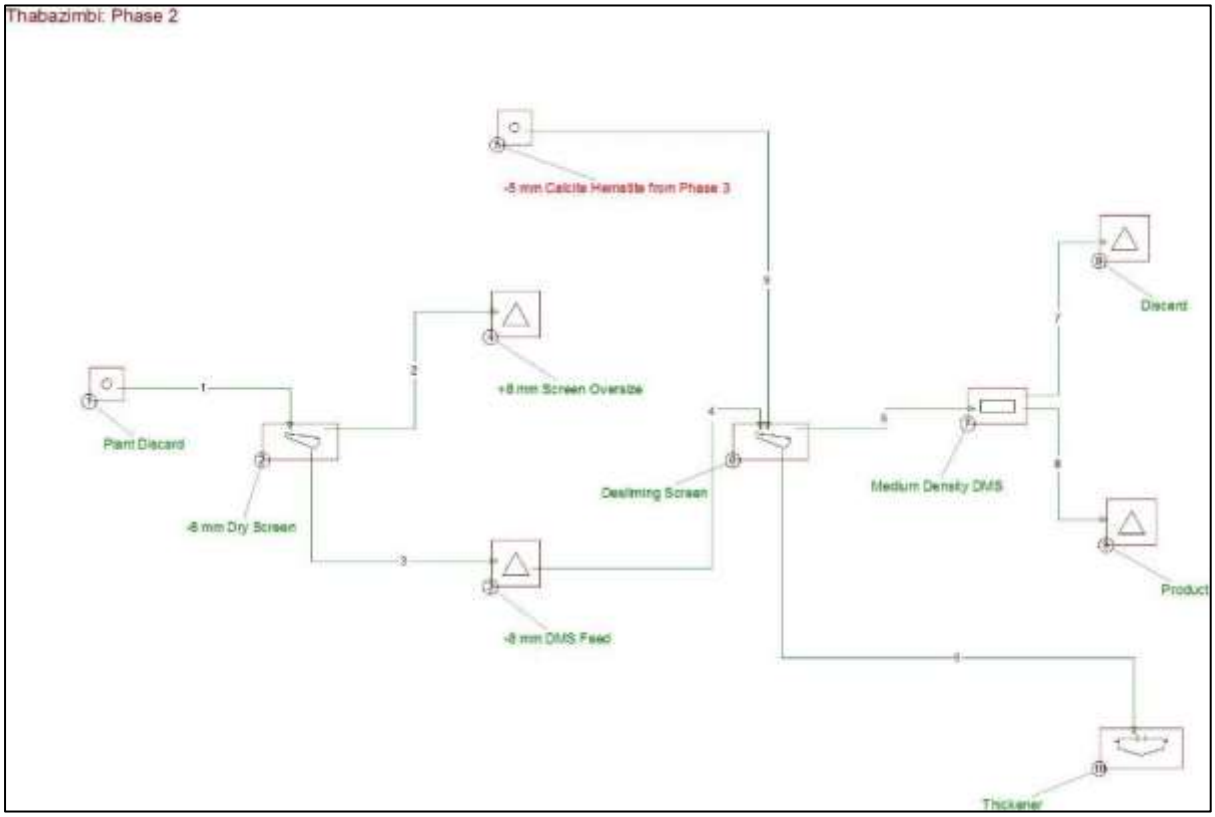


Figure 7: Secondary crushing and screening process flow

Figure 8 below is a process flow diagram that illustrates the scope of tertiary crushing and screening:

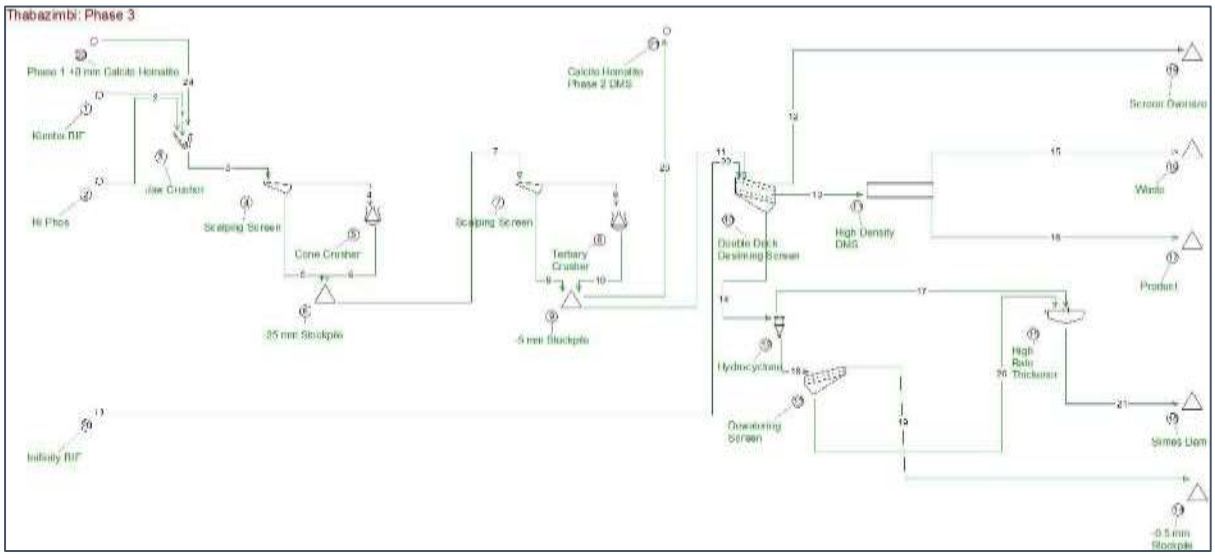


Figure 8: Tertiary crushing and screening process flow

Processing of the existing D1 - Old Plant Discard Dump, D2 - Old Plant Discard Dump, D3 – Supply Chain Discard Dump and Slimes Dams is planned to be completed over a 4-year period (2021 – 2025) and integrates into an existing project that is currently being undertaken to reclaim existing Run of Mine (“ROM”) stockpiles located throughout the site. The process to extract the iron ore is divided into three stages (see descriptions below). Figure 9 illustrates the process flow of the greater project by TIOM. Figure 10 provides an overview of the indicative crush, screen and beneficiation operation. Figure 11 illustrates the process flow for the project.

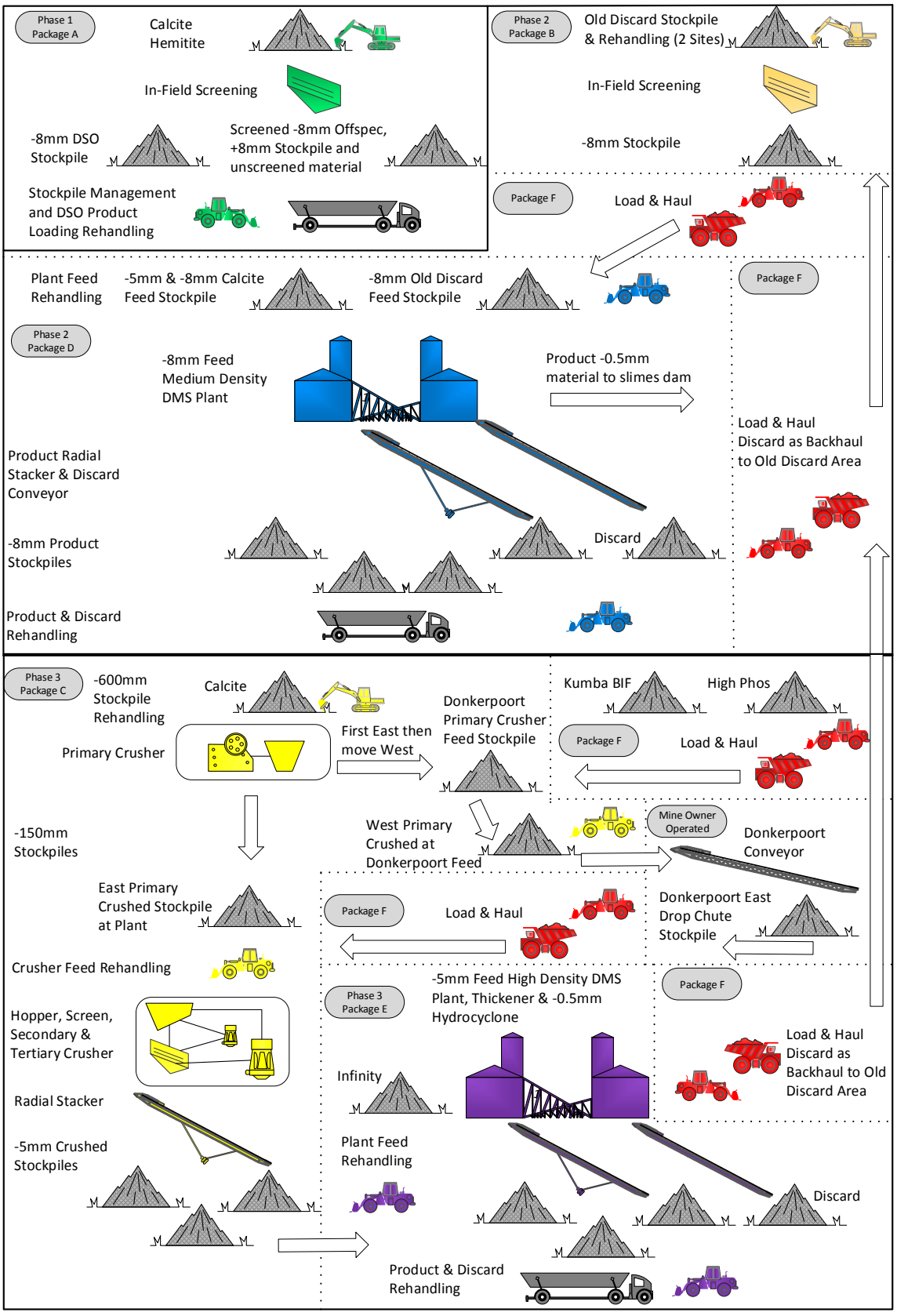


Figure 9: Process flow illustration of the greater reclamation project

The following process flow diagram provides an overview of the indicative crush, screen and beneficiation operation.

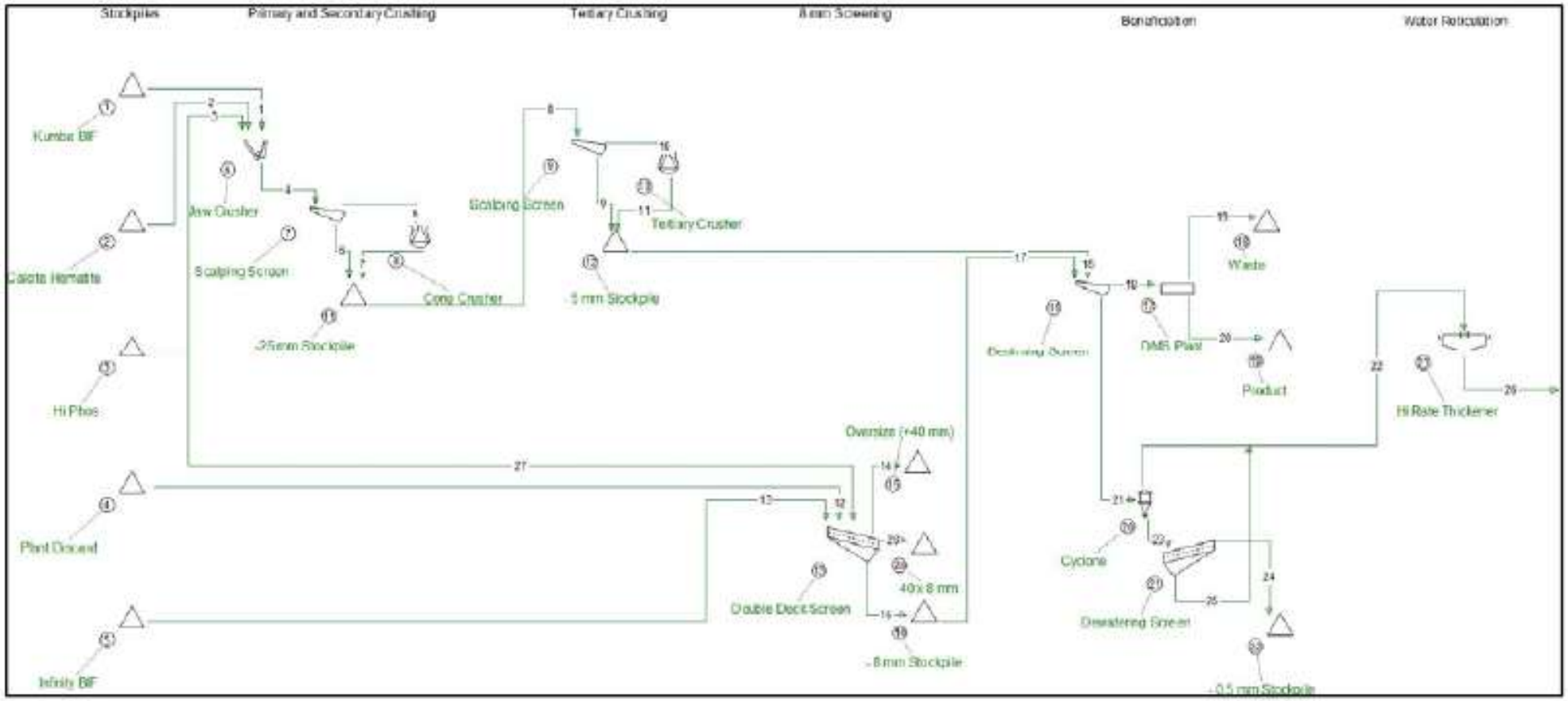


Figure 10: Process flow Illustration of the crush, screen and beneficiation process

The following process flow diagram provides an overview of the process flow of the project.

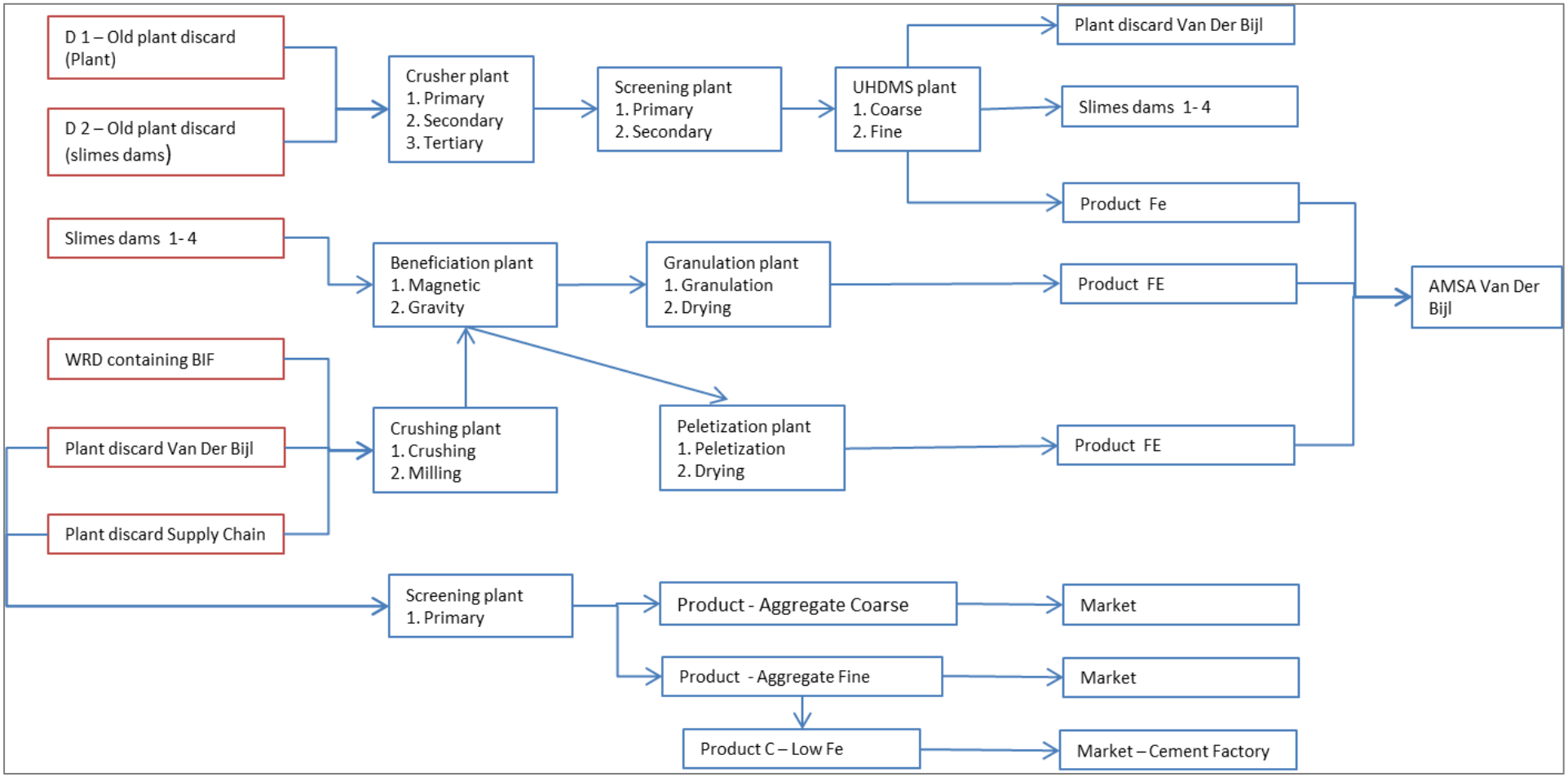


Figure 11: Process flow Illustration for the project

4.2.4 Water Management

The conceptual Storm Water Management Plan ("SWMP ") for the reclamation of the existing D1 - Old Plant Discard Dump, D2 - Old Plant Discard Dump, D3 - Supply Chain Discard Dump and the existing Slimes Dams aims to address concerns that have been identified in terms of clean and dirty water separation. The plan attempts to provide management measures that should be in place to prevent flood damage proactively contain affected water runoff and contribute to the effective management of surface water.

TIOM have an existing SWMP (*Thabazimbi Stormwater Management Plan*, dated 03 July 2015 and compiled by Aurecon. The existing SWMP plan does, however, not consider the activities associated with the reclamation of the existing D1 - Old Plant Discard Dump, D2 - Old Plant Discard Dump, D3 - Supply Chain Discard Dump and the existing Slimes Dams. Accordingly, the conceptual SWMP should be read in conjunction with the existing SWMP (existing SWMP attached as Annexure B to the conceptual SWMP).

The storm water management assessment for the reclamation of the existing D1 - Old Plant Discard Dump, D2 - Old Plant Discard Dump, D3 - Supply Chain Discard Dump and the existing Slimes Dams provides an examination of the situation at the various areas and an investigation of different rainfall scenarios for the operation that are critical to the planning process for effective storm water management during the operational phase. Runoff simulations were performed based on the relevant area as defined by the operation.

Based on the results of the geochemical assessment (refer to Chapter 4.2.2), the discard and slimes material is considered of low risk with low potential for contaminant release. Therefore, the devised storm water management measures only consider containment of affected surface water runoff, from the affected areas related to the reclamation of the existing D1 - Old Plant Discard Dump, D2 - Old Plant Discard Dump, D3 - Supply Chain Discard Dump and the existing Slimes Dams, to prevent the physical deterioration of water quality as a result of increased sedimentation.

Table 9 below reflects the peak runoff and volumes expected during a 1:50 year and 1:100-year flood scenario applicable to the TIOM area.

Table 9: Flood peaks and volumes of the sub-catchment

Watercourse	1:20 years	1:50 years	1:100 years	RMF
Crocodile River	358 m^3/s	584 m^3/s	895 m^3/s	2 790 m^3/s
Rooikuilspruit	225 m^3/s	357 m^3/s	539 m^3/s	1 628 m^3/s

The catchment depicted in Figure 12 below are clean water runoff that will need to be diverted away from the existing D1 - Old Plant Discard Dump, D2 - Old Plant Discard Dump, D3 - Supply Chain Discard Dump and the existing Slimes Dams.

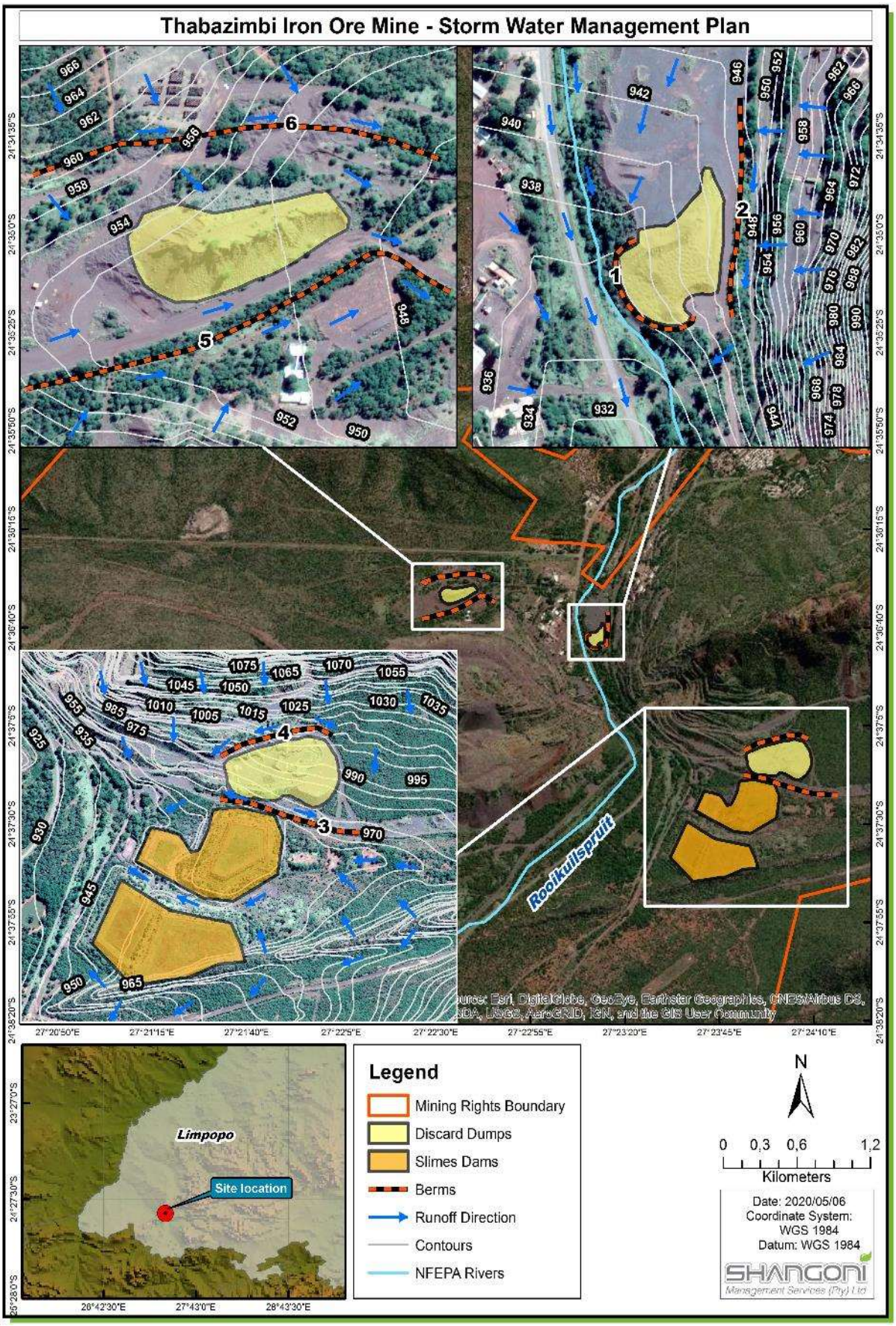


Figure 12: Storm water management plan

4.2.5 Bulk Supplies

4.2.5.1 Water Supply

The principal design concept is that all fresh water will be supplied to the contractors at the identified sites from the existing licenced boreholes. The water will be supplied, via existing pipelines.

4.2.5.2 Electricity Supply

The principal design concept is that all electrical power will be supplied to the contractors at the identified sites via existing powerlines. The electricity will be provided at the supply terminals of the distribution panel ("DB") in close proximity to the operating site.

4.2.5.3 Roads

The existing haul and access roads will be utilised for the project. There are approximately 815 m of existing roads that will be regraded in order to get access to the already constructed asphalt access road from District Road R510 at Meyer's Mine and as well as upgrading the road to the Donkerpoort conveyor tipping stockpile area.

5 Policy and legislative context

The following table is a summary of the policy and legislative context applicable to the project.

Table 10: Policy and legislative context applicable to the project

Applicable legislation and guidelines used to compile the report	Reference in the report	Compliance and response of the project
The Constitution of the Republic of South Africa, 1996.	Throughout this EIAR / EMPr.	The Constitution of the Republic of South Africa was considered and applied to throughout the report as the Constitution states that everyone has the right – (a) to an environment that is not harmful to their health or well-being; and (b) To have the environment protected, for the benefit of present and future generations.
The Mineral and Petroleum Resources Development Act (Act No. 28 of 2002, as amended).		TIOM has an approved EMPr in terms of the Mineral and Petroleum Resources Development Act (Act No. 28 of 2002). Once the EA and WML have been approved a section 102 application will be required for the project.
The National Environmental Management Act (Act No. 107 of 1998 as amended).	Throughout this EIAR / EMPr.	The EIAR and EMPr have been compiled in terms of GN R.982, as amended and promulgated in terms of Sections 24(5), 24M and 44 of the National Environmental Management Act, Act No. 107 of 1998 ("NEMA").
The Environmental Impact Assessment Regulations (GN R982 dated 2014, as amended).		The EIAR and EMPr was compiled in terms of the requirements of Appendix 2 of the Environmental Impact Assessment ("EIA") Regulations (GN R.982 dated 2014, as amended).

Applicable legislation and guidelines used to compile the report	Reference in the report	Compliance and response of the project
Mine Health and Safety Act (Act No.29 of 1996).	Throughout this EIAR / EMPr.	The project will be undertaken to meet the requirements of the Mine Health and Safety Act.
The Environmental Impact Assessment Regulation. Listing Notice 1. (GN R983 dated 2014, as amended).	Section 4.1 of Part A of this EIAR / EMPr	Activity 12 of Listing Notice 1 is applied for as part of the reclamation of the D1 - Old Plant Discard Dump.
The Environmental Impact Assessment Regulation. Listing Notice 3. (GN R985 dated 2014, as amended).		Activity 14 of Listing Notice 3 is applied for as part of the reclamation of the D1 -Old Plant Discard Dump
Integrated Environmental Management Guideline: Guideline on Need and Desirability (2017).	Section 6.1 of Part A of this EIAR / EMPr.	The need and desirability were assessed for the project. The project will utilise existing waste (i.e. D1 - Old Plant Discard Dump, D2 - Old Plant Discard Dump, D3 – Supply Chain Discard Dump and Slimes Dams) to produce a product.
Mining and Biodiversity Guideline: Mainstreaming biodiversity into the mining sector.	Chapters E, F and L of Section 8.4.1; and Section 8.4.4 of Part A of this EIAR / EMPr.	Biodiversity related to the project was not considered when sites were selected, and alternatives considered as the project relates to the reclamation of existing Discard Dumps and Slimes Dams. Furthermore, the project will take place on existing disturbed areas.
The National Water Act (Act No. 36 of 1998, as amended).	Chapter G and H of Section 8.4.1 of Part A of this EIAR / EMPr.	The project will require a General Authorisation ("GA"), as per the GN 509 risk assessment undertaken[5] due to the D1 – Old Plant Discard Dump being within 500 m of the Rooikuilspruit. The GA is being applied for separately.
Regulations on use of water for mining and related activities aimed at the protection of water resources published in terms of the National Water Act under Government Notice 704 of 4 June 1999 (GN R704).	Section 9.9 and Chapter G of Section 8.4.1 of Part A of this EIAR / EMPr.	Storm water management measures, in compliance to GN R704, will be implemented at the project. A conceptual SWMP was developed by Shangoni Management Services (Pty) Ltd dated October 2020 for the project and is attached as Annexure E4.
The National Environmental Management: Biodiversity (Act 10 of 2004, as amended).	Chapter E, F and L of Section 8.4.1 of Part A of this EIAR / EMPr.	Biodiversity related to the project was not considered when sites were selected, and alternatives considered as the project relates to the reclamation of existing Discard Dumps and Slimes Dams. Furthermore, the project will take place on existing disturbed areas. No permits and/or licences in terms of National Environmental Management: Biodiversity (Act 10 of 2004, as amended) will be required for the project.
National Forests Act (Act No.84 of 1998).		

[5] GN 509 risk assessment undertaken in the report titled: Riparian delineation and water use risk assessment for the proposed reworking of a discard dump at the Thabazimbi Iron Ore Mine, dated 2020 and compiled by Wetland Consulting Scientific (Pty) Ltd. The abovementioned report is attached as Annexure E3 to this EIAR / EMPr.

Applicable legislation and guidelines used to compile the report	Reference in the report	Compliance and response of the project
Alien and Invasive Species Regulations (GN R598 dated 2014).		The occurrence of alien and invasive species will be assessed and mitigated (in accordance to these regulations) during the operational phase of the project.
Conservation of Agricultural Resources (Act 43 of 1983).		Erosion potential will be assessed and mitigated (in accordance to this act) during the operational phase of the project.
The National Environmental Management: Air Quality (Act 39 of 2004, as amended).	Chapter I of Section 8.4.1 of Part A of this EIAR / EMPr.	No Atmospheric Emissions License ("AEL") is required for the project.
SABS Code of Practice 0103 of 2008: The measurement and rating of environmental noise with respect to land use, health, annoyance and to speech communication. SABS Code of Practice 0328 of 2008: Environmental Noise Impact Assessments.	Chapter J of Section 8.4.1 of Part A of this EIAR / EMPr.	The SABS Code of Practice 0103 will be taken into account when the mitigation measures for the project are identified.
National Environmental Management: Waste Act (Act No. 59 of 2008, as amended).	Section 4.1 of Part A of this EIAR / EMPr.	Waste management activities are applied for as part of the project. The activity applied for in terms of NEM:WA, 2008 - GN 921 includes activity 11 in Category B: *The establishment or reclamation of a residue stockpile or residue deposit resulting from activities which require a mining right, exploration right or production right in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002).*
National Heritage Resources Act (Act No. 25 of 1999, as amended).	Chapter K of Section 8.4.1 of Part A of this EIAR / EMPr.	No archaeological or historical sites are affected by and in close proximity to the areas where the project will be taking place.
DMR Guideline for Consultation with communities and Interested and Affected Parties. As required in terms of Sections 16(4)(b) or 27(5)(b) of the MPRDA, and in accordance with the standard directive for the compilation thereof as published on the official website of the Department	Sections 8.2 and 9.7 of Part A of this EIAR / EMPr.	The public participation process is done in accordance to the DMRE guideline for consultation with communities and interested and affected parties. However, the communities play an important role in the project as it will be operated by a contractor who may source residents from the local community as employees.

Applicable legislation and guidelines used to compile the report	Reference in the report	Compliance and response of the project
of Mineral Resources.		
Government Gazette 39425. Government Notice R.1147 dated 2015, "*Regulations pertaining to the financial provision for prospecting, exploration, mining or production operations*"	Section 19 of Part A of this EIAR / EMPr.	The financial provisioning for TIOM is included in Section 19 of Part A of this EAIR / EMPr.
Integrated Environmental Management Information Series. Criteria for determining alternatives in EIA.	Section 8.7 and Section 9.1 of Part A of this EIAR / EMPr.	Alternatives were assessed for the project in Section 8.1 of Part A of this EIAR / EMPr.

6 Need and desirability of the proposed activities

6.1 Need and desirability in terms of the Guideline on Need and Desirability, 2017

In 2017, the Department of Environmental Affairs published an Integrated Environmental Management Guideline, the Guideline on Need and Desirability. The following table indicates on how the guideline requirement were considered in this EIAR.

Table 11: Need and Desirability of the project

Requirement	Part where requirement is addressed/ response
"securing ecological sustainable development and use of natural resources"[6]	
How will this development (and its separate elements/aspects) impact on the ecological integrity of the area?[7]	
1.1 How were the following ecological integrity considerations taken into account?	
1.1.1 Threatened Ecosystems[8]	The project will have a minimal impact on the ecological integrity of the area as the areas where the proposed reclamation of the D1 - Old Plant Discard Dump, D2 - Old Plant Discard Dump, D3 – Supply Chain Discard Dump and Slimes Dams are already disturbed. Refer to
1.1.2 Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems require specific attention in management and planning procedures, especially where they are subject to	

6 Section 24 of the Constitution refers.

7 Section 24 of the Constitution and section 2(4)(a)(vi) of NEMA refer.

8Must consider the latest information including the notice published on 9 December 2011 (Government Notice No. 1002 in Government Gazette No. 34809 of 9 December 2011 refers) listing threatened ecosystems in terms of Section 52 of National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004).

Requirement	Part where requirement is addressed/ response
significant human resource usage and development pressure[9]	Chapters E, F and L of Section 7.4.1 of Part A of this report and Section 7.5 of Part A for potential impacts.
1.1.3 Critical Biodiversity Areas ("CBAs") and Ecological Support Areas ("ESAs").	
1.1.4 Conservation targets	
1.1.5 Ecological drivers of the ecosystem.	
1.1.6 Environmental Management Framework.	The Thabazimbi Local Municipality's Integrated Development Plan 2018/19, states that the provincial economy is predominantly driven by the mining and commodity services sectors that contribute 27.6 % and 23.8 %, respectively. This application relates to the proposed reclamation of the D1 - Old Plant Discard Dump, D2 - Old Plant Discard Dump, D3 – Supply Chain Discard Dump and Slimes Dams and will have minimal impact on the ecological integrity of the area.
1.1.7 Spatial Development Framework.	
1.1.8 Global and international responsibilities relating to the environment (e.g. RAMSAR sites, Climate Change, etc.)[10]	The project is situated within the Waterberg Bojanala Priority Area, one of the three declared airshed priority areas. Anticipated emissions from the proposed reclamation of the Discard Dumps and Slimes Dams (i.e. carbon dioxide, methane, dust) will have an impact on the air quality in the area. The impacts are further discussed and assessed in Section 7.5 of Part A of this report.
1.2 How will this development disturb or enhance ecosystems and/or result in the loss or protection of biological diversity? What measures were explored to firstly avoid these negative impacts, and where these negative impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts?[11]	The potential impacts that have been identified and may occur as a result of the project have been discussed and assessed in Section 7.5 of Part A of this report.
1.3 How will this development pollute and/or degrade the biophysical environment? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy (including	

[9] Section 2(4)(r) of NEMA refers.

[10] Section 2(4)(n) of NEMA refers

[11] Section 24 of the Constitution and Sections 2(4)(a)(i) and 2(4)(b) of NEMA refer.

Requirement	Part where requirement is addressed/ response
offsetting) the impacts? What measures were explored to enhance positive impacts?[12]	
1.4 What waste will be generated by this development? What measures were explored to firstly avoid waste, and where waste could not be avoided altogether, what measures were explored to minimise, reuse and/or recycle the waste? What measures have been explored to safely treat and/or dispose of unavoidable waste?[13]	Existing waste (i.e. D1 - Old Plant Discard Dump, D2 - Old Plant Discard Dump, D3 – Supply Chain Discard Dump and Slimes Dams) will be processed to generate a product. The waste generated from this plant process will be slurry that will be disposed of on the existing Slimes Dam and a proposed new Slimes Dam in accordance with the results of the waste classification. It should be noted that the necessary authorisations (if required) for the new Slimes Dam do not form part of this application. All general waste generated will be disposed of at the Thabazimbi Local Municipality landfill site as is currently practiced.
1.5 How will this development disturb or enhance landscapes and/or sites that constitute the nation's cultural heritage? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts?[14]	The project will not impact any cultural heritage of the area as the activities taking place will be located on already disturbed areas. Refer to Chapter K of Section 7.4.1 of Part A. Refer to Section 7.5 of Part A for the potential impacts on the different aspects of the environment.
1.6 How will this development use and/or impact on non-renewable natural resources? What measures were explored to ensure responsible and equitable use of the resources? How have the consequences of the depletion of the non-renewable natural resources been considered? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts?[15]	The project will reduce the impact on non-renewable natural resource, as no new material will be mined but rather existing residue stockpiles will be reclaimed. Furthermore, the footprint of the mine will be decreased and the mine's "waste" will be used to generate a product. The preliminary potential impacts that have been identified and may occur as a result of the project have been discussed and assessed in Section 7.5 of Part A of this report.
1.7 How will this development use and/or impact on renewable natural resources and the ecosystem of which they are part? Will the use of the resources and/or impact on the ecosystem jeopardise the integrity of the resource and/or system taking into account carrying capacity restrictions, limits of acceptable change, and thresholds? What	

[12] Section 24 of the Constitution and Sections 2(4)(a)(ii) and 2(4)(b) of NEMA refer

[13] Section 24 of the Constitution and Sections 2(4)(a)(iv) and 2(4)(b) of NEMA refer

[14] Section 24 of the Constitution and Sections 2(4)(a)(iii) and 2(4)(b) of NEMA refer.

[15] Section 24 of the Constitution and Sections 2(4)(a)(v) and 2(4)(b) of NEMA refer

Requirement	Part where requirement is addressed/ response
measures were explored to firstly avoid the use of resources, or if avoidance is not possible, to minimise the use of resources? What measures were taken to ensure responsible and equitable use of the resources? What measures were explored to enhance positive impacts?[16]	
1.7.1 Does the proposed development exacerbate the increased dependency on increased use of resources to maintain economic growth or does it reduce resource dependency (i.e. de-materialised growth)? (note: sustainability requires that settlements reduce their ecological footprint by using less material and energy demands and reduce the amount of waste they generate, without compromising their quest to improve their quality of life)	The project will decrease the dependency on the use of natural resources. Furthermore, by partial reclamation the Discard Dumps and Slimes Dams, the footprint of the mine will be decreased.
1.7.2 Does the proposed use of natural resources constitute the best use thereof? Is the use justifiable when considering intra- and intergenerational equity, and are there more important priorities for which the resources should be used (i.e. what are the opportunity costs of using these resources this the proposed development alternative?)	
1.7.3 Do the proposed location, type and scale of development promote a reduced dependency on resources?	
1.8 How were a risk-averse and cautious approach applied in terms of ecological impacts?[17]	The project will have a minimal impact on the ecological integrity of the area. Refer to Chapters E, F and L of Section 7.4.1 of this report and Section 7.5 for potential impacts. A conservative approach was followed in terms of the identification and assessing of environmental impacts associated with the project.
1.8.1 What are the limits of current knowledge (note: the gaps, uncertainties and assumptions must be clearly stated)?	Refer also to Section 7.6.2 of Part A of this report.
1.8.2 What is the level of risk associated with the limits of current knowledge?	The level of risk associated with the limits of current knowledge can be considered low. The potential risks have been identified in Section 7.5 of Part A of this report.
1.8.3 Based on the limits of knowledge and the level of risk, how and to what extent was a risk-averse and cautious approach applied to the development?	

[16] Section 24 of the Constitution and Sections 2(4)(a)(vi) and 2(4)(b) of NEMA refer

[17] Section 24 of the Constitution and Section 2(4)(a)(vii) of NEMA refer.

Requirement	Part where requirement is addressed/ response
1.9 How will the ecological impacts resulting from this development impact on people's environmental right in terms following:[18]	
1.9.1 Negative impacts: e.g. access to resources, opportunity costs, loss of amenity (e.g. open space), air and water quality impacts, nuisance (noise, odour, etc.), health impacts, visual impacts, etc. What measures were taken to firstly avoid negative impacts, but if avoidance is not possible, to minimise, manage and remedy negative impacts?	All potential negative and positive impacts associated with the project have been identified and discussed in Section 7.5 below of this report.
1.9.2 Positive impacts: e.g. improved access to resources, improved amenity, improved air or water quality, etc. What measures were taken to enhance positive impacts?	
1.10 Describe the linkages and dependencies between human wellbeing, livelihoods and ecosystem services applicable to the area in question and how the development's ecological impacts will result in socio-economic impacts (e.g. on livelihoods, loss of heritage site, opportunity costs, etc.)?	
1.11 Based on all of the above, how will this development positively or negatively impact on ecological integrity objectives/targets/considerations of the area?	
1.12 Considering the need to secure ecological integrity and a healthy biophysical environment, describe how the alternatives identified (in terms of all the different elements of the development and all the different impacts being proposed), resulted in the selection of the "best practicable environmental option" in terms of ecological considerations?[19]	Refer to Section 7.1 of this report for an assessment of the alternatives identified.
1.13 Describe the positive and negative cumulative ecological/biophysical impacts bearing in mind the size, scale, scope and nature of the project in relation to its location and existing and other planned developments in the area?[20]	The potential impacts associated with the project are included in Section 7.5 of Part A of this report. These impacts (including the residual and cumulative impacts) are described and assessed in detail and the significance determined.
2.“Promoting justifiable economic and social development”[21]	
2.1 What is the socio-economic context of the area, based on, amongst other considerations, the following considerations?	

[18] Section 24 of the Constitution and Sections 2(4)(a)(viii) and 2(4)(b) of NEMA refer

[19] Section 2(4)(b) of NEMA refer

[20] Regulations 22(2)(i)(i), 28(1)(g) and 31(2)(1) in Government Notice No. R. 543 refer

[21] Section 24 of the Constitution refers.

Requirement	Part where requirement is addressed/ response
2.1.1 The IDP (and its sector plans' vision, objectives, strategies, indicators and targets) and any other strategic plans, frameworks of policies applicable to the area,	The Thabazimbi Local Municipality's Integrated Development Plan 2018/19, states that the provincial economy is predominantly driven by the mining and commodity services sectors that contribute 27.6 % and 23.8 %, respectively. This application relates to the proposed reclamation of the D1 - Old Plant Discard Dump, D2 - Old Plant Discard Dump, D3 - Supply Chain Discard Dump and Slimes Dams. The project will continue to contribute to the socio economy in the area as mining of iron ore can continue.
2.1.2 Spatial priorities and desired spatial patterns (e.g. need for integrated of segregated communities, need to upgrade informal settlements, need for densification, etc.),	
2.1.3 Spatial characteristics (e.g. existing land uses, planned land uses, cultural landscapes, etc.), and	
2.1.4 Municipal Economic Development Strategy ("LED Strategy").	
2.2 Considering the socio-economic context, what will the socio-economic impacts be of the development (and its separate elements/aspects), and specifically also on the socio-economic objectives of the area?	
2.2.1 Will the development complement the local socio-economic initiatives (such as local economic development (LED) initiatives), or skills development programs?	
2.3 How will this development address the specific physical, psychological, developmental, cultural and social needs and interests of the relevant communities?[22]	
2.4 Will the development result in equitable (intra- and inter-generational) impact distribution, in the short- and long-term?[23] Will the impact be socially and economically sustainable in the short- and long-term?	
2.5 In terms of location, describe how the placement of the proposed development will:[24]	
2.5.1 result in the creation of residential and employment opportunities in close proximity to or integrated with each other,	This application relates to the proposed reclamation of the D1 - Old Plant Discard Dump, D2 - Old Plant Discard Dump, D3 – Supply Chain Discard Dump and Slimes Dams that will assist in decreasing TIOM's footprint and will continue to contribute to the socio economy in the area through employment of contractors from the local community, but also optimise the use of existing resources and infrastructure. The proposed reclamation of the D1 - Old Plant
2.5.2 reduce the need for transport of people and goods,	
2.5.3 result in access to public transport or enable non-motorised and pedestrian transport (e.g. will the development result in densification and the achievement of thresholds in terms	

[22] Section 2(2) of NEMA refers

[23] Sections 2(2) and 2(4)(c) of NEMA refers.

[24] Section 3 of the Development Facilitation Act, 1995 (Act No. 67 of 1995) ("DFA") and the National Development Plan refer

Requirement	Part where requirement is addressed/ response
public transport),	Discard Dump, D2 - Old Plant Discard Dump, D3 - Supply Chain Discard Dump and Slimes Dams will take place on already disturbed areas.
2.5.4 compliment other uses in the area,	
2.5.5 be in line with the planning for the area,	
2.5.6 for urban related development, make use of underutilised land available with the urban edge,	
2.5.7 optimise the use of existing resources and infrastructure,	
2.5.8 opportunity costs in terms of bulk infrastructure expansions in non-priority areas (e.g. not aligned with the bulk infrastructure planning for the settlement that reflects the spatial reconstruction priorities of the settlement),	
2.5.9 discourage "urban sprawl" and contribute to compaction/densification,	
2.5.10 contribute to the correction of the historically distorted spatial patterns of settlements and to the optimum use of existing infrastructure in excess of current needs,	
2.5.11 encourage environmentally sustainable land development practices and processes,	The project will reduce the footprint of the mine by generating product from “waste” material that would have been left on the mine. Refer to Section 1.4 of Part B of this report for detailed management and mitigation measures.
2.5.12 take into account special locational factors that might favour the specific location (e.g. the location of a strategic mineral resource, access to the port, access to rail, etc.),	Refer to Section 7.1 of Part A of this report for details of alternatives.
2.5.13 the investment in the settlement or area in question will generate the highest socio-economic returns (i.e. an area with high economic potential),	This application relates to the proposed reclamation of the D1 - Old Plant Discard Dump, D2 - Old Plant Discard Dump, D3 – Supply Chain Discard Dump and Slimes Dams that will assist in decreasing TIOM’s footprint and will continue to contribute to the Socio Economy in the area through employment of contractors from the local community.
2.5.14 impact on the sense of history, sense of place and heritage of the area and the socio-cultural and cultural-historic characteristics and sensitivities of the area, and	
2.5.15 in terms of the nature, scale and location of the development promote or act as a catalyst to create a more integrated settlement?	As application relates to the proposed reclamation of the existing D1 - Old Plant Discard Dump, D2 - Old Plant Discard Dump, D3 – Supply Chain Discard Dump and Slimes Dams, the nature and scale of the project is limited, thus does not act as a catalyst to create
2.6 How were a risk-averse and cautious approach applied in terms of socio-economic impacts?[25]	

[25] Section 2(4)(a)(vii) of NEMA refers

Requirement	Part where requirement is addressed/ response
	a more integrated settlement. A conservative approach was followed in terms of the identification and assessing of socio-economic impacts associated with the project. Furthermore, the proposed project will have positive impacts on the socio economy. Refer to the risk assessment in Section 7.5 of Part of this report.
2.6.1 What are the limits of current knowledge (note: the gaps, uncertainties and assumptions must be clearly stated)?[26]	The level of risk associated with the limits of current knowledge is low.
2.6.2 What is the level of risk (note: related to inequality, social fabric, livelihoods, vulnerable communities, critical resources, economic vulnerability and sustainability) associated with the limits of current knowledge?	
2.6.3 Based on the limits of knowledge and the level of risk, how and to what extent was a risk-averse and cautious approach applied to the development?	
2.7 How will the socio-economic impacts resulting from this development impact on people's environmental right in terms following	
2.7.1 Negative impacts: e.g. health (e.g. HIV-Aids), safety, social ills, etc. What measures were taken to firstly avoid negative impacts, but if avoidance is not possible, to minimise, manage and remedy negative impacts?	This application relates to the proposed reclamation of the D1 - Old Plant Discard Dump, D2 - Old Plant Discard Dump, D3 – Supply Chain Discard Dump and Slimes Dams that will assist in decreasing TIOM's footprint and will continue to contribute to the Socio Economy in the area through employment of contractors from the local community. The project will have a temporary impact on the air quality of the surrounding area, however, mitigation measures will be proposed to minimise such risks.
2.7.2 Positive impacts. What measures were taken to enhance positive impacts?	Refer to Section 7.7 of Part A of this report for an identification of the positive impacts.
2.8 Considering the linkages and dependencies between human wellbeing, livelihoods and ecosystem services, describe the linkages and dependencies applicable to the area in question and how the development's socioeconomic impacts will result in ecological impacts (e.g. over utilisation of natural resources, etc.)?	The identified impacts from the project are presented in Section 7.5 of Part A of this report.
2.9 What measures were taken to pursue the selection of the "best practicable environmental	Refer to Section 7.1 of Part A of this report for an assessment of the alternatives identified and

[26] Section 24(4) of NEMA refers

Requirement	Part where requirement is addressed/ response
option" in terms of socio-economic considerations?[27]	their potential impacts on the social environment.
2.10 What measures were taken to pursue environmental justice so that adverse environmental impacts shall not be distributed in such a manner as to unfairly discriminate against any person, particularly vulnerable and disadvantaged persons (who are the beneficiaries and is the development located appropriately)?[28] Considering the need for social equity and justice, do the alternatives identified, allow the "best practicable environmental option" to be selected, or is there a need for other alternatives to be considered?	
2.11 What measures were taken to pursue equitable access to environmental resources, benefits and services to meet basic human needs and ensure human wellbeing, and what special measures were taken to ensure access thereto by categories of persons disadvantaged by unfair discrimination?[29]	Refer to point 2.7 (of this table) above.
2.12 What measures were taken to ensure that the responsibility for the environmental health and safety consequences of the development has been addressed throughout the development's life cycle?[30]	The identification of the potential impacts has been presented in Section 7.5 of Part A of this report.
2.13 What measures were taken to:	
2.13.1 ensure the participation of all interested and affected parties,	Refer to the Public Participation Report attached hereto as Annexure D.
2.13.2 provide all people with an opportunity to develop the understanding, skills and capacity necessary for achieving equitable and effective participation,[31]	
2.13.3 ensure participation by vulnerable and disadvantaged persons,[32]	
2.13.4 promote community wellbeing and empowerment through environmental education, the raising of environmental awareness, the	

[27] Section 2(4)(b) of NEMA refers.

[28] Section 2(4)(c) of NEMA refers.

[29] Section 2(4)(d) of NEMA refers.

[30] Section 2(4)(e) of NEMA refers.

[31] Section 2(4)(f) of NEMA refers

[32] Section 2(4)(f) of NEMA refers.

Requirement	Part where requirement is addressed/ response
sharing of knowledge and experience and other appropriate means,[33]	
2.13.5 ensure openness and transparency, and access to information in terms of the process,[34]	
2.13.6 ensure that the interests, needs and values of all interested and affected parties were taken into account, and that adequate recognition were given to all forms of knowledge, including traditional and ordinary knowledge[35]*, and*	
2.13.7 ensure that the vital role of women and youth in environmental management and development were recognised and their full participation therein were being promoted?[36]	Refer to the Public Participation Report attached hereto as Annexure D. The Public Participation Report presents the detail of all Interested and Affected Parties ("I&APs") that were identified, how the I&APs were notified and involved in the process, any issues and concerns raised by the I&APs, and the final results of the Public Participation Process.
2.14 Considering the interests, needs and values of all the interested and affected parties, describe how the development will allow for opportunities for all the segments of the community (e.g. a mixture of low-, middle-, and high-income housing opportunities) that is consistent with the priority needs of the local area (or that is proportional to the needs of an area)?[37]	
2.15 What measures have been taken to ensure that current and/or future workers will be informed of work that potentially might be harmful to human health or the environment or of dangers associated with the work, and what measures have been taken to ensure that the right of workers to refuse such work will be respected and protected?[38]	All contractors, sub-contractors and workers will attend compulsory environmental awareness training and inductions. This training will highlight the dangers associated with the workplace. Procedures relating to environmental risks will also be put in place and will be regularly updated
2.16 Describe how the development will impact on job creation in terms of, amongst other aspects	
2.16.1 the number of temporary versus permanent jobs that will be created,	This application relates to the proposed reclamation of the D1 - Old Plant Discard Dump, D2 - Old Plant Discard Dump, D3 – Supply Chain Discard Dump and Slimes Dams that will assist in decreasing TIOM's footprint and will continue to contribute to the socio economy in the area through employment of contractors/workers from the local community.
2.16.2 whether the labour available in the area will be able to take up the job opportunities (i.e. do the required skills match the skills available in the area),	
2.16.3 the distance from where labourers will	

[33] Section 2(4)(h) of NEMA refers.

[34] Section 2(4)(k) of NEMA refers.

[35] Section 2(4)(g) of NEMA refers.

[36] Section 2(4)(q) of NEMA refers.

[37] Section 2(4)(g) of NEMA refers.

[38] Section 2(4)(j) of NEMA refers

Requirement	Part where requirement is addressed/ response
have to travel,	
2.16.4 the location of jobs opportunities versus the location of impacts (i.e. equitable distribution of costs and benefits), and	
2.16.5 the opportunity costs in terms of job creation (e.g. a mine might create 100 jobs, but impact on 1000 agricultural jobs, etc.).	
2.17 What measures were taken to ensure:	
2.17.1 that there were intergovernmental coordination and harmonisation of policies, legislation and actions relating to the environment, and	Refer to the Public Participation Report attached hereto as Annexure D. Other government departments are included on the list of I&APs and stakeholders and received the notifications of the project as well as notifications on the availability of the report for review. All applicable environmental legislation was considered during the scoping process.
2.17.2 that actual or potential conflicts of interest between organs of state were resolved through conflict resolution procedures?	
2.18 What measures were taken to ensure that the environment will be held in public trust for the people, that the beneficial use of environmental resources will serve the public interest, and that the environment will be protected as the people's common heritage?[39]	During the initial Public Participation Process, all issues and concerns raised by the I&APs, stakeholders and the Organs of State are considered, and responses provided.
2.19 Are the mitigation measures proposed realistic and what long-term environmental legacy and managed burden will be left?[40]	Mitigation measures for each of the identified impacts were described in detail in Section 7.5 Part A of this report. The mitigation measures are realistic to protect both the bio-physical and socio-economic environment in both the short and long-term.
2.20 What measures were taken to ensure that the costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects will be paid for by those responsible for harming the environment?[41]	TIOM will be responsible for the costs of any remediation of pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects. The Financial Provisioning has been included in Section 19 of Part A of this report.
2.21 Considering the need to secure ecological integrity and a healthy bio-physical environment, describe how the alternatives identified (in terms of all the different elements of the development and all the different impacts being proposed), resulted in the selection of the best practicable	A conservative approach was followed in terms of the identification and assessing of environmental impacts associated with the existing mining activities. The alternatives for the project are described in

[39] Section 2(4)(o) of NEMA refers.

[40] Section 240(1)(b)(iii) of NEMA and the National Development Plan refer.

[41] Section 2(4)(p) of NEMA refers.

Requirement	Part where requirement is addressed/ response
environmental option in terms of socio-economic considerations?[42]	Section 7.1 of Part A of this report and assessed in terms of the following four categories: • Environmental; • Technical/Engineering; • Economical; and • Social.
2.22 Describe the positive and negative cumulative socio-economic impacts bearing in mind the size, scale, scope and nature of the project in relation to its location and other planned developments in the area?[43]	The impacts have been presented in Section 7.5 of Part A of this report.

7 Motivation for the preferred development footprint within the approved site

7.1 Details of alternatives considered as part of the project

The following alternatives have been identified as part of the project.

7.1.1 Mining Alternatives

Reclamation alternative:

The project is an extension to an existing project that is currently being undertaken by TIOM that focusses on the reclamation of material stockpiles located throughout the mine boundary (Refer to Figure 3). The preferred alternative is to reclaim the existing D1 - Old Plant Discard Dump, D2 - Old Plant Discard Dump, D3 – Supply Chain Discard Dump and Slimes Dams. As the facilities as well as associated infrastructure are existing, the footprint of the mine will not be increased. Furthermore, an existing approved crushing and screening plant as well as an existing mobile plant will be utilised to screen and crush the materials. No undisturbed areas will be impacted upon. As TIOM is currently focusing on rehabilitation activities, the project will assist in decreasing the mine's footprint, thus decreasing the costing of rehabilitation. Furthermore, by implementing the project, jobs will be retained for an additional 4 – 5 years.

Mining alternative:

The alternative to the project is to recommence with mining of the pits. The estimated time to do the necessary specialist studies and design will take approximately 8 years to complete before recommence of mining the pits can take place. .

[42] Section 2(4)(b) of NEMA refers.

[43] Regulations 22(2)(i)(i), 28(1)(g) and 31(2)(1) in Government Notice No. R. 543 refer.

7.1.2 No-go Option

The no-go option would mean that the status quo of the environmental would remain as is (size of the dumps will stay the same and will be rehabilitated according to current practice) and there would be no additional impacts to the mine. However, the opportunity to reclaim the available iron ore resources within the mine residue will be lost. The project will ensure that TIOM is able to generate income, thus jobs will be retained through an extension of the life of mine.

7.2 Details of the Public Participation Process Followed

Section 24 of the Constitution of the Republic of South Africa, 1996 guarantees everyone the right to an environment that is not harmful to their health and well-being and to have the environment protected for the benefit of present and future generations. In order to give effect to this right, NEMA came into effect.

In terms of Section 24(4) of NEMA, procedures for the investigation, assessment and communication of the potential consequences or impacts of activities on the environment must, inter alia, ensure, with respect to every application:

- Coordination and cooperation between organs of state in the consideration of assessments where an activity falls under the jurisdiction of more than one organ of state.
- That the findings and recommendations flowing from an investigation, the general objective of integrated management laid down in NEMA and the principles of environmental management set out in Section 2 of NEMA are taken into account in any decision made by the organ state in relation to any proposed policy, programme, process, plan or projects, consequences or impacts.
- Public information and participation procedures which provide all integrated and affected parties, including all organs of state in all spheres of government that may have jurisdiction over any aspect of the activity, with a reasonable opportunity to participate in those information and participation procedures.

One of the general objectives of integrated environmental management laid down in Section 23(2)(d) of NEMA is to: “ensure adequate and appropriate opportunity for public participation in decisions that may affect the environment.”

The National Environmental Management Principles as stipulated in NEMA say;

- Environmental management must place people and their needs at the forefront of its concern, and serve their physical, psychological, developmental, cultural and social interests equitably.
- The participation of all interested and affected parties in environmental governance must be promoted, and all people must have an opportunity to develop the understanding, skills and capacity necessary to achieve equitable and effective participation, and participation by vulnerable and disadvantage persons must be ensured”.

The public participation process for this project was conducted by Shangoni Management Services (Pty) Ltd in terms of:

- The procedures and provisions in terms of the NEMA;
- Chapter 6 of the 2014 EIA Regulations;
- GN 807 of 2012; Public Participation Guideline; and
- Other relevant legislation such as the Promotion of Access to Information Act (PAIA), 2000.

7.2.1 Identification and registration of I&APs and key stakeholders

Table 12 below lists the landowners, adjacent landowners and organs of state identified and notified (by means of e-mail, telephone, fax and/or post) of the project. All organs of state which may have jurisdiction in respect of the project is considered to be registered I&APs.

Table 12: List of landowners and adjacent landowners identified and notified

Organs of state and stakeholders
National Departments
Department of Mineral Resources and Energy
Department of Human Settlements, Water and Sanitation
Provincial Departments
Limpopo Department of Economic Development, Environment and Tourism
Waterberg District Municipality
Thabazimbi Local Muncipality
Other interested and affected parties
Adjacent landowners
Aldo van Reenen
Petro van Reenen
Lourens du Plessis
Kruger Robbertse
Bones van der Linde
Faan van der Linde
Hannes Harmse
Piet van Rensburg
Dr. Jan Grobler
Boet Rheeders
Nolte Roets
Wessel de Clerq
Kobus Hermann
Dr. Marthinus Maree

Organs of state and stakeholders
Pieter Paulie
Tony Iorio
Marius Coetzee
Gary Bauer
Chris Ellis
Richard Kearney
Anton vd Berg
Chris Botha
Marie Roets
Tercia Ellis
Belinda Rheeders
C Pelser
Jan Viljoen
Ampie le Roux
Louis Bezuidenhout
Kobus van Vuuren
Piet van Schalkwyk
Evert Kleynhans
Wayne Birch
Andre Neethling
Fred Few
Other
Thabazimbi Ratepayers Association
Limpopo Provincial Heritage Resources Authority (“LIHRA”)
Northam Comprehensive High School
Frikkie Meyer Laerskool
De Gloria Primary School
Groenvlei Secondary School
Tshekganang Primary School
Ysterberg School Primary School
Makoppa Combined School
Thabazimbi Town clinic

Organs of state and stakeholders
Thabazimbi South African Police Services
Thabazimbi Tourism centre
Thabazimbi Busiess Chamber

7.2.2 Methods of notification

7.2.2.1 Advertisement(s)

During the scoping phase, the project was advertised in the Platinum Bushvelder newspaper on the 21st of February 2020. The Platinum Bushvelder newspaper was found to be the most appropriate newspaper in terms of its accessibility to the I&APs. A copy of the Advertisement is attached hereto in Annexure D1 and proof of placement in the Platinum Bushvelder newspaper attached hereto in Annexure D2.

7.2.2.2 Placement of site- and public notices

During the scoping phase, notice was also given to Interested and Affected Parties ("I&APs") by notice boards. Notice boards were placed at different, noticeable and conspicuous places on the 21st of February 2020. A copy of the site notice is attached in Annexure D3 and proof of placement of the site notices in Annexure D4.

7.2.2.3 Background Information Document

During the scoping phase, the Background Information Document ("BID") developed for the project provides background information pertaining to the project and is intended to inform I&APs of the project. The BID also includes a registration form that I&APs, stakeholders and organs of state are encouraged to complete in order to register as an I&AP for the project. The BID was made available on the 21st of February 2020 to all landowners within and surrounding the site on which the project will be undertaken, as well as to all organs of state that may have jurisdiction over any aspect of the activity. The BID will also be made available to any other person who becomes involved in the on-going Public Participation Process. A copy of the BID is attached hereto in Annexure D5 and proof of notification to I&APs in Annexure D6

7.2.3 I&APs register

Once all landowners, adjacent landowners, organs of state and the public were notified of the project, an I&APs register is kept and will be updated during the process. Refer to Table 12 and Annexure D6 for a list of organs of states, stakeholders and landowners notified. A copy of details may be provided upon request.

7.2.4 Access and opportunity to comment on written submissions

The draft Scoping Report was made available to the public for review for a period of thirty (30) days, from 21st of February 2020 to 23rd of March 2020. Hard copies of the mentioned document have been

made available at the Thabazimbi Public Library, the mine's security office and on the Shangoni's website (www. shangoni.co.za) for the I&APs to view and a copy of the document was also submitted to the DMR and DWS for review. All the registered I&APs were notified of the availability of the Scoping Report for public review by 21 February 2019. Proofs of the draft Scoping Report submitted for public comment is attached hereto in Annexure D7.

Comments and registration forms, as well as Shangoni's response to the comments are attached in Annexure D8.

7.2.5 Consultation with the relevant Authorities

7.2.5.1 Application form in terms of the NEMA

The application for environmental authorisation was submitted to the Department of Mineral Resources and Energy Limpopo Region ("DMRE") on 21 February 2020

A copy of the application for environmental authorisation form is attached hereto in Annexure C1 and DMRE's acceptance letter in Annexure C3.

7.2.5.2 Further consultation with relevant Authorities

Further consultation will be done with the DMRE during the EIA phases.

7.3 Summary of issues raised by I&APs

Table 13 below has been completed with the comments and issues raised during the Scoping Phase and prior to completion of the draft EIAR and EMPr. Any comments received hereafter will be included in the final EIAR and EMPr.

Table 13: Summary of issues raised by I&APs

Interested and Affected Parties	Date Comments Received	Issues Raised	EAPs Response to Issues as Mandated by the Applicant	Section and Paragraph Reference in this Report Where the Issues and or Responses Were Incorporated.
Gary Bauer	03 March 2020	Dear Sir Please find attached the completed document. • Length of time of envisaged process; • Length of time of rehabilitation process as initiated on the Western Dump; • Joint Effects of the proposed water pipeline to Medupi from the Crocodile River; and • Maintenance of the shared servitude	Good Day Gary I trust you are well. Your email sent on 03 March 2020 with regards to the Thabazimbi Iron Ore Mine application for a waste management licence for the proposed reclamation of discard dumps and slimes dams holds reference. Please see below response to your comments: **Length of time of envisaged process** Shangoni Response: As indicated on page 14 (Section 4.2.1) of the Draft Scoping Report, the processing of the existing D1 - Old Plant Discard Dump, D2 - Old Plant Discard Dump, D3 - Supply Chain Discard Dump and Slimes Dams is planned to be completed over a 4-year period (2021 - 2025) and integrates into an existing project that is currently being undertaken to reclaim existing ROM Stockpiles located throughout the site. **Length of time of rehabilitation**	Annexure D

Interested and Affected Parties	Date Comments Received	Issues Raised	EAPs Response to Issues as Mandated by the Applicant	Section and Paragraph Reference in this Report Where the Issues and or Responses Were Incorporated.
			process as initiated on the Western Dump Shangoni Response: The rehabilitation of the Western Dump is out of our scope of this project. As the Western Dump is not part of this project, I cannot provide any further detail in this regard. However, I do understand that the mine has a rehabilitation plan in place and should you require any further information in this regard, the mine can be contact directly. **Joint Effects of the proposed water pipeline to Medupi from the Crocodile River.** Shangoni Response: The project regarding the water pipeline to Medupi from the Crocodile River is not part of the mine's project. The pipeline does indeed cross the mine's property, however, the pipeline is not the mine's. **Maintenance of the shared servitude** Shangoni Response: Please may you provide more detail with regards to the reference of the shared servitude.	
Gary Bauer	33 March 2020	Good day Marvin	Hi Gary	Annexure D

Interested and Affected Parties	Date Comments Received	Issues Raised	EAPs Response to Issues as Mandated by the Applicant	Section and Paragraph Reference in this Report Where the Issues and or Responses Were Incorporated.
		Please see my comments in UPPER CASE in the body of your email. I&AP Response: Thank You Very Much I&AP Response: Thank you very much - please could you direct me to the relevant person with whom i can take this up? I&AP Response: Yes, I understand this, but never in one meeting has any representative of the mine been present to discuss joint issues with immediate parties affected by the weir site and initial part of the pipeline. Again, could you direct me to the relevant person at the mine to discuss this. .I&AP Response: Please see attached the shared servitude. Numerous attempts at getting the mine to fulfil their responsibility regarding assistance of other users in maintaining the servitude have to date been unsuccessful (contact person to whom I was referred was Mrs. H. Hattingh	I trust you are well. Please may you contact Paul Fouche who is the mine manager. He will provide you with a detailed response regarding the queries that you have that are outside the scope of this project. His details are provided below. Mr Paul Fouche Mine Manager: Thabazimbi Iron Ore Mine T: 087 352 8167 / 0832688867 E: paul.fouche@ arcelormittal.com	

7.4 Description on the baseline environment

7.4.1 The type of environment affected by the proposed activity

A baseline description or “status quo” of the of the present environmental situation is provided in this part of the document. The following attributes / aspects have been described in detail, in the following respective chapters:

- Chapter A: Geology;
- Chapter B: Climate;
- Chapter C: Topography;
- Chapter D: Soils, Land Use and Land Capability;
- Chapter E: Biodiversity;
- Chapter F: Surface water;
- Chapter G: Groundwater;
- Chapter H: Air Quality;
- Chapter I: Noise;
- Chapter J: Archaeology and cultural history;
- Chapter K: Sensitive landscapes;
- Chapter L: Visual aspects; and
- Chapter M: Regional socio-economic structure.

Section 7.4.1 provides both a summary of the baseline environment as applicable to the proposed activities, informed by:

- Shangoni Management Services (Pty) Ltd. 2010. *Thabazimbi Iron Ore Mine Pty Ltd Thabazimbi Mine Environmental Management Programme LP30/5/1/3/2/1(45) and (47) EM*.
- Shangoni Management Services (Pty) Ltd. 2019. *Sishen Iron Ore Company (Pty) Ltd: Thabazimbi Iron Ore Mine - Integrated Water and Waste Management Plan*.
- Shangoni Management Services (Pty) Ltd. 2019. *ArcelorMittal: Thabazimbi Iron Ore Mine Air Quality Model Update – TZ0031-2018.*
- Shango AquiScience. 2020. *Thabazimbi Iron Ore Mine (Pty) Ltd: A Subsidiary of ArcelorMittal South Africa Limited – Thabazimbi Iron Ore Mine Desktop Geohydrological Report for a Waste Management Licence Application.*
- Shangoni AquiScience. 2020. *Thabazimbi Iron Ore Mine (Pty) Ltd: A Subsidiary of ArcelorMittal South Africa Limited - SANS 10234 Classification for an application to exclude a waste stream or portion of a waste stream from the definition of waste, in terms of GN 715 of 18 July 2018*.

Chapter A: Geology

The following information was sourced from the *Thabazimbi Iron Ore Mine Pty Ltd Thabazimbi Mine Environmental Management Programme LP30/5/1/3/2/1(45) and (47) EM,* compiled by Shangoni Management Services (Pty) Ltd, dated 2010.

The Thabazimbi mining area consists of rocks of the Transvaal Supergroup, an early to mid-Precambrian volcano-sedimentary sequence overlying the granite gneisses of the Kaapvaal Craton, refer to Figure 13.

The Transvaal Supergroup was formed approximately 2 100 to 2 300 million years ago; the Hekpoort andesite is some 2 224 million years of age. This age was determined with a fair degree of certainty because of intrusions by the Bushveld Igneous Complex, which dates back ± 2 095 million years.

The iron ore deposits at Thabazimbi occur mainly as basal units in the Penge Formation. The Penge Formation consists largely of alternate thick units of the autochthonous iron formation and thin units of autochemical iron formation. The upper part consists of allochemical-orthochemical iron formation cycles.

Chapter B: Climate

The following information was sourced from the document titled *Sishen Iron Ore Company (Pty) Ltd: Thabazimbi Iron Ore Mine - Integrated Water and Waste Management Plan*, compiled by Shangoni Management Services (Pty) Ltd, dated February 2019.

Regional Climate

The Thabazimbi area lies in the summer rainfall region of the Bushveld. The Thabazimbi Mine area lies at an altitude of 995 to 1 445 mamsl. The Thabazimbi area is known for its relatively high temperatures, with day temperatures that may rise above 40°C in summer. The mean maximum summer temperature is about 30°C.

Rainfall

TIOM is situated in a summer rainfall area with little to no rainfall in the winter months. Precipitation in the area is highly seasonal with a mean annual rainfall of 525.3 mm according to the rainfall data from the then Department of Water and Sanitation (“DWS”) hydrological datasets collected at station A2E012 (Nooitgedacht at Bierspruit Dam).

Table 14: Monthly rainfall data from weather station A2E012 (Nooitgedacht at Bierspruit Dam)

Month	Mean Rainfall (mm)
January	107.5
February	85.1
March	78.4
April	62.8
May	17.7

Month	Mean Rainfall (mm)
June	4.9
July	0.1
August	3.3
September	6.4
October	37.6
November	62.2
December	80.6
Annual	525.3

Evaporation

Evaporation is measured at station A2E012 (Nooitgedacht at Bierspruit Dam) for an A-class pan. Table 15 below lists the average evaporation recordings. The average annual evaporation is calculated at 2355.7 mm.

Table 15: Monthly evaporation data (A Class Pan) from weather station A2E012 (Nooitgedacht at Bierspruit Dam)

Month	Mean Evaporation (mm)
January	259.6
February	213.9
March	204.1
April	137.7
May	119.1
June	99.3
July	119.2
August	161.3
September	233.1
October	279.8
November	249.4
December	265.0
Annual	2355.7

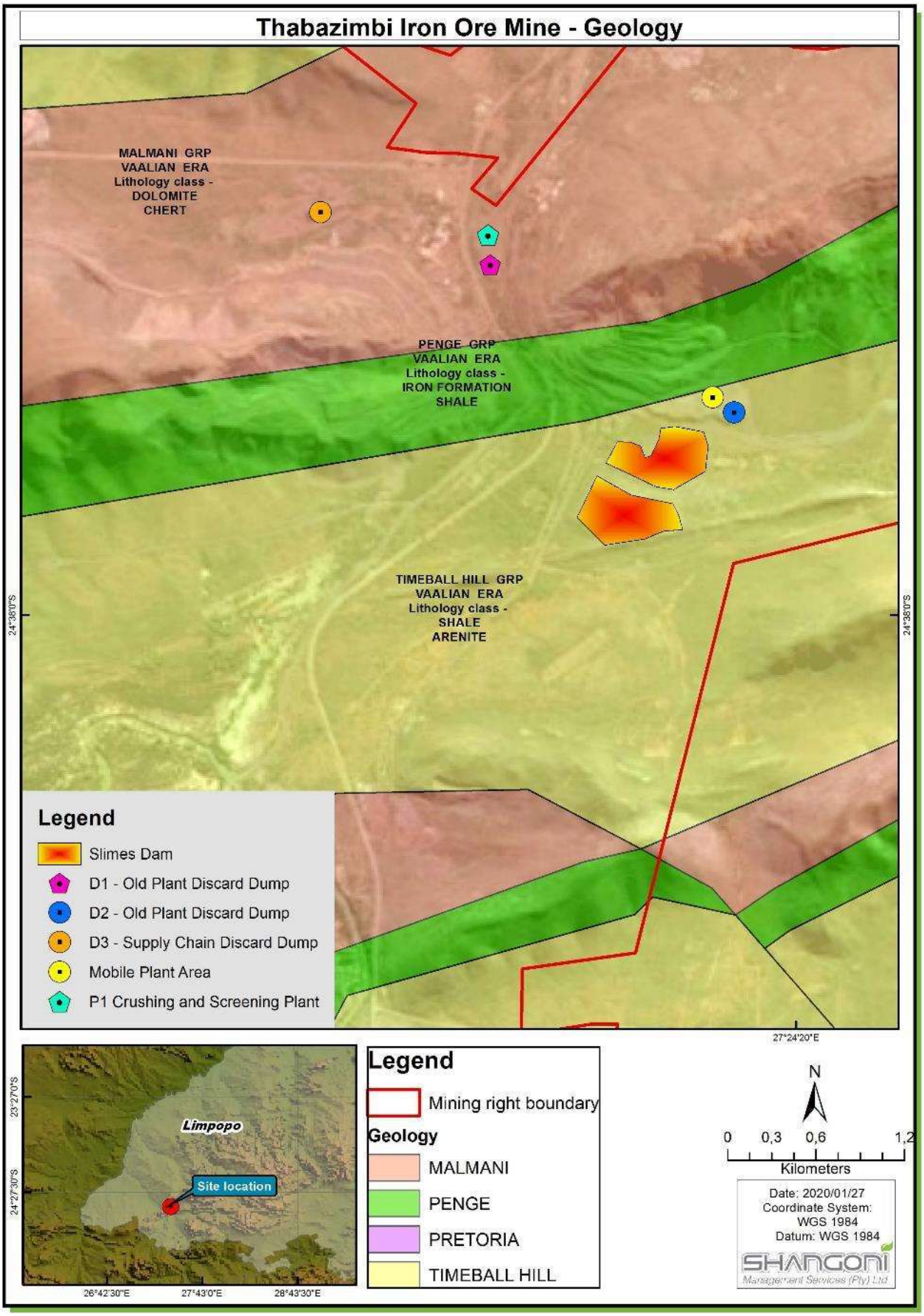


Figure 13: Geology of TIOM

Chapter C: Topography

The following information was sourced from the *Thabazimbi Iron Ore Mine Pty Ltd Thabazimbi Mine Environmental Management Programme LP30/5/1/3/2/1(45) and (47) EM,* compiled by Shangoni Management Services (Pty) Ltd, dated 2010.

The topography of the region is characterised by a valley rising from west to east and bound on the northern and southern sides by two prominent mountain ranges. The non-perennial Crocodile River crosses a flood plain that forms the western part of the valley. An intermittent creek (which flows only after a heavy shower), the Rooikuilspruit, separates the mining areas of the northern range into two separate mountain sections. The Rooikuilspruit flows into the Crocodile River. To the south of Thabazimbi, on the underlying Bush Veldt Layered complex, the topography is flat to slightly undulating. The surface undulates between 850 and 950 mamsl.

In the immediate mining area, thrusting, faulting and weathering have caused the BIF, Shales, quartzite's and dolomites of the Transvaals sequence to form prominent ranges of relative steep hills (30-45° from horizontal). These hills rise up to 500 m from the valleys below, to a maximum of about 1650 mamsl in the Rossouw's kop area to the west of Thabazimbi. The hills usually comprise the BIS formations or quartzites while the valleys are the remembrance of the less erosion-resistant dolomite, shale and lava.

To the north of the area, the hills taps out to flat bushveld topography, until the rise of the escarpment of the Kransberg formed by the sandstones, shales and conglomerates of the Water berg succession is reached.

Chapter D: Soils, Land Use and Land Capability

The following information was sourced from the *Thabazimbi Iron Ore Mine Pty Ltd Thabazimbi Mine Environmental Management Programme LP30/5/1/3/2/1(45) and (47) EM,* compiled by Shangoni Management Services (Pty) Ltd, dated 2010.

Soils

From the specialist soil survey that was conducted for the purpose of the approved EMPr, dated October 2005, it is conclusive the dominant soils on the 10 807 ha, according to the Taxonomical Soil Classification System of South Africa, are Hutton, Mispah, Dundee and Coega soils. The effective depths of the Hutton and Dundee soils are 1 800 mm, 150 mm for the Mispah and 175 mm for the Coega soils respectively. Theoretically the agricultural potential of the Hutton and Dundee soils is considered high under dryland (>650 mm / a rainfall) and irrigation conditions (>10 – 15 mm / week 33 – 1 500 kPa plant available water).

The theoretical agriculture potential of the Mispah and Coega soils is considered low. Considering the general climate of the Thabazimbi region taking cognizance of the various water balance contributors, it is reasonable to estimate an average negative water balance for 95 % of the year, i.e. dry soil moisture conditions. Taking this into account and the scarcity of available groundwater for irrigation

purposes the agricultural potential (dryland and irrigation) for crop and pasture production is considered low for the Hutton, Mispah, Dundee and Coega soils.

No evidence of soil erosion or misuse was observed on any of the soils during the investigation. An estimated area of 5 633 ha could potentially be covered 300 mm thick @ Bulk Density 1.275 kg /m^3 during rehabilitation taking into consideration a 10 % loss of topsoil from the 18 773 300 m^3 due to handling, compaction etc. Since only limited areas are considered for establishment of mining infrastructure, i.e. plant, tailings dam etc., it would not be recommended from a cost benefit perspective to strip any topsoil.

The specified horizons of the Hutton, Mispah, Dundee and Coega soils are suitable for rehabilitation purposes. However, considering only limited areas with low impact on the environment are considered for establishment of mining infrastructure, i.e. tailings dam, plant, etc., which would most likely be shallow Mispah soils no topsoil stripping from an economical perspective was recommended.

Pre-mining land capability and land use

In the Thabazimbi Local Municipality ("TLM"), approximately 40 % of the land situated within the municipal area is utilised for game farming (western and eastern part), ± 2 % for irrigation, ± 3 % for dry-land farming e.g. cotton and sunflower, mining 0.4 % and approximately 5 % for towns, roads and other infrastructure. The remainder of the area is utilised for extensive cattle farming. The geographical area of the TLM comprises approximately 9 862 km^2.

The areas to the northern, northwest and southeast of Thabazimbi Town are mainly environmentally sensitive areas due to the location of the Waterberg Biosphere, the Nature Reserves and the game farms.

Prior to the mining operations commencing in 1931, the land capability was mainly focused on cattle farming and the areas next to the Crocodile River had the potential for planting crops. The mountainous areas and the valley enclosed by the Northern and Southern mountain ranges were used for cattle farming. These areas were also frequented by various game species. Although the areas adjacent to the Crocodile River had the potential for planting crops this was never done.

The main structures on the mining area prior to mining were farming related structures. These structures could not be used as part of the mining activities and most became derelict ruins during the early years of the mine's operation.

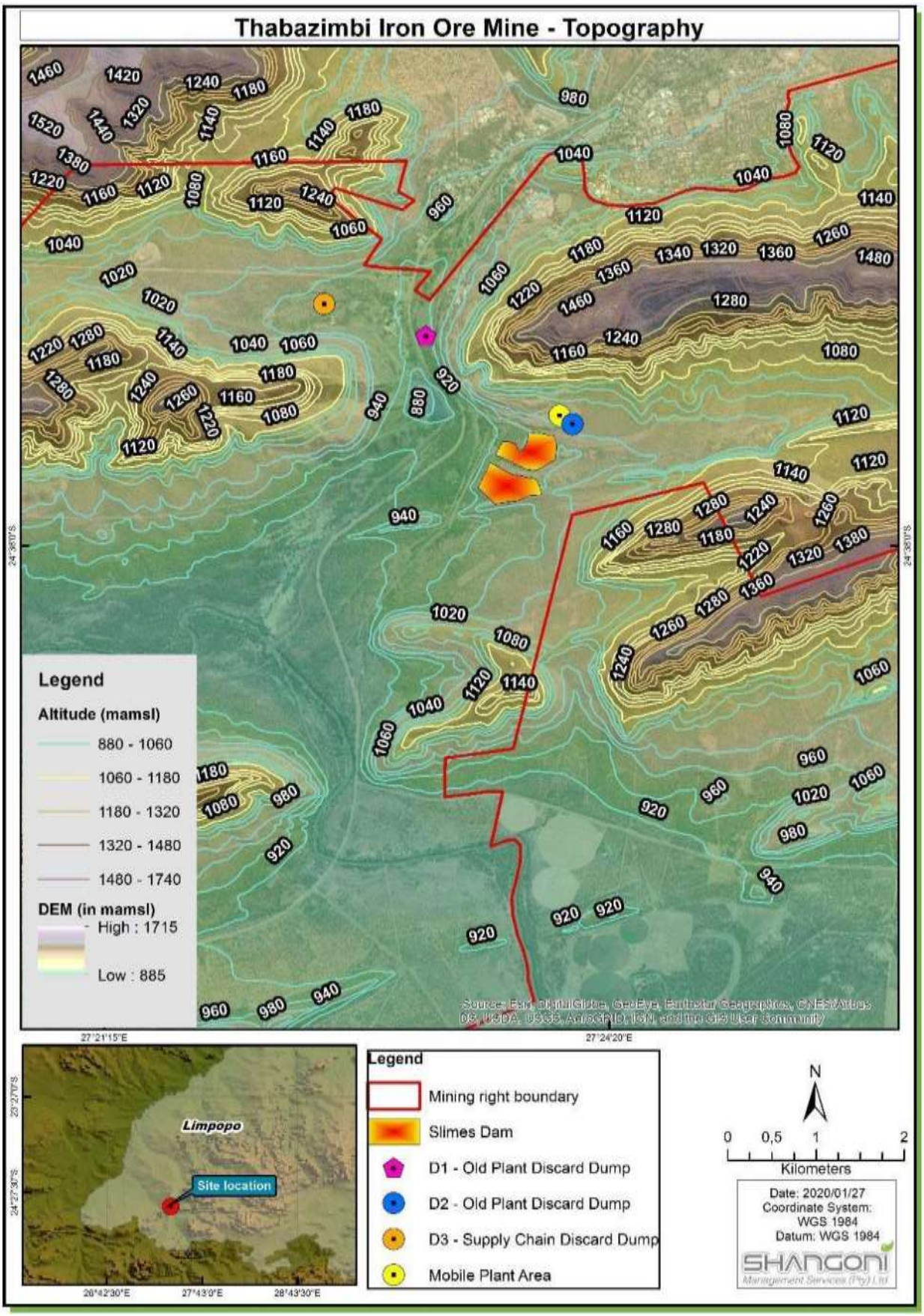


Figure 14: Map showing topography of the TIOM.

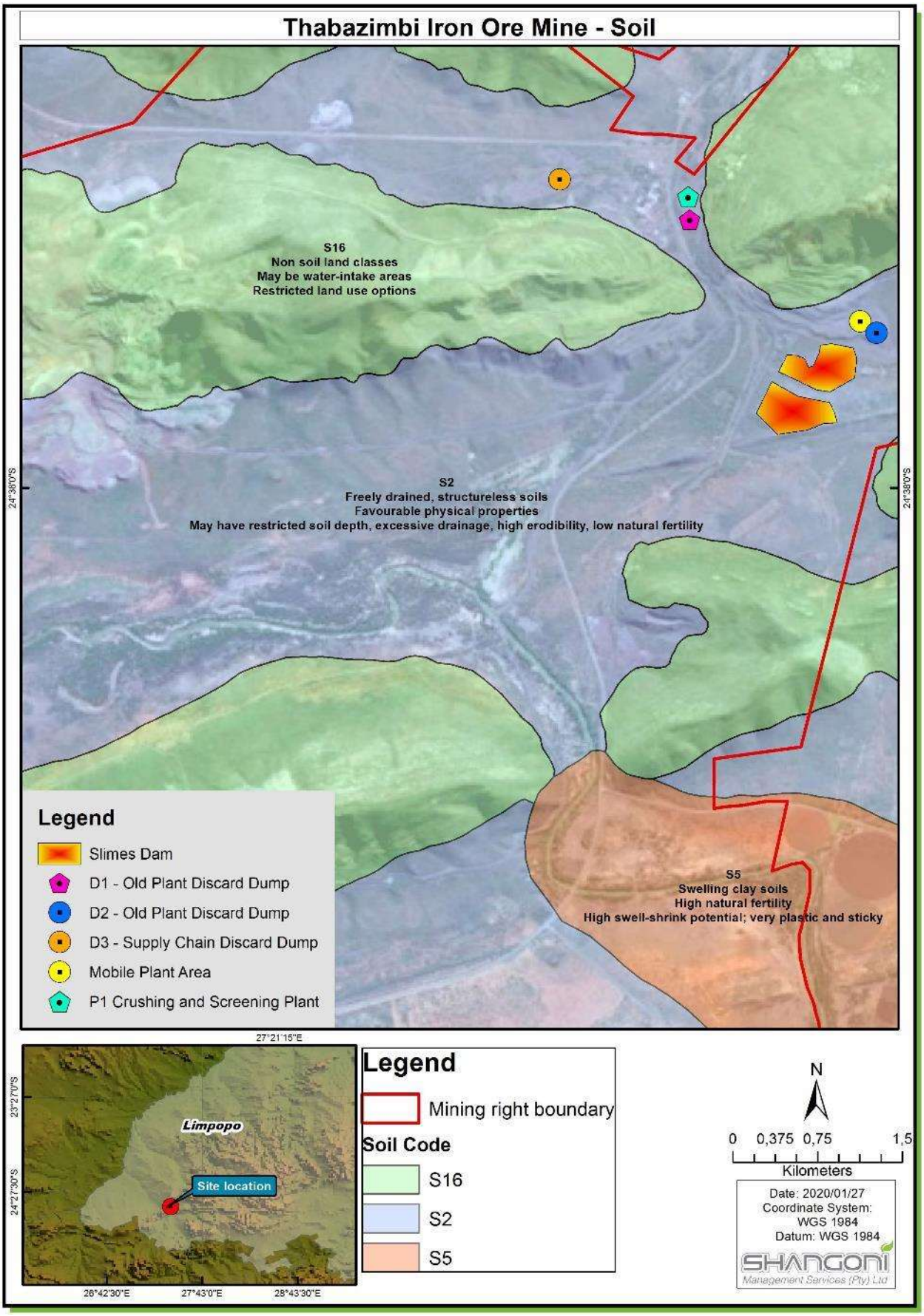


Figure 15: Soil Map of TIOM

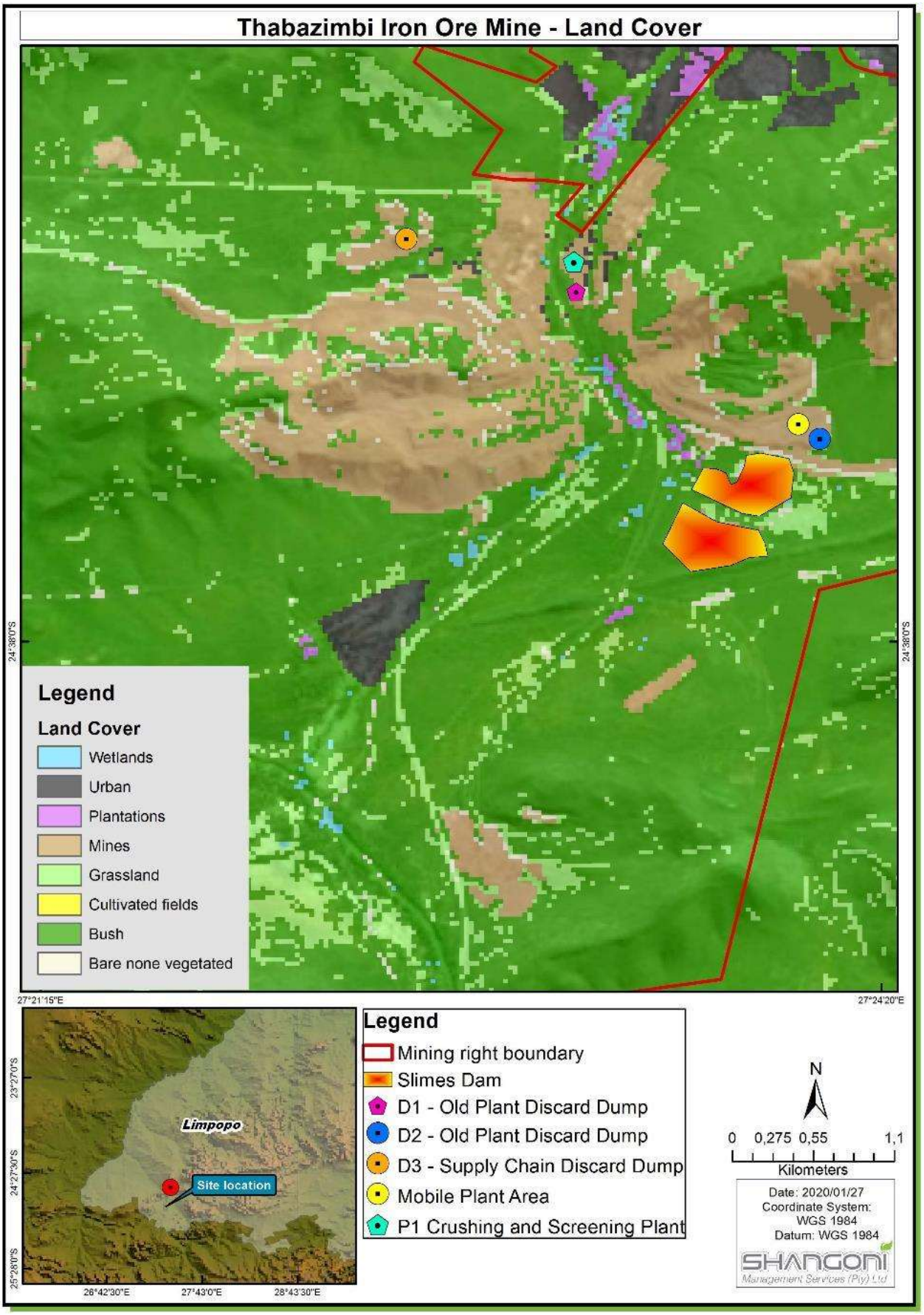


Figure 16: Land Cover at TIOM

Chapter E: Biodiversity

Vegetation

The following information was sourced from the *Thabazimbi Iron Ore Mine Pty Ltd Thabazimbi Mine Environmental Management Programme LP30/5/1/3/2/1(45) and (47) EM,* compiled by Shangoni Management Services (Pty) Ltd, dated 2010.

Thabazimbi Mine falls within three different vegetation units. Refer to Figure 17 for the vegetation in terms of Thabazimbi Mine. These vegetation units are described below.

SVcb 1 - Dwaalboom Thornveld:

D1 – Old Plant Discard Dump falls within this vegetation unit. According to Acocks (1953) the vegetation is described as “Other Turf Thornveld (58 %)”; and according to Low & Rebelo (1996) the vegetation is described as “Clay Thorn Bushveld (48 %) and Mixed Bushveld (43 %).

This vegetation type occurs in the Limpopo and North West Provinces on the flats north of the Dwarsberge and associated ridges mainly west of the Crocodile River in the Dwaalboom area but including a patch around Centrum. South of the ridges it extends eastwards from the Nietverdiend area, north of the Pilanesberg to the Northam area. Altitude is between 900 - 1200 mamsl (Mucina *et a*l. 1996).

The vegetation and landscape features can be described as: Plains with a layer of scattered, low to medium high, deciduous microphyllous trees and shrubs with a few broad-leaved tree species, and an almost continuous herbaceous layer dominated by grass species.

Acacia tortilis and *A. Nilotica* dominate on the medium clays (at least 21 % clay in the upper soil horizon but high in the lower horizons. On particularly heavy clays (>55 % clay in all horizons) most other woody plants are excluded and the diminutive *A. tenuispina* dominates at a height of less than 1 m above ground on the sandy clay loam soils (with not more than 35 % in the upper horizon but high in the lower horizons). *A. erubescens* is the most prominent tree. The alteration of these substrates types creates a mosaic of patches typically 1 – 5 km across, the unit west of Thabazimbi.

The following are important taxa of this vegetation type:

- Tall trees: *Acacia erioloba*;
- Small trees: *Acacia erubescens, A. nilotica, A. tortilis subsp. heteracantha, A. fleckii, A. mellifera subsp detinens, Combretum imberbe, Rhus lancea, Ziziphus mucronata*;
- Tall shrubs: *Acacia hebeclada subsp. hebeclada, Combretum hereroense, Diospyros lycoides subsp. lycoides, Euclea undulate, Grewia flava, Tarchonanthus camphorates*;
- Low shrubs: *Acacia tenuispana, Abutilon austro-africanum, Aptosimum elongatum, Hirpicium bechuanense, Pavonia burchelli, Solanum delagoense*;
- Succulent shrubs: *Kalanchoe rotundifolia, Talinum caffrum*;
- Herbaceous climber: *Rhynchosia minima*;

- Graminoids: *Aristida bipartite*, *Bothriochloa insculpta, Digitaria eriantha subsp eriantha, Ischaemum afrum, Panicum maximum, Cymbopogon pospischilii, Eragrostis curvula, Sehima galpinii, Setaria incrassata*; and
- Herbs: *Heliotropium ciliatum, Kohautia caespitose subsp. brachyloba, Nidorolla hottentotica*.

In terms of Conservation status, this vegetation type is the least threatened. The target is set at 19 % but only 6 % is statutorily conserved, mostly within the Madikwe National Park in the west. Approximately 14 % is transformed mainly due to cultivation. The erosion is low to very low. This vegetation type is mostly used for extensive cattle grazing.

SVcb 17 - Waterberg Mountain Bushveld:

D2 – Old Plant Discard Dump, D3 – Supply Chain Discard Dump and the Slimes Dams fall within this vegetation unit. According to Acocks (1953) the vegetation is described as “Sour Bushveld (73 %)”; and according to Low & Rebelo (1996) the vegetation is described as “Waterberg Moist Mountain Bushveld (83 %).

This vegetation types occur in the Limpopo Province, in the Waterberg Mountains, including the foothills, escarpment and tablelands south of the line between Lephalale and Marken and north of Bela-Bela and west of Mokopane and with outliers in the southwest such as the Boshofsberge and Vlieepoortberge near Thabazimbi. The altitude is about 1 000 – 1 600 m and generally at a lower altitude than the Gm 29 Waterberg-Magaliesberg summit Sourveld.

Vegetation and Landscape features include rugged mountains with vegetation grading from Faurea saligna-Protea caffra bushveld on higher slopes (in turn grading into the Gm 29 Waterberg-Magaliesburg Summit Sourveld) through broad-leaved deciduous bushveld (dominated by Diplorhynchus cana-Terminalia sericea savanna in the lower-lying valleys as well as on deeper sands on the plateaus. The grass layer is moderately developed or well developed.

Important taxa for this vegetation type are as follows:

- Tall trees: *Acacia robusta*;
- Small trees: *Acacia caffra, Burkea africana, Combretum apiculatum, Croton gratissimus, Cusonia transvaalensis, Faurea saligna, Heteropyxis natalensis, Ochna pulcra, Protea caffra, Albizia tanganyicensis, Combretum molle, Englerophytum magalismontanum, Ficus burkei, F. Glumosa, Ochna pretoriensis, Pseudolachnostylis mapronefolia, Rhus lances, Terminalia sericea, Vangueria infausta, V. Parvifolia*;
- Tall shrubs: *Diplorhynchus condylocaron, Elephantorhiza burkei, Combretum moggii, C. Nelsonii, Dichrostachys cinerea, Euclea crispa subsp. crispa, Gnidia kraussiana, Olea capensis subsp enervis,O. Europaea subsp. africana, Rhus pyroides var. pyroides, Strychnos pungens, Vitex rehmannii*;
- Low shrubs: *Anthospermum rigidum subsp. rigidum, Barleria affinis, Felicia muricata, Helichrysum krausii, Protea welwitschii subsp. welwitschii, Rhus rigida var. Dentate*; *Geoxylic Suffrutices: Dichapetalum cynosum, Parinari capensis subsp. Capensis;*
- Succulent shrubs: *Aloe chabaudii. Lopholaena coriifolia*;

- Woody climbers: *Ancylobotrys capensis, Rhoicissus revoilii*;
- Graminoids: *Loudetia simplex, Schizachyrium sanguineum, Trachypogon spicatus, Brachiaria serrata, Digitaria eriantha subsp. eriantha, Elionurus muticus, Enneapogon scoparius, Setaria sphacelata, Themeda triandra, Tristachya leucothrix*;
- Herbs: *Berkheya insignis, Chamaecrista mimosoides, Geigeria elongate, Hibiscus meyeri subsp. transvaalensis, Xerophyta retinervis*; and
- Geophytic Herbs: *Haemanthus humilis subsp. humilis, Hypoxis rigidula*.

Biogeographically important taxa are as follows: (Central Bushveld endemic, Northern Sourveld endemic) Small tree: *Encephalartos Eugene-maraisii*, Tall Shrub: *Enythrophysa transvaalensis* (protected species), Soft Shrub: *Chorisochora transvaalensis*, Graminoid: *Mosdenia leptostachys*.

Endemic taxa are as follows: Tall Shrubs: *Grewia rogersii, Pachystigma triflorum*, Herb: *Oxygonum dregeanum subsp. canescens var. Pilosum*.

In terms of conservation status this vegetation type is the least threatened. The set target is 24 % but only 9 % is statutorily conserved mainly in the Marakele National Park and Moepel Nature Reserve. More than 3 % is transformed, mainly by cultivation. The human population is considered low and erosion is low to very low.

Fauna

The following information was sourced from the *Thabazimbi Iron Ore Mine Pty Ltd Thabazimbi Mine Environmental Management Programme LP30/5/1/3/2/1(45) and (47) EM,* compiled by Shangoni Management Services (Pty) Ltd, dated 2010.

The greater Ben Alberts game reserve, about 7 km south-west of Thabazimbi, was created by Iscor. The purpose of this reserve was to re-introduce the animal species that occurred in the area years ago and were displaced by human settlement. The reserve occupies 5 000 ha, and with its topography consisting of mountains, plateaux and plains and the Crocodile River flowing through it, it is eminently suitable for accommodating all sorts of game. The following animals can be found in the reserve, see Table 16.

Table 16: Animals occurring in the Ben Albert's Nature Reserve

COMMON NAME	SCIENTIFIC NAME
Impala	*Aepyceros melampus*
Mountain reedbuck	*Redunca fulvorufula*
Oryx	*Oryx gazelle*
Waterbuck	*Kobus ellipsiprymnus*
Blue Wildebeest	*Connochaetes taurinus*
Civet cat	*Felis silvestris libyca*
Shrub hare	*Lepus saxatilis*

COMMON NAME	SCIENTIFIC NAME
Aardwolf	*Proteles cristatus*
Klipspringer	*Oreotragus*
Zebra	*Equus zebra*
Giraffe	*Giraffa camelopardalis*
Cape hartebeest	*Alcelaphus caama*
Baboon	*Papio ursinus*
Vervet monkey	*Cercopithecus aethiops*
Dwarf mongoose	*Helogale parvula*
White tail mongoose	*Ichneumia albicauda*
Brown Hyena	*Parahyaena brunnea, formerly Hyaena brunnea*
Tsessebe	*Damaliscus lunatus*
Bushbuck	*Tragelaphus scriptus*
Nyala	*Tragelaphus angasii*
Warthog	*Phacochoerus africanus*
Bush pig	*Potamochoerusl arvatus*
Porcupine	*Hystrix cristata*
Genet cat	*Genetta tigrina*
Cape Honey Badger	*Mabuya capensis*
Rock Dassie	*Procavia capensis*
Jackal	*Canis mesomelas*
Steenbuck	*Raphicerus campestris*
Kudu	*Tragelaphus strepsiceros*
Duiker	*Sylvicapra grimmia*
Mountain Reedbuck	*Redunca fulvorufula*
Leopard	*Panthera pardis*
Caracal	*Caracal*
Aardvark	*Orycteropus afer*

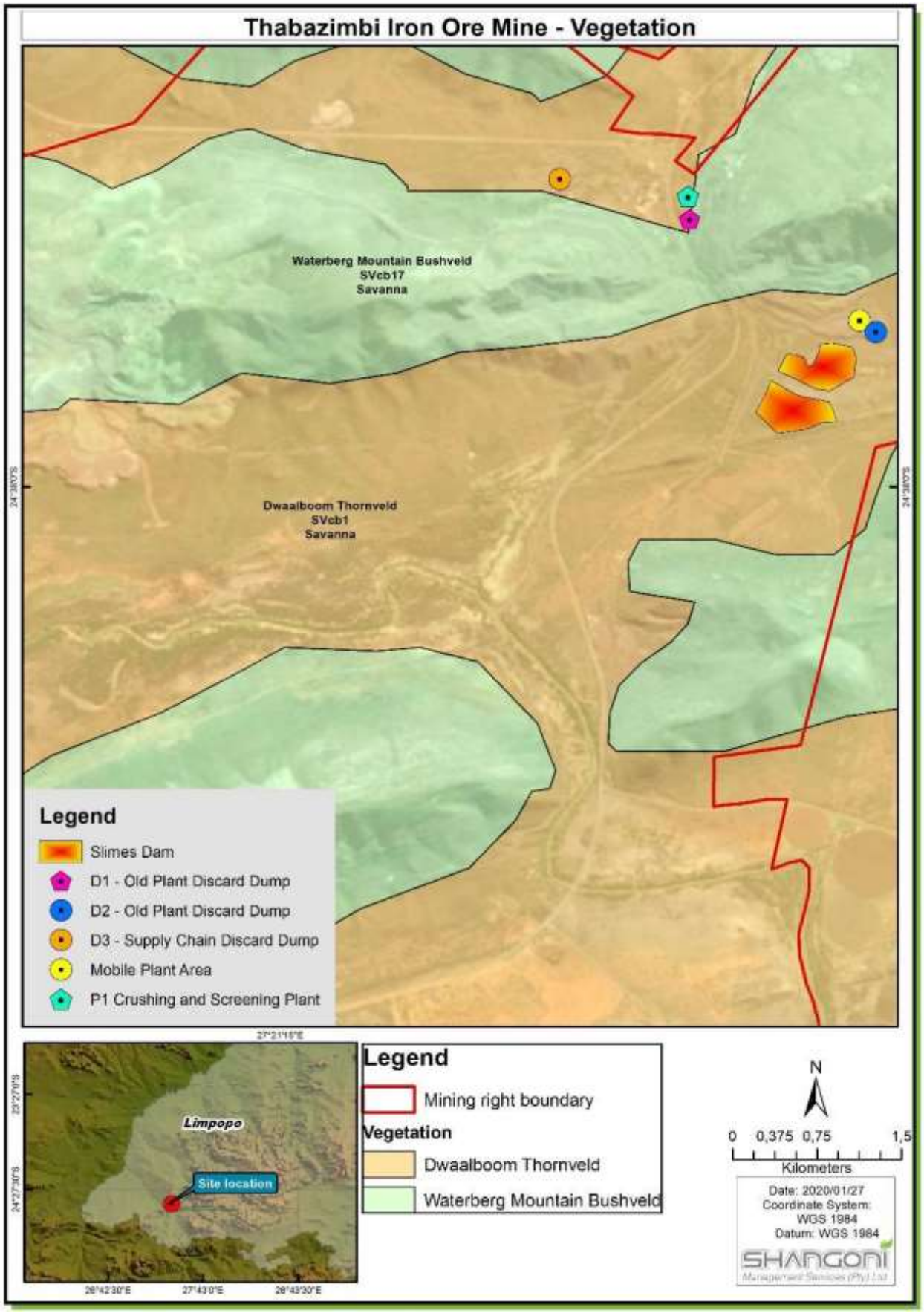


Figure 17: Vegetation Map of TIOM

It is found that game and birds move away only temporarily because of the mining activities. Of those listed below, some are found within only one or two kilometres from the sites of current mining activities, namely:

- Klipspringers (*Oreotragus oreotragus*);
- Mountain reedbuck (*Redunca fulvorufula*);
- Hyrax (*Procavia capensis*); and
- Black eagles (*Aquila verreauxii*).

A "Vulture Restaurant" was initially established at Bobbejaanwater from where it was later moved to a new location east of the explosives magazine. The main purpose of this site is to provide food for the endangered vulture species of the area. The following species gave been observed at the feeding site:

- Cape vulture (*Gyps coprotheres*);
- Whitebacked vulture (*Gyps africanus*);
- Lappet-faced vulture (*Torgos tracheliotus*);
- White-headed vulture (*Trigonoceps occipitalis*);
- Marabou stork (*Leptoptilos crumeniferus*);
- Black eagle (*Aquila verreauxii*);
- Martial eagle (*Polemaetus bellicosus*);
- Brown hyena (*Parahyaena brunnea*);
- Warthog (*Phacochoerus africanus*); and
- Jackal (*Canis mesomelas*).

Experience has shown that traps and poaching are the greatest threats. Regular investigations and checks by TIOM officers charged with nature conservation curtail this evil to some extent. The following protected bird species, the following are found:

- Ostrich (*Struthio camelus molybdophanes*);
- Marabou stork (*Leptoptilos crumeniferus*);
- Hamerkop (*Scopus umbretta*);
- Martial eagle (*Polemaetus bellicosus*);
- African fish eagle (*Haliaeetus vocifer*);
- Grey heron (*Ardea cinerea*);
- Black eagle (*Aquila verreauxii*);
- Buzzard (*Buteo buteo*); and
- Great white egret (*Coqui Francolin*).

See Table 17 for the protected bird species found.

Table 17: Protected Bird Species Found

SCIENTIFIC NAME	COMMON NAME

SCIENTIFIC NAME	COMMON NAME
Endangered species found in the area	
Gyps africanus	White-backed vulture
Gyps coprotheres	Cape vulture
Torgos tracheliotus	Lappet-faced vulture
Vulnerable species	
Polemaetus bellicosus	Martial eagle

The following areas on the mine are considered to have high occurrence of game:

- Lower slopes of Donkerpoort Mountain; and
- Crocodile River Floodplain.

Chapter F: Surface water

The following information was obtained from the *Sishen Iron Ore Company (Pty) Ltd: Thabazimbi Iron Ore Mine Integrated Water and Waste Management Plan*, dated February 2019 and compiled by Shangoni Management Services (Pty) Ltd.

Water Management Area

TIOM is situated within the Crocodile (West) and Marico Water Management Area. The North West Department of Water and Sanitation is the responsible water authority.

Surface Water hydrology

Catchment area and watercourses

The catchment boundaries and relevant streams at TIOM are shown on Figure 18. Unpolluted storm water is diverted by cut-off drains into the Crocodile River, Rooikuilspruit and Bierspruit. The total catchment area is estimated at 29 400 km^2. The upper catchment of the Crocodile River is in the Gauteng Province, near Hartbeespoort Dam. The north or northeast catchment areas are in the Limpopo Province and the central and western areas drain the North West Province (Limpopo DFED, 2004).

The relevant watercourses, namely the Rooikuilspruit, Bierspruit and part of the Crocodile River are non-perennial streams that carry no water during normal dry weather.

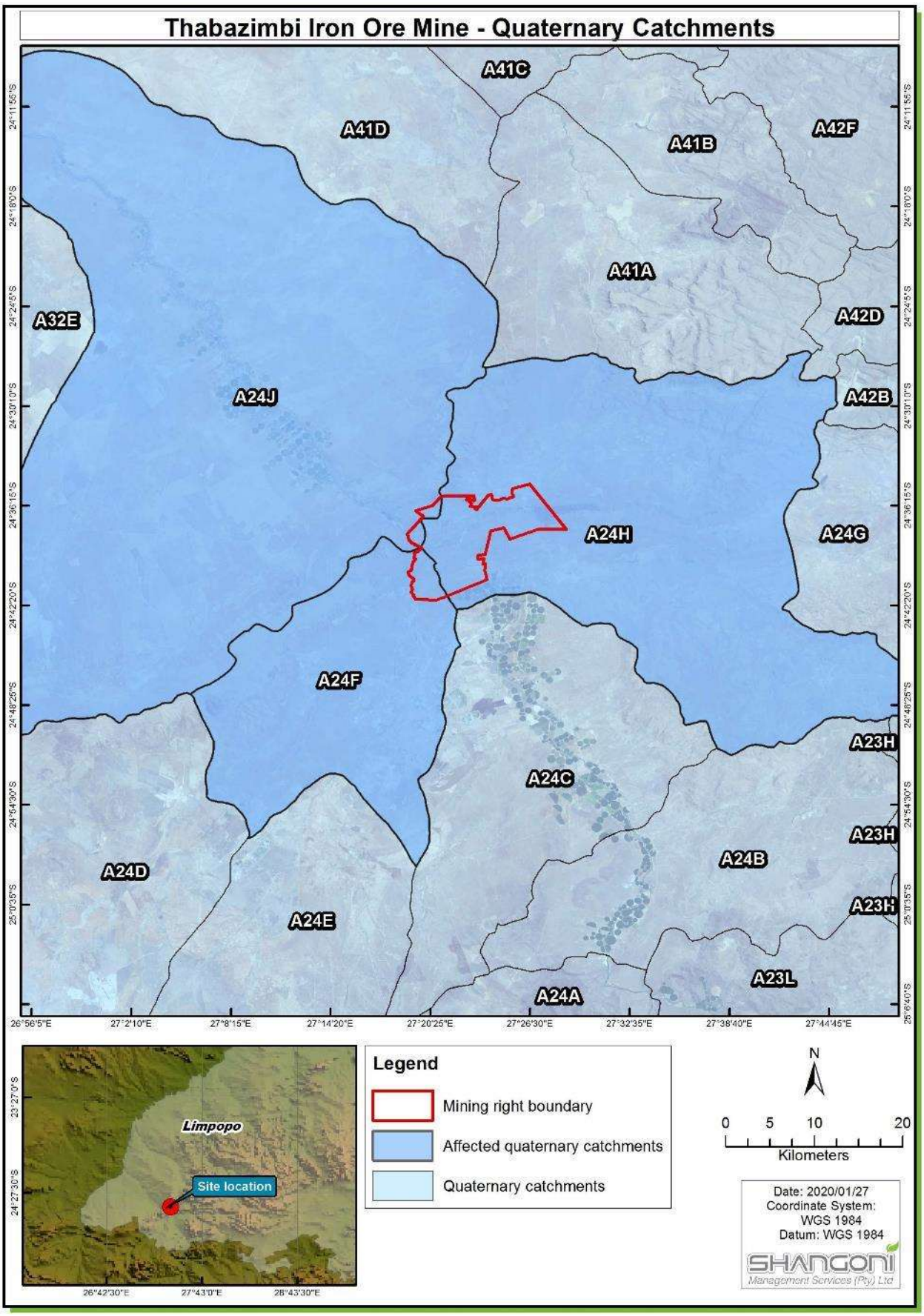


Figure 18: Catchments associated with TIOM

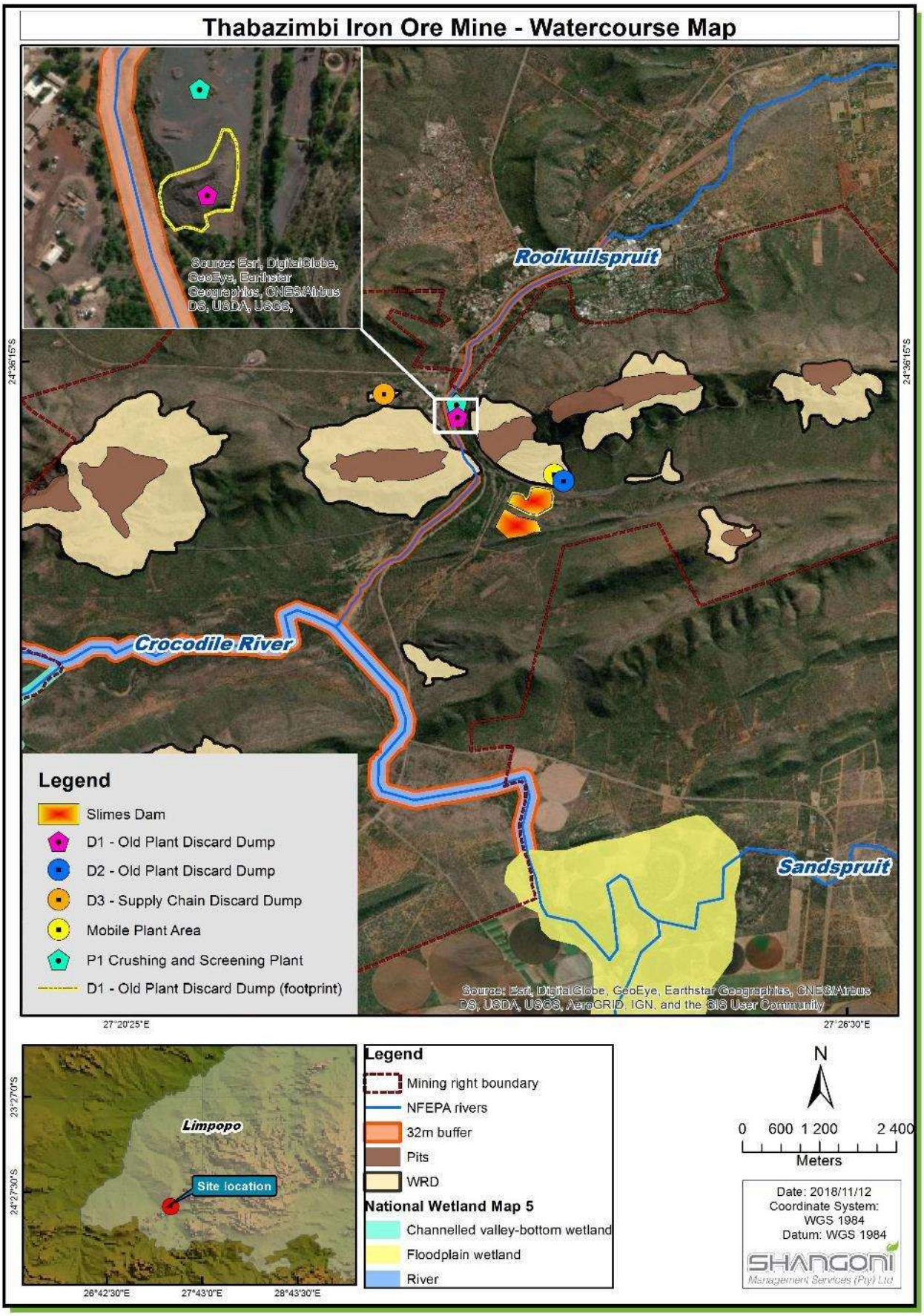


Figure 19: Map indicating the sensitive areas around the TIOM

Flood peaks and volumes

The following flood peaks and volumes are applicable to the TIOM area:

Table 18: Flood peaks and volumes of the sub-catchment

Watercourse	1:20 years	1:50 years	1:100 years	RMF
Crocodile River	358 m^3/s	584 m^3/s	895 m^3/s	2 790 m^3/s
Rooikuilspruit	225 m^3/s	357 m^3/s	539 m^3/s	1 628 m^3/s

Surface water and biomonitoring results

The following information was extracted from the report *Aquatic Biomonitoring Survey and Toxicity Testing of Selected Sites Associated with The Closing of Kumba Iron Ore in Thabazimbi, Limpopo South Africa High Flow Survey*, dated October 2019 and prepared by JG Afrika.

For each ecological component at each river site, an assessment was undertaken of the reference, or natural, conditions. This field monitoring survey determined the Present Ecological State ("PES") for the ecological response groups (riparian vegetation, aquatic invertebrates, diatoms and fish) for each site. These methods are based on the River Health Programme ("RHP") models for each main ecosystem component as follows:

- Visual assessment;
- HQI: Habitat Quality Index;
- IHAS v.2: Integrated Habitat Assessment Index, version 2 (McMillan, 1998);
- Sediment assessment; and
- Water Quality analysis: Surface water sampling and analysis undertaken by an accredited laboratory in accordance with methods prescribed by the SABS (Standards Act No 30 of 1982).

Responses:

- Diatoms (Taylor et al. 2005);
- VEGRAI: Riparian Vegetation (Kleynhans et al. 2007);
- SASS5: South African Scoring System version 5 (Dickens & Graham, 2002); and
- FRAI: Fish Response Assessment Index (Kleynhans, 2007).

Driver baseline conditions for habitat, sediment and water quality surface water were determined and were used to enrich and validate responder data.

Site selection:

The procedure of selecting sites for purposes of assessing impacts was based on the standard approach of "Before-After-Control-Impact". A visual assessment was undertaken at each site by completing a field datasheet that was based on the field manuals and -data sheets for the National River Health Programme compiled by Dallas (2005). All photographs were taken on site to support the visual assessment. The location and description of each site are provided in Table 19.

Table 19: Watercourses, sampling site, coordinates and location description

Water Courses	Site	GPS Coordinates		Location description
		Latitude	Longitude	
Rooikuil River	RK1	24° 36.797'S	27° 23.206'E	Below WWTW and upstream of the previous mining activities.
Rooikuil River	RK2	24° 37.801'S	27° 22.706'E	Below WWTW and downstream of the previous mining activities.
Bierspruit	BS1	24° 41.999'S	27° 19.513'E	Upstream of previous mining activities.
Bierspruit	BS2	24° 40.793'S	27° 19.399'E	Downstream of previous andalusite mining activities.
Crocodile River	CR1	24° 38.617'S	27° 22.261'E	Relative reference site upstream of most mining activities.
Crocodile River	CR2	24° 38.443'S	27° 22.104'E	Downstream of the confluence of the Rooikuil and Crocodile Rivers.
Crocodile River	CR3	24° 38.674'S	27° 20.746'E	Upstream of the confluence of the Bierspruit and the Crocodile River.
Crocodile River	CR4	24° 38.683'S	27° 19.502'E	Downstream of the confluence of the Bierspruit and the Crocodile River.
Crocodile River	CR5	24° 34.971'S	27° 14.791'E	Final downstream site, located approximately ten kilometres from previous mining activities.

The following conclusion on the status of affected watercourses is included in the most recent biomonitoring report.

Regarding the habitat condition, the results obtained from the Integrated Habitat Assessment System ("IHAS") show that the majority of the sites are in a poor condition. A poor IHAS score means that there is insufficient habitat to support a diverse community of macro-invertebrates. The exceptions are the sites CR2 and CR5 on the Crocodile River, that are located downstream of weirs, which create some riffle habitat and are considered adequate for supporting a diverse aquatic macro-invertebrate community.

The Habitat Quality Index (HQI) analyses show that the sites are all in a fair quality, except for CR5, which shows good quality. The fair habitats mean that there is only a moderate risk of modifying the biotic template. The lower scores are due to the severe erosion and the steep banks at most of the sites. The lack of stones habitat and the decrease in different types of velocity are habitat limiting factors.

The metal concentrations in the sediment have increased, when compared to the previous surveys. The aluminium and iron are very high in all the samples, and this may be attributed to the natural geology of the study area. Metal concentrations that exceed the guideline concentrations in the Crocodile and Rooikuilspruit Rivers are Arsenic (As - only Rooikuilspruit), chromium (Cr), copper (Cu - only Rooikuilspruit), manganese (Mn), nickel (Ni), zinc (Zn - only Rooikuilspruit) and selenium (Se). In general, the current October 2019 low flow survey indicated higher metal concentrations than those

found during the April 2019 high flow survey. In general, it is expected that high flow concentrations are higher than low flow conditions; hence these results indicating higher concentrations during the low flow season are interesting. The organic content was found to range from 0.5% to 4.53% in the Crocodile River, while the organic content in the Rooikuilspruit River ranged from 9.4 to 20.4%. Therefore, these results indicate high organic content in the sediment; especially in the Rooikuilspruit River.

The water quality in the Rooikuilspruit and Crocodile River is bad. When compared to the resource water quality objectives ("RWQOs") as specified in the Water Use License, the EC, TDS, turbidity, nitrate, chloride, magnesium and sodium levels are high. The dissolved oxygen and percentage oxygen saturation for the sites on the Rooikuilspruit River were much lower than the RWQO standards for the catchment. The EC and TDS levels at the majority of the sites are above the RWQOs and indicate high salt concentrations during this survey. The turbidity levels are exceeding the RWQOs at all the sites. The nitrate concentrations at CR1 are higher than the RWQOs. The sodium concentrations at RK1 and RK2, chloride concentrations at RK1 as well as the magnesium concentration at RK2, are greater that the tolerant concentration. Overall, increases in the trace metal concentrations were observed at all the sites. The Crocodile River shows an increase in pollution after the confluence with the Rooikuilspruit River, with high levels of E. coli, faecal coliform, total coliform and TPC noticeable at CR2 and CR3. Overall, there are deteriorations to WQ conditions at all the sites during this survey, when compared to the previous April 2019 survey. This might be due to a decrease in flow, water levels and lack of the dilution effect.

A total of 63 diatom species were recorded at the seven sites during this survey. The sites on the Bierspruit River (BS1 and BS2), which flows directly into the Crocodile River, were not sampled due to dry conditions and were therefore excluded from the analyses.

The diatom assemblages generally comprise of species characteristic of fresh brackish, circumneutral to alkaline waters and eutrophic to hyper-eutrophic conditions. The pollution levels indicate that there is some form of pollution evident at all of the seven sites. The sites on the Crocodile River system show no spatial variation in the ecological water quality during this survey. All the sites appeared to be impacted to the same extent and reflected Bad water quality conditions with high levels of organic pollution. Regarding the sites on the Rooikuilspruit River, there appear to be no spatial variation, as both sites are impacted to the same extent. The sites reflect Bad water quality conditions with high levels of organic pollution.

According to the temporal analyses for the ecological water quality for sites on the Crocodile River system, the diatom analyses indicate that the ecological water quality has shown on average consistently Poor conditions with very high levels of organic pollution. The impacts observed at these sites may be associated with point and/or non-point source pollution such as agricultural run-off. The temporal variation for the ecological water quality for sites on the Rooikuilspruit River System showed on average consistently Bad conditions with high levels of organic pollution. The site RK1 has consistently been impacted to a greater extent compared to site RK2 over the monitoring period. This

result is noteworthy because site RK1 is located upstream of the mine, indicating that some other form of non-point source pollution may be impacting this site and not necessarily the mine.

The macro-invertebrate assemblages indicate that the Rooikuilspruit River sites are critically modified (F category) and continue to have low SASS5 and ASPT scores and this may be attributed to the high levels of organic pollution in this system. Four of the sites on the Crocodile River remain largely modified (D category), whilst the final downstream site CR5 is moderately modified (C Category). There are increases in the SASS5 scores for four of the sites (CR1, CR3, CR4 and CR5), but a decrease in the SASS5 score at CR2 on the Crocodile River. The number of taxa sampled per site range between 15 (CR3) and 29 (CR5). More moderately sensitive species like Baetidae (>2sp), Atyidae, Aeshnidae, Chlorocyphidae, Ecnomidae, Hydracarina and Hydraenidae, were sampled at the sites. The habitat diversities at all the sites on the Crocodile River are poor to adequate, but there was a decrease in flow and water levels. Therefore, natural variations and seasonal differences were observed in the SASS5 scores for all the sites on the Crocodile River.

The fish community in the river ecosystems associated with the Thabazimbi Mine activities were sampled during October 2019. The fish surveys since 2010 have resulted in 14 species out of the potential 16 species on the reference list being sampled at the various sites in the Crocodile River. Within the current survey, only 10 of the 16 fish species that should occur within the Crocodile River system were sampled, while during the surveys in 2017 and 2018 11 different species were sampled. Therefore, similar species diversity was present within the last two years. However, the abundances during this survey, as well as the last few years, have been quite low. Two alien fish were sampled, namely the mosquito fish Gambusia affinis and the common carp, Cyprinus carpio. The fish community of the Crocodile River was found to be moderately to largely modified (C/D category) while the fish community at the Bierspruit tributary was also found to be largely modified (D category). The fish community in the Rooikuilspruit River was found to be critically modified (F category) with no fish sampled. This is due to poor water quality and discharge of untreated WWTW effluent. Fish community results have decreased throughout 2017 to 2019 and it should be further investigated, in detail, during the biomonitoring surveys in 2020, with a focus on available habitat for especially rheophilic species. A focus point should also be the Bierspruit River, and field surveys should be arranged around stable water flow within this system. Impacts on the fish community are generally due to upstream activities causing changes in the instream habitat, while the input of extremely poor water quality from the Thabazimbi WWTW via the Rooikuilspruit River is also a potential impact. The fish community is potentially affected in this reach by sedimentation, algal blooms (especially during low flow season), erosion and bacteriological pollution. It was expected that the high flows/floods in 2017 would potentially flush the Crocodile River and the follow up low flow surveys will be able to determine the recovery of the fish population. However, currently, the fish diversity is still depressed, based on biomonitoring fish sampling protocols.

The recently published RQOs for the various resource units associated with the Thabazimbi Mine indicated that all of the fish RQOs were broadly complied with. The overall FRAI scores were higher than the recommended 42% of the fish RQOs, and therefore the Crocodile River was classed as a D

ecological category (largely modified). Furthermore, more than four and six species where sampled in the Bierspruit and the Crocodile River, respectively. One concern was the low abundance and absence of flow and habitat sensitive species such as Chiloglanis sp., Micralestes acutidens, Labeo molybdinus, and habitat sensitive species – M. johnstoni, Marcusenius macrolepidotus and Enteromius annectens. It is recommended that targeted surveys for these species should be initiated within the next one or two biomonitoring surveys to confirm these taxa in the Crocodile River system.

Overall, the bioaccumulation of metals in the fish tissue did not indicate any trend of increasing concentrations from site CR2 to site CR5 that could be attributed to the Thabazimbi mining activities during this October 2019 survey. In some cases there was an increase in the metal concentrations from site CR1 to site CR5. There was also no conclusive evidence that concentrations in fish muscle tissue increased from 2018 to 2019. The few metal concentrations that did show increased concentrations, were of metals that are high in the environment in any case (e.g. iron) and together with the limited number of replicates analysed, resulted in inconclusive evidence. These results are only valuable if long term monitoring are implemented to assess metal pollution in fish from the system. Presently, all data indicate that no increased or problematic metal concentrations in fish are evident. It is recommended that future bioaccumulation studies should include the use of passive sampling devices, such as the new chemical sampling device e.g. an artificial mussel (AM), to determine bioavailability of metals in the Crocodile River system.

Regarding the toxicity assessment, only four of the nine sites had water, namely T2, T3, T5 and T9. The toxicity at the site T2 is a Slight Acute Hazard. The toxicity at the remaining three sites T3, T5 and T9 became an Acute Hazard. The site T2 and T9, increased in toxicity from the previous assessment, whilst T3 decreased. The toxicity at site T5 remained the same. The water at the sites T2 and T5 showed the most changes in toxicity, ranging from no acute to acute hazard, over the years. The water at site T3 has shown toxicity to be most hazardous, ranging from an acute to a very high acute hazard over the years, whilst the water at T9 has been found to present a slight acute hazard during three of the previous assessments. Overall, the toxicity of the water is moderate at most of the sampling sites.

Mean Annual Runoff

The mean annual runoff (“MAR”) from the larger catchment upstream of the point of discharge into the Crocodile River and Rooikuilspruit is 1 287 097 500 m^3. The MAR of the Rooikuilspruit (28 195 ha) is 11 820 075 m^3.

Surface water user survey

The dilution ratio of the sporadic inflows from the non-perennial creeks into the Crocodile River is very high. The watercourses in the study area run sporadically in the rainy season. Most of them run into the Crocodile River. Water from the Crocodile River is mainly used for irrigation by farmers.

Sensitive areas survey

There are no natural wetlands located within the mine boundary area (EMPr, 2011; IWWMP, 2014). TIOM undertakes regular biomonitoring in affected watercourses.

Resource class and river health / Receiving water quality objectives and reserve

The following information was extracted from the *GN1388 – Proposed Classes of Water Resource and Resource Quality Objectives for Mokolo, Matlabas, Crocodile (West) And Marico Catchments*, dated 08 December 2017.

TIOM falls within the Integrated Unit of Analysis ("IUA") number 12 and 13, called the Bierspruit catchment area and Lower Crocodile catchment area respectively. The resource quality objectives for the specific IUAs is depicted in Table 20 below.

Table 20: Resource quality objectives

RU Number	Component	Sub-component	Resource Quality Objectives	Indicator	Numerical limit
IUA 12 - Bierspruit					
12_2	Quality	Nutrients	Instream concentration of nutrients must be improved to sustain aquatic ecosystem health and ensure the prescribed ecological category is met. Concentrations should not be allowed to deteriorate.	Orthophosphate (PO_4^-) as Phosphorus	≤0.125 milligrams/litre (mg/ℓ) (50th percentile)
				Nitrate (NO_3^-) & Nitrite (NO_2^-) as Nitrogen	≤1.0 milligrams/litre (50th percentile)
		Salts	Instream salinity must be maintained at acceptable levels to support a healthy aquatic ecosystem and the water quality requirements of water users. Concentrations should not be allowed to deteriorate.	Electrical conductivity (EC)	≤85 milliSiemens/metre (mS/m) (95th percentile)
				Sulphate (SO_4)	≤100 milligrams/litre (95th percentile)
				Sodium (Na)	≤100 milligrams/litre (95th percentile)
				Chloride (Cl)	≤100 milligrams/litre (95th percentile)
		System Variables	pH range must be maintained within limits specified to support the aquatic ecosystem and water user requirements.	pH range	6.0 (5th percentile) and 8.5 (95th percentile)
			A baseline assessment to determine the present state instream turbidity is required.	Turbidity	A 10 % variation from background concentration is allowed. Limits must be determined.
		Toxics	The concentrations of toxicants must pose no risk to aquatic organisms and to human health.	Aluminium (Al)	≤0.1 milligrams/litre (mg/ℓ) (95th percentile)
				Manganese (Mn)	≤0.15 milligrams/litre (mg/ℓ) (95th

RU Number	Component	Sub-component	Resource Quality Objectives	Indicator	Numerical limit
					percentile)
				Iron (Fe)	≤0.3 milligrams/litre (mg/ℓ) (95th percentile)
				Lead (Pb) hard	≤0.0095 milligrams/litre (mg/ℓ) (95th percentile)
				Copper (Cu) hard	≤0.0073 milligrams/litre (mg/ℓ) (95th percentile)
				Nickel (Ni)	≤0.07 milligrams/litre (mg/ℓ) (95th percentile)
				Cobalt (Co)	≤0.05 milligrams/litre (mg/ℓ) (95th percentile)
				Zinc (Zn)	≤0.002 milligrams/litre (mg/ℓ) (95th percentile)
		Pathogens	The presence of pathogens should pose a low risk to human health.	*Escherichia coli (E. coli)*	130 counts/100 millilitres (mℓ) (95th percentile)
	Habitat	Instream	Habitat diversity should be maintained within a D ecological category. Maintain natural flow regime. Improve instream habitat and velocity/depth for fish and macroinvertebrate diversity.	Index of Habitat Integrity, Rapid Habitat Assessment Method and Model (RHAMM)	Instream Habitat Integrity EC = D ≥ 42%
		Riparian habitat	Riparian vegetation should be maintained within a D ecological category. Development into the riparian zone must be controlled and limited. Siltation impacts must be managed.	Vegetation Response Assessment Index	VEGRAI EC = D ≥ 42%

<table>
<tr><th>RU Number</th><th>Component</th><th>Sub-component</th><th>Resource Quality Objectives</th><th>Indicator</th><th>Numerical limit</th></tr>
<tr><td></td><td>Biota</td><td>Fish</td><td>Fish community should be maintained within a D ecological category or improved upon. An assessment of the fish community should be conducted annually to monitor against the prescribed ecological category.</td><td>Fish Response Assessment Index (FRAI)</td><td>Fish ecology category = D FRAI ≥ 42%
Collect 4+ species in 20 min sampling effort.</td></tr>
<tr><td colspan="6">IUA 13 – Lower Crocodile</td></tr>
<tr><td rowspan="3">13_1</td><td rowspan="2">Quantity</td><td>Low flows</td><td>EWR maintenance low and drought flows:
Crocodile River at CROC_EWR7 in A24C
NMAR = 463.4x10xm^3 REC=D category
The maintenance low flows and drought flows must be attained to support the aquatic ecosystem and the downstream users.</td><td>Base Flows
Maintenance flows and drought flows.
Monitoring of Crocodile River at A2H132</td><td><table><tr><th></th><th>Maintenance Low flows (m³/s)</th><th>Drought flows (m³/s)</th></tr><tr><td>Oct</td><td>1.134</td><td>1.134</td></tr><tr><td>Nov</td><td>1.362</td><td>1.362</td></tr><tr><td>Dec</td><td>1.481</td><td>1.481</td></tr><tr><td>Jan</td><td>1.938</td><td>1.938</td></tr><tr><td>Feb</td><td>2.638</td><td>2.488</td></tr><tr><td>Mar</td><td>2.481</td><td>2.481</td></tr><tr><td>Apr</td><td>2.118</td><td>2.118</td></tr><tr><td>May</td><td>1.745</td><td>1.745</td></tr><tr><td>Jun</td><td>1.574</td><td>1.574</td></tr><tr><td>Jul</td><td>1.389</td><td>1.389</td></tr><tr><td>Aug</td><td>1.262</td><td>1.262</td></tr><tr><td>Sep</td><td>1.172</td><td>1.172</td></tr></table></td></tr>
<tr><td>High flows</td><td>EWR high flows:
Crocodile River at CROC_EWR7 in A24C
NMAR = 463.4x10xm^3
REC=D category
High flows must be attained as specified to support aquatic ecosystem requirements.</td><td>Floods
High flow also specified as individual flood requirements in terms of size and duration (See Appendix A)
Monitoring of Crocodile River at A2H132</td><td><table><tr><th></th><th>High flows (m³/s)</th></tr><tr><td>Oct</td><td>0</td></tr><tr><td>Nov</td><td>0.790</td></tr><tr><td>Dec</td><td>1.529</td></tr><tr><td>Jan</td><td>0</td></tr><tr><td>Feb</td><td>1.270</td></tr><tr><td>Mar</td><td>0</td></tr><tr><td>Apr</td><td>0.790</td></tr><tr><td>May</td><td>0</td></tr><tr><td>Jun</td><td>0</td></tr><tr><td>Jul</td><td>0</td></tr><tr><td>Aug</td><td>0</td></tr><tr><td>Sep</td><td>0</td></tr></table></td></tr>
<tr><td>Quality</td><td>Nutrients</td><td>Instream concentration of nutrients must be improved to</td><td>Orthophosphate (PO_4^-) as Phosphorus</td><td>≤0.060 milligrams/litre (mg/ℓ) (50th percentile)</td></tr>
</table>

RU Number	Component	Sub-component	Resource Quality Objectives	Indicator	Numerical limit
			sustain aquatic ecosystem health and ensure the prescribed ecological category is met. Concentrations should not be allowed to deteriorate.	Nitrate (NO_3^-) & Nitrite (NO_2^-) as Nitrogen	≤1.0 milligrams/litre (50th percentile)
		Salts	Instream salinity must be maintained at the levels specified to support a healthy aquatic ecosystem and the water quality requirements of water users. Concentrations should not be allowed to deteriorate.	Electrical conductivity (EC)	≤85 milliSiemens/metre (mS/m) (95th percentile)
				Sulphate (SO_4)	≤100 milligrams/litre (95th percentile)
				Sodium (Na)	≤80 milligrams/litre (95th percentile)
				Chloride (Cl)	≤80 milligrams/litre (95th percentile)
		Pathogens	The presence of pathogens should pose no risk to human health.	*Escherichia coli (E.coli)*	130 counts/100 millilitres (ml) (95th percentile)
		System Variables	pH range must be maintained within limits specified to support the aquatic ecosystem and water user requirements.	pH range	6.5 (5th percentile) and 8.5 (95th percentile)
			A baseline assessment to determine the present state instream turbidity is required.	Turbidity	A 10 % variation from background concentration is allowed.
			Dissolved oxygen levels must be attained to support the aquatic ecosystem.	Dissolved oxygen	≥6 milligrams/litre (mg/ℓ)
		Toxics	The concentrations of toxicants must pose no risk to aquatic	Atrazine	≤0.078 milligrams/litre (mg/ℓ)
				Metolachlor	≤0.30 milligrams/litre (mg/ℓ)

RU Number	Component	Sub-component	Resource Quality Objectives	Indicator	Numerical limit
			organisms and to human health.	Aluminium (Al)	≤0.1 milligrams/litre (mg/ℓ) (95th percentile)
				Manganese (Mn)	≤0.15 milligrams/litre (mg/ℓ) (95th percentile)
				Iron (Fe)	≤0.3 milligrams/litre (mg/ℓ) (95th percentile)
				Lead (Pb) hard	≤0.0095 milligrams/litre (mg/ℓ) (95th percentile)
				Copper (Cu) hard	≤0.0073 milligrams/litre (mg/ℓ) (95th percentile)
				Nickel (Ni)	≤0.07 milligrams/litre (mg/ℓ) (95th percentile)
				Cobalt (Co)	≤0.05 milligrams/litre (mg/ℓ) (95th percentile)
				Zinc (Zn)	≤0.002 milligrams/litre (mg/ℓ) (95th percentile)
				Aluminium (Al)	≤0.1 milligrams/litre (mg/ℓ) (95th percentile)
	Habitat	Instream	Habitat diversity should be maintained within a D ecological category or better condition. Maintain good low flows to sustain habitat for substrate and habitat sensitive species and taxa.	Index of Habitat Integrity, Rapid Habitat Assessment Method and Model (“RHAMM”)	Instream Habitat Integrity EC = D ≥ 42%
		Riparian habitat	Rehabilitation/remediation required. Indigenous vegetation	Vegetation Response Assessment Index	VEGRAI EC = D ≥ 42%

RU Number	Component	Sub-component	Resource Quality Objectives	Indicator	Numerical limit
			must be protected (unique *Acacia galpinii* (Monkey thorn). Riparian vegetation should be maintained within a D ecological category or better condition. Maintain riparian zone in cultivated areas. Control development.		
	Biota	Fish	Fish community should be maintained within a D ecological category or better condition. Flow velocity/depth must be adequate for flow sensitive species *CPRE* and *LMOL* and habitat sensitive species – *AJOH*.	Fish Response Assessment Index (FRAI)	Fish ecology category = D FRAI ≥ 42% Sample 6+ species per sample effort Indicator Species *Sensitive fish species. Course substrate, CPRE, LMOL*
		Aquatic Macroinvertebrates	Macroinvertebrate assemblage must be maintained within a D ecological category or improved upon.	Macroinvertebrate Response Assessment Index, and the South African Scoring System Version 5 (SASS5)	MIRAI EC = D ≥ 42% SASS ≥ 60 ASPT ≥ 4.5 (Site A2CROC-KOEDO)

Chapter G: Groundwater

The following information was obtained from the *Thabazimbi Iron Ore Mine (Pty) Ltd: A Subsidiary of ArcelorMittal South Africa Limited – Thabazimbi Iron Ore Mine Desktop Geohydrological Report for A Waste Management Licence Application*, dated April 2020 and Compiled by Shangoni AquiScience.

Aquifer Characterisation

Aquifer Vulnerability

Groundwater plays an important role in supplying water to many regions of Southern Africa due to its low annual average precipitation of 460 mm, which is well below the world average of 860 mm. The quality of groundwater resources in South Africa has therefore received considerable focus and attention on the need for a proactive approach to protect these sources from contamination (Lynch *et. al.*, 1994). Groundwater protection needs to be prioritised based upon the susceptibility of an aquifer towards pollution. This can be done in two ways, namely i) pollution risk assessments and ii) aquifer vulnerability. Pollution risk assessments consider the characteristics of a specific pollutant, including source and loading while aquifer vulnerability considers the characteristics of the aquifer itself or parts of the aquifer in terms of its sensitivity to being adversely affected by a contaminant should it be released.

The DRASTIC model concept developed for the USA (Aller et. al., 1987) is well suited for producing a groundwater vulnerability evaluation for South African aquifers. The DRASTIC evaluates the intrinsic vulnerability (IV) of an aquifer by considering factors including **D**epth to water table, natural **R**echarge rates, **A**quifer media, **S**oil media, **T**opographic aspect, **I**mpact of vadose zone media, and hydraulic **C**onductivity. Different ratings are assigned to each factor and then summed together with respective constant weights to obtain a numerical value to quantify the vulnerability:

DRASTIC Index *(IV) = DrDw + RrRw+ ArAw + SrSw + TrTw + IrIw + CrCw*

Where D, R, A, S, T, I, and C are the parameters, r is the rating value, and w the constant weight assigned to each parameter (Lynch *et al*, 1994). The scores associated with the vulnerability of South African aquifers are shown in Table 21.

Table 21: South African National Groundwater Vulnerability Index to Pollution (Lynch et al, 1994)

Score	Vulnerability
50-87	Least susceptible
87 - 109	Moderate susceptible
109 - 226	Most susceptible

The concept of DRASTIC in vulnerability assessments is based on:

- A contaminant is introduced at the surface of the earth;
- A contaminant is flushed into the groundwater by precipitation;

- A contaminant has the mobility of water; and
- The area evaluated is 0.4 km^2 or larger

The weighting for each parameter is constant. The minimum value for the DRASTIC index that one can calculate (assuming all seven factors were used in the calculation) is 24 with the maximum value being 226. The higher the DRASTIC index the greater the vulnerability and possibility of the aquifer to become polluted if a pollutant is introduced at the surface or just below it. Note that conductivity values for fractured rock aquifers are difficult to estimate and sufficient information on hydraulic conductivity values for Southern Africa is not available at present. In addition, due to the considerable variation over short distances in hard rock aquifers, the use of this parameter was in doubt.

Because of the highly heterogenic nature of the aquifers and aquifer properties at TIOM it is not possible to characterise aquifer vulnerability on a micro-scale. Aquifer parameters will vary significantly over short distances. It is therefore clear that on a very small scale (microscopic scale or pore scale) a porous (homogenous) media approach would lead to an inadequate description with resulting inaccuracies. The realistic alternative, therefore, is to move to a coarser scale of aquifer description by introducing measurable phenomenological coefficients such as hydraulic gradients. In the continuum approach, the concept of the Representative Elementary Volume ("REV") is evoked. The REV is a theoretical approach in which representative values for flow (and transport) parameters are averaged over an appropriate volume. On a larger scale (macroscopic scale) parameters are averaged, and for a sufficiently large modelling cell size a porous media approach can be adopted by specifying regional representative aquifer parameters.

Table 22 summarizes the aquifer classification vulnerability scores for the aquifer/s in vicinity (based on the REV approach) of the project area. The final DRASTIC score of 101 indicates that the fractured aquifer in the region has a moderate susceptibility to pollution and a medium level of aquifer protection is, therefore, required.

Table 22: DRASTIC vulnerability scores (fractured aquifer)

Factor	Range/Type	Weight	Rating	Total
D	15 - 30 m	5	3	15
R	10 - 50 mm	4	6	24
A	Fractured	3	6	18
S	clay loam/silty loam	2	2	4
T	0-2%	1	10	10
I	Pretoria Group, dolomite	5	6	30
C	-	3	-	-
DRASTIC SCORE = 101				

Aquifer Classification

The then Department of Water and Sanitation ("DWS"), currently the Department of Human Settlements, Water and Sanitation ("DHSWS"), has characterised South African aquifers based on the rock formations in which they occur together with its capacity to transmit water to boreholes drilled into specific formations. The water bearing properties of rock formations in South Africa can be classified into four classes defined as:

- Class a - Intergranular
    - Aquifers associated either with loose and unconsolidated formations such as sands and gravels or with rock that has weathered to only partially consolidated material.
- Class b - Fractured
    - Aquifers associated with hard and compact rock formations in which fractures, fissures and/or joints occur that are capable of both storing and transmitting water in useful quantities.
- Class c - Karst
    - Aquifers associated with carbonate rocks such as limestone and dolomite in which groundwater is predominantly stored in and transmitted through cavities that can develop in these rocks.
- Class d - Intergranular and fractured
    - Aquifers that represent a combination of Class A and B aquifer types. This is a common characteristic of South African aquifers. Substantial quantities of water are stored in the intergranular voids of weathered rock but can only be tapped via fractures penetrated by boreholes drilled into the fractured aquifer.

Each of these classes is further subdivided into groups relating to the capacity of an aquifer to transmit water to boreholes, typically measured in l/s. The groups therefore represent various ranges of borehole yields.

The study areas are predominantly located in a c3 and d4 aquifer class regions. The groundwater yield potential is classed as fair to good on the basis that most of the boreholes on record in vicinity of the study areas produce between 0.5 and 5 ℓ/s. These good aquifer regions are primarily associated with the east-west striking thrust faults at the mine. The vast majority of the Thabazimbi municipal groundwater is abstracted from the alluvial aquifer along the Crocodile River.

According to the regional aquifer classification map of South Africa, the regional aquifer has been identified as a minor aquifer with good to fair groundwater quality, with EC ranging between 70 and 300 mS/m and sporadic NO_3 and F of >10 mg/ℓ and F >1.55 mg/ℓ, respectively. The aquifer/s has/have a medium vulnerability and a medium susceptibility towards contamination. Based on the 'undisturbed' underlying hydrogeology of the project area the aquifers are classified, according to Parsons (1995), as a minor aquifer. A 'special' and primary intergranular aquifer region is identified more towards the south of Thabazimbi and the mining area.

The principle groundwater occurrences and yields expected are summarised in Table 23.

Table 23: Principle groundwater occurrences and classification according to the Parsons (Parsons, 1995) classification system for undisturbed aquifers

Aquifer	Type	Lithology	Groundwater occurrence	Probable yield (l/s)	Classification
Pretoria Group	Confined to semi-confined	Shale, quartzite, andesite, diabase, conglomerate	Contacts between different rock lithologies and bedding planes within sedimentary rock	2 – 5	**Minor aquifer**
Chuniespoort (Malmani Subgroup & Penge Formation)	Confined to semi-confined	Dolomite, shale, erosive breccia	a) Well developed joints and fractures occur in the competent (banded iron) are favourable for high yielding aquifers b) Carbonate rocks of the Malmani Subgroup have moderate to high yields. Groundwater occurs in fractures, joints, solution cavities and diabase intrusive contact zones.	0.5 – 2.0	**Minor aquifer**

Aquifer Protection Classification

In order to achieve the Groundwater Quality Management Index a point scoring system as presented in Table 24 and Table 25 was used for the naturally occurring undisturbed aquifers in the wider study area.

The occurring aquifer, in terms of the above definitions, is classified as a minor aquifer system. The vulnerability, or the tendency or likelihood for contamination to reach a specified position in the groundwater system after introduction at some location above the uppermost aquifer is classified as medium. The level of groundwater protection based on the Groundwater Quality Management Classification is shown in Table 26.

Table 24: Ratings for the Aquifer System Management and Second Variable Classifications

Aquifer System Management Classification		
Class	Points	Study Area
Sole Source Aquifer System	6	
Major Aquifer System	4	
Minor Aquifer System	2	2
Non-Aquifer System	0	
Special Aquifer System	0-6	

Aquifer System Management Classification		
Second Variable Classification (fractured)		
High	3	
Medium	2	2
Low	1	

Table 25: Ratings for the Groundwater Quality Management (GQM) Classification System

Aquifer System Management Classification		
Class	Points	Study Area
Sole Source Aquifer System	6	
Major Aquifer System	4	
Minor Aquifer System	2	2
Non-Aquifer System	0	
Special Aquifer System	0-6	
Aquifer Vulnerability Classification		
High	3	
Medium	2	2
Low	1	

Table 26: GQM index for the study area

GQM Index	Level of Protection	Study Area
<1	Limited	
1-3	Low level	
3-6	**Medium level**	**4**
6-10	High level	
>10	Strictly non-degradation	

The ratings for the Aquifer System Management Classification and Aquifer Vulnerability Classification yield a GQM index of 4 for the study area, indicating that a **medium level of groundwater protection** is required to adhere to DHSWS's water quality objectives. Reasonable and sound groundwater protection measures are recommended to ensure that no cumulative pollution affects the aquifer, during short- and long-term. DHSWS's water quality management objectives are to protect human health and the environment. Therefore, the significance of this aquifer classification is that if any potential risk exists, measures must be taken to limit the risk to the environment, which in this case is

the protection of the underlying sedimentary and dolomitic aquifers, the primary aquifer associated with the Crocodile River and aquatic ecosystem of the Crocodile River and its tributaries.

Recharge

The infiltration of water from the shallow weathered aquifer system to the deeper fractured bedrock aquifer system is heterogeneous and requires permeable soils, or permeable horizons (i.e. 'infiltration routes'), and 'open' and interconnected fracture systems in the bedrock. Hydraulic continuity must exist between groundwater reservoir(s) in the overlying horizons (or weathered overburden) and the underlying bedrock. The fracture zones act as conduits for deeper flow from groundwater reservoirs located in upper permeable soils or the weathered overburden. Groundwater flows through interconnected fracture systems with the potential of rapid vertical groundwater flow from the weathered overburden (and surface water bodies) to greater depths along interconnected conductive zones.

High transmissivity aquifer units, such as the upper Breccia Basin and the Crocodile River alluvial aquifer units, may enhance both lateral flow in the shallow weathered aquifer and vertical flow between the shallow and deeper aquifer systems. Lateral groundwater flow in the shallow aquifer is predominantly driven by topographic gradients and/or localised recharge mounds due to e.g. irrigation and seepage from the Slimes Dams, etc.

There are several processes occurring at surface that contribute to the amount of recharge to groundwater from rainfall. Figure 20 presents a simplified water balance for illustrative purposes. Precipitation (P) that falls on the land surface enters various pathways of the hydrologic cycle. Some water can be temporarily stored on the land surface in wetlands, perched aquifers and water puddles (ΔSW), some will be evaporated directly from surface (ET) or from wetlands, perched aquifers and puddles (ETW). Some water will drain across the land surface to stream channels (run-off, RO) and some water will infiltrate through porous surface soil and seep into the ground. Water is stored in the vadose (unsaturated) zone from where it can be accessed by vegetation via the roots and used by the plants (transpired). Water infiltrating the soil/rock matrix reaching the water table is called groundwater recharge (RCH) and contributes to groundwater storage (ΔSGW).

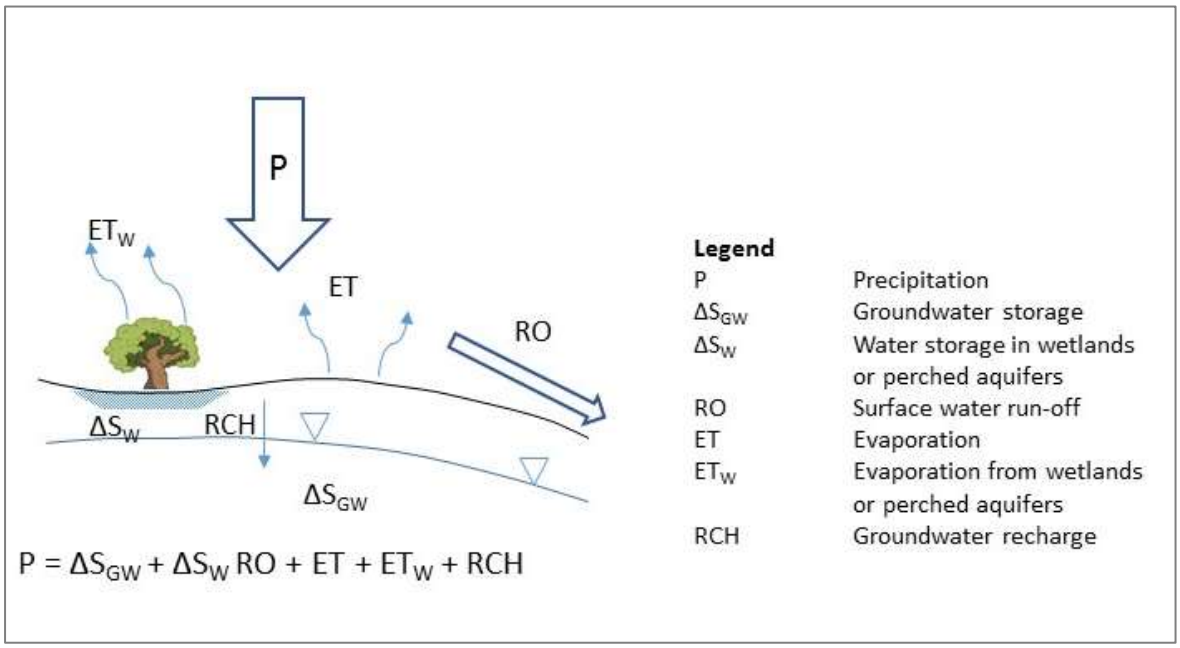


Figure 20: Surface processes related to precipitation and groundwater recharge

The collection of direct field measurements for groundwater recharge is difficult and was not included in the field investigation.

Water enters the aquifer systems predominantly as recharge from precipitation deeper flow from interconnected higher lying areas. The deeper, regional groundwater flow is not discussed in this report. The effective groundwater recharge is estimated to be between ~ 0.3 and ~ 25 % of MAP.

The following mechanisms are expected to contribute to groundwater recharge in the study area:

- Direct infiltration of rainfall through the overlying unconsolidated material and the weathered matrix; and
- Significantly higher recharge compared to ambient is expected within disturbed sediments and from mine residue deposits while lesser recharge is expected from built-up or concreted/tarred surfaces.

GCS developed a groundwater model (GCS, 2019) and the recharge values calibrated are shown in Table 27.

Table 27: Recharge rates expected to occur into the geological formations

Hydrostratigraphic unit	Recharge	
	% (MAP)	mm/a
Bushveld Igneous Complex (BIC)	0.3	1.61
Banded Iron Formation (BIF)	5	32.25
Diabase	1	6.45
Dolomite	3	19.35

Hydrostratigraphic unit	Recharge	
Granites, Quartzite and Shale	0.5	3.23
Quaternary surface deposit	1.5	9.68
Waterberg Sedimentary	1	6.45
Breccia Basin	10	64.50
Mine faults	4	25.8
Alluvial deposits – Crocodile River	4	25.8
Mine residue deposits/stockpiles	25	161.25

Potential Contaminants of Concern

The whole rock analyses revealed certain elements to be enriched within the discard and slimes material with reference to the GN R635 National Norms and Standards. These include Al, As, Cu, Ba Fe, Mn, F and Si of which only Mn, Si and F leached in noteworthy concentrations. Macro-elements including Ca, Mg, Na, Cl, K, F and NO_3 also leached in noteworthy concentrations, of which Ca, Mg and K do not pose any risks. Although As did not leach in any substantial concentrations, concentrations of this metalloid were recorded to be high in one borehole (*B01325*) downgradient from the Supply Chain Discard. Based on these tests the following potential contaminants of concern were identified:

- As, Mn, F, N (as NO_3 and NH_4), Na, Cl

Ground Water Levels

Thabazimbi Iron Ore Mine maintains an effective surface and groundwater monitoring programme. The objective of the monitoring programme is to detect any changes in the water levels and water quality at cessation of mine production compared to the available mine and natural baseline environments. The monitoring network consists of regional boreholes to obtain background data away from the mine and local monitoring boreholes within the mining site. Water quality as well as water levels are monitored to determine the hydraulic heads as well as the contaminant risk to the natural environment and to surrounding users.

Monitoring of water levels were conducted at 58 boreholes during the 2018 annual water monitoring period by GCS. The monitoring was conducted on a quarterly basis for the first year, thereafter bi-annually. The current distribution of the groundwater water monitoring points is shown in Figure 22.

The groundwater levels obtained during the August 2019 monitoring event ranged between 5.75 and 73.36 mbs. Generally, groundwater levels have increased post closure and stabilised since 2017 (GCS, 2019).

Seventeen boreholes, which are in vicinity of the 2 Discard Dumps and 4 slimes compartments, are applicable to this project. These boreholes are listed in Table 28 and their locations relative to the facilities are shown in Figure 23 These boreholes mostly function as source monitoring boreholes to

identify seepage from the facilities into the groundwater while others are background boreholes located upgradient from the facilities.

Table 28: Groundwater monitoring localities relevant to the project

Facility	Boreholes
Slimes compartments	NBH2, BA06 BH1314, BA6 Slikdam-16
D1 - Old Plant Discard	BH013330, SM1, BTD1, BHO1330, Boorgat16a-35, BHO1323
D3 - Supply Chain Discard	BH01332, BH01328, Borehole 9-24, BH1327, BH01325,

Figure 21 shows the available groundwater levels for the boreholes relevant to the present project. Rebounding water levels are evident between December 2016 to April 2017 during post closure where after a seasonal effect is noted.

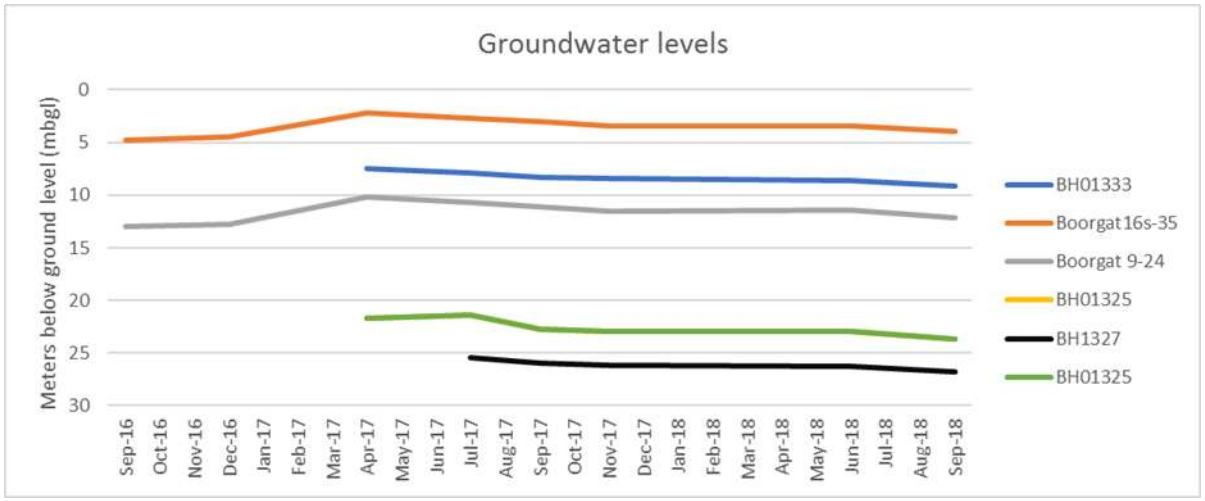


Figure 21: Groundwater levels recorded within boreholes relevant to the project

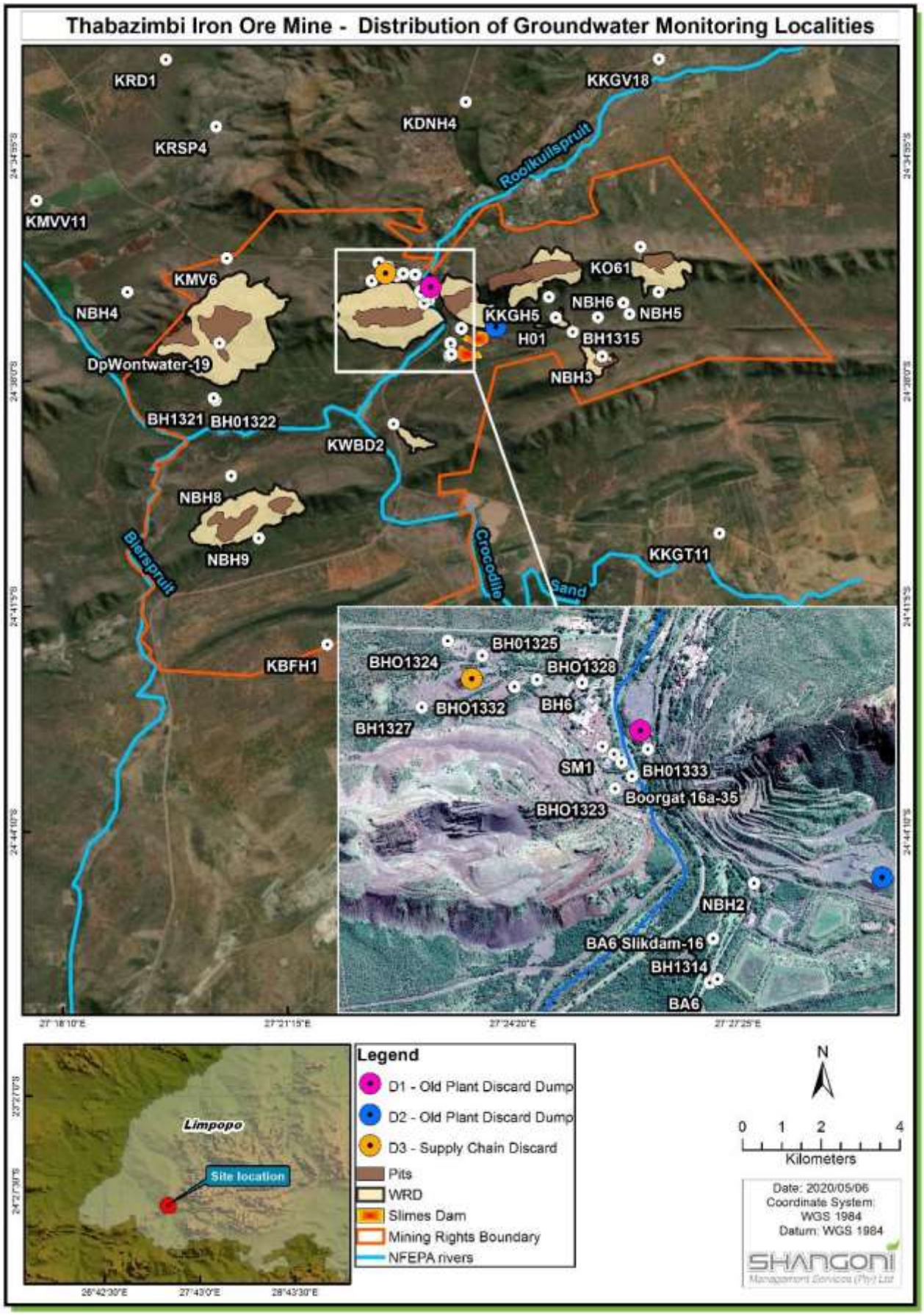


Figure 22: Thabazimbi Iron Ore Mine groundwater monitoring distribution

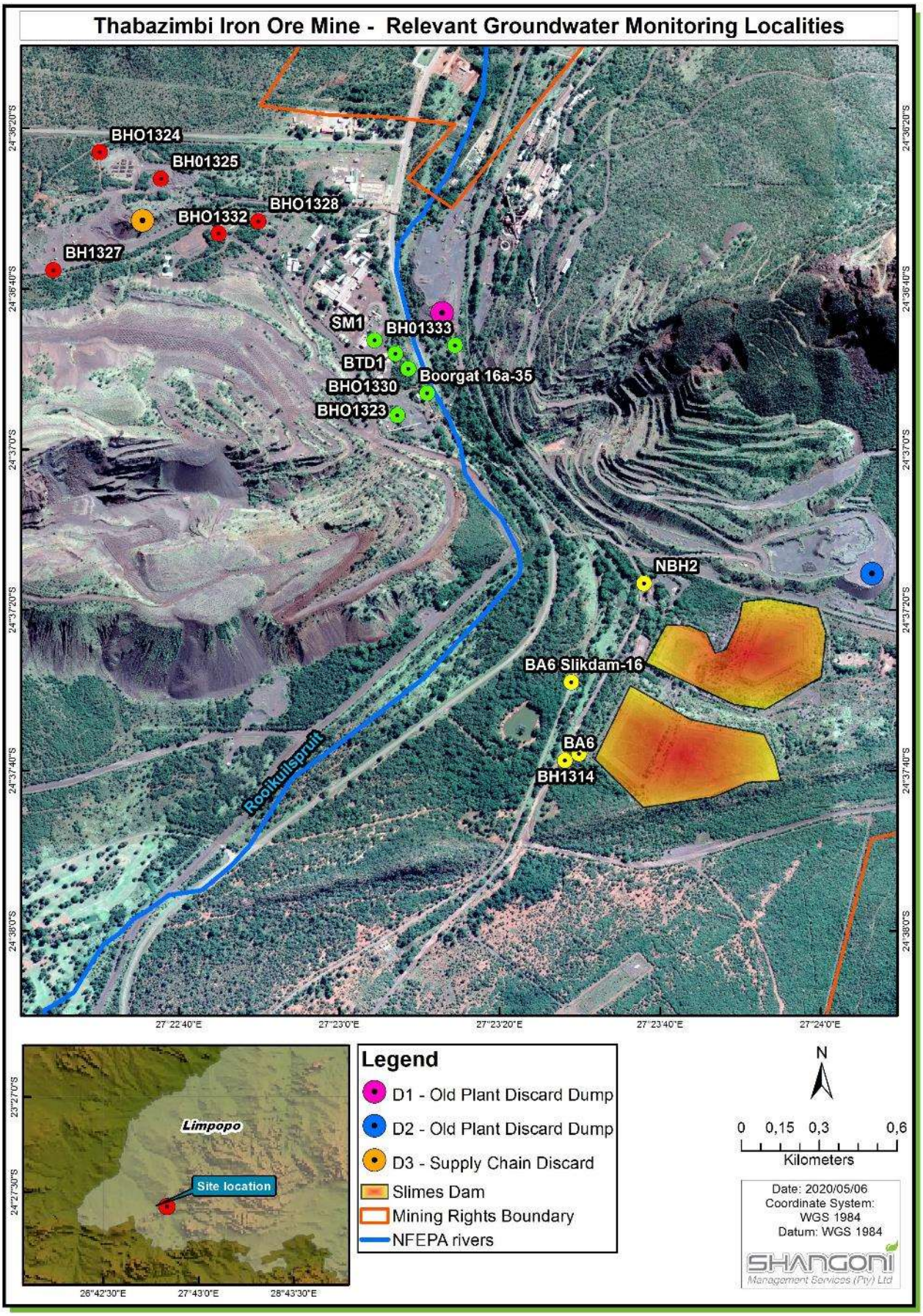


Figure 23: Groundwater monitoring localities relevant to the project

Groundwater Quality

As mentioned previously, 17 boreholes are applicable to this project. These boreholes function either as source monitoring or background boreholes located up- or downgradient relative the slime compartments or discard dumps.

Groundwater monitoring at the slimes dam compartments

Four boreholes monitor the groundwater quality downgradient from the 4 slimes compartments at TIOM. Data for the 2 bi-annual monitoring periods in 2018 (*Thabazimbi Mine – Surface and Groundwater Monitoring Report*, dated 21 December 2018 and prepared by GCS Water and Environmental Consultants) are displayed in Table 29. Note that no data is available for *BA6* or *BA6 Slikdam-16*. According to GCS (2018) these boreholes are most probably destroyed.

Table 29: Groundwater quality sampled from groundwater downgradient from the slimes compartments (GCS, 2018)

Parameters	SANS 214: 2015	NBH2		BH1314	
		Jun 18	Nov 18	Jun 18	Nov 18
pH	5.0-9.7	7.4	7.65	7.66	7.86
EC (mS/m)	170	42.3	45.4	19.4	25.9
TDS (mg/ℓ)	1200	314	298	132	130
Total alkalinity (mg $CaCO_3$/ℓ)	na	222	203	34.9	25.9
Total hardness (mg $CaCO_3$/ℓ)	na	249	215	89	86
Ca (mg/ℓ)	na	29.8	27.4	14.3	14.8
Mg (mg/ℓ)	na	42.3	35.7	13	12
Na (mg/ℓ)	200	23.2	19.8	18.2	17.2
K (mg/ℓ)	na	0.806	0.785	0.825	0.665
Cl (mg/ℓ)	300	37	33.5	58.7	65
SO_4 (mg/ℓ)	250, 500	7.05	6.38	<0.141	<0.141
NO_3-N (mg/ℓ)	11	2.49	4.28	0.201	0.262
NH_4-N (mg/ℓ)	1.5	0.04	0.058	0.223	0.272
PO_4-P (mg/ℓ)	na	<0.005	<0.005	<0.005	<0.005
F (mg/ℓ)	1.5	<0.263	<0.263	<0.263	<0.263
Al (mg/ℓ)	0.3	<0.002	<0.002	<0.002	<0.002
As (mg/ℓ)	0.007	<0.006	<0.006	<0.006	<0.006
Ba (mg/ℓ)	0.7	0.022	0.019	0.005	0.009

Parameters	SANS 214:	NBH2		BH1314	
Be (mg/ℓ)	na	<0.005	<0.005	<0.005	<0.005
Bi (mg/ℓ)	na	<0.004	<0.004	<0.004	<0.004
B (mg/ℓ)	2.4	<0.013	<0.013	<0.013	<0.013
Cd (mg/ℓ)	0.003	<0.002	<0.002	<0.002	<0.002
Co (mg/ℓ)	na	<0.03	<0.003	<0.003	<0.003
Cu (mg/ℓ)	2	0.005	<0.002	<0.002	<0.002
Cr (mg/ℓ)	0.05	<0.003	<0.003	<0.003	<0.003
Ga (mg/ℓ)	na	0.006	<0.001	0.003	<0.001
Fe (mg/ℓ)	0.3, 2	<0.004	<0.004	<0.004	<0.004
Pb (mg/ℓ)	0.01	<0.004	<0.004	<0.004	<0.004
Li (mg/ℓ)	na	0.014	0.013	0.015	0.013
Mn (mg/ℓ)	0.4; 0.1	**0.11**	0.036	<0.001	<0.001
Mo (mg/ℓ)	na	<0.004	<0.004	<0.004	<0.004
Ni (mg/ℓ)	0.07	<0.002	<0.002	<0.002	<0.002
Rb (mg/ℓ)		<0.002	<0.002	<0.002	<0.002
Se (mg/ℓ)	0.04	<0.002	<0.002	<0.002	<0.002
Ag (mg/ℓ)	na	<0.001	<0.001	<0.001	<0.001
Sr (mg/ℓ)	na	<0.002	0.054	<0.002	<0.002
Zn (mg/ℓ)	5	<0.002	<0.002	<0.002	<0.002

Two different chemical profiles exist for the *NBH2* and *BH1314*. *NBH2* is a Mg-CO_3 type water. These types of groundwaters are typical of fresh, clean, relatively young groundwater that has started to undergo Mg ion exchange, often found in- dolomitic terrain. The pH of *NBH2* is circum-neutral (7.4-7.65), non-saline and hard. Nitrate (NO_3) is slightly raised (2.4 - 4.28 mg N/ℓ) but still in the low ranges and well within SANS 241: 2015 drinking water quality guidelines. Except for manganese (Mn), all trace metals recorded well within drinking water guidelines, most being undetected. Manganese recorded a concentration of 0.11 mg/ℓ during June 2018, marginally exceeding the SANS standards of 0.1 mg/ℓ.

In contrast, *BH1314* displays a Mg-Cl type water. These water types are typically a mix of different types – either clean water that has undergone Cl mixing/contamination or old stagnant NaCl dominated water that has mixed with water richer in Mg. The pH of *BH1314* is circum-neutral with non-saline and moderately soft water. All trace metals recorded in the ppb or undetected ranges while NO_3 and NH_4 concentrations recorded in the low ranges. All parameters as analyses are well within the SANS 241: 2015 Drinking Water Guidelines.

Groundwater monitoring at D1 – Old Plant Discard Dump

Six boreholes monitor the groundwater quality downgradient from the D1 - Old Plant Discard Dump at TIOM. Data for the 2 bi-annual monitoring periods in 2018 (GCS, 2018) are displayed in Table 30, Note that no data is available for boreholes *BH01330* and *BH01323* as these are monitored for water level and biomonitoring only.

Table 30: Groundwater quality sampled from boreholes downgradient from the Old Plant Discard

Parameters	SANS 214: 2015	BH01333		SM1		BTD1		Boorgat16a-35	
		Jun-18	Nov-18	Jun-18	Nov-18	Jun-18	Nov-18	Jun-18	Nov-18
pH	5.0-9.7	7.02	7.67	7.95	8.14	8.43	8.54	7.39	8.02
EC (mS/m)	170	69.1	90.5	33.3	43.3	105	143	72	95.8
TDS (mg/ℓ)	1200	502	543	251	266	869	921	563	685
Total alkalinity (mg $CaCO_3$/ℓ)	na	269	213	234	251	803	856	351	436
Total hardness (mg $CaCO_3$/ℓ)	na	408	339	215	213	634	636	464	565
Ca (mg/ℓ)	na	86	78.5	38.6	37.1	19.6	20	86.2	121
Mg (mg/ℓ)	na	46.9	34.9	28.9	29.2	142	142	60.4	63.8
Na (mg/ℓ)	200	36.3	55.7	14.4	13.6	119	123	33.8	35.3
K (mg/ℓ)	na	3.83	13.8	2.71	1.62	1.48	0.74	1.71	1.83
Cl (mg/ℓ)	300	77.9	114	7.76	10.1	73.3	77.5	67	74.8
SO_4 (mg/ℓ)	250, 500	73.8	101	<0.141	<0.141	1.12	8.71	41.1	49.6
NO_3-N (mg/ℓ)	11	0.27	0.982	<0.194	0.448	<0.194	0.296	5.92	8.75
NH_4-N (mg/l)	1.5	0.026	0.054	0.134	0.161	0.4	0.417	0.021	0.047
PO_4-P (mg/ℓ)	na	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
F (mg/ℓ)	1.5	0.286	0.301	<0.263	0.274	0.431	0.493	<0.263	0.265
Al (mg/ℓ)	0.3	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
As (mg/ℓ)	0.007	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Ba (mg/ℓ)	0.7	0.031	0.02	0.03	0.043	0.317	0.334	<0.002	0.002
Be (mg/ℓ)	na	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

Parameters	SANS 214:	BH01333		SM1		BTD1		Boorgat16a-35	
Bi (mg/ℓ)	na	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
B (mg/ℓ)	2.4	0.021	0.023	0.141	0.124	0.117	0.116	0.023	<0.013
Cd (mg/ℓ)	0.003	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Co (mg/ℓ)	na	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Cu (mg/ℓ)	2	0.005	<0.002	<0.002	<0.002	0.014	0.004	0.007	<0.002
Cr (mg/ℓ)	0.05	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Ga (mg/ℓ)	na	0.01	<0.001	0.003	<0.001	0.003	<0.001	0.001	<0.001
Fe (mg/ℓ)	0.3, 2	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Pb (mg/ℓ)	0.01	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Li (mg/ℓ)	na	0.003	0.002	0.015	0.001	0.006	0.006	0.004	0.004
Mn (mg/ℓ)	0.4; 0.1	0.839	0.049	0.652	0.788	0.086	0.042	<0.001	<0.001
Mo (mg/ℓ)	na	<0.004	<0.004	0.01	0.005	0.009	0.008	<0.004	<0.004
Ni (mg/ℓ)	0.07	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Rb (mg/ℓ)		0.004	<0.002	0.003	<0.002	0.003	<0.002	0.005	<0.002
Se (mg/ℓ)	0.04	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Ag (mg/ℓ)	na	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Sr (mg/ℓ)	na	0.004	0.102	0.003	0.059	0.003	0.163	0.005	0.085
Zn (mg/ℓ)	5	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002

Fairly similar water quality profiles are evident for the boreholes at the D1 - Old Plant Discard Dump. Boreholes *BH01333, Boorgat16a-35* and *SM1* display Mg (Ca)-HCO_3- while BTD1 has a Mg (Na)-HCO_3- type character. Groundwater from these boreholes is typical of fresh, clean, relatively young groundwater that has started to undergo Mg ion exchange, often found in dolomitic terrain. Although the chemical profiles and ratios between elements are relatively similar, substantial differences in their macro-elemental concentrations are evident, especially with reference to Ca, Mg, Na, Cl, HCO_3 and SO_4. Manganese (Mn) is the only element with substantial variances, which is slightly raised in boreholes *BH01333* and *SM1*. Some of these variances can be attributed to redox while others could be geology related or related to seepages. Relatively raised NO_3 is present in borehole *Boorgat16a-35* but is absent from the remaining boreholes.

Groundwater monitoring at D3 – Supply Chain Discard Dump

Five boreholes are included in the routine groundwater monitoring programme in vicinity of the D3 - Supply Chain Discard Dump at Thabazimbi Iron Ore Mine. Data for the 2 bi-annual monitoring periods in 2018 (GCS, 2018) are displayed in Table 31. Note that only one dataset is available (November 2018) for *BH01332* and *BH01328*.

Except for one dataset, all samples are typical of fresh, clean recently recharged groundwater that has started to undergo Mg ion exchange, mostly within dolomitic aquifers. Mg (Ca)-HCO_3- type groundwaters typical for dolomitic geological subsurface.

The pH levels recorded in circum-neutral ranges. Compared to the other boreholes relevant to this study, the groundwater in vicinity of the D3 - Supply Chain Discard Dump is relatively more saline with TDS ranging between 138 and 1193 mg/ℓ. The EC recorded for *B01327* in November 2018 (181 mS/m) exceed the permissible SANS 241 guidelines for EC set at <170 mS/m.

The arsenic (As) concentrations in borehole *B01325* are relatively high with 0.02 and 0.024 mg/ℓ recorded in June and November 2018, respectively. Both these As levels exceed the permissible SANS guidelines. Similarly, Mn concentrations recorded in high to elevated concentrations in *BH01328*, *B01325* and *B01327* ranging between 0.28 and 5.7 mg/ℓ. The former recorded for *B01327* in June 2018 and the latter in *B01325* also in June 2018. Nitrate (NO_3) was recorded to be slightly raised in boreholes *Borehole 9-24* and *B01327*, ranging between 3.62 and 8.75 mg N/ℓ but remain within SANS drinking water guidelines of <11 mg N/ℓ.

Table 31: Groundwater quality sampled from boreholes in vicinity of the D3 - Supply Chain Discard Dump

Parameters	SANS 214: 2015	BH01332		BH01328		Borehole 9-24		B01325		B01327	
		Jun-18	Nov-18	Jun-18	Nov-18	Jun-18	Nov-18	Jun-18	Nov-18	Jun-18	Nov-18
pH	5.0-9.7	-	8.09	-	8.06	6.99	7.77	6.93	7.49	7.06	7.56
EC (mS/m)	170	-	77.6	-	66.9	58.3	72.2	22.7	22.4	140	**181**
TDS (mg/ℓ)	1200	-	566	-	441	418	465	138	147	1077	1193
Total alkalinity (mg $CaCO_3$/ℓ)	na	-	429	-	294	237	262	111	126	579	657
Total hardness (mg $CaCO_3$/ℓ)	na	-	442	-	302	-	336	-	89	-	804
Ca (mg/ℓ)	na	-	70.6	-	46.2	56.4	58.1	10.8	11.9	134	146
Mg (mg/ℓ)	na	-	64.5	-	45.4	44.7	46.5	12.8	14.3	108	107
Na (mg/ℓ)	200	-	40.2	-	50.3	28.3	29.5	10.5	11.3	129	128
K (mg/ℓ)	na	-	1.58	-	0.834	1.57	2.44	2.45	2.54	1.92	1.87
Cl (mg/ℓ)	300	-	84.1	-	89.9	64.9	72.7	4.71	5.09	184	230
SO_4 (mg/ℓ)	250, 500	-	23.1	-	<0.141	29.7	37.7	3.15	<0.141	106	112
NO_3-N (mg/ℓ)	11	-	0.512	-	0.966	3.62	5.14	<0.194	0.369	7.38	8.75
NH_4-N (mg/ℓ)	1.5	-	0.04	-	0.054	0.03	0.067	0.061	0.03	0.068	0.019
PO_4-P	na	-	<0.005	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

Parameters	SANS	BH01332		BH01328		Borehole 9-24		B01325		B01327	
(mg/ℓ)											
F (mg/ℓ)	1.5	-	<0.263	-	0.277	<0.263	<0.263	<0.263	<0.263	<0.263	0.275
Al (mg/ℓ)	0.3	-	<0.002	-	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
As (mg/ℓ)	0.007	-	<0.006	-	<0.006	<0.006	<0.006	**0.02**	**0.024**	<0.006	<0.006
Ba (mg/ℓ)	0.7	-	0.024	-	0.416	0.021	0.023	2.24	3.26	<0.002	<0.002
Be (mg/ℓ)	na	-	<0.005	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bi (mg/ℓ)	na	-	<0.004	-	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
B (mg/ℓ)	2.4	-	<0.013	-	<0.013	0.013	<0.013	<0.013	<0.013	<0.013	<0.013
Cd (mg/ℓ)	0.003	-	<0.002	-	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Co (mg/ℓ)	na	-	<0.003	-	<0.003	<0.003	<0.003	<0.003	<0.003	0.008	<0.003
Cu (mg/ℓ)	2	-	0.003	-	<0.002	0.006	<0.002	<0.002	<0.002	0.021	<0.002
Cr (mg/ℓ)	0.05	-	<0.003	-	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Ga (mg/ℓ)	na	-	<0.001	-	<0.001	0.005	<0.001	<0.001	<0.001	0.033	<0.001
Fe (mg/ℓ)	0.3, 2	-	<0.004	-	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Pb (mg/ℓ)	0.01	-	<0.004	-	2.44	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Li (mg/ℓ)	na	-	0.004	-	0.005	0.004	0.005	<0.001	0.002	<0.001	<0.001
Mn (mg/ℓ)	0.4; 0.1	**-**	<0.001	**-**	**2.44**	<0.001	<0.001	**5.7**	**5.1**	**0.277**	0.013
Mo (mg/ℓ)	na	-	<0.004	-	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	0.005
Ni (mg/ℓ)	0.07	-	<0.002	-	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Rb (mg/ℓ)		-	<0.002	-	<0.002	0.004	<0.002	0.006	<0.002	0.029	<0.002

Parameters	SANS	BH01332		BH01328		Borehole 9-24		B01325		B01327	
Se (mg/ℓ)	0.04	-	<0.002	-	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Ag (mg/ℓ)	na	-	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	0.012	<0.001
Sr (mg/ℓ)	na	-	0.063	-	0.077	0.004	0.072	0.006	0.055	0.029	0.05
Zn (mg/ℓ)	5	-	<0.002	-	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002

Chapter H: Air Quality

The following information was obtained from the *ArcelorMittal: Thabazimbi Iron Ore Mine Air Quality Model Update – TZ0031-2018,* compiled by Shangoni Management Services (Pty) Ltd, dated May 2019.TIOM falls within one of South Africa's airshed priority areas, the Waterberg Bojanala Priority Area. An ambient air quality monitoring station was identified in Thabazimbi (Site ID: 2003, Latitude: -27.391605, Longitude: -24.591058). The purpose of the ambient air quality monitoring station is to monitor residential emissions and emissions from mines located approximately 15 to 20 km from the station. The ambient air quality monitoring results for Thabazimbi show periodic exceedances of the National Ambient Air Quality Standards ("NAAQS") for daily PM_{10} and $PM_{2.5}$ and the NAAQS for annual PM_{10} and $PM_{2.5}$ (Refer to Table 32). TIOM conducts dustfall monitoring and ambient PM_{10} and $PM_{2.5}$ monitoring (-24.595434°, 27.402567°) within its mining right boundary. TIOM's ambient PM_{10} and $PM_{2.5}$ monitoring results show a general compliance to the NAAQSs for daily PM_{10} and $PM_{2.5}$ (Refer to Figure 24 and Figure 25). The dustfall monitoring results show a general compliance to the National Dust Control Regulations standard for non-residential areas (Refer to Figure 26).

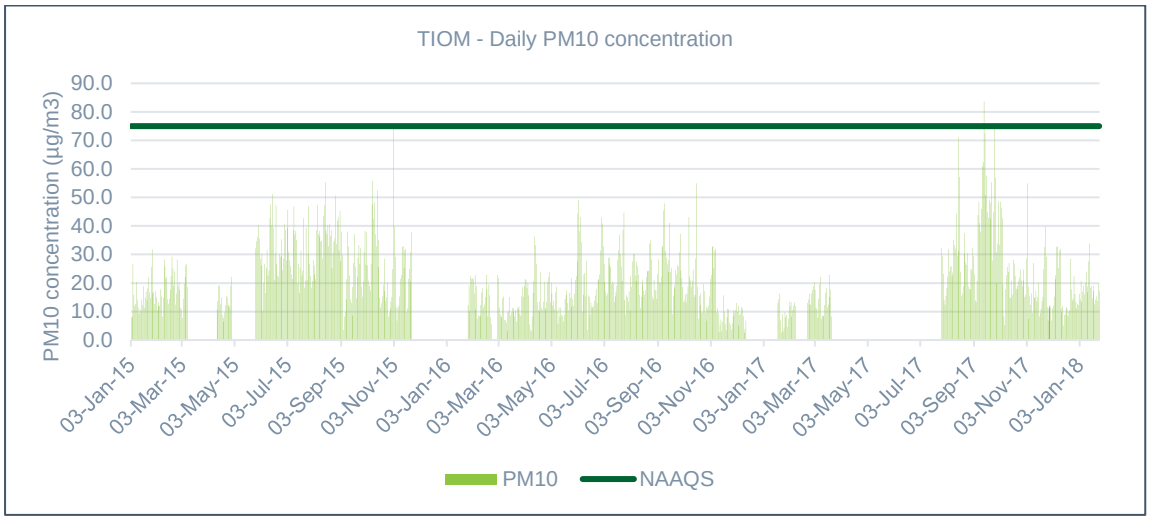


Figure 24: TIOM - Daily PM_{10} concentration

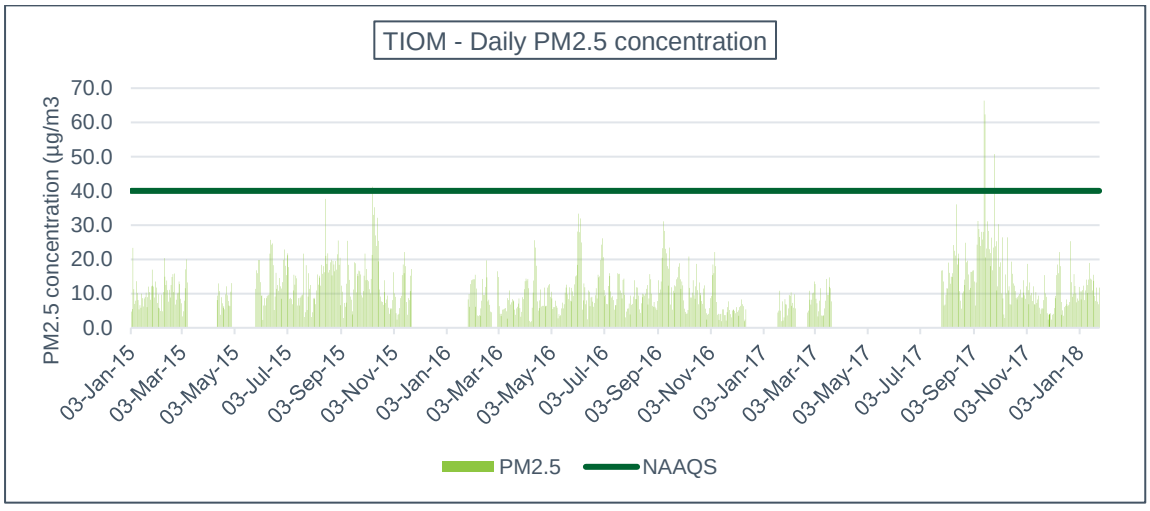
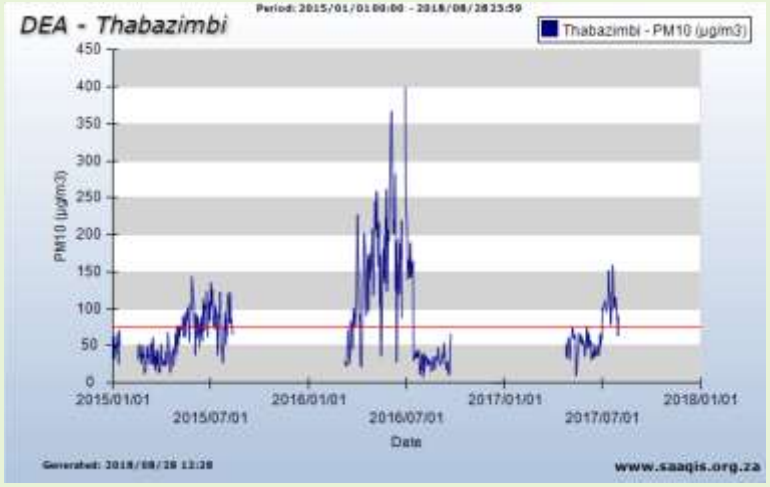
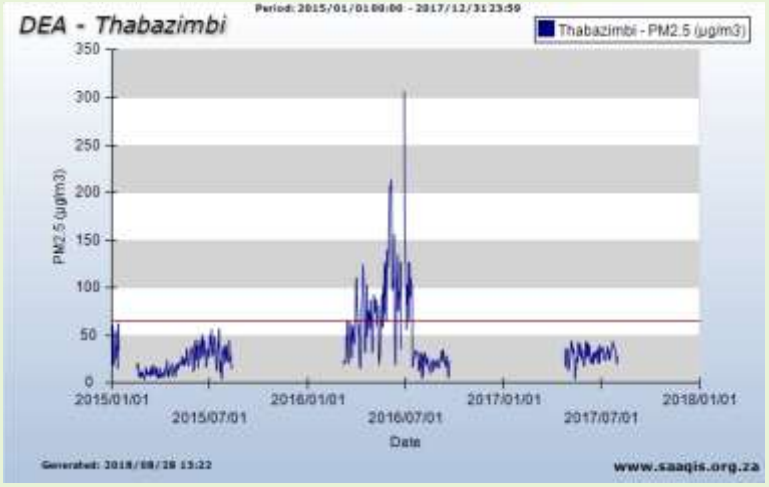
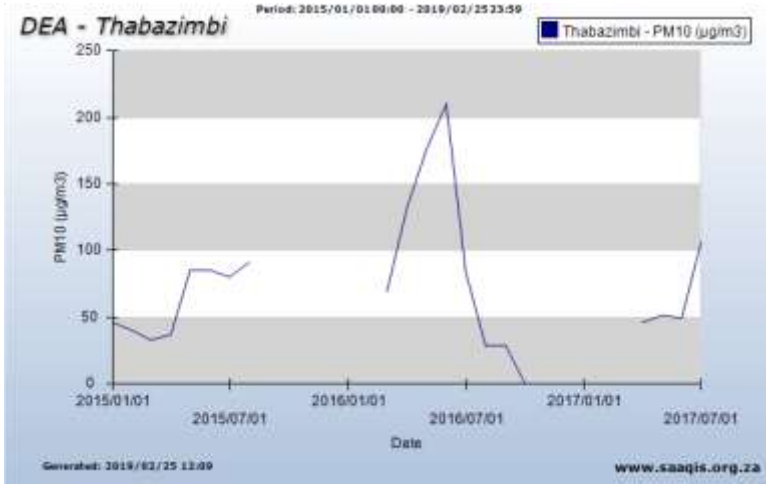
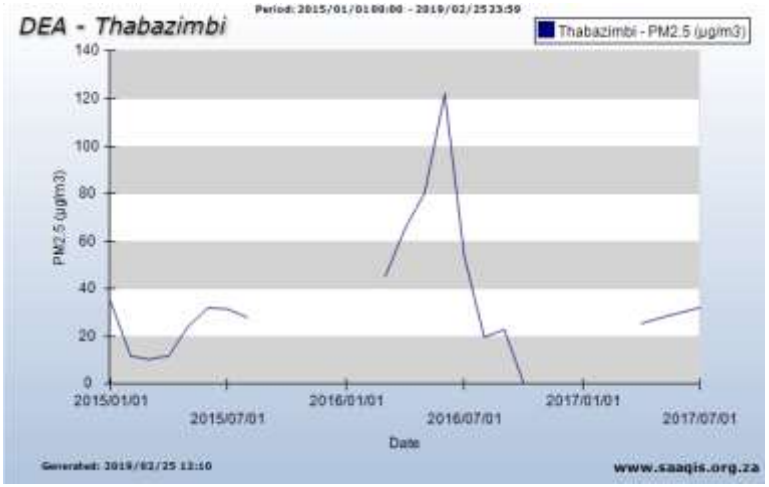


Figure 25: TIOM - Daily PM2.5 concentration

Table 32: Background ambient air quality – Thabazimbi

Average daily PM10 levels		Average daily PM2.5 levels	
Average monthly PM10 levels		Average monthly PM2.5 levels	

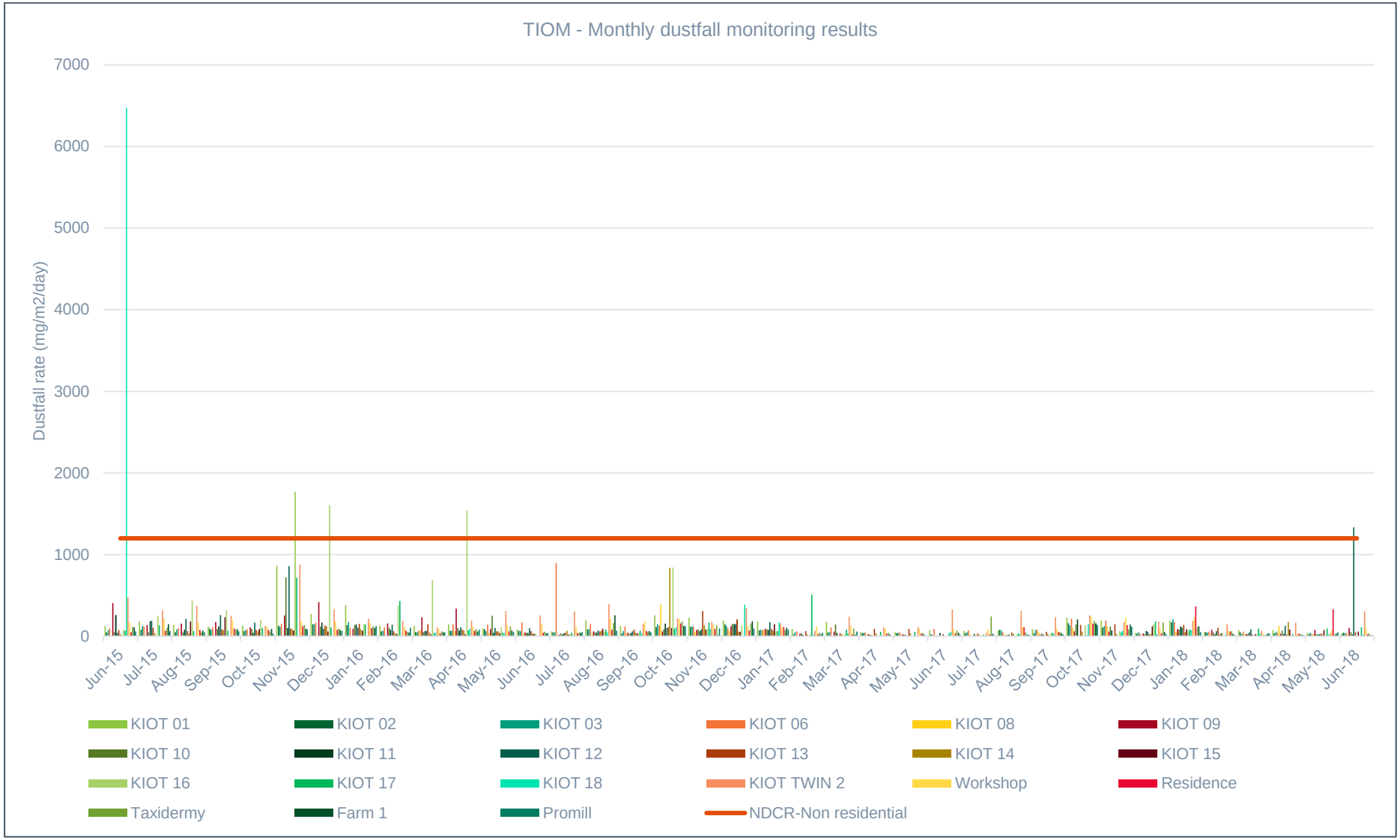


Figure 26: TIOM - Monthly dustfall monitoring results

Chapter I: Noise

A Noise Impact Study was conducted for the project Phoenix, the results of which were incorporated into the report titled, *Thabazimbi Iron Ore Mine (Project Phoenix Noise Impact Assessment),* dated September 2006, compiled by OH&AP Consulting Services.

As part of the above-mentioned Noise Impact Study, measurements were conducted to determine the current ambient noise levels at sensitive receptors near Thabazimbi Mine. The following findings were as follows:

- Based on the sound propagation modelling the increase in the residual noise level ("noise impact) at none of the selected critical receptor areas exceed 1 dBA (an increase of below 7 dBA is viewed as acceptable); and
- The SANS 10103:2004 standards for environmental noise is exceeded at the three locations selected inside the Thabazimbi residential area. This can mainly be contributed to high residual noise levels ambient in the environment and not as a result of the proposed mining activities.

Chapter J: Archaeology and cultural history

The following information was sourced from the *Thabazimbi Iron Ore Mine Pty Ltd Thabazimbi Mine Environmental Management Programme LP30/5/1/3/2/1(45) and (47) EM,* compiled by Shangoni Management Services (Pty) Ltd, dated 2010.

Centuries before Iscor began mining the haematite ore in the Thabazimbi Mountain for smelting in its blast furnaces, native inhabitants recovered the iron-bearing ore in the area with hand tools and processed it with primitive smelting methods.

At the site of the present Bobbejaanwater pit, native "miners" used to dig up the reddish-brown ore to fabricate metal tips for their spears, axes and pickaxes. The prospecting trenches dug by Iscor officials up the hillsides a few years ago are just a few steps away from some of the ancient excavations – the old and the new side by side.

According to calculations by ethnologists, the black tribes responsible for the mines lived in these regions between 900 and 1 200 years ago. Yet these primitive ore diggers employed a modern-day mining method by leaving pillars in the excavations to support the roof.

It is assumed that these miners dug up the ore using stone and iron tools and carried it down the hill in hide bags and gourds for smelting somewhere in the valley on the present farm Kwaggashoek or in the Vliegepoort valley. It is unlikely that smelting was done on the slopes of the hill, as the hardwoods that must have been used to fire the clay furnaces grow mainly in the valleys. Remnants of smelting furnaces have in fact been found on the quartz hillocks between the northern and southern ranges.

Ancient smelting works discovered in 1955 consist of remnants of such furnaces on the outskirts of Thabazimbi. The conservation possibilities are being investigated in collaboration with the University of Pretoria.

A detailed heritage assessment was done. The assessment identified three applicable eras namely:

- Stone age;
- Iron age; and
- Current age.

Stone Age

Stone tools were only encountered to the direct east of the area known as BA 3 in an area affected by sheet erosion. The tools appear to be mainly from the period known as the “Middle Stone Age” and because no dating was done can only approximately be assigned to a period of between 30 000 and 120 000 years ago. The fact that these were the only tools observed does not necessary mean that there are not more tools present in lower levels.

With the knowledge of the general richness in remnants of artefacts from the stone tool people at the Limpopo valley to the west, the Magalies Mountain to the south and the Waterberg to the east one would have expected more Stone Age material from the riverbanks of the Crocodile River that runs through the TIOM property. On the other hand it is known that owing to regional pluvial and inter-pluvial periods Stone Age people were forced to move away from places that were either to wet or to dry.

There does not appear to be any sites on the property that indicate long periods of use of the landscape.

There are no rock-art sites, either of paintings or engravings on the property. On such a large area it is often indicative of low use of the region during the Stone Age.

Iron Age

The Iron Age on the Thabazimbi Mine property is represented by a number of stone walled structures as well as a number of smelting ovens. The period that this occupation reflects is between 1400 and 1600. Although there is circumstantial evidence that peoples from both earlier and later periods have had access to utilize the iron ore source no direct evidence is forthcoming at present.

Previous excavations and reconstruction work has sensitised the mine authorities to its responsibility and a number of positive steps have been taken to ensure the protection of the sites involved. Even though this work was done in the past, some questions still need to be addressed, and further academic research on the site should be supported by the mining authorities.

Current

Du Randt Homestead

The site could only be visited on a Saturday afternoon after 14h00 after active dumping had ceased on the spoil site above the homestead and the approach road to it. This is owing to mine safety regulations preventing people to enter dangerous areas that can be affected by the spoiling process. Even this precaution may not be sufficient, as the spoil-tail stays “alive” for several hours after actual dumping and even during our visit to the site, settlement of the dump could be noticed.

Of the building itself only three walls (east, west and north) are still standing in its original position while the rest have all collapsed owing to natural decay. The site is also rather overgrown with

pioneer trees such as sickle bush (Dichrostachys cinerea) and black thorn (Acacia mellifera) that impedes movement to and on the site, and are also actively enhancing the natural decay process.

Owing to the collapse of the walls and the trees growing around the structure, it is nearly impossible to determine the floor plan of the structure at present.

The walls of the building consist of banded ironstone semi-dressed stones as can be seen in the photographs mortared with mud. Andalusite stone slabs were dressed for window sills, and inside walls were possibly built from unfired semi-fired clay bricks

From casual inspection no functions could be positively ascribed to defined areas, but one will assume that the northern side would have been fronted with a “stoep” with two bedrooms and a “voorkamer” or sitting/dining room in the middle as the northern rooms. The southern side could have been a kitchen, a dining room and another bedroom. According to the mining officials there is also a “bakoond” somewhere to the south of the building that were not seen on this occasion.

According to Williams’s map a spring in the kloof above the house provided water for the family, but the “kloof” is now covered by the spoil-dump. Similarly in the valley below the homestead there are plantations of eucalyptus trees and a deep hole that appears to have been a well.

Thabazimbi Town

In Mollie’s there are a number of old photographs that gives us at least some idea of what the early days of Thabazimbi looked like, and also what it appeared like at its heyday in the early 1960’s. Some of the building techniques of the architecture are unique in the sense that the buildings were concrete cast with horizontal plank-shuttering. Especially the stores shop and the garage have distinct late Art Deco features in the sweeping patio-facade of the shop and the curved concrete roof of the garage. Small detail of this style is also to be found in the old “bottle-store” and at the entrance to the “heartbreak hotel”. All the photographs in Mollie’s can be used to in the partial compilation of at least a usable document on the past and present appearances of buildings.

Even though time was limited Mr E. Botha could name most of the buildings, their use and who was associated with them. It is the opinion of the author that many more of the retired miners are still alive that will have memories and photographs that will bolster a compilation of information of the old town and its inhabitants.

In the time available most of the buildings were photographed at random as part of the present survey, but no specific details such as plan, material and style were documented. A visit to the local drawing office did not render any detail from the past building and no old “town plan” could be found. The only town plan that was available is a relatively late document possibly associated with the time that some properties were sold off to private owners.

In Mollie’s there is some information available regarding some of the mine managers, but specific information relating to either white or black miners are not forthcoming.

Although some of the buildings have been altered in appearance most were well maintained as could be expected from a well-run mining company. Even though some buildings have been lost either through mishaps such as fire, or renewal, the greater part of the town is well preserved, especially with the enhancement of atmosphere by the ample planting of indigenous trees.

The conservation efforts of the mine could also be noticed by a number of commemorative plaques that were placed in focal areas on large ore boulders. These include the 50th year of Union, the arrival of the railways and the 50th commemoration of the existence of the mine.

Efforts to restore the first mine manager's home were made in the past, but typically, because no actual use was ascribed to the building, it was eventually subjected to vandalism. This type of conservation / vandalism is more often than not a negative influence on people associated with conservation action, and should be more carefully planned and executed.

The effort of the mine and its officials that went into the establishment of "Mollie's" is praiseworthy. In this one little building a wealth of material and information was gathered, that now, and in the future, will be the foundation of further conservation efforts and awareness.

What is most important to realise though with efforts such as this one (and the manager's house), is that the process of conservation is a journey and not a destination. Once a restored "manager's house" or a "Mollie's" is established and "completed" the concerned parties must ensure a continuation of the process by including the projects in a company's budget and to ensure the continual use or tender of such building or depository on a daily base.

Chapter K: Sensitive landscapes

The following information was obtained from the *Riparian Delineation and Water Use Risk Assessment for the Proposed Reworking of a Discard Dump at the Thabazimbi Iron Ore Mine*, dated 2020 and compiled by Wetland Consulting Scientific (Pty) Ltd.

Riparian Delineation and Classification

The Rooikuilspruit flows past from north to south just to the west of the D1 – Old Plant Discard Dump and the P1 Crushing and Screening Plant, between the D1 – Old Plant Discard Dump and the R510 tar road. It appears that historically the course of the Rooikuilspruit may have been slightly diverted/adjusted to allow for the development of the D1 – Old Plant Discard Dump; this appears out of the alignment and shape of the channel and structure of the riparian vegetation along the reach of the Rooikuilspruit adjacent to the D1 – Old Plant Discard Dump when compared to the upstream and downstream reaches. However, no formal confirmation of such a "diversion/adjustment" could be obtained through literature searches or review of historical aerial imagery (the D1 – Old Plant Discard Dump pre-dates all available historical aerial imagery).

Currently, the D1 – Old Plant Discard Dump extends to within only a couple of meters of the active channel of the Rooikuilspruit; at its closest less than 5 m separates the D1 – Old Plant Discard Dump from the channel. Within this reach the Rooikuilspruit is associated with a fairly narrow strip of riparian vegetation and has been typed as a riparian zone rather than a wetland. Adjacent to the D1 – Old

Plant Discard Dump the riparian habitat is characterised by an active channel roughly 2 - 4 m wide that was strongly flowing at the time of the site visit. Water within the channel was highly turbid, dark grey in colour, and smelled strongly of raw sewage at the time of the site visit. Anecdotal evidence suggests that these conditions represent the status quo and suggest that the upstream Waste Water Treatment Works ("WWTW") is not fully functional.

The active channel was characterised by open, slow-flowing water with a fringe of *Paspalum urvillei* and *Paspalum distichum* on the immediate channel edge and *Cenchrus ciliaris* along the outer edge of the marginal zone. Woody species along this reach of the Rooikuilspruit included the indigenous species *Ziziphus mucronata, Searsia lancea, Celtis africana*, and *Peltophorum africanum*. Alien species recorded were *Lantana camara, Melia azedarach*, and *Ricinus communis*.

Just downstream of the D1 – Old Plant Discard Dump an old mine road crossing used to occur over the Rooikuilspruit, though the actual culvert structure has been removed. From here downstream the Rooikuilspruit appears to follow its original course and is characterised by a more extensive and well-developed riparian zone. The marginal zone and active channel support fringing stands of *Cyperus sexangularis* with the riparian zone characterised by very large *Senegalia galpinii* trees (previously *Acacia galpinii),* especially near the R510 crossing.

Numerous linear infrastructures impact on the riparian habitat, with two old conveyors crossing the Rooikuilspruit within the affected reach (one upstream and one downstream of the D1 – Old Plant Discard Dump), a number of mine haul roads running in close proximity to and within the riparian habitat, most notably the haul road running from the D1 – Old Plant Discard Dump to the R510 which passes through a grove of large *Senegalia galpinii* trees. Associated with the haul road are a number of pipelines, with at least 2 leaks observed during the site visit spilling water into the riparian habitat. Several powerlines also cross the riparian habitat, while the R510 tar road runs in very close proximity to the Rooikuilspruit, and likely within the historical extent of the riparian habitat.

To better understand changes that have occurred to the Rooikuilspruit riparian habitat, historical aerial imagery from 1980 was sourced and compared to recent aerial imagery. Unfortunately, no earlier imagery could be obtained. Figure 28 below shows a comparison between current and historical conditions. From the imagery it is clear that many of the disturbances observed on site during the recent field survey were already in evidence 40 years ago, including also the D1 – Old Plant Discard Dump. Noticeably absent from the 1980 image is the Thabazimbi WWTW. The riparian habitat looks largely similar across the two images, with a marginal increase in woody vegetation cover evident under current conditions.

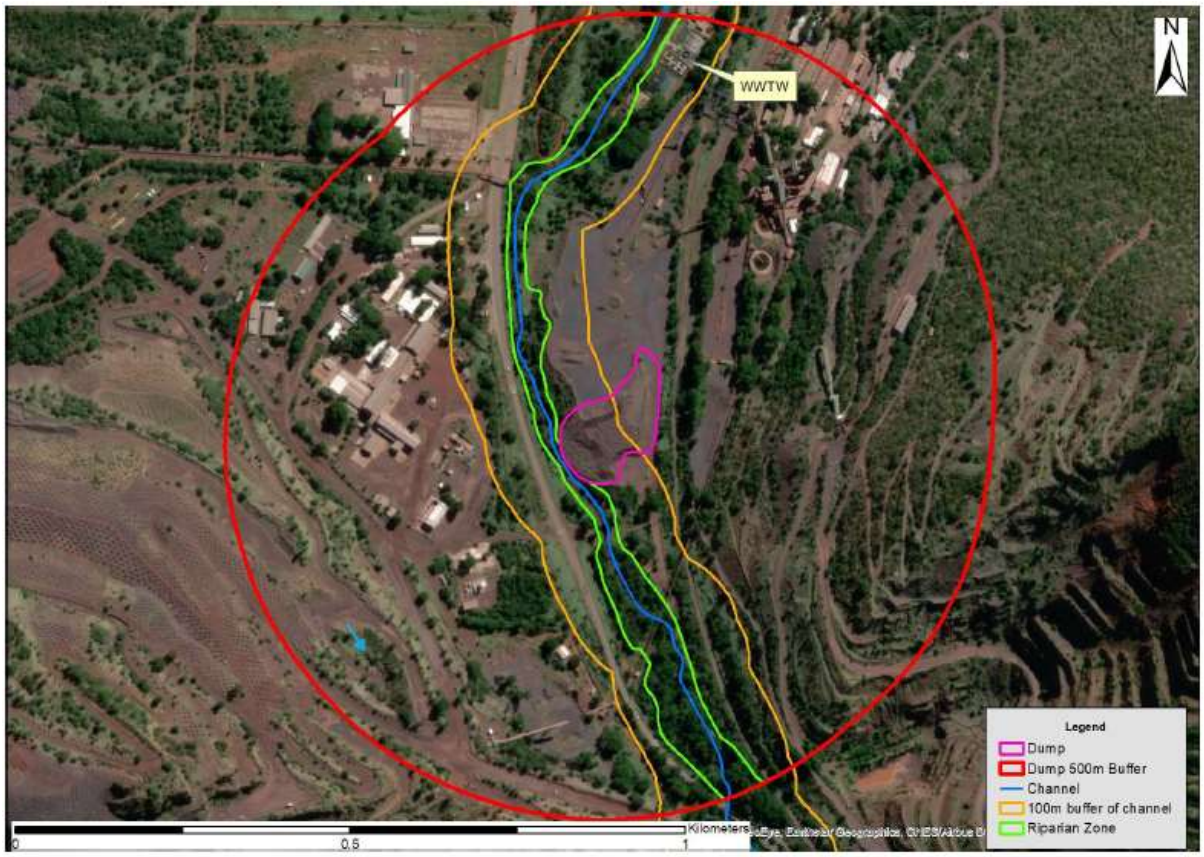


Figure 27: Map showing the extent of the delineated riparian habitat associated with the Rooikuilspruit (Source: WCS, 2020)

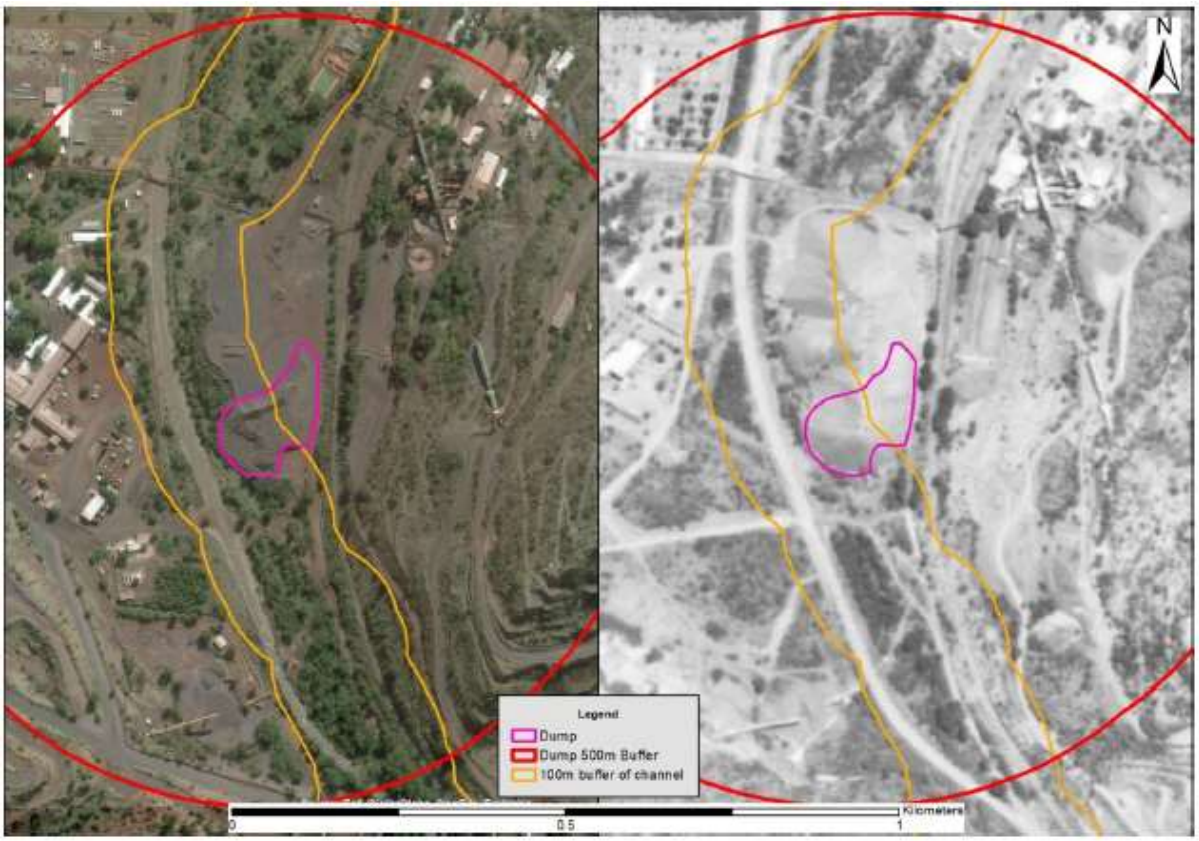


Figure 28: Comparison between current and historical aerial imagery from 1980 (Source: WCS, 2020

Functional Assessment

Riparian zones have specific biotic and abiotic characteristics that are important in terms of the functioning of the river. These functions provide certain benefits, not only from an ecological perspective, but also from a number of other perspectives. The riparian zone of the affected section of stream undoubtedly has the following functions that provide important benefits in terms of the river, the downstream environment and the adjacent landscape:

- It provides habitat and migratory pathways for terrestrial fauna. This function is of elevated importance within a largely modified environment such as encountered on site. Certain fauna may utilise the riparian zone during parts of their life cycles and others may be confined solely to the system;
- Despite the presence of some exotic plant species occurring in the riparian zone, it nevertheless forms a centre of species biodiversity within the surrounding landscape that is significantly transformed;
- The riparian habitat buffers the aquatic environment from increasing surface runoff and noise pollution;
- The rooting system of the trees (and other vegetation) helps to stabilise the banks and limit erosion;
- The changes in flow characteristics caused by the riparian plants during flooding results in increased deposition of both organic and inorganic suspended materials and decreases flood energy;
- Riparian plants provide a refuge for aquatic species utilizing the river, and also create a mosaic of habitats that encourage greater diversity among the species able to utilise the river ecosystem;
- Allochthonous organic inputs to the river provide a food source for aquatic species;
- The canopy cover provided by the trees shades the river and contributes towards maintaining lower water temperatures; and
- More generally, the riparian zone provides an aesthetic quality to the overall landscape of the area. The very large *Senegalia galpinii* trees are especially important from an aesthetic perspective.

Present Ecological Status ("PES") Assessment

The PES assessment compares the current condition of a wetland/watercourse with its expected reference or natural conditions and rates the change on a scale of A to F as per Table 33 below.

As no information is available on the reference state of the wetland on site, historical aerial imagery of the area was used to determine the likely nature of the watercourse under natural conditions. Unfortunately the earliest available imagery shows most of the disturbance evident on site already in place. It is however out for interpretation that a small diversion/adjustment of the Rooikuilspruit was undertaken to allow for the placement of the various discard dumps along the edge of the stream, while clearing and removal of riparian vegetation would also have been undertaken during construction of the various linear infrastructures affecting the area: R510 road, mine haul road, various powerlines, pipelines, and two old conveyor crossings. The most significant current impact to

the Rooikuilspruit is, however likely the discharge of poorly treated or untreated sewage into the stream from the WWTW located just upstream of the D1 – Old Plant Discard Dump. As indicated, the full reach of the Rooikuilspruit surveyed was characterised by highly turbid, dark coloured water with a strong smell of sewage at the time of the site, with anecdotal evidence suggesting this is the norm and has been ongoing for a considerable time. This is likely to have had a severe deleterious effect on aquatic biota. In addition, the Rooikuilspruit drains out of Thabazimbi town and conveys significant volumes of urban storm water following rainfall events. This is likely to further impact on water quality but also to exacerbate flood peaks and erosive energy of flows.

Based on the above discussion it is clear that the Rooikuilspruit and associated riparian habitat on site has been significantly impacted on and modified by various activities. **The PES assessment revealed that the system is considered largely modified (PES category D).**

Table 33: Table showing the rating scale used for the PES assessment (taken from Kleynhans, MacKenzie and Louw, 2006, as modified from Kleynhans 1996 & Kleynhans 1999

Ecological Category	Description	Score (% of Total)
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	80-89
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Critically modified. Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible	0-19

Chapter L: Visual aspects

The D1 - Old Plant Discard dump is the only dump that is visible to the public from District Road R510 and the discard dump is located adjacent to District Road R510. The D2 - Old Plant Discard Dump, D3 - Supply Chain Discard Dump and the Slimes Dams are not visible to the public.

Chapter M: Regional socio-economic structure

The following information was obtained from the *Sishen Iron Ore Company (Pty) Ltd: Thabazimbi Iron Ore Mine Integrated Water and Waste Management Plan*, dated February 2019 and compiled by Shangoni Management Services (Pty) Ltd.

Provincial View

Limpopo covers a total area of 123,910 km^2, making it the fourth largest province in South Africa. In terms of population size, it is the fifth largest province with a population of 5.4 million in 2011. Limpopo Province shares international borders with districts and provinces of three different countries: Botswana's Central and Kgatleng districts to the west and northwest respectively; Zimbabwe's Matabeleland South and Masvingo provinces to the north and northeast respectively, and Mozambique's Gaza Province to the east.

The economy of the northern region of Limpopo Province is based on trading, game farming and cattle farming, while mining is the major economic activity in the south-western region. The province contains much of the Waterberg biosphere, a UNESCO-designated Biosphere Reserve. The Waterberg biosphere, a massif of approximately 15 000 km^2, is the first region in the northern part of South Africa to be named as a UNESCO Biosphere Reserve. Within the Waterberg there are archaeological finds dating back to the Stone Age, and early evolutionary finds related to ancient human origins. Despite rich natural and mineral resources, the province faces severe socio-economic development challenges, as identified in the province's Employment Growth and Development Plan (EGDP, 2009–2014). It is expected that these challenges will remain relevant until at least 2019:

- Most of the economic regions in the province are struggling to overcome abject poverty but also lack productive capacities to move out of the poverty trap of high unemployment and low levels of income, gross fixed capital formation and growth;
- Insufficient attention is paid to a long-term perspective of building sustainable, successful, competitive and integrated economic regions in the provincial districts;
- There is a lack of attention to the potential development contribution of industry and, in particular, manufacturing, with insufficient attention given to economic consolidation and support for the growth of a labour-intensive, industrialisation path-based economy; and
- Insufficient productive capacities in the local economies are expected to have an adverse effect on efforts to shape the new geography of industrial production and distribution.

Based on the identified socio-economic development challenges, the Province has been focusing the strategies and deliverables of its departments on the following priority areas since 2009, under the guidance of the Premier's Employment and Growth Advisory Council:

- Creating decent work and sustainable livelihoods;
- Education;
- Health;
- Rural development, food security and land reform; and
- Combating crime and corruption.

The Province has identified five geographical areas in Limpopo as potential "special economic zones" ("SEZs"), where economic growth projects and investment will be focused. Thabazimbi and surrounds fall outside these identified areas:

- Musina/Muttashi (regional economic integration and cross-border trading);
- Lephalale (coal, CBM and energy complex);
- Polokwane (inter-modal freight and logistics);
- Makhado/Vele (coal, CTL, GTL and power generation); and
- Burgersfort (platinum hydrogen economy)

Implementation of the Limpopo Provincial Government's grand plans for economic growth in the province is hampered by its municipalities' lack of basic governance mechanisms and poor application of management principles. The Auditor-General's municipal audit in 2012/13 could not give a single municipality in the province an unqualified audit opinion with no findings, or even an unqualified opinion with findings. The audit findings indicate the same root causes for poor results identified in prior years:

- In 88 % of Limpopo municipalities, some of the key officials lack minimum competencies and skills [including 52 % of CFOs] and there are vacancies in key positions (16 % of chief financial officer positions were vacant at year-end);
- The impact of these key vacancies and shortfalls in skills and competencies is illustrated by the fact that 24 out of 25 (96 %) sets of annual financial statements reported on contained material misstatements; and
- Unauthorised, irregular and fruitless and wasteful expenditure remained high.

A view of the Waterberg District

Limpopo is divided into five municipal districts: Capricorn, Sekhukhune, Waterberg, Mopani and Vhembi. The Waterberg District Municipality comprises six municipalities: Bela-Bela, Lephalale, Modimolle, Mogalakwena, Mookgopong and Thabazimbi. While it is the largest of the Limpopo districts in terms of area, Waterberg has the smallest population and accounts for 11.7 % of the province's population.

The Waterberg District Municipality is located in the southwest part of Limpopo within easy reach of the urban and industrial complex of Gauteng. The municipality has the highest employment rate (38.1 %) within the Limpopo Province. In terms of income, it has the lowest percentage (57.3 %) of households with incomes below R 9,600 per annum or R 800 per month. Waterberg District Municipality has the highest Gross Geographic Product ("GGP") per capita in the province.

The strongest economies within the Waterberg District Municipality are Thabazimbi and Lephalale, where employment and income levels are higher than in the other local municipalities forming part of the district. Mining activities (Thabazimbi and Lephalale) and the development of the Medupi Power Station (Lephalale) are the reasons why these two municipal areas' economies are stronger.

The development priorities of the Waterberg District Municipality are set out in its 2015/16 Integrated Development Plan ("IDP") and fall into eight thrusts. Some key initiatives are planned:

- institutional development (e.g. revival of the Waterberg Economic Development Agency);

- mining development and beneficiation (e.g. establishment of a mining beneficiation hub and mining recycling plant);
- industrial development and investment (e.g. expansion of agro-processing and agro-tourism products, and investment in biotechnology);
- the green economy (e.g. manufacturing of biodiesel and investment in waste recycling plants);
- agriculture and agro-processing (e.g. establishment of a regional fresh produce market and increasing exports of agricultural produce);
- small business and retail development (e.g. implementation and support for small business incubators);
- tourism development (marketing and advertising of tourism sites and activities); and
- transport and logistics (e.g. tourism corridor/nodal development).

The Thabazimbi Economy

The Thabazimbi municipal area contributed approximately 8 % (R 9.1 billion) to the total Limpopo economy in 2013. The primary drivers in the local economy are mining (87.6 %) and trade (3.2 %). The mining sector has been the main economic driver of the local economy over the past 18 years, with minimal change in the sectorial composition. Mining activity contributes approximately 90 % to the local economy in GVA and provides 70 % of local employment.

Economic growth in the Thabazimbi municipal area has fluctuated between very high positive in 1998 (23.1 %) to negative in 2008 (-7.3 %) during the recession. The average economic growth rate for the municipal area between 1996 and 2013 was 1.7 % per annum while the provincial growth rate over the corresponding period was 3 % per annum. The Thabazimbi municipal area accounted for approximately 4 % of Limpopo employment during 2013. Employment in the local economy seems to follow a trend where employment levels increase more or less every five years, followed by a period of about four years of more with stable, but lower employment levels. It is evident that employment levels in Thabazimbi fluctuate and are seldom stable. The average employment growth for the local economy is illustrated in Table 34.

Table 34: Thabazimbi employment growth

Period	Growth
18 years	2.6%
10 years	2.7%
3 years	7.1%

The mining sector is the largest employer in the local economy and its contribution has increased substantially from 1995 to 2013. The employment contribution from agriculture has decreased from 2003 and by 2013 only accounted for 6.4 % of all employment in the local economy. The trade sector (6.1 %) and community and social services sector (6 %) are the other larger contributors.

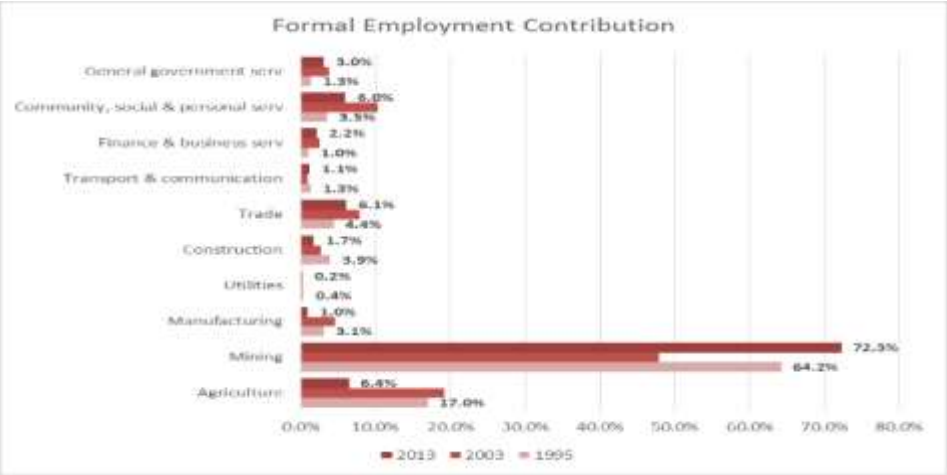


Figure 29: Formal employment per sector in the Thabazimbi municipal area (Source: Demacon ex Quantec, 2015)

Semi- and unskilled labour forms the largest segments of the employed workforce within the local economy. The skill level determines the type of occupation or work that people can do.

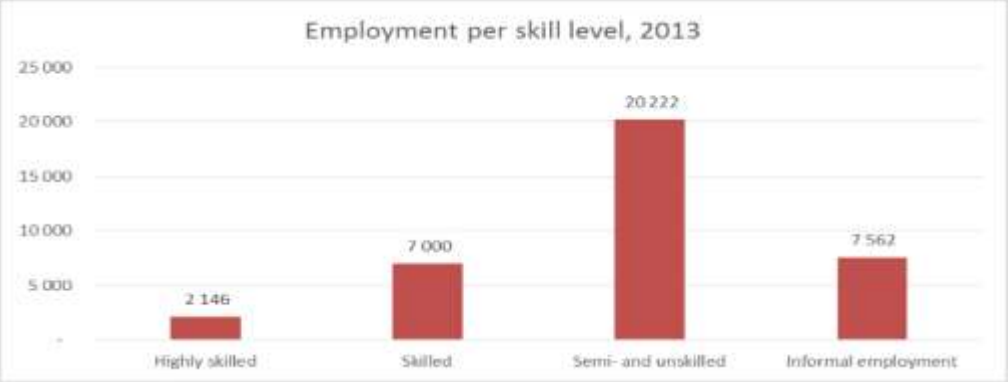


Figure 30: Employment per skill level, 2013 (Source: Demacon ex. Quantec, 2015)

Table 35 indicates the growth rate for employment in different skills levels over an 18-year period. Within the formal employment segment, it is evident that the highly skilled employment opportunities had the highest growth while the semi- and unskilled segments had the lowest growth.

Table 35: Skill-level employment growth

Period	Growth (18-year period)
Highly skilled	5.0%
Skilled	4.1%
Semi- and unskilled	2.0%
Informal	6.7%

An analysis of location quotient ratings for different sectors in the local economy found two sectors with high location quotient ratings: mining and agriculture. These high ratings indicate that the sectors

are serving needs that extend beyond the boundaries of the local economy and export goods and services to the rest of the country.

When compared to the national economy, the Thabazimbi local economy has a high concentration of mining activity that has stayed high and increased within the local economy. The location quotient illustrates that mining dominates local activity and as a result is by far the most competitive, export-driven sector in the local economy. The mining sector in the study area has a clear competitive advantage over other sectors in the economy.

The agricultural sector has shown a decrease from 2003 to 2013 but is still the sector with the second highest location quotient. The significance of game farming, exotic game breeding and hunting is evident in the local area; it falls within the agricultural sector and is also a contributor to tourism. Linking closely to game lodges is the provision of catering and accommodation. The location quotient of the catering and accommodation sub-sector has decreased somewhat since 2003 and is low in comparison to the national economy.

According to the National Spatial Perspective (2006), tourism includes a diverse set of activities and is a contributor to most of the main economic sectors. The sector is generally less spatially focused than, for instance, the manufacturing and services sector, but is nonetheless dependent on tourist attractions (e.g. nature/conservation sites, eco-scenery, culture, heritage), good transport routes, safety, and, in certain cases, high-quality medical services, restaurants, retail outlets and hotels.

The Thabazimbi area is endowed with vast areas of bushveld which is currently used for game farming, hunting and game lodges. A large percentage of these farms attract international visitors who hunt game during the winter months, which are mild and temperate.

The proximity of the Marakele National Park and the Waterberg biosphere to Thabazimbi strengthens the local tourism market. Given the size and number of tourist attractions locally, the tourism sector provides an additional competitive advantage in the local economy.

7.4.2 Description of the current land uses

In the TLM, approximately 40% of the land situated within the municipal area is utilised for game farming (western and eastern part), ± 2% for irrigation, ± 3% for dry-land farming e.g. cotton and sunflower, mining 0.4% and approximately 5% for towns, roads and other infrastructure. The remainder of the area is utilised for extensive cattle farming. The geographical area of the TLM comprises approximately 9 862 km^2.

The areas to the northern, northwest and southeast of Thabazimbi Town are mainly environmentally sensitive areas due to the location of the Waterberg Biosphere, the Nature Reserves and the game farms.

The project falls within the existing surface rights of the TIOM thus the current land uses associated with the project is mining.

7.4.3 Description of specific environmental features and infrastructure on the site

The specific environmental features on site related to land use, flora, fauna, wetlands and surface water have been described in the relevant chapters in Section 7.4.1 of Part A. In addition to the above, the infrastructure on site consists of buildings, infrastructure, roads, mining operations, railways, etc.

7.4.4 Environmental and current land use map

Refer to Figure 31 below for an indication of the current land use and environmental features present

7.5 Impacts and Risks Identified

The risk assessment was compiled utilising Shangoni's methodology applied for the project (refer to Section 7.6 below). Furthermore, risks were drawn from the following specialist reports:

- *Thabazimbi Iron Ore Mine (Pty) Ltd: A Subsidiary of Arcelormittal South Africa Limited – Thabazimbi Iron Ore Mine Desktop Geohydrological Report for A Waste Management Licence Application*, compiled by Shangoni AquiScience and dated April 2020;
- *Riparian Delineation and Water Use Risk Assessment for the Proposed Reworking of a Discard Dump at the Thabazimbi Iron Ore Mine*, dated 2020 and compiled by Wetland Consulting Scientific (Pty) Ltd; and
- *Thabazimbi Iron Ore Mine (Pty) Ltd: Thabazimbi Iron Ore Mine: Conceptual Storm Water Management Plan*, compiled by Shangoni Management Services (Pty) Ltd and dated August 2020.

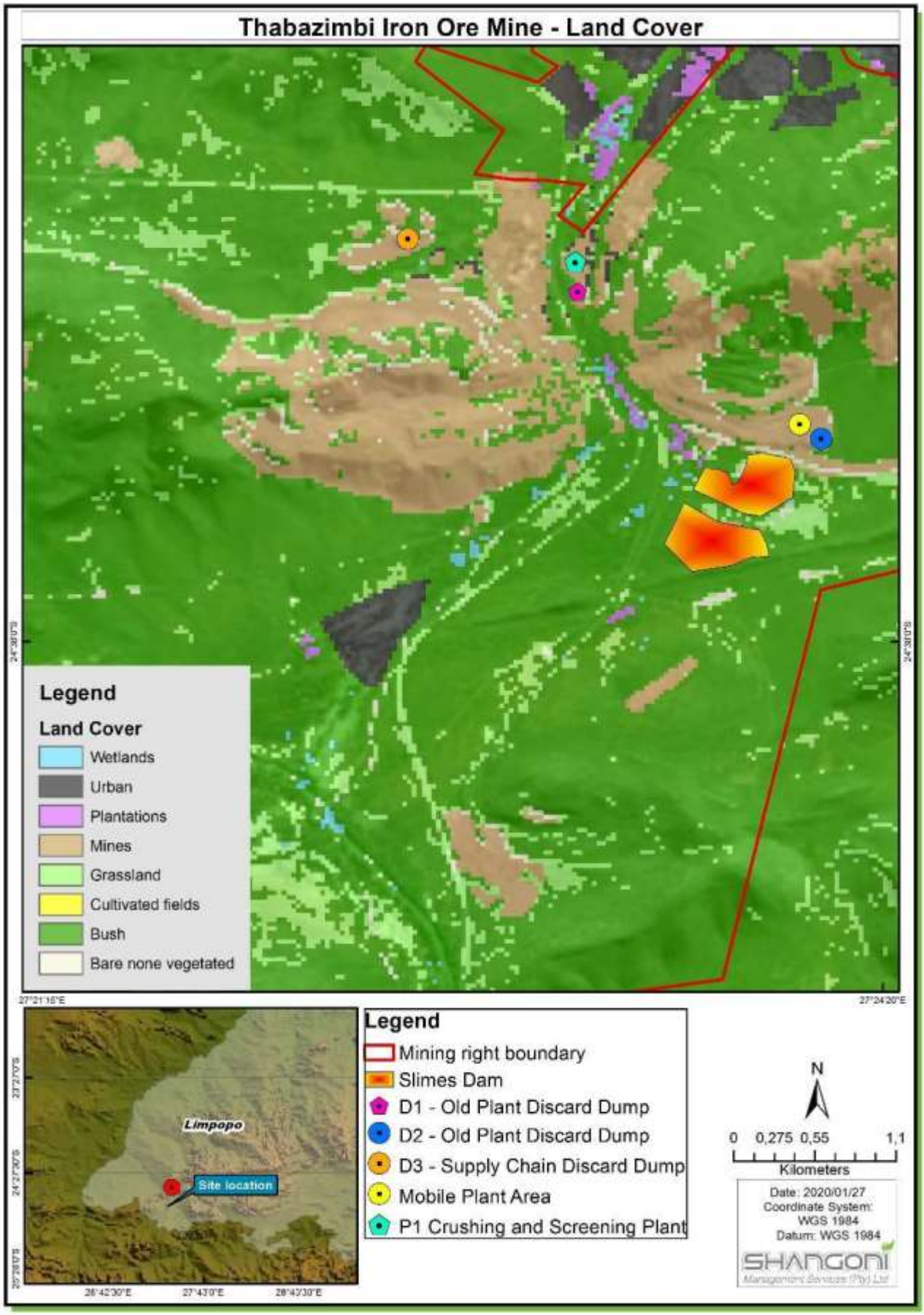


Figure 31: Land Use Map associated with the project at the TIOM

7.5.1 Impacts and risks associated with the project

Table 36: Impacts and Risks identified including mitigation/management measures for the project

No.	Aspect affected	Activity	Potential Impact	Reversibility	Irreplaceable loss	Phase	Size and scale of disturbance	Significance pre-mitigation			Mitigation Type	Significance post- mitigation		
								Probability	Magnitude	Significance		Probability	Magnitude	Significance
1a	Geology	Reclamation of D1 - Old Plant Discard Dump	There are no impacts identified to Geology as a result of the reclamation of the D1 - Old Plant Discard Dump.											
1b	Geology	Reclamation of D2 - Old Plant Discard Dump	There are no impacts identified to Geology as a result of the reclamation of the D2 - Old Plant Discard Dump.											
1c	Geology	Reclamation of D3 - Supply Chain Discard Dump	There are no impacts identified to Geology as a result of the reclamation of the D3 - Supply Chain Discard Dump.											
1d	Geology	Reclamation of Slimes Dams	There are no impacts identified to Geology as a result of the reclamation of the Slimes Dams.											
2a	Topography	Reclamation of D1 - Old Plant Discard Dump	Slight alteration due to removal of dumps, but thereby promoting pre-disturbed topography.	Irreversible	Low Degree	Operational	1.5 ha	3	3	Medium	Control	2	2	Low
2b	Topography	Reclamation of D2 - Old Plant Discard Dump		Irreversible	Low Degree	Operational	11.4 ha	3	3	Medium	Control	2	2	Low

No.	Aspect affected	Activity	Potential Impact	Reversibility	Irreplaceable	Phase	Size and scale of	Significance pre-mitigation			Mitigation Type	Significance post- mitigation		
2c	Topography	Reclamation of D3 - Supply Chain Discard Dump		Irreversible	Low Degree	Operational	2.7 ha	3	3	Medium	Control	2	2	Low
2d	Topography	Reclamation of Slimes Dams		Irreversible	Low Degree	Operational	34.5 ha	3	3	Medium	Control	2	2	Low
3a	Soils, Land Use and Land Capability	Maintenance of vehicles in the pit. Repair front-end loaders	Incorrect disposal of waste that may pollute soil. Spillage of chemicals.	Impact assessed on Page 176 (No. 20) and Page 178 (No.24) in the EMPr titled *Thabazimbi Iron Ore Mine (Pty) Ltd Thabazimbi Mine Environmental Management Programme*, (LP30/5/1/3/2/1(45) And (47) EM).								2	2	Low
3b	Soils, Land Use and Land Capability	Maintenance of conveyors and structure (replacing rollers, maintaining water sprays, crusher.	Incorrect disposal of waste that may pollute soil.	Impact assessed on Page 183. (No. 44) in the EMPr titled *Thabazimbi Iron Ore Mine (Pty) Ltd Thabazimbi Mine Environmental Management Programme*, (LP30/5/1/3/2/1(45) And (47) EM).								2	2	Low
3c	Soils, Land Use and Land Capability	Ineffective management of Discard Dumps	Erosion	Impact assessed on Page 231. (No. 266) in the EMPr titled *Thabazimbi Iron Ore Mine (Pty) Ltd Thabazimbi Mine Environmental Management Programme*, (LP30/5/1/3/2/1(45) And (47) EM).								2	2	Low
3d	Soils, Land Use and Land Capability	Replacing pipes as part of slimes dam operations	Disposal of hazardous waste	Impact assessed on Page 362. (No. 380) in the EMPr titled *Thabazimbi Iron Ore Mine (Pty) Ltd Thabazimbi Mine Environmental Management Programme*, (LP30/5/1/3/2/1(45) And (47) EM).								2	2	Low

No.	Aspect affected	Activity	Potential Impact	Reversibility	Irreplaceable	Phase	Size and scale of	Significance pre-mitigation			Mitigation Type	Significance post- mitigation		
3e	Soils, Land Use and Land Capability	Pipe maintenance, including: Repair, lengthening and shortening, replacing & removing old pipes and installation of new pipes	Erosion brought about by maintenance on pipelines.	Impact assessed on Page 266. (No. 393) in the EMPr titled *Thabazimbi Iron Ore Mine (Pty) Ltd Thabazimbi Mine Environmental Management Programme*, (LP30/5/1/3/2/1(45) And (47) EM).				3		1				Medium
4a	Biodiversity	Reclamation of D1 - Old Plant Discard Dump	Spread of alien invasive plant species. Dust generated from activities may also negatively affect flora species.	Reversible	Low Degree	Operational	1.5 ha	3	3	Medium	Control	2	2	Low
4b	Biodiversity	Reclamation of D2 - Old Plant Discard Dump		Reversible	Low Degree	Operational	11.4 ha	3	3	Medium	Control	2	2	Low
4c	Biodiversity	Reclamation of D3 - Supply Chain Discard Dump		Reversible	Low Degree	Operational	2.7 ha	3	3	Medium	Control	2	2	Low
4d	Biodiversity	Reclamation of Slimes Dams		Reversible	Low Degree	Operational	34.5 ha	3	3	Medium	Control	2	2	Low
4e	Biodiversity	Reclamation of D1 - Old Plant Discard Dump	Hauling activities could result in road mortalities since many animals, especially nocturnal animals, that attempt to cross the road are at risk to	Reversible	Low Degree	Operational	1.5 ha	3	3	Medium	Control	2	2	Low

No.	Aspect affected	Activity	Potential Impact	Reversibility	Irreplaceable	Phase	Size and scale of	Significance pre-mitigation			Mitigation Type	Significance post- mitigation		
4f	Biodiversity	Reclamation of D2 - Old Plant Discard Dump	collide with oncoming haul traffic.	Reversible	Low Degree	Operational	11.4 ha	3	3	Medium	Control	2	2	Low
4g	Biodiversity	Reclamation of D3 - Supply Chain Discard Dump		Reversible	Low Degree	Operational	2.7 ha	3	3	Medium	Control	2	2	Low
4h	Biodiversity	Reclamation of Slimes Dams		Reversible	Low Degree	Operational	34.5 ha	3	3	Medium	Control	2	2	Low
5a	Surface Water	Reworking of D1-Old Plant Discard Dump	Surface water quality: The reworking of the dump will allow for the liberation and increased mobilisation of sediment. This will result in a physical deterioration of the quality of the surface water runoff to the Rooikuilspruit.	Reversible	Low Degree	Operational	1.5 ha	5	3	High	Control	2	1	Low
5b	Surface Water	Reworking of D2-Old Plant Discard Dump	Surface water quality: The reworking of the dump will allow for the liberation and increased mobilisation of sediment. This will result in a physical deterioration of the quality of the surface water runoff to the environment.	Reversible	Low Degree	Operational	11.4 ha	3	3	Medium	Control	2	1	Low

No.	Aspect affected	Activity	Potential Impact	Reversibility	Irreplaceable	Phase	Size and scale of disturbance	Significance pre-mitigation			Mitigation Type	Significance post- mitigation		
5c	Surface Water	Reworking of D3-Supply Chain Discard Dump	Surface water quality: The reworking of the dump will allow for the liberation and increased mobilisation of sediment. This will result in a physical deterioration of the quality of the surface water runoff to the current clean water management system of TIOM.	Reversible	Low Degree	Operational	2.7 ha	3	3	Medium	Control	2	1	Low
5d	Surface Water	Reworking of the slimes dams	Surface water quality: The reworking of the slimes dams will allow for the liberation and increased mobilisation of sediment. This will result in a physical deterioration of the quality of the surface water runoff to the Rooikuilspruit.	Reversible	Low Degree	Operational	34.5 ha	5	3	High	Control	2	2	Low
5e	Surface Water	Use of vehicles for the reworking activities	Surface water quality: Hydrocarbon (diesel, petrol, oils and greases) leaks and spillages from the mining vehicles and equipment may occur during the reworking activities. Should any surface water runoff come into contact with the hydrocarbons, such will result in the chemical deterioration of the quality of the surface water runoff.	Reversible	Low Degree	Operational	50.1 ha	3	2	Medium	Control	2	1	Low
5f	Surface Water	Cleaning of vehicles	Contamination of surface water resources.	Impact assessed on Page 195. (No. 81) in the EMPr titled *Thabazimbi Iron Ore Mine (Pty) Ltd Thabazimbi Mine Environmental Management Programme*, (LP30/5/1/3/2/1(45) And (47) EM).								3	2	Medium
5g	Surface Water	Maintaining portable toilets	Disposal of hazardous waste	Impact assessed on Page 233. (No. 237) in the EMPr titled *Thabazimbi Iron Ore Mine (Pty) Ltd Thabazimbi Mine Environmental Management Programme*, (LP30/5/1/3/2/1(45) And (47) EM).								2	2	Low

No.	Aspect affected	Activity	Potential Impact	Reversibility	Irreplaceable	Phase	Size and scale of	Significance pre-mitigation	Mitigation Type	Significance post- mitigation		
5h	Surface Water	Slimes dam operations	Disposal of hazardous waste. Emergency during breaking of dam wall resulting in spillage of slimes will be treated as an emergency situation.	Impact assessed on Page 263. (No. 381) in the EMPr titled *Thabazimbi Iron Ore Mine (Pty) Ltd Thabazimbi Mine Environmental Management Programme*, (LP30/5/1/3/2/1(45) And (47) EM).						3	2	Medium
5i	Surface Water	Pipe maintenance, including: Repair, lengthening and shortening, replacing & removing old pipes and installation of new pipes	Spillage of other material e.g. slimes that could be contained in the pipe that is being repaired, lengthened, shortened, replaced.	Impact assessed on Page 266. (No. 394) in the EMPr titled *Thabazimbi Iron Ore Mine (Pty) Ltd Thabazimbi Mine Environmental Management Programme, (LP30/5/1/3/2/1(45) And (47) EM).*						2	2	Low
5j	Surface Water	Contaminated water generated when pipes burst or pipes blocked and could be released into the environment depending where the incident occur.	Opening of slimes (tailings) pipes	Impact assessed on Page 274. (No. 430) in the EMPr titled *Thabazimbi Iron Ore Mine (Pty) Ltd Thabazimbi Mine Environmental Management Programme, (LP30/5/1/3/2/1(45) And (47) EM).*						3	2	Medium
5k	Surface Water	Storm water management - general	Ineffective storm water management	Impact assessed on Page 282. (No. 472) in the EMPr titled *Thabazimbi Iron Ore Mine (Pty) Ltd Thabazimbi Mine Environmental Management Programme, (LP30/5/1/3/2/1(45) And (47) EM).*						3	2	Medium

No.	Aspect affected	Activity	Potential Impact	Reversibility	Irreplaceable	Phase	Size and scale of disturbance	Significance pre-mitigation			Mitigation Type	Significance post- mitigation		
6a	Ground Water Quantity	Reclamation of D1 - Old Plant Discard Dump	Increased recharge with localised mounding of Ground Water table	Reversible	Low Degree	Operational	1.5 ha	2	1	Low	Control	2	1	Low
6b	Ground Water Quantity	Reclamation of D2 - Old Plant Discard Dump		Reversible	Low Degree	Operational	11.4 ha	2	1	Low	Control	2	1	Low
6c	Ground Water Quantity	Reclamation of D3 - Supply Chain Discard Dump		Reversible	Low Degree	Operational	2.7 ha	2	1	Low	Control	2	1	Low
6d	Ground Water Quantity	Reclamation of Slimes Dams		Reversible	Low Degree	Operational	34.5 ha	2	1	Low	Control	2	1	Low
6e	Ground Water Quality	Reclamation of D1 - Old Plant Discard Dump	Contaminants of concern identified during the geochemical and geohydrological assessment include As, Mn, F, N (as NO_3 and NH_4), Na and Cl. However, status quo groundwater conditions at TIOM indicate relatively unimpacted water quality. The seepage quality from the facilities is likely to be circum-neutral to alkaline	Reversible	Low Degree	Operational	1.5 ha	3	3	Medium	Control	2	1	Low
6f	Ground Water Quality	Reclamation of D2 - Old Plant Discard Dump		Reversible	Low Degree	Operational	11.4 ha	3	3	Medium	Control	2	1	Low

No.	Aspect affected	Activity	Potential Impact	Reversibility	Irreplaceable	Phase	Size and scale of	Significance pre-mitigation			Mitigation Type	Significance post- mitigation		
6g	Ground Water Quality	Reclamation of D3 - Supply Chain Discard Dump	as no potential for acid formation.	Reversible	Low Degree	Operational	2.7 ha	3	3	Medium	Control	2	1	Low
6h	Ground Water Quality	Reclamation of Slimes Dams		Reversible	Low Degree	Operational	34.5 ha	3	3	Medium	Control	2	1	Low
6i	Ground Water Quantity	Reclamation of D1 - Old Plant Discard Dump	Current groundwater mounding will decline. Complete removal of the tailings and rehabilitation of the footprint will result in a seepage flux comparable with background groundwater recharge rates. Any residual groundwater mounding, if any, is likely to be limited to the footprints. Provided all material is removed, the significance of impacts on groundwater quantity is low to insignificant.	Reversible	Low Degree	Closure	1.5 ha	2	2	Low	Control	2	2	Low
6j	Ground Water Quantity	Reclamation of D2 - Old Plant Discard Dump		Reversible	Low Degree	Closure	11.4 ha	2	2	Low	Control	2	2	Low
6k	Ground Water Quantity	Reclamation of D3 - Supply Chain Discard Dump		Reversible	Low Degree	Closure	2.7 ha	2	2	Low	Control	2	2	Low
6l	Ground Water Quantity	Reclamation of Slimes Dams		Reversible	Low Degree	Closure	34.5 ha	2	2	Low	Control	2	2	Low

No.	Aspect affected	Activity	Potential Impact	Reversibility	Irreplaceable	Phase	Size and scale of	Significance pre-mitigation			Mitigation Type	Significance post- mitigation		
6m	Ground Water Quality	Reclamation of D1 - Old Plant Discard Dump	The reclamation footprints will be rehabilitated to a land-use similar to that prevalent in the study area. Partial reclamation of the facilities will obviously result in long term reduction of the pollution source strengths as potentially pollution material is removed. Some residual soil contamination may remain within the footprints but if this is rehabilitated to acceptable and National standards, no significant leaching of contaminants is expected during the post-closure phase and a net positive impact of the total removal of the pollution source is recognised. Groundwater quality beneath the reclaimed footprints is expected to return to a quality similar to the background quality resulting in a low/insignificant impact.	Reversible	Low Degree	Closure	1.5 ha	2	2	Low	Control	2	2	Low
6n	Ground Water Quality	Reclamation of D2 - Old Plant Discard Dump		Reversible	Low Degree	Closure	11.4 ha	2	2	Low	Control	2	2	Low
6n	Ground Water Quality	Reclamation of D3 - Supply Chain Discard Dump		Reversible	Low Degree	Closure	2.7 ha	2	2	Low	Control	2	2	Low
6o	Ground Water Quality	Reclamation of Slimes Dams		Reversible	Low Degree	Closure	34.5 ha	2	2	Low	Control	2	2	Low
7a	Air Quality	Reclamation of D1 - Old Plant Discard Dump	Dust as generated from the various activities may arise from activities associated with excavation/reclamation, crushing, storage and haulage. Dust impacts may be both of nuisance (fallout) as well as respiratory (PM) to humans as well as to vegetation (fall out dust), also with limited impact on the surrounding surface water.	Reversible	Low Degree	Operational	1.5 ha	3	3	Medium	Control	2	2	Low
7b	Air Quality	Reclamation of D2 - Old Plant Discard Dump		Reversible	Low Degree	Operational	11.4 ha	3	3	Medium	Control	2	2	Low

No.	Aspect affected	Activity	Potential Impact	Reversibility	Irreplaceable	Phase	Size and scale of disturbance	Significance pre-mitigation			Mitigation Type	Significance post- mitigation		
7c	Air Quality	Reclamation of D3 - Supply Chain Discard Dump		Reversible	Low Degree	Operational	2.7 ha	3	3	Medium	Control	2	2	Low
7d	Air Quality	Reclamation of Slimes Dams		Reversible	Low Degree	Operational	34.5 ha	3	3	Medium	Control	2	2	Low
7e	Air Quality	Use of vehicles, and other mobile equipment for operational activities	Vehicles will generate emissions to the atmosphere during general operations. The emissions are limited due to regular maintenance on vehicles.	Impact assessed on Page 172 (No. 6) in the EMPr titled *Thabazimbi Iron Ore Mine (Pty) Ltd Thabazimbi Mine Environmental Management Programme*, (LP30/5/1/3/2/1(45) And (47) EM).								3	2	Medium
7f	Air Quality	Stockpiling ore next to national road	Generation of emissions to atmosphere	Impact assessed on Page 242 (No. 283) in the EMPr titled *Thabazimbi Iron Ore Mine (Pty) Ltd Thabazimbi Mine Environmental Management Programme*, (LP30/5/1/3/2/1(45) And (47) EM).								2	2	Low
8a	Noise and Vibration	Reclamation of D1 - Old Plant Discard Dump	Noise generated from various activities that include heavy vehicles (excavation and haulage) and plant equipment (e.g. crushing and screening operations). Noise impacts may be primarily a nuisance but is considered low due to the proximity to neighbouring receptors.	Reversible	Low Degree	Operational	1.5 ha	4	2	Medium	Control	3	2	Medium
8b	Noise and Vibration	Reclamation of D2 - Old Plant Discard Dump		Reversible	Low Degree	Operational	11.4 ha	3	2	Medium	Control	2	2	Low
8c	Noise and Vibration	Reclamation of D3 - Supply Chain Discard Dump		Reversible	Low Degree	Operational	2.7 ha	3	2	Medium	Control	2	2	Low

No.	Aspect affected	Activity	Potential Impact	Reversibility	Irreplaceable	Phase	Size and scale of disturbance	Significance pre-mitigation			Mitigation Type	Significance post- mitigation		
8d	Noise and Vibration	Reclamation of Slimes Dams		Reversible	Low Degree	Operational	34.5 ha	3	2	Medium	Control	2	2	Low
8e	Noise and Vibration	Management of plant beneficiation equipment	The plant beneficiation equipment generates noise but this is limited to the plant area and does not cause an impact on this surrounding area.	Impact assessed on Page 273 (No. 425) in the EMPr titled *Thabazimbi Iron Ore Mine (Pty) Ltd Thabazimbi Mine Environmental Management Programme, (LP30/5/1/3/2/1(45) And (47) EM).*								2	1	Low
9a	Archaeology and cultural history	Reclamation of D1 - Old Plant Discard Dump	There are no impacts identified on sites of archaeological and cultural importance as a result of the proposed reclamation of D1 - Old Plant Discard Dump.											
9b	Archaeology and cultural history	Reclamation of D2 - Old Plant Discard Dump	There are no impacts identified on sites of archaeological and cultural importance as a result of the proposed reclamation of D2 - Old Plant Discard Dump.											
9c	Archaeology and cultural history	Reclamation of D3 - Supply Chain Discard Dump	There are no impacts identified on sites of archaeological and cultural importance as a result of the proposed reclamation of D3 - Supply Chain Discard Dump.											
9d	Archaeology and cultural history	Reclamation of Slimes Dams	There are no impacts identified on sites of archaeological and cultural importance as a result of the proposed reclamation of the Slimes Dams.											
10	Sensitive landscapes	Re-working of discard material using front-end loader. Onsite crushing and screening of discard material.	• Disturbance of adjacent riparian vegetation; • Increased sediment movement into Rooikuilspruit and riparian habitat; • Spillage of contaminants leading to water quality impacts;	Reversible	Low Degree	Operational	1.5 ha	2	2	Low	Control	1	2	Low

No.	Aspect affected	Activity	Potential Impact	Reversibility	Irreplaceable	Phase	Size and scale of	Significance pre-mitigation			Mitigation Type	Significance post- mitigation		
		Noise pollution, light pollution.	• Increase in alien vegetation; • Changes in floodlines; and • Rehabilitation of cleared D1 - Old Plant Discard Dump footprint.											
		Re-shaping of remaining discard material and rehabilitation of cleared footprint												
11a	Visual	Reclamation of D1 - Old Plant Discard Dump	The reclamation of the D1 - Old Plant Discard dump may result in topography changes (noted that such is previously mine associated structure). Dust may also contribute to the visual aspect during the reclamation activities.	Reversible	Low Degree	Operational	1.5 ha	2	2	Low	Control	2	2	Low
11b	Visual	Reclamation of D2 - Old Plant Discard Dump		Reversible	Low Degree	Operational	11.4 ha	2	2	Low	Control	2	1	Low
11c	Visual	Reclamation of D3 - Supply Chain Discard Dump		Reversible	Low Degree	Operational	2.7 ha	2	2	Low	Control	2	1	Low
11d	Visual	Reclamation of Slimes Dams		Reversible	Low Degree	Operational	34.5 ha	2	2	Low	Control	2	1	Low
12a	Socio-Economic	Reclamation of D1 - Old Plant Discard Dump	Jobs will be retained, providing income, therefore, having a further impact on the regional socio-economy	Reversible	Low Degree	Operational	1.5 ha	Positive			Control	Positive		

No.	Aspect affected	Activity	Potential Impact	Reversibility	Irreplaceable	Phase	Size and scale of	Significance pre-mitigation	Mitigation Type	Significance post- mitigation
12b	Socio-Economic	Reclamation of D2 - Old Plant Discard Dump	aspects of the area, along with other benefits arising from the Social and Labour Plan.	Reversible	Low Degree	Operational	11.4 ha	Positive	Control	Positive
12c	Socio-Economic	Reclamation of D3 - Supply Chain Discard Dump		Reversible	Low Degree	Operational	2.7 ha	Positive	Control	Positive
12d	Socio-Economic	Reclamation of Slimes Dams		Reversible	Low Degree	Operational	34.5 ha	Positive	Control	Positive

7.6 Methodology used in determining and ranking potential environmental impacts and risks

7.6.1 Shangoni's methodology applied for the project

The environmental risk of any aspect is determined by a combination of parameters associated with the impact. Each parameter connects the physical characteristics of an impact to a quantifiable value to rate the environmental risk. Impact assessments should be conducted based on a methodology that includes the following:

- Clear processes for impact identification, predication and evaluation;
- Specification of the impact identification techniques;
- Criteria to evaluate the significance of impacts;
- Design of mitigation measures to lessen impacts;
- Definition of the different types of impacts (indirect, direct or cumulative); and
- Specification of uncertainties.

After all impacts have been identified, the nature and scale of each impact can be predicted. The impact prediction will take into account physical, biological, socio-economic and cultural information and will then estimate the likely parameters and characteristics of the impacts. The impact prediction will aim to provide a basis where the significance of each impact can be determined and appropriate mitigation measures can be developed.

The risk assessment methodology is based on defining and understanding the three basic components of the risk, i.e. the source of the risk, the pathway and the target that experiences the risk (receptor). Refer to Figure 32 below for a model representing the above principle (as contained in the DWA's Best Practice Guideline: G4 – Impact Prediction).

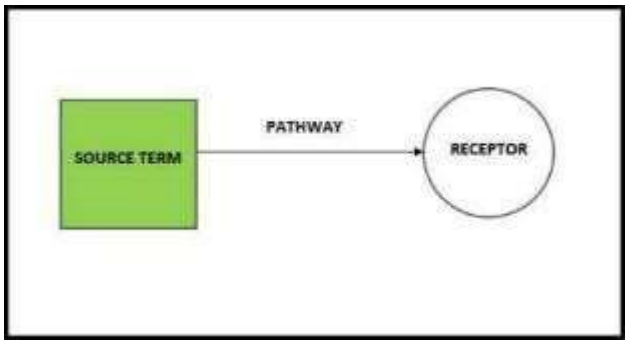


Figure 32: Impact prediction model

Table 37 and Table 38 below indicate the methodology to be used in order to assess the Probability and Magnitude of the impact, respectively, and Table 39 provides the Risk Matrix that will be used to plot the Probability against the Magnitude in order to determine the Severity of the impact.

Table 37: Determination of Probability of impact

Score	Frequency of aspect / unwanted event	Availability of pathway from the source to the receptor	Availability of receptor
1	Never known to have happened, but may happen	A pathway to allow for the impact to occur is never available	The receptor is never available
2	Known to happen in industry	A pathway to allow for the impact to occur is almost never available	The receptor is almost never available
3	< once a year	A pathway to allow for the impact to occur is sometimes available	The receptor is sometimes available
4	Once per year to up to once per month	A pathway to allow for the impact to occur is almost always available	The receptor is almost always available
5	Once a month - Continuous	A pathway to allow for the impact to occur is always available	The receptor is always available

Step 1: *Determine the* ***PROBABILITY*** *of the impact by calculating the average between the Frequency of the Aspect, the Availability of a pathway to the receptor and the availability of the receptor.*

Table 38: Determination of Magnitude of impact

Score	Source			Receptor		
	Duration of impact	Extent	Volume / Quantity / Intensity	Toxicity / Destruction Effect	Reversibility	Sensitivity of environmental component
1	Lasting days to a month	Effect limited to the site. (metres);	Very small quantities / volumes / intensity (e.g. < 50 ℓ or < 1 ha)	Non-toxic (e.g. water) / Very low potential to create damage or destruction to the environment	Bio-physical and/or social functions and/or processes will remain unaltered.	Current environmental component(s) are largely disturbed from the natural state.
2	Lasting 1 month to 1 year	Effect limited to the activity and its immediate surroundings. (tens of metres)	Small quantities / volumes / intensity (e.g. 50 ℓ to 210 ℓ or 1 ha to 5 ha)	Slightly toxic / Harmful (e.g. diluted brine) / Low potential to create damage or destruction to the environment	Bio-physical and/or social functions and/or processes might be negligibly altered or enhanced / Still reversible	Receptor of low significance / sensitivity
3	Lasting 1 – 5 years	Impacts on extended area beyond site boundary (hundreds of metres)	Moderate quantities / volumes / intensity (e.g. > 210 ℓ < 5000 ℓ or 5 – 8 ha)	Moderately toxic (e.g. slimes) Potential to create damage or destruction to the environment	Bio-physical and/or social functions and/or processes might be notably altered or enhanced / Partially reversible	Current environmental component(s) are moderately disturbed from the natural state.
4	Lasting 5 years to Life of Organisation	Impact on local scale / adjacent sites (km)	Very large quantities / volumes / intensity (e.g. 5000 ℓ – 10 000 ℓ or 8 ha– 12 ha)	Toxic (e.g. diesel & Sodium Hydroxide)	Bio-physical and/or social functions and/or processes might be considerably altered or enhanced / potentially irreversible	No environmentally sensitive components.
5	Beyond life of Organisation / Permanent impacts	Extends widely (nationally or globally)	Very large quantities / volumes / intensity (e.g. > 10 000 ℓ or > 12 ha)	Highly toxic (e.g. arsenic or TCE)	Bio-physical and/or social functions and/or processes might be severely/substantially altered or enhanced / Irreversible	Current environmental component(s) are a mix of disturbed and undisturbed areas.

Step 2: *Determine the* ***MAGNITUDE*** *of the impact by calculating the average of the factors above*

Table 39: Determination of Severity of impact

Environmental Impact Rating / Priority					
Probability	**Magnitude**				
	1 Minor	2 Low	3 Medium	4 High	5 Major
5 Almost Certain	Low	Medium	High	High	High
4 Likely	Low	Medium	High	High	High
3 Possible	Low	Medium	Medium	High	High
2 Unlikely	Low	Low	Medium	Medium	High
1 Rare	Low	Low	Low	Medium	Medium

Step 3: *Determine the* ***SEVERITY*** *of the impact by plotting the averages that were obtained above for Probability and Magnitude.*

7.7 Positive and negatives that the proposed activity (in terms of the initial site layout) and alternatives will have on the environment and community affected

The positive and negative implication of the project and the alternatives identified have been provided below and assessed in terms of the following four categories:

- Environmental.
- Technical/Engineering.
- Economical.
- Social.

Table 40: Advantage and disadvantages of the proposed activities and identified alternatives

Alternative		Advantages	Disadvantages
Reclamation of the discard dump and Slimes Dams			
Activity Alternative			
Activity Reclamation alternative (preferred)	**Reclamation alternative:** Reclamation of existing D1 - Old Plant Discard Dump, D2 - Old Plant Discard Dump, D3 – Supply Chain Discard Dump and Slimes Dams.	**Environmental:** The proposed reclamation activities are part of the greater closure objectives of the mine, thus, will result in the closure objectives being implemented. **Technical/Engineer:** No new engineering or technical designs are required. **Economical:** It is cost effective to reclaim the existing dumps instead of recommencing mining. **Social:** The plant is located far from any sensitive receptors, thus being less of a nuisance. Creation of additional employment opportunities during the operational phases of the project as preference will be given to a contractor from the local community. Job opportunities will be retained. Benefits arising from the SLP such as LED projects, learnerships etc. will continue.	**Environmental:** Impacts may arise, e.g. dust arising from excavation, hauling of material, crushing and screening processes. **Technical/Engineer:** None identified. **Economical:** As the technology has not been obtained for the reworking of the Slimes Dams, it will require greater financial input. **Social:** None
Activity Mining alternative (alternative)	**Mining alternative:** Recommence with mining of Ore from Pits	**Environmental:** None identified. **Technical/Engineer:** Continuation of existing engineering practices. **Economical:** None. **Social:** Creation of additional employment opportunities.	**Environmental:** Previous environmental impacts associated with the mining of the pits will recommence and continue. **Technical/Engineer:** New machinery and technology will need to be purchased to ensure that geology is stable. Additional studies and new designs will be required to proof economic viability. **Economical:** Project can only be executed in approximately 8 years.. **Social:** None.
No-go alternative	No go option	**Environmental:** Status quo of the site will remain as is (no additional environmental impacts will occur as a result of the	**Environmental:** Residue facilities will continue to contribute to impacting on the environment, also with more intensive

Alternative		Advantages	Disadvantages
		mining and related activities). **Technical/Engineer:** No additional machinery and resources required. **Economical:** No additional materials required to be purchased. **Social:** None identified	rehabilitation requirements. **Technical/Engineer:** None identified **Economical:** This will affect the productivity of the mine and will have cumulative impacts on the local, provincial and national economy. **Social:** No additional job opportunities will arise. The LOM will also reduce.

7.8 Possible mitigation measures that could be applied and the level of risk

The impact management measures and level of risk have been included under Section 7.5 of Part A.

7.9 Motivation where no alternative sites were considered

No site alternatives were considered as the project is specifically aimed at the reclamation of existing Discard Dumps (D1 - Old Plant Discard Dump, D2 - Old Plant Discard Dump and D3 – Supply Chain Discard Dump) and Slimes Dams.

7.10 Final site layout plan

Refer to Figure 33 below for the final site layout map.

8 Full description of the process undertaken to identify, assess and rank the impacts and risks

All impacts and risks as identified are contained within Part A Section 7.5 Impacts and risks identified. As further provided is an assessment of the significance of each issue and risk and an indication of the extent to which the issue and risk could be avoided or addressed by the adoption of mitigation measures. The methodology applied in assessing and ranking the impacts and risks on the preferred site is described in Section 7.6 of Part A.

9 Assessment of each identified potentially significant impact and risk

Refer to the full risk assessment and mitigation measures table provided in Section 7.5 of Part A above.

10 Summary of specialist reports

Specialist study	Recommendations of specialists	Reference to applicable section in report where specialist recommendation is included
Desktop Geohydrological Report	A Water Management Plan is required to ensure that the infrastructure do not impact negatively on water quality to unacceptable levels. It will also serve as early warning systems to implement mitigation measures at early stages to reduce cumulative impacts. To ensure that the natural receiving environment is protected, monitoring is required on an on-going basis even during the closure phases. Status quo monitoring is recommended to continue. The status quo monitoring, as per the *Annual Water*	Section 1.4 of Part B

Specialist study	Recommendations of specialists	Reference to applicable section in report where specialist recommendation is included
	Monitoring Report (GCS, 2018), should continue at TIOM. No new monitoring boreholes are recommended at this stage.	
Wetland Assessment	It is critical that no direct disturbance of the Rooikuilspruit is allowed and all care should be taken to prevent any further increase of the D1 – Old Plant Dump disturbance footprint towards the Rooikuilspruit. Modelling of floodlines pre- and post-removal should also be undertaken to ensure changes in floodlines that may occur pose no risk to infrastructure or people. Water quality impacts associated with the re-working of the D1 – Old Plant Discard Dump are likely to be dominated by mobilisation of sediments transported into the Rooikuilspruit by surface runoff from the site. The need for sediment control measures around the D1 – Old Plant Discard Dump is, therefore, highlighted. Furthermore, the cleared footprint of the D1 – Old Plant Discard Dump following re-working should be analysed to ensure no potential contaminants occur within the soil profile that could leach into the Rooikuilspruit over time. Should potentially harmful contaminants in the soil be found, then *in situ* remediation of the soil should be undertaken (informed by specialist inputs) or, where this is not possible, removal of the contaminated material should be undertaken. Re-working of the D1 – Old Plant Discard Dump also provides an opportunity of clearing land currently covered by discard and rehabilitating such land through the planting of trees and indigenous vegetation. It is recommended that such rehabilitation be focussed on the area immediately adjacent to the Rooikuilspruit and that typical riparian tree species of the area be re-established on site.	Section 1.4 of Part B
Conceptual Storm Water Management Plan	The capacity of all storm water conveyance and containment structures should accommodate at least a 1:50 year flood event. All storm water management infrastructure should be inspected and serviced regularly to ensure design capacity and integrity are maintained. Storm water control measures should be kept clear of obstructions by objects as well as siltation, especially where the velocity of the runoff is induced. All surfaces where possible storm water pollution might occur should be kept as small as possible. Dirty areas should be isolated as discussed within	Section 1.4 of Part B

Specialist study	Recommendations of specialists	Reference to applicable section in report where specialist recommendation is included
	the report and pollution prevention principles should be applied throughout the surface responsibility area of TIOM to limit the impact on surface water runoff. Affected runoff water should be controlled and management measures should be considered and implemented as proposed in this report. No affected water from TIOM is allowed to spill into the clean water environment. This should be ensured through operational control measures. Siltation of storm water containment and conveyance infrastructure is a continual challenge. It is important to design these structures for easy maintenance and servicing. Silt build-up within conveyance and containment facilities, should be monitored and regularly removed to ensure sufficient storage capacity in case of a 1:50 year flood event. Erosion prevention measures (e.g. grass, cement or rock) should be in place at all water flow concentration points. These areas include roads, channels, channel outlets and other infrastructure that may increase surface runoff. Rehabilitation of the reworked areas should be planned to promote free drainage and to minimise or eliminate ponding of storm water.	

11 Environmental impact statement

11.1 Summary of the key findings of the environmental impact assessment

This EIAR / EMPr has served to identify the potential impacts associated with the activities of the associated project. In accordance with the relevant environmental legislation, reasonable measures to mitigate the potential impacts arising from the proposed activities have been assessed and the significance of each of these impacts under both the pre- and post-mitigation scenarios identified and detailed. The methodology utilised to undertake the impact assessment has incorporated, amongst other skills, professional experience, relevant literature and local knowledge of the site and surrounding area.

No fatal flaws were identified with the project. Storm water management measures will be implemented to reduce the impact on the Rooikuilspruit. Furthermore, the extent of impact will be limited as the project is taking place on already disturbed areas. It is the EAP's opinion that based on the process that has been followed and the findings of the impact assessment, in conjunction with the

proposed mitigation measures, that no unmanageable adverse impacts are expected to occur, and some positive impacts are expected.

11.2 Final site map

Refer to Figure 33 below for the final site layout map.

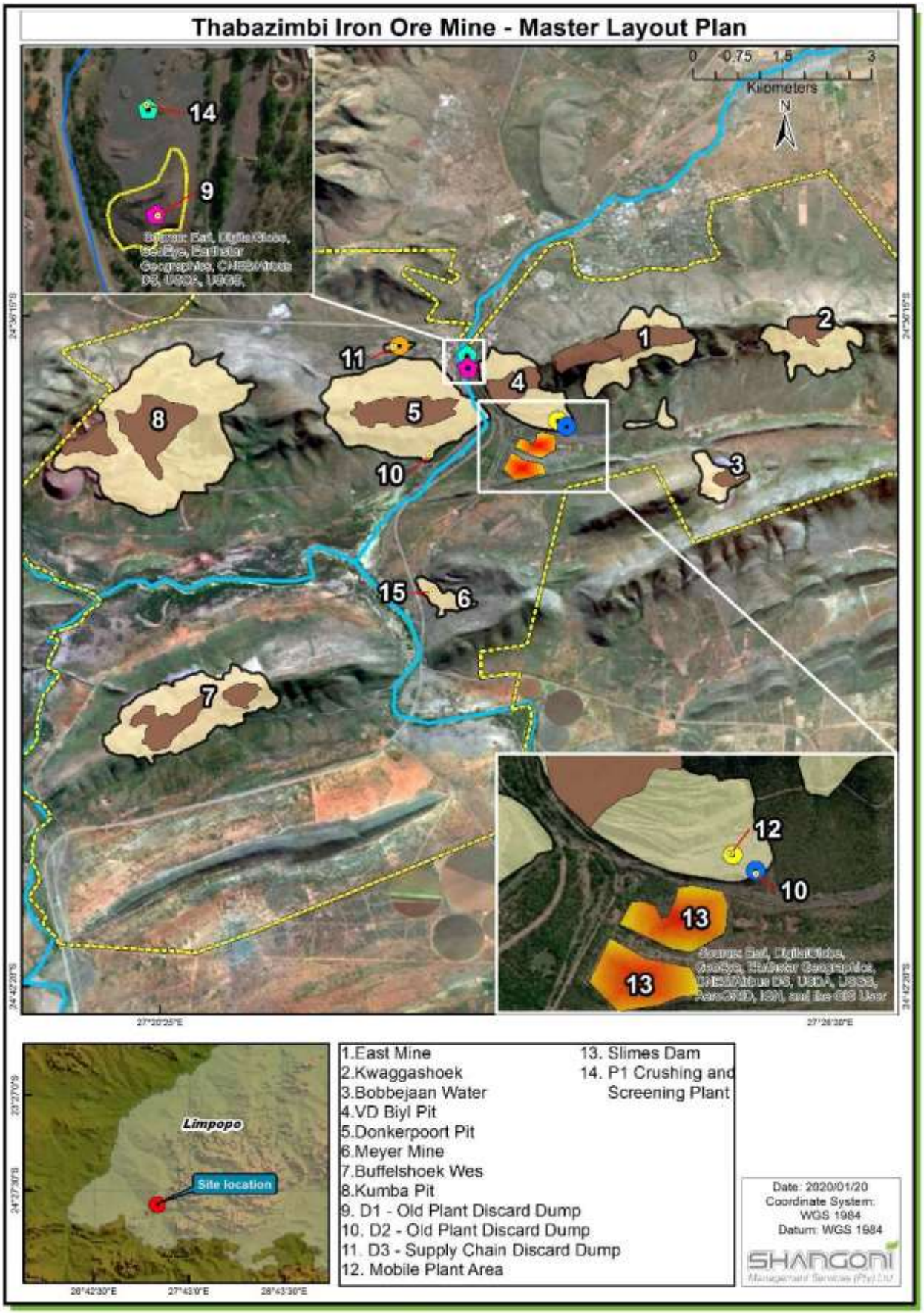


Figure 33: Final site map

11.3 Summary of the positive and negative implications and risks of the proposed activity

11.3.1 Summary of the negative implications and risks associated with the project

Table 41: Summary of the negative environmental impacts, after mitigation

NO	ASPECTS AFFECTED	ACTIVITY	POTENTIAL IMPACT	PHASE in which impact is anticipated	SIGNIFICANCE IF MITIGATED
2a	Topography	Reclamation of D1 - Old Plant Discard Dump	Slight alteration due to removal of dumps, but thereby promoting pre-disturbed topography.	Operational	Low
2b	Topography	Reclamation of D2 - Old Plant Discard Dump		Operational	Low
2c	Topography	Reclamation of D3 - Supply Chain Discard Dump		Operational	Low
2d	Topography	Reclamation of Slimes Dams		Operational	Low
3a	Soils, Land Use and Land Capability	Maintenance of vehicles in the pit. Repair front-end loaders	Incorrect disposal of waste that may pollute soil. Spillage of chemicals.	Operational	Low
3b	Soils, Land Use and Land Capability	Maintenance of conveyors and structure (replacing rollers, maintaining water sprays, crusher.	Incorrect disposal of waste that may pollute soil.	Operational	Low
3c	Soils, Land Use and Land Capability	Ineffective management of Discard Dumps	Erosion	Operational	Low
3d	Soils, Land Use and Land Capability	Replacing pipes as part of slimes dam operations	Disposal of hazardous waste	Operational	Low
3e	Soils, Land Use and Land Capability	Pipe maintenance, including: Repair, lengthening and shortening, replacing & removing old pipes and installation of new pipes	Erosion brought about by maintenance on pipelines.	Operational	Medium
4a	Biodiversity	Reclamation of D1 - Old Plant Discard Dump	Spread of alien invasive plant species. Dust generated from activities may also negatively affect flora species.	Operational	Low
4b	Biodiversity	Reclamation of D2 - Old Plant Discard Dump		Operational	Low

NO	ASPECTS AFFECTED	ACTIVITY	POTENTIAL IMPACT	PHASE in which impact is anticipated	SIGNIFICANCE IF MITIGATED
4c	Biodiversity	Reclamation of D3 - Supply Chain Discard Dump		Operational	Low
4d	Biodiversity	Reclamation of Slimes Dams		Operational	Low
4e	Biodiversity	Reclamation of D1 - Old Plant Discard Dump	Hauling activities could result in road mortalities since many animals, especially nocturnal animals, that attempt to cross the road are at risk to collide with oncoming haul traffic.	Operational	Low
4f	Biodiversity	Reclamation of D2 - Old Plant Discard Dump		Operational	Low
4g	Biodiversity	Reclamation of D3 - Supply Chain Discard Dump		Operational	Low
4h	Biodiversity	Reclamation of Slimes Dams		Operational	Low
5a	Surface Water	Reworking of D1-Old Plant Discard Dump	<u>Surface water quality:</u> The reworking of the dump will allow for the liberation and increased mobilisation of sediment. This will result in a physical deterioration of the quality of the surface water runoff to the Rooikuilspruit.	Operational	Low
5b	Surface Water	Reworking of D2-Old Plant Discard Dump	<u>Surface water quality:</u> The reworking of the dump will allow for the liberation and increased mobilisation of sediment. This will result in a physical deterioration of the quality of the surface water runoff to the environment.	Operational	Low
5c	Surface Water	Reworking of D3-Supply Chain Discard Dump	<u>Surface water quality:</u> The reworking of the dump will allow for the liberation and increased mobilisation of sediment. This will result in a physical deterioration of the quality of the surface water runoff to the current clean water management system of TIOM.	Operational	Low
5d	Surface Water	Reworking of the slimes dams	<u>Surface water quality:</u> The reworking of the slimes dams will allow for the liberation and increased mobilisation of sediment. This will result in a physical deterioration of the quality of the surface	Operational	Low

NO	ASPECTS AFFECTED	ACTIVITY	POTENTIAL IMPACT	PHASE in which impact is anticipated	SIGNIFICANCE IF MITIGATED
			water runoff to the Rooikuilspruit.		
5e	Surface Water	Use of vehicles for the reworking activities	<u>Surface water quality:</u> Hydrocarbon (diesel, petrol, oils and greases) leaks and spillages from the mining vehicles and equipment may occur during the reworking activities. Should any surface water runoff come into contact with the hydrocarbons, such will result in the chemical deterioration of the quality of the surface water runoff.	Operational	Low
5f	Surface Water	Cleaning of vehicles	Contamination of surface water resources.	Operational	Medium
5g	Surface Water	Maintaining portable toilets	Disposal of hazardous waste	Operational	Low
5h	Surface Water	Slimes dam operations	Disposal of hazardous waste. Emergency during breaking of dam wall resulting in spillage of slimes will be treated as an emergency situation.	Operational	Medium
5i	Surface Water	Pipe maintenance, including: Repair, lengthening and shortening, replacing & removing old pipes and installation of new pipes	Spillage of other material e.g. slimes that could be contained in the pipe that is being repaired, lengthened, shortened, replaced.	Operational	Low
5j	Surface Water	Contaminated water generated when pipes burst or pipes blocked and could be released into the environment depending where the incident occur.	Opening of slimes (tailings) pipes	Operational	Medium
5k	Surface Water	Storm water management - general	Ineffective storm water management	Operational	Medium
6a	Ground Water Quantity	Reclamation of D1 - Old Plant Discard Dump	Increased recharge with localised mounding of Ground Water table	Operational	Low
6b	Ground Water Quantity	Reclamation of D2 - Old Plant		Operational	Low

NO	ASPECTS AFFECTED	ACTIVITY	POTENTIAL IMPACT	PHASE in which impact is anticipated	SIGNIFICANCE IF MITIGATED
		Discard Dump			
6c	Ground Water Quantity	Reclamation of D3 - Supply Chain Discard Dump		Operational	Low
6d	Ground Water Quantity	Reclamation of Slimes Dams		Operational	Low
6e	Ground Water Quality	Reclamation of D1 - Old Plant Discard Dump	Contaminants of concern identified during the geochemical and geohydrological assessment include As, Mn, F, N (as NO_3 and NH_4), Na and Cl. However, status quo groundwater conditions at TIOM indicate relatively unimpacted water quality. The seepage quality from the facilities is likely to be circum-neutral to alkaline as no potential for acid formation.	Operational	Low
6f	Ground Water Quality	Reclamation of D2 - Old Plant Discard Dump		Operational	Low
6g	Ground Water Quality	Reclamation of D3 - Supply Chain Discard Dump		Operational	Low
6h	Ground Water Quality	Reclamation of Slimes Dams		Operational	Low
6i	Ground Water Quantity	Reclamation of D1 - Old Plant Discard Dump	Current groundwater mounding will decline. Complete removal of the tailings and rehabilitation of the footprint will result in a seepage flux comparable with background groundwater recharge rates. Any residual groundwater mounding, if any, is likely to be limited to the footprints. Provided all material is removed, the significance of impacts on groundwater quantity is low to insignificant.	Closure	Low
6j	Ground Water Quantity	Reclamation of D2 - Old Plant Discard Dump		Closure	Low
6k	Ground Water Quantity	Reclamation of D3 - Supply Chain Discard Dump		Closure	Low
6l	Ground Water Quantity	Reclamation of Slimes Dams		Closure	Low
6m	Ground Water Quality	Reclamation of D1 - Old Plant Discard Dump	The reclamation footprints will be rehabilitated to a land-use similar to that prevalent in the study area. Total reclamation of the facilities (100% reduction in height) will obviously result in long term reduction of the pollution source strengths as potentially pollution material is removed. Some residual soil contamination may remain within the footprints but if this is rehabilitated to acceptable and National standards, no significant leaching of contaminants is expected during the post-	Closure	Low
6n	Ground Water Quality	Reclamation of D2 - Old Plant Discard Dump		Closure	Low
6n	Ground Water Quality	Reclamation of D3 - Supply Chain Discard Dump		Closure	Low
6o	Ground Water Quality	Reclamation of Slimes Dams		Closure	Low

NO	ASPECTS AFFECTED	ACTIVITY	POTENTIAL IMPACT	PHASE in which impact is anticipated	SIGNIFICANCE IF MITIGATED
			closure phase and a net positive impact of the total removal of the pollution source is recognised. Groundwater quality beneath the reclaimed footprints is expected to return to a quality similar to the background quality resulting in a low/insignificant impact.		
7a	Air Quality	Reclamation of D1 - Old Plant Discard Dump	Dust as generated from the various activities may arise from activities associated with excavation/reclamation, crushing, storage and haulage. Dust impacts may be both of nuisance (fallout) as well as respiratory (PM) to humans as well as to vegetation (fall out dust), also with limited impact on the surrounding surface water.	Operational	Medium
7b	Air Quality	Reclamation of D2 - Old Plant Discard Dump		Operational	Low
7c	Air Quality	Reclamation of D3 - Supply Chain Discard Dump		Operational	Low
7d	Air Quality	Reclamation of Slimes Dams		Operational	Medium
7e	Air Quality	Use of vehicles, and other mobile equipment for operational activities	Vehicles will generate emissions to the atmosphere during general operations. The emissions are limited due to regular maintenance on vehicles.	Operational	Medium
7f	Air Quality	Stockpiling ore next to national road	Generation of emissions to atmosphere	Operational	Low
8a	Noise and Vibration	Reclamation of D1 - Old Plant Discard Dump	Noise generated from various activities that include heavy vehicles (excavation and haulage) and plant equipment (e.g. crushing and screening operations). Noise impacts may be primarily a nuisance but is considered low due to the proximity to neighbouring receptors.	Operational	Medium
8b	Noise and Vibration	Reclamation of D2 - Old Plant Discard Dump		Operational	Low
8c	Noise and Vibration	Reclamation of D3 - Supply Chain Discard Dump		Operational	Low
8d	Noise and Vibration	Reclamation of Slimes Dams		Operational	Low
8e	Noise and Vibration	Management of plant beneficiation equipment	The plant beneficiation equipment generates noise but this is limited to the plant area and does not cause an impact on this surrounding area.	Operational	Low
10	Sensitive Landscapes	Re-working of discard material using front-end	• Disturbance of adjacent riparian	Operational	Low

NO	ASPECTS AFFECTED	ACTIVITY	POTENTIAL IMPACT	PHASE in which impact is anticipated	SIGNIFICANCE IF MITIGATED
		loader.	vegetation; • Increased sediment movement into Rooikuilspruit and riparian habitat; • Spillage of contaminants leading to water quality impacts; • Increase in alien vegetation; • Changes in floodlines; and • Rehabilitation of cleared D1 - Old Plant Discard Dump footprint.		
		Onsite crushing and screening of discard material.			
		Noise pollution, light pollution.			
		Re-shaping of remaining discard material and rehabilitation of cleared footprint			
11a	Visual	Reclamation of D1 - Old Plant Discard Dump	The reclamation of the D1 - Old Plant Discard dump may result in topography changes (noted that such is previously mine associated structure). Dust may also contribute to the visual aspect during the reclamation activities.	Operational	Low
11b	Visual	Reclamation of D2 - Old Plant Discard Dump		Operational	Low
11c	Visual	Reclamation of D3 - Supply Chain Discard Dump		Operational	Low
11d	Visual	Reclamation of Slimes Dams		Operational	Low

11.3.2 Summary of the positive implications and risks associated with the project

Table 42: Summary of the positive environmental impacts, after mitigation

NO	ASPECTS AFFECTED	ACTIVITY	POTENTIAL IMPACT	PHASE in which impact is anticipated	SIGNIFICANCE IF MITIGATED
12a	Socio-Economic	Reclamation of D1 - Old Plant Discard Dump	Jobs will be retained, providing income, therefore, having a further impact on the regional socio-economy aspects of the area, along with other benefits arising from the Social and Labour Plan.	Operational	Positive
12b	Socio-Economic	Reclamation of D2 - Old Plant Discard Dump		Operational	Positive
12c	Socio-Economic	Reclamation of D3 - Supply Chain Discard Dump		Operational	Positive
12d	Socio-Economic	Reclamation of Slimes Dams		Operational	Positive

12 Proposed impact management outcomes for inclusion into the EMPr

Based on the assessment and where applicable the recommendations from specialist reports, the table below summarises the impact management outcomes for the project for inclusion in the EMPr as well as for inclusion as conditions of authorisation.

Table 43: Impact management outcomes

Aspect affected	Impact management outcome	Standard to be achieved
Geology	Not applicable.	Not applicable.
Topography	General implementation of activities taking Mining and Biodiversity Guidelines into account.	Adherence to the closure land use alternative assessment report
Soil	Bio-monitoring (Bi-annual). Groundwater monitoring (Quarterly). Surface water monitoring (Quarterly) Rehabilitation monitoring to be undertaken by suitably qualified rehabilitation specialist (in consultation with ecologist). General implementation of activities taking Mining and Biodiversity Guidelines into account.	Adherence to the closure land use alternative assessment report
Biodiversity	Rehabilitation monitoring to be undertaken by suitably qualified rehabilitation specialist (in consultation with ecologist). General implementation of activities taking Mining and Biodiversity Guidelines into account.	Implementation of the control of Alien Invasive Vegetation Procedure.
Sensitive Landscapes (including wetlands)	Bio-monitoring (Bi-annual). Groundwater monitoring (Quarterly). Surface water monitoring (Quarterly).	To prevent sedimentation of watercourse.
Ground Water	Groundwater monitoring (quarterly)	To minimise the extent of disturbance of the aquifer and to limit degeneration of groundwater quality and quantity.
Surface Water	Surface water quality monitoring (Quarterly).	To conserve the surface water resource and prevent impact on downstream water users.
Air Quality	Dust fallout monitoring (monthly).	To reduce air quality impacts from the operational activities.
Visual	Rehabilitation on closure.	To minimise the visual impact.
Sites of cultural	Not applicable.	Not applicable.

Aspect affected	Impact management outcome	Standard to be achieved
and archaeological importance		
Socio-Economic	Implementation of approved Social and Labour Plan.	Prevent socio economic impacts by employment opportunities.

13 Final proposed alternatives

13.1 Site alternative

No site alternatives were considered as previously discussed.

13.2 Mining alternative

The preferred alternative is the reclamation alternative that is to reclaim existing D1 - Old Plant Discard Dump, D2 - Old Plant Discard Dump and D3 – Supply Chain Discard Dump and the Slimes Dams.

13.3 No-go option

The no-go option would mean that the status quo of the environmental would remain as is and there would be no additional impacts to the mine, the size of the dumps will stay the same and be rehabilitated in accordance to current practice. The opportunity to reclaim available iron ore resources within the mine residue will be lost. The project will ensure that TIOM is able to generate income, thus jobs will be retained through an extension of the life of mine.

14 Aspects for inclusion as conditions of the authorisation

Should the DMRE grant authorisation, it should be subject to the following conditions:

- The mine should remain in full compliance with the requirements of the EMPr and with all regulatory requirements;
- The EMPr should be implemented by qualified environmental personnel who have the competence and credibility to interpret the requirements of the EMPr; and
- Stakeholder engagement must be maintained during all phases.

15 Description of any assumptions, uncertainties and gaps in knowledge

Table 44: Specialist assumptions and limitations

Specialist study	Assumptions and limitations
Thabazimbi Iron Ore Mine (Pty) Ltd: A Subsidiary of ArcelorMittal South Africa Limited – Thabazimbi Iron Ore Mine: Desktop Geohydrological Report for a Waste Management Licence Application, dated April 2020	No assumptions and limitations were provided for by the specialist.
Riparian delineation and water use risk assessment for the proposed reworking of a discard dump at the Thabazimbi Iron Ore Mine, dated 2020 and compiled by Wetland Consulting Scientific (Pty) Ltd.	The scale of the remote imagery used (1:10 000 aerial photographs and Google Earth Imagery), as well as the accuracy of the handheld GPS unit used to delineated riparian areas in the field, result in the delineated riparian boundaries being accurate to about 10 m on the ground. Should greater mapping accuracy be required, the riparian areas would need to be pegged in the field and surveyed using conventional survey techniques. Groundtruthing and field verification of riparian vegetation boundaries as part of this project was limited to a reach roughly 300 m upstream and downstream of the D1 – Old Plant Discard Dump. A single day site visit was undertaken on the 17th June 2020 during which all riparian habitats within and immediately adjacent to the study area were identified and delineated. This water use risk assessment was based on the project description and proposed development and activity descriptions as detailed and illustrated in this report. Should any changes be made to the project description and method statements, the water use risk assessment may require updating and the outcomes of the risk assessment may change. In addition, it is recognised that the passage of time may affect the information and assessment provided in this report. WCS' opinions are, therefore, based upon the information that was made available to WCS and which existed at the time of compiling this report. Reference conditions of the wetland habitats are unknown. This limits the confidence with which the present ecological category ("PES") is assigned.
Thabazimbi Iron Ore (Pty) Ltd: Thabazimbi Iron Ore Mine – Conceptual Storm Water Management Plan, dated August 2020 and compiled by Shangoni Management Services (Pty) Ltd	Storm water control recommendations are based on industry experience and best practice. Final designs for construction should be authorised by an approved engineer. Upstream catchment activities are interpreted according to common practices and no detailed insight is available on possible storm water measures beyond the site. The assessment does not guarantee the integrity of downstream infrastructure in the event of release or discharge from site. The measures proposed as part of the storm water management section

Specialist study	Assumptions and limitations
	of the report do not impose preference as this is an operational document to assist in the complete management of clean and dirty surface water in the vicinity of the operation. The measures proposed in the storm water management plan section of the report do not specifically cover considerations relevant to storm water management for the purpose of safety, like mine flooding and loss of life; the primary focus being environmental management and the identification of potential environmental concerns. The measures proposed in this storm water management plan are conceptual in nature and no calculations with regards to flood peaks and volumes was conducted.

16 Reasoned opinion as to whether the proposed activity should or should not be authorised

16.1 Reasons why the activity should be authorised or not

In accordance with the EIA Regulations GN R982, the Environmental Impact Assessment Practitioner ("EAP") must provide an opinion as to whether the activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation must be stated.

The impact assessment undertaken for the proposed activities considered both the biophysical and socio-economic environments. The assessment of the biophysical environment revealed that there are no significant negative impacts, and further no environmental fatal flaws associated with the project should mitigation and management measures be implemented.

The EAP is of opinion that this project should be authorised.

16.2 Conditions that must be included in the authorisation

Should the DMRE grant authorisation, it should be subject to the following conditions:

- The mine should remain in full compliance with the requirements of the EMPr and with all regulatory requirements;
- The EMPr should be implemented by qualified environmental personnel who have the competence and credibility to interpret the requirements of the EMPr. Such persons must be issued with a written mandate by mine management to provide guidance and instructions to employees and contractors; and
- Stakeholder engagement must be maintained during all phases.

17 Period for which Environmental Authorisation is required

The period for which environmental authorisation is required is at least 30 years (from the date of approval provided by the DMRE).

18 Undertaking

The undertaking by the EAP is provided in Section 2 of Part B (Environmental Management Programme) below. This undertaking confirms: the correctness of the information provided in the reports, the inclusion of comments and inputs from stakeholders and I&APs, the inclusion of inputs and recommendations from the specialist reports where relevant and the acceptability of the project in relation to the finding of the assessment and level of mitigation proposed.

19 Financial provisions

The main focus of the waste management licence application is to authorise the reworking and reuse of mine residue deposit material. Considering this it would mean that the mine residue volumes will decrease thus decreasing the closure liability cost. The current mine residue deposits that will be affected by this application is listed in the table below as well as the current liability cost and the expected final liability cost once the reworking is completed. The revegetation of the footprint of the residue deposits is included in the calculation of the liability cost. An assessment was conducted of all the infrastructure and all the activities related to the project that fall within the responsibility of TIOM An additional slimes pipeline and return water pipeline is planned to allow for the deposition of slimes and return of water from the return water dam to the screening plant. This infrastructure is included in physical demolition cost.

Table 45: TIOM closure liability calculation, 2019

Area	Current liability cost	Reduction / addition	Total
Old plant discard dump (being moved to VDB waste rock dump)	R515 190.33	100% removal	0
Old plant discard dump area footprint revegetation	R783 294.51	Remains	R783 294.51
Long slope revegetation – Northern side (plant discard at SCM area)	R395 636.66	100% removal	0
Slimes dams vegetation	R 16 936 356.95	50% removal	R8,468,178.47
Slimes dam footprint			R8,468,178.47

Area	Current liability cost	Reduction / addition	Total
revegetation			
Slimes pipeline -200m	0	R78.31/m demolition rate	R15 662.00
Long slope revegetation – Northern side (plant discard at SCM area) footprint revegetation			R395 636.66
Total	**R18 630 478.45**		**R18 130 950.12**

Based on the reclamation activities it is envisaged that the total liability cost will decrease by approximately R499 528.33.

19.1 Confirm that this amount can be provided for from operating expenditure

The closure liability for TIOM is reviewed annually and provided for in the form of bank guarantees. The closure liability as listed above is currently included in the annual calculation. Due to the reworking activities the liability will slightly decrease and no additional liability cost is envisage.

20 Deviations from the approved scoping report and plan of study

No deviations from the approved scoping report and plan of study have been undertaken.

21 Other information required by the competent authority

21.1 Compliance with the provisions of section 24(4)(a) and (b) read with section 24(3)(a) and (7) of the National Environmental Management Act 107 of 1998

21.1.1 Impact on the socio-economic conditions of any directly affected person

Results of investigation, assessment and evaluation of impact on any directly affected person	Reference to where mitigation is reflected
As per the Social and Labour Plan, during the Life of Mine, TIOM aims: • To promote employment and advance the social and economic welfare of all employees and uplift all stakeholders within the communities in which we operate; • To contribute to the transformation of our	Section 1.4 of Part B

Results of investigation, assessment and evaluation of impact on any directly affected person	Reference to where mitigation is reflected
industry; and • To ensure that the holders of mining rights contribute to the socio-economic development of the communities in which they operate, including major labour sending areas.	

21.1.2 Impact on any national estate referred to in section 3(2) of the National Heritage Resources Act 25 of 1999

Results of investigation, assessment and evaluation of impact on any directly affected person	Reference to where mitigation is reflected
No impact on national estate in terms of the Heritage Resources Act (Act 25 of 1999), are identified as part of the project.	Section 1.4 of Part B

22 Other matters required in terms of section 24(4) (a) and (b) of the Act

An impact assessment for the project has been undertaken and include consultation with and participation of interested and affected parties. Applying the hierarchical approach to impact management was firstly considered to avoid negative impacts, but where avoidance was not possible, to better mitigate and manage negative impacts. Where impacts were found to be potentially significant, various mitigation measures to manage and monitor the impacts of the project have been proposed. Furthermore, the environmental impact statement (Part A Section 11) summarises the key findings of the environmental impact assessment and negative implications of the project.

PART B

ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT

1 Draft environmental management programme

1.1 Details of the EAP

The requirements for the provision of the detail and expertise of the EAP are included in Section 1.2 of Part A.

1.2 Description of the aspects of the activity

The requirement to describe the aspects of the activity that are covered by the draft environmental management programme is included in Section 7.5 of Part A.

1.3 Composite map

Refer to Figure 33 above as well as Annexure A for a map that superimposes the proposed activity, its associated structures and infrastructures on the environmental sensitivities of the preferred sites.

1.4 Description of the impact management outcomes and actions

Table 46: Measures to rehabilitate the environment affected by the project

No.	Aspect affected	Activity	Potential Impact	Phase	Mitigation type	Standard to be Achieved	Impact management actions / Mitigation measures	Time period for implementation
1a	Geology	Reclamation of D1 - Old Plant Discard Dump	There are no impacts identified to Geology as a result of the reclamation of the D1 - Old Plant Discard Dump.					
1b	Geology	Reclamation of D2 - Old Plant Discard Dump	There are no impacts identified to Geology as a result of the reclamation of the D2 - Old Plant Discard Dump.					
1c	Geology	Reclamation of D3 - Supply Chain Discard Dump	There are no impacts identified to Geology as a result of the reclamation of the D3 - Supply Chain Discard Dump.					
1d	Geology	Reclamation of Slimes Dams	There are no impacts identified to Geology as a result of the reclamation of the Slimes Dams.					
2a	Topography	Reclamation of D1 - Old Plant Discard Dump	Slight alteration due to removal of dumps, but thereby promoting pre-disturbed topography.	Operational	Control	Adherence to the closure land use alternative assessment report	Ensure that the topography is free draining upon completion of the reclamation	30 years
2b	Topography	Reclamation of D2 - Old Plant Discard Dump					Reclamation and associated activities to be limited to areas required the activity.	
2c	Topography	Reclamation of D3 - Supply Chain Discard Dump						
2d	Topography	Reclamation of Slimes Dams					General implementation of activities taking Mining and Biodiversity Guidelines into account.	
3a	Soils, Land Use and Land Capability	Maintenance of vehicles in the pit. Repair front-end loaders	Incorrect disposal of waste that may pollute soil. Spillage of chemicals.	Mitigation measure provided for on Page 313. (Section 5.2.2) in the EMPr titled *Thabazimbi Iron Ore Mine (Pty) Ltd Thabazimbi Mine Environmental Management Programme*, (LP30/5/1/3/2/1(45) And (47) EM).				
3b	Soils, Land Use and Land Capability	Maintenance of conveyors and structure (replacing rollers, maintaining water sprays, crusher.	Incorrect disposal of waste that may pollute soil.					
3c	Soils, Land Use and Land Capability	Ineffective management of Discard Dumps	Erosion	Mitigation measure provided for on Page 316. (Section 5.2.7) in the EMPr titled *Thabazimbi Iron Ore Mine (Pty) Ltd Thabazimbi Mine Environmental Management Programme*, (LP30/5/1/3/2/1(45) And (47) EM).				
3d	Soils, Land Use and Land Capability	Replacing pipes as part of slimes dam operations	Disposal of hazardous waste					
3e	Soils, Land Use and Land Capability	Pipe maintenance, including: Repair, lengthening and shortening, replacing & removing old pipes and installation of new pipes	Erosion brought about by maintenance on pipelines.	Mitigation measure provided for on Page 316. (Section 5.2.7) in the EMPr titled *Thabazimbi Iron Ore Mine (Pty) Ltd Thabazimbi Mine Environmental Management Programme*, (LP30/5/1/3/2/1(45) And (47) EM).				
4a	Biodiversity	Reclamation of D1 - Old Plant Discard Dump	Spread of alien invasive plant species. Dust generated from activities may also negatively affect flora species.	Operational	Control	Implementation of the control of Alien Invasive Vegetation Procedure.	Alien invasive species should be removed, where possible (prioritising NEMBA category 1A & B species).	30 years
4b	Biodiversity	Reclamation of D2 - Old Plant Discard Dump					Activities should be restricted to the development footprint	
4c	Biodiversity	Reclamation of D3 - Supply Chain Discard Dump					A rehabilitation plan is followed with annual schedules and maintenance of post rehabilitated areas.	

No.	Aspect affected	Activity	Potential Impact	Phase	Mitigation type	Standard to be Achieved	Impact management actions / Mitigation measures	Time period for implementation
4d	Biodiversity	Reclamation of Slimes Dams					Rehabilitation monitoring to be undertaken by suitably qualified rehabilitation specialist (in consultation with ecologist). General implementation of activities taking Mining and Biodiversity Guidelines into account.	
4e	Biodiversity	Reclamation of D1 - Old Plant Discard Dump	Hauling activities could result in road mortalities since many animals, especially nocturnal animals, that attempt to cross the road are at risk to collide with oncoming haul traffic.	Operational	Control	None.	Enforce speed limit of 40 km/h for HDV and 60 km/h for LDV's on haul roads.	30 Years
4f	Biodiversity	Reclamation of D2 - Old Plant Discard Dump						
4g	Biodiversity	Reclamation of D3 - Supply Chain Discard Dump					Any mortalities to be reported to the Environmental Officer.	
4h	Biodiversity	Reclamation of Slimes Dams						
5a	Surface Water	Reworking of D1 - Old Plant Discard Dump	<u>Surface water quality:</u> The reworking of the dump will allow for the liberation and increased mobilisation of sediment. This will result in a physical deterioration of the quality of the surface water runoff to the Rooikuilspruit.	Operational	Control	To ensure that surface water contamination is prevented	Allow a portion of the dump to act as a berm to prevent surface water runoff from flowing to the Rooikuilspruit. Construct a berm upstream of the reworking activities to limit the volume of surface water runoff to the active area, where practical. Discharge any storm water into well vegetated areas outside riparian habitat if possible. As it is likely that only a part of the D1 – Old Discard Dump will be cleared during reworking, it is recommended that such clearing focusses on the area closest to the Rooikuilspruit riparian area. Cleared areas outside direct development footprint should be re-vegetated and seeded (where necessary) as soon as possible following disturbance. Priority should be given to utilising species indigenous to the Thabazimbi area. Cleared areas should be fully rehabilitated, which includes removal or remediation of any contaminated soils potentially harmful to the environment. Any likely changes to the floodlines associated with the Rooikuilspruit should be investigated and measures put in place to mitigate any possible risk to people or infrastructure.	30 Years
5b	Surface Water	Reworking of D2-Old Plant Discard Dump	<u>Surface water quality:</u> The reworking of the dump will allow for the liberation and increased mobilisation of sediment. This will result in a physical deterioration of the quality of the surface water runoff to the environment.	Operational	Control	To ensure that surface water contamination is prevented	Continue to maintain the existing berm along the length of the haul road that is located downstream of the dump. Should it be determined during the reworking of the dump that the existing berm is proving to be insufficient, the berm should be upgraded. Construct a berm upstream of the reworking activities to limit the volume of surface water runoff to the active area.	30 Years

No.	Aspect affected	Activity	Potential Impact	Phase	Mitigation type	Standard to be Achieved	Impact management actions / Mitigation measures	Time period for implementation
							Discharge any storm water into well vegetated areas, where possible.	
							Cleared areas outside direct development footprint should be re-vegetated and seeded (where necessary) as soon as possible following disturbance. Priority should be given to utilising species indigenous to the Thabazimbi area.	
							Cleared areas should be fully rehabilitated, which includes removal or remediation of any contaminated soils potentially harmful to the environment.	
5c	Surface Water	Reworking of D3-Supply Chain Discard Dump	<u>Surface water quality:</u> The reworking of the dump will allow for the liberation and increased mobilisation of sediment. This will result in a physical deterioration of the quality of the surface water runoff to the current clean water management system of TIOM.	Operational	Control	To ensure that surface water contamination is prevented	Continue to maintain the clean water diversions berms that divert clean surface water runoff around the dump.	30 Years
							On-going monitoring of the reworking activities is to be undertaken to determine whether the activities are resulting in additional sediment input into the clean water system. Should it be determined that there is an additional sediment input into the clean water system, containment berms are to be implemented (dimensions determined by a hydrological assessment) downstream of the reworking activities.	
							Ongoing inspection and maintenance of the clean water management infrastructure.	
							Discharge any storm water into well vegetated areas.	
							Cleared areas outside direct development footprint should be re-vegetated and seeded (where necessary) as soon as possible following disturbance. Priority should be given to utilising species indigenous to the Thabazimbi area.	
							Cleared areas should be fully rehabilitated, which includes removal or remediation of any contaminated soils potentially harmful to the environment.	
5d	Surface Water	Reworking of the slimes dams	<u>Surface water quality:</u> The reworking of the slimes dams will allow for the liberation and increased mobilisation of sediment. This will result in a physical deterioration of the quality of the surface water runoff to the Rooikuilspruit.	Operational	Control	To ensure that surface water contamination is prevented	No unauthorised reworking activities should be undertaken within the drainage line between Compartment 1 and 2 and Compartments 3 and 4 of the Slimes Dams.	30 Years
							Continue to utilise the existing water management infrastructure on the slimes dams as far possible, until such a time that the reworking activities compromise such.	
							Ensure that the reworking activities do not cause an obstruction within the drainage line between Compartment 1 and 2 and Compartments 3 and 4 of the Slimes Dams.	
							Construct a diversion berm (implementation thereof dependent on final mine plan) directly upstream of the active reworking area to divert clean surface water runoff around the active reworking area.	
							Construct a containment berm (implementation thereof dependent on final mine plan) directly downstream of the active reworking area.	

No.	Aspect affected	Activity	Potential Impact	Phase	Mitigation type	Standard to be Achieved	Impact management actions / Mitigation measures	Time period for implementation
							Discharge any storm water into well vegetated areas.	
							Cleared areas outside direct development footprint should be re-vegetated and seeded (where necessary) as soon as possible following disturbance. Priority should be given to utilising species indigenous to the Thabazimbi area.	
							Cleared areas should be fully rehabilitated, which includes removal or remediation of any contaminated soils potentially harmful to the environment.	
5e	Surface Water	Use of vehicles for the reworking activities	<u>Surface water quality:</u> Hydrocarbon (diesel, petrol, oils and greases) leaks and spillages from the mining vehicles and equipment may occur during the reworking activities. Should any surface water runoff come into contact with the hydrocarbons, such will result in the chemical deterioration of the quality of the surface water runoff.	Operational	Control	To ensure that surface water contamination is prevented	Mining vehicles and equipment are to be inspected prior to use for any leaks.	30 Years
							Continued ongoing maintenance of mining vehicles and equipment	
							Drip trays are to be utilised under parked vehicles and equipment.	
							Limit mine vehicle movement only to areas required for the reworking activities.	
							Regular inspections of the active reworking areas are to be undertaken.	
							Where hydrocarbon spillages and contaminated soils are identified, such are to be treated as hazardous waste and managed and disposed of in accordance to TIOM procedures. The area is then to be rehabilitated.	
							Refuelling only to be undertaken at designated refuelling areas.	
							Maintenance only to be undertaken at designated maintenance areas.	
5f	Surface Water	Cleaning of vehicles	Contamination of surface water resources.	Mitigation measure provided for on Page 316. (Section 5.2.7) in the EMPr titled *Thabazimbi Iron Ore Mine (Pty) Ltd Thabazimbi Mine Environmental Management Programme*, (LP30/5/1/3/2/1(45) And (47) EM).				
5g	Surface Water	Maintaining portable toilets	Disposal of hazardous waste					
5h	Surface Water	Slimes dam operations	Disposal of hazardous waste. Emergency during breaking of dam wall resulting in spillage of slimes will be treated as an emergency situation.	Mitigation measure provided for on Page 319. (Section 5.2.8) in the EMPr titled *Thabazimbi Iron Ore Mine (Pty) Ltd Thabazimbi Mine Environmental Management Programme*, (LP30/5/1/3/2/1(45) And (47) EM).				
5i	Surface Water	Pipe maintenance, including: Repair, lengthening and shortening, replacing & removing old pipes and installation of new pipes	Spillage of other material e.g. slimes that could be contained in the pipe that is being repaired, lengthened, shortened, replaced.	Mitigation measure provided for on Page 316. (Section 5.2.7) in the EMPr titled *Thabazimbi Iron Ore Mine (Pty) Ltd Thabazimbi Mine Environmental Management Programme*, (LP30/5/1/3/2/1(45) And (47) EM).				

No.	Aspect affected	Activity	Potential Impact	Phase	Mitigation type	Standard to be Achieved	Impact management actions / Mitigation measures	Time period for implementation
5j	Surface Water	Contaminated water generated when pipes burst or pipes blocked and could be released into the environment depending where the incident occur.	Opening of slimes (tailings) pipes	Mitigation measure provided for on Page 316. (Section 5.2.7) in the EMPr titled *Thabazimbi Iron Ore Mine (Pty) Ltd Thabazimbi Mine Environmental Management Programme*, (LP30/5/1/3/2/1(45) And (47) EM).				
6a	Ground Water Quantity	Reclamation of D1 - Old Plant Discard Dump	Increased recharge with localised mounding of Ground Water table	Operational	Control	To minimise the extent of disturbance of the aquifer. To limit degeneration of groundwater quantity.	Continue with groundwater level and quality monitoring	30 Years
6b	Ground Water Quantity	Reclamation of D2 - Old Plant Discard Dump						
6c	Ground Water Quantity	Reclamation of D3 - Supply Chain Discard Dump					Separate clean and affected water	
6d	Ground Water Quantity	Reclamation of Slimes Dams					Groundwater monitoring (quarterly).	
6e	Ground Water Quality	Reclamation of D1 - Old Plant Discard Dump	Contaminants of concern identified during the geochemical and geohydrological assessment include As, Mn, F, N (as NO_3 and NH_4), Na and Cl. However, status quo groundwater conditions at TIOM indicate relatively unimpacted water quality. The seepage quality from the facilities is likely to be circum-neutral to alkaline as no potential for acid formation.	Operational	Control	To minimise the extent of disturbance of the aquifer. To limit degeneration of groundwater quantity.	Continue with groundwater monitoring and separate clean and affected water	30 Years
6f	Ground Water Quality	Reclamation of D2 - Old Plant Discard Dump						
6g	Ground Water Quality	Reclamation of D3 - Supply Chain Discard Dump					Relevant areas should be free-draining, and ponding of water should be minimised as far as practical or relevant.	
6h	Ground Water Quality	Reclamation of Slimes Dams					Groundwater monitoring (quarterly)	
6i	Ground Water Quantity	Reclamation of D1 - Old Plant Discard Dump	Current groundwater mounding will decline. Complete removal of the tailings and rehabilitation of the footprint will result in a seepage flux comparable with background groundwater recharge rates. Any residual groundwater mounding, if any, is likely to be limited to the footprints. Provided all material is removed, the significance of impacts on groundwater quantity is low to insignificant.	Closure	Control	To minimise the extent of disturbance of the aquifer. To limit degeneration of groundwater quantity.	Continue with groundwater monitoring and separate clean and affected water.	30 Years
6j	Ground Water Quantity	Reclamation of D2 - Old Plant Discard Dump						
6k	Ground Water Quantity	Reclamation of D3 - Supply Chain Discard Dump					Groundwater monitoring (quarterly)	
6l	Ground Water Quantity	Reclamation of Slimes Dams						
6m	Ground Water Quality	Reclamation of D1 - Old Plant Discard Dump	The reclamation footprints will be rehabilitated to a land-use similar to that prevalent in the study area. Total reclamation of the facilities (100% reduction in height) will obviously result in long term reduction of the pollution source strengths as potentially pollution material is removed. Some residual soil contamination may remain within the	Closure	Control	To minimise the extent of disturbance of the aquifer. To limit degeneration of groundwater quantity.	Continue with groundwater monitoring and separate clean and affected water	30 years
6n	Ground Water Quality	Reclamation of D2 - Old Plant Discard Dump						
6n	Ground Water Quality	Reclamation of D3 - Supply Chain Discard Dump					Groundwater monitoring (quarterly)	

No.	Aspect affected	Activity	Potential Impact	Phase	Mitigation type	Standard to be Achieved	Impact management actions / Mitigation measures	Time period for implementation
6o	Ground Water Quality	Reclamation of Slimes Dams	footprints but if this is rehabilitated to acceptable and National standards, no significant leaching of contaminants is expected during the post-closure phase and a net positive impact of the total removal of the pollution source is recognised. Groundwater quality beneath the reclaimed footprints is expected to return to a quality similar to the background quality resulting in a low/insignificant impact.					
7a	Air Quality	Reclamation of D1 - Old Plant Discard Dump	Dust as generated from the various activities may arise from activities associated with excavation/reclamation, crushing, storage and haulage. Dust impacts may be both of nuisance (fallout) as well as respiratory (PM) to humans as well as to vegetation (fall out dust), also with limited impact on the surrounding surface water.	Operational	Control	To reduce air quality impacts from the operational activities.	Ensure dust suppression is implemented on haul roads	30 Years
7b	Air Quality	Reclamation of D2 - Old Plant Discard Dump						
7c	Air Quality	Reclamation of D3 - Supply Chain Discard Dump					Enforce speed restrictions to roads (haul roads) to suppress dust	
7d	Air Quality	Reclamation of Slimes Dams					Monthly dust fallout monitoring.	
7e	Air Quality	Use of vehicles, and other mobile equipment for operational activities	Vehicles will generate emissions to the atmosphere during general operations. The emissions are limited due to regular maintenance on vehicles.	Mitigation measure provided for on Page 320. (Section 5.2.10) in the EMPr titled *Thabazimbi Iron Ore Mine (Pty) Ltd Thabazimbi Mine Environmental Management Programme*, (LP30/5/1/3/2/1(45) And (47) EM).				
7f	Air Quality	Stockpiling ore next to national road	Generation of emissions to atmosphere					
8a	Noise and Vibration	Reclamation of D1 - Old Plant Discard Dump	Noise generated from various activities that include heavy vehicles (excavation and haulage) and plant equipment (e.g. crushing and screening operations). Noise impacts may be primarily a nuisance but is considered low due to the proximity to neighbouring receptors.	Operational	Control	To reduce noise levels	Regular inspections of vehicles and machinery.	30 Years
8b	Noise and Vibration	Reclamation of D2 - Old Plant Discard Dump					Ensure machinery and vehicles with excessive noise impacts are removed from site.	
8c	Noise and Vibration	Reclamation of D3 - Supply Chain Discard Dump					Ensure stakeholders are aware of the relevant grievance mechanisms available to them	
8d	Noise and Vibration	Reclamation of Slimes Dams					Make use of appropriate communication channels and engagement platforms to interact with the affected stakeholders proactively	
8e	Noise and Vibration	Management of plant beneficiation equipment	The plant beneficiation equipment generates noise but this is limited to the plant area and does not cause an impact on this surrounding area.	Mitigation measure provided for on Page 322. (Section 5.2.12) in the EMPr titled *Thabazimbi Iron Ore Mine (Pty) Ltd Thabazimbi Mine Environmental Management Programme*, (LP30/5/1/3/2/1(45) And (47) EM).				
9a	Archaeology and cultural history	Reclamation of D1 - Old Plant Discard Dump	There are no impacts identified on sites of archaeological and cultural importance as a result of the proposed reclamation of D1 Old Plant Discard Dump.					

No.	Aspect affected	Activity	Potential Impact	Phase	Mitigation type	Standard to be Achieved	Impact management actions / Mitigation measures	Time period for implementation
9b	Archaeology and cultural history	Reclamation of D2 - Old Plant Discard Dump	There are no impacts identified on sites of archaeological and cultural importance as a result of the proposed reclamation of D2 Old Plant Discard Dump.					
9c	Archaeology and cultural history	Reclamation of D3 - Supply Chain Discard Dump	There are no impacts identified on sites of archaeological and cultural importance as a result of the proposed reclamation of D3 Supply Chain Discard Dump.					
9d	Archaeology and cultural history	Reclamation of Slimes Dams	There are no impacts identified on sites of archaeological and cultural importance as a result of the proposed reclamation of the Slimes Dams.					
10	Sensitive landscapes	Reclamation of D1 - Old Plant Discard Dump: Re-working of discard material using front-end loader.	• Disturbance of adjacent riparian vegetation; • Increased sediment movement into Rooikuilspruit and riparian habitat; • Spillage of contaminants leading to water quality impacts; • Increase in alien vegetation; • Changes in floodlines; and • Rehabilitation of cleared D1 - Old Plant Discard Dump footprint.	Operational	Control	To minimise impacts on the Rooikuilspruit	The most significant riparian impacts are expected to be associated with any increase in the current footprint of the D1 – Old Plant Dump towards the Rooikuilspruit, specifically the slumping or pushing of discard material into the riparian zone and active channel of the Rooikuilspruit. The most important mitigation measure is as follows: • No further increase in the D1 – Old Plant Discard Dump disturbance footprint towards the Rooikuilspruit should be allowed; • No slumping of material towards the Rooikuilspruit may be allowed to occur; • No pushing into or placing of discard material within the delineated Rooikuilspruit riparian zone; • No movement of machinery within the delineated Rooikuilspruit riparian zone; • No removal of trees or any clearing of vegetation within the delineated Rooikuilspruit riparian zone; and • Implementation of sediment fences (remaining portion of dump to act as berm) along the downslope edge of the D1 - Old Plant Discard Dump along the edge of the Rooikuilspruit riparian zone. Only locally occurring indigenous species should be used for revegetation. An alien vegetation management plan must be developed and implemented. To prevent water quality deterioration, all potentially harmful substances used on site should be stored in bunded areas so that spills and leaks can be contained and no contamination of soils or surface runoff occurs Servicing and cleaning of vehicles and machinery to take place off site at designated facilities, e.g. existing TIOM workshops. Storage of fuel and diesel on site to be limited to quantities used during 1 day's work. Management plan for waste collection, storage and handling on site must be drawn up. All waste to be disposed of in designated facilities	30 Years

No.	Aspect affected	Activity	Potential Impact	Phase	Mitigation type	Standard to be Achieved	Impact management actions / Mitigation measures	Time period for implementation
		Onsite crushing and screening of discard material.					Further mitigation measures include the following: • Design and implement a site-specific storm water and sediment management plan that aims to minimise the concentration of flow and increase in flow velocity, as well as minimising sediment transport off site. • Where practically possible, the major earthworks/material movements should be undertaken during the dry season (roughly from April to November) to limit erosion due to rainfall runoff. • Install sediment barriers(remaining portion of dump to act as berm) and/or low berms along the downslope edge of the D1 – Old Plant Discard Dump to trap sediments on site, especially in areas where surface runoff is directed towards the Rooikuilspruit. Design of sediment barriers should be such that expected flow velocities will not damage the barriers or impair their function. Regular cleaning and maintenance of the barriers should be undertaken. • Discharge storm water into well vegetated areas outside riparian habitat if possible. • Install energy dissipaters and erosion protection at points of discharge where significant flow concentration occurs and erosion is likely. • Cleared areas outside direct development footprint should be re-vegetated and seeded (where necessary) as soon as possible following disturbance. Priority should be given to utilising species indigenous to the Thabazimbi area. • Regular monitoring and inspections at rehabilitated sites should be undertaken to ensure successful rehabilitation.	
		Noise pollution, light pollution.					As it is likely that only a part of the D1 – Old Plant Discard Dump will be cleared during reworking, it is recommended that such clearing focusses on the area closest to the Rooikuilspruit riparian area.	
		Re-shaping of remaining discard material and rehabilitation of cleared footprint					Cleared areas should be fully rehabilitated, which includes removal or remediation of any contaminated soils potentially harmful to the environment.	
							Cleared areas to be shaped to the natural landscape profile as far as possible and re-vegetation with locally occurring species, including suitable riparian tree species in locations close to the Rooikuilspruit.	
							Any likely changes to the floodlines associated with the Rooikuilspruit should be investigated and measures put in place to mitigate any possible risk to people or infrastructure.	
							Bio-monitoring (Bi-annual).	
							Groundwater monitoring (Quarterly).	
							Surface water monitoring (Quarterly).	
11a	Visual	Reclamation of D1 - Old Plant Discard Dump	The reclamation of the D1 - Old Plant Discard dump may result in topography changes (noted that such is previously mine	Operational	Control	To minimise the visual impact.	Maintain the site during operational phase	30 years
							Implement a rehabilitation plan	

No.	Aspect affected	Activity	Potential Impact	Phase	Mitigation type	Standard to be Achieved	Impact management actions / Mitigation measures	Time period for implementation
			associated structure). Dust may also contribute to the visual aspect during the reclamation activities.				Rehabilitation on closure.	
11b	Visual	Reclamation of D2 - Old Plant Discard Dump		Operational	No mitigation measures proposed.			
11c	Visual	Reclamation of D3 - Supply Chain Discard Dump		Operational	No mitigation measures proposed.			
11d	Visual	Reclamation of Slimes Dams		Operational	No mitigation measures proposed.			
12a	Socio-Economic	Reclamation of D1 - Old Plant Discard Dump	Jobs will be retained, providing income, therefore, having a further impact on the regional socio-economy aspects of the area, along with other benefits arising from the Social and Labour Plan.	Operational	Control	Prevent socio economic impacts by employment opportunities.	Where possible and feasible, local procurement of labour should be applied to ensure the maximum benefit to the impacted community	30 Years
12b	Socio-Economic	Reclamation of D2 - Old Plant Discard Dump		Operational	Control			
12c	Socio-Economic	Reclamation of D3 - Supply Chain Discard Dump		Operational	Control		Continuous skills and development training	
12d	Socio-Economic	Reclamation of Slimes Dams		Operational	Control		Implementation of approved Social and Labour Plan.	

1.5 Closure objectives and financial provision

The high-level mine closure objectives, as supportive to the vision, relate to the following:

- Rehabilitate disturbed mining area to such an extent that the mining area can be fully utilised as part of a game farming unit;
- Dispose of or demolish all infrastructure that cannot be included in the game farming activity in a meaningful way; and
- Minimise potential negative socio-economic impact and maximise potential socio-economic benefit to leave a positive legacy.

1.5.1 Calculate and state the quantum of the financial provision required to manage and rehabilitate the environment in accordance with the applicable guideline

Refer to Section 19 of Part A.

1.5.2 Confirm that the financial provision will be provided as determined

Financial provision will be provided by means of both an allocation within the TIOM Trust Fund and through provision of a bank guarantee.

1.6 Mechanisms for monitoring compliance

The aim of environmental monitoring and auditing is to develop a cost-effective approach to monitoring the operations' environmental performance. Certain parameters (e.g. water quality) can be monitored through measurements, others can only be monitored through observation (e.g. maintenance effectiveness). However, in all cases anticipation of environmental problems through assessment of the environmental impact of the operations' working methods, followed by forward planning to prevent problems or at least limit their effects, is seen as the key to successful environmental management.

1.6.1 Monitoring at TIOM

The following management procedures have been developed and implemented to assist TIOM:

Table 47: Management Procedures at TIOM

Procedure Number	Description
TZ-SPR-MW-002	Legal Compliance
TZ-SPR-MW-012	Audits
TZ-OPR-MW-010	Management of Change
TZ-SPR-MW-007	Communication, Participation and Consultation
TZ-SPR-MW-006	Competence, Training and Awareness
TZ-SPR-MW-008	Document Control and Record Keeping

Procedure Number	Description
TZ-SPR-MW-001	Identification of Aspects / Impacts and Hazards / Risks
TZ-SPR-MW-014	SHE Management System Road Map
TZ-SPR-MW-004	MPs
TZ-SPR-MW-013	Management Review
TZ-SPR-MW-011	Non-Conformance and Incident Investigation and Reporting Procedure
TZ-SPR-MW-003	Objectives and Targets
TZ-OPR-MW-004	Resource Management Procedure
TZ-SPR-MW-005	Resources, Roles, Responsibilities, Accountability and Authority
TZ-SPR-MW-009	Procedure for emergency preparedness and response
TZ-OPR-MW-013	Fire
TZ-OPR-MW-022&24	Movement of WRD's
TZ-OPR-MW-041	Snake bites
TZ-OPR-MW-003	Spillages of chemicals
TZ-OPR-MW-076	Off-Site Emergencies and Crisis Management

The following procedures have been developed and implemented in order to manage activities relating to the environmental impacts of the mine:

Table 48: Procedures to manage environmental impacts at TIOM

Procedure Number	Description
TZ-OPR-MW-001	Waste Management Procedure
TZ-OPR-MW-002	Management of Hazardous Chemical Substance
TZ-OPR-MW-003	Spill Management Procedure
TZ-OPR-MW-004	Resource Management Procedure
TZ-OPR-MW-005	Equipment Lock Out Procedure
TZ-OPR-MW-006	Sewage Management
TZ-OPR-MW-008	Receiving, Storage and Disposal of Vehicle Batteries Procedure
TZ-OPR-MW-009	Wastewater Management
TZ-OPR-MW-010	Management of change
TZ-OPR-MW-013	Procedure for Fires and Fire Fighting Equipment
TZ-OPR-MW-016	Dust Suppression Procedure
TZ-OPR-MW-018	Pit and WRD Design, Control and Construction

Procedure Number	Description
TZ-OPR-MW-022	Stability Monitoring and Control of Pit Walls and WRDs Procedure
TZ-OPR-MW-076	Off-site Emergencies and Crisis Management
TZ-SPR-MW-010	Performance Measurement and Monitoring
TZ-OPR-MIN-001	Topsoil Management

1.7 Programme for reporting on compliance

Unless otherwise instructed by the Competent Authority (in this case, the DMRE) or as a condition to the authorisation / EMPr approval, environmental compliance audits on the EMPr will be undertaken on a biennial basis (every second year), and the resultant audit reports will be submitted to the DMRE. The auditing process, as well as report format will comply with the requirements as contained in the EIA Regulations, GN R982, dated December 2014, as amended.

1.8 Environmental awareness plan

1.8.1 Manner in which the applicant intends to inform his or her employees of any environmental risk which may result from their work

The following Environmental Awareness Training will be implemented by TIOM in order to inform employees and contractors of the environmental risk that may result from their work, or the risk of their interaction with the sensitive environment. The training will be conducted as part of the induction process for all new employees (including contractors) that will perform work in terms of the proposed activities. Proof of all training provided must be kept on-site.

The Environmental Awareness Training will, as a minimum cover the following topics:

Air Quality

- Activities that may result or mitigate impact on air quality; speeding on roads, the requirements for dust suppression, covering of haul trucks etc; and
- Negative impacts on the receiving environment if mitigation measures are not implemented.

Surface and groundwater

- Risks to surface and groundwater, e.g. spillages from slimes dam and discard dump;
- How incidents should be reported, and emergency requirements;
- The importance of storm water control, maintenance of surface water runoff canals infrastructure; and
- The importance to reuse water and to prevent spillages.

Cultural Heritage

- To remain within working areas and not to enter or interfere with any cultural heritage.

Fauna

- Overview of the fauna found on site and the uniqueness thereof;
- Mitigation measures that all contractors and employees need to abide by; and
- No contractor or personnel allowed to catch or kill any species, and how any sightings should be reported if further actions are required (e.g. to catch and release).

Flora

- Overview of the flora diversity on site, and the rare and endangered nature thereof;
- Measures taken by the mine to protect species; and
- No contractor or personnel allowed to remove, harvest or destroy any flora species unless clearly instructed based on the construction and operational plans.

Waste management

- The correct segregation of general and hazardous waste;
- Do's and don'ts with respect to waste disposal; and
- Measures to avoid waste generation and to participate in waste minimisation/reduction strategies.

Traffic

- Abide by traffic rules, no speeding allowed;
- To stay on designated roads (and not to drive on areas that are not fit and designed for this purpose); and
- To be aware of the fauna species and to be on the lookout and avoid collisions.

Natural Resource Consumption

- Minimise unnecessary use of energy by making use of energy saving devices, switching off non-essential appliances etc; and
- Optimise utilisation of mining and plant equipment, travelling routes etc.

Emergency Preparedness and Response

- How to report any emergency or incident.

General rules and conduct

- Respect for the sensitive environment;
- Do not litter;
- HIV/AIDS awareness;
- Respect for each other and for different cultures; and
- Safety and health requirement.

1.8.2 Manner in which risks will be dealt with in order to avoid pollution or the degradation of the environment

1.8.2.1 Training Awareness and Competence

Environmental training takes place on various levels within the organization at Thabazimbi Iron Ore Mine. The training process is governed by the system procedure on training (TZ-SPR-MW-006). All

employees are compelled to go through a process of general environmental awareness training. In support of the environmental awareness training additional competency training is done on a pre-determined and scheduled basis. The effectiveness of the training is tested on a regular basis through internal and external audits.

- The importance of the SHE Policy and Management System;
- Significant SHE risks of their work activities and the benefits of improved personal performance;
- Their roles and responsibilities in achieving conformance with the requirements of the management system; and
- The potential consequences of departure from specified operating procedures.

1.8.2.2 Communication and Consultation

Formal internal communication regarding Thabazimbi Mine's SHE hazards occur through the appropriate forums specified in the procedure in procedure referenced TZ-SPR-MW-0015 – Communication, TZ-SPR-MW-016 – Consultation and engagement . Informal communication to all employees is conducted through campaigns, posters, memos, etc;

Consultation on policies and procedures occur internally through established processes and forums. The General Manager handles external communication with local authorities and other interested parties. External communication of the significant SHE risks will occur and be driven by the General Manager.

1.8.2.3 Document Control and Records

An electronic document management system is used as a mechanism to ensure that the latest version of documentation is available mine wide and to meet the document control requirements. The SHE Policy, procedures in procedure referenced TZ-SPR-MW-008 and records are distributed, approved and controlled according to the requirements of ISO 45001 and ISO 14001.

1.8.2.4 Emergency Preparedness and Response

SHE risks associated with emergency situations are prevented or mitigated through applying the Emergency Preparedness and Response Procedure in procedure referenced TZ-SPR-MW-009. The procedure includes a list of emergencies that occur on site with reference to the appropriate procedure. The procedures are tested on a frequent basis through emergency drills where practicable.

1.8.2.5 Checking and corrective action

The effective operation of the management system is maintained through the following measures:

Monitoring and Measurement

Occupational Health monitoring is conducted internally with the aim of identifying areas or activities which could cause ill health or safety incidents / accidents. Corrective steps are taken to rectify any deficiencies identified.

Inspections are performed to provide additional means of verifying effective implementation of actions to minimise SHE risks (TZ-OPR-MW-007).

Periodic environmental legal compliance assessments are performed to determine the level of compliance with regards to environmental legal requirements. During this assessment compliance to other requirements are also assessed.

Environmental monitoring is conducted to identify and monitor the key characteristics of Thabazimbi Mine's activities, which might have an impact on the environment or health of their employees or the community. All monitoring results are recorded and used in the development of MPs to implement corrective actions.

This is done in procedure in procedure referenced TZ-SPR-MW-010.

Physical Monitoring

Thabazimbi Iron Ore Mine monitors the significant aspects and impacts on the environment in accordance with a pre-determined frequency. The results obtained from the environmental monitoring exercises feed into the EMS (ISO 14 001). The Monitoring and Measurement Procedure (TZ-SPR-MW-010) describes the basis of the various monitoring programs conducted throughout the mining area.

Monitoring is done on various aspects of the mining activities. The information generated during this exercise is used for the following purposes:

- To assess compliance to legal requirements;
- To assess compliance with internal requirements;
- To identify potential trends;
- To set early warning levels (preventive action);
- To assess the level of achieving existing objectives and targets; and
- To set new objectives and targets.

Monitoring results are thus actively used and not generated for the sake of fulfilling legal requirements. The following key characteristics are monitored:

- Water;
- Air;
- Vegetation;
- Erosion;
- Waste; and
- Energy consumption.

Non-Conformance and Corrective and Preventive Action (TZ-SPR-MW-011)

Any problem affecting safety, health of employees or the state of the environment is regarded as important is be addressed by reporting, investigating the incidents and initiating corrective and preventive actions to eliminate the direct causes.

Records

Records of SHE activities are maintained to demonstrate conformance to the requirements of the management systems, regulated in procedure referenced TZ-SPR-MW-008.

Management System Audit

The SHE Management System is audited on a regular basis to ensure conformance to SHE legislation, and requirements of the ISO45001 and ISO 14001 standards. The process for scheduling, planning and execution of the internal SHE Management System Audits are defined in procedure referenced Inspection, audits and reviews – TZ-SPR-MW-022.

Management Review

To ensure that the SHE Management System comply and meet internal requirements, the system is regularly reviewed to ensure its continuing suitability, adequacy and effectiveness. This review is performed by top management on an annual basis. This is regulated in procedure referenced Inspection, audits and reviews – TZ-SPR-MW-022.

1.9 Specific information required by the Competent Authority

Ref No.	Department Comment	Shangoni Management Services Response
3	Please ensure that comments from all relevant stakeholders are submitted to the Department with the Environmental Impact Assessment Report (EIAR). This includes but is not limited to the Provincial Heritage Resources Authority, Provincial Environmental Department, Department of Agriculture, Forestry and Fisheries (DAFF), Department of Water and Sanitaton (DWS), Department of Economic Development, Environment and Tourism (LEDET) and the local Municipality. Proof of correspondence with the various stakeholders must be included in the EAIR. Should you be unable to obtain comments. Proof of the attempts that wree made to obtain comments should be submitted to the Department.	Shangoni takes note of this comment. The EIAR / EMPr will be submitted to the relevant Departments as indicated.
4	In addition, the following amendments and additional information are required for the EIR and EMPr:	
4a	Details of the future land use for the site and infrastructure after decommissioning in 20-30 years	Future land use will be in line with the Closure objectives as identified in Section 1.5 of Part B above.
4b	The total footprint of the proposed development should be indicated.	Shangoni takes note of this comment. The total footprint is indicated in Table 3 of Section

Ref No.	Department Comment	Shangoni Management Services Response
		4.1 of Part A above.
4c	Possible impacts and effects of the development on the vegetation ecology with regard to lowland-highland interface in the locality should be indicated.	Shangoni takes note of this comment. Refer to Section 7.5.1 of Part A for the risks and Section 1.4. of Part B above for the mitigation measures associated with the project.
4d	Possible impacts and effects of the development on the surrounding industrial area.	Shangoni takes note of this comment. Refer to Section 7.5.1 of Part A for the risks and Section 1.4. of Part B above for the mitigation measures associated with the project.
4e	A construction and operational phase EMPr to include mitigation and monitoring measures.	Shangoni takes note of this comment. Refer to Section 1.4. of Part B above for the mitigation measures associated with the project.
6	Please ensure that the EIAR includes the A3 size locality maps of the area and illustrates the exact location of the proposed development. The maps must be of acceptable quality and a minimum, have the following attributes: • Maps are relatable to one another; • Co-ordinates; • Legible legends; • Indicate alternatives; and • Scale.	Shangoni takes note of this comment. A3 size maps are included in Annexure A of this EIAR / EMPr.
7	Further, it must be reiterated that, should an application for Environmental Authorisation be subjected to any permits or authorisations in terms of the provisions of any Specific Environmental Management Acts (SEMAs), proof of such application will be required.	Shangoni and TIOM takes note of this comment.
8	You are requested to submit three (3) hard copies of the EIAR and EMPr and at least one electronic copy (CD/DVD) of the complete EIAR and EMPr to this Regional Office	Shangoni takes note of this comment. Submission of three hard copies and an electronic copy of the EIAR and EMPr will submitted to the Regional Office.

2 Undertaking

The EAP herewith confirms

- the correctness of the information provided in the reports ☒
- the inclusion of comments and inputs from stakeholders and I&APs; ☒
- the inclusion of inputs and recommendations from the specialist reports where relevant; ☒and
- the acceptability of the project in relation to the finding of the assessment and level of mitigation proposed; ☒

TO BE SIGNED ON FINAL

_____ _____

Signature of EAP **Date**

3 Declaration of independence

Shangoni hereby declares that it is an independent auditor in that it has no business, financial, personal or other interest in this project in respect of which Shangoni is appointed. Furthermore, no circumstances exist that may compromise the objectivity of Shangoni, excluding fair remuneration for work performed in connection with this project.

Report compiled by:	**TO BE SIGNED ON FINAL** **Marvin Grimett** **TO BE SIGNED ON FINAL** **Minnette Le Roux**	**Report reviewed by:**	**TO BE SIGNED ON FINAL** **Brian Hayes (Pr Eng)**