DMRE REFERENCE:

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2023

FINAL SCOPING REPORT FOR THE THARISA WASTE ROCK DUMP NAMED: TAILINGS STORAGE FACILITY 3 WASTE ROCK DUMP EXTENSION 1, NEAR MARIKANA

/ Solutions

mineral resources

Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

FINAL SCOPING REPORT

FOR LISTED ACTIVITIES ASSOCIATED WITH THE MINING RIGHT FOR THE PROPOSED THARISA WASTE ROCK DUMP NAMED: TAILINGS STORAGE FACILITY 3 (TSF3) WASTE ROCK DUMP (WRD) EXTENSION 1 IN TERMS OF REGULATION 16 OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (ACT 107 OF 1998) (NEMA): ENVIRONMENTAL IMPACT ASSESSMENT (EIA) REGULATIONS 2014 (AS AMENDED), IN RESPECT OF (NW) 30/5/1/2/3/2/1/358EM

SUBMITTED FOR ENVIRONMENTAL AUTHORIZATIONS IN TERMS OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 AND THE NATIONAL ENVIRONMENTAL MANAGEMENT WASTE ACT, 2008 IN RESPECT OF LISTED ACTIVITIES THAT HAVE BEEN TRIGGERED BY APPLICATIONS IN TERMS OF THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT, 2002 (MPRDA) (AS AMENDED). AN AMENDMENT IN TERMS OF SECTION 102 OF THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT (ACT 28 OF 2002): SECTION 23 (A), (B) AND (C) READ TOGETHER WITH REGULATION 11(1) (G). NATIONAL WATER ACT, ACT 36 OF 1998 (NWA) IN TERMS OF SECTION 40. THE NATIONAL HERITAGE RESOURCES ACT (NO. 25 OF 1999).

NAME OF APPLICANT: THARISA MINERALS (Pty) Ltd (Tharisa)

FILE REFERENCE NUMBER SAMRAD: (NW) 30/5/1/2/3/2/1/358EM

FINAL SCOPING REPORT FOR THE THARISA WRD NAMED: TSF 3 WRD EXTENSION 1, NEAR MARIKANA

Prepared by

OMI SOLUTIONS (PTY) LTD

On behalf of

THARISA MINERALS PTY LTD

In respect of

DMRE REFERENCE: (NW) 30/5/1/2/3/2/1/358EM

Dated:

AUGUST 2023

OMI SOLUTIONS (PTY) LTD
Registration Number: 2018/343416/07
VAT Number: 4190288177
BBEE Level 2
Director: Robyn Sally Mellett

DOCUMENT PREPARED BY

OMI SOLUTIONS (Pty) Ltd
Registration Number 2018/343416/07
VAT: 4190288177
BBBEE Level 2

WISA Membership: 10615

Mountain Honey Estate
74 Sterkfontein Ave
Doornkloof East
Pretoria
0157

Telephone: +27 79 494 7771
Email: info@omisolutions.co.za

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AUTHORS		
Name	Nosipho Sithole	Chantal Uys
Designation and Professional Registrations	Environmental Assessment Practitioner, Cand. EAP (EAPASA)	Assistant Director Operations, Reg. EAP (EAPASA)
Date	15 June 2023	7 June 2023
REVIEW		
Name	Reneé Kruger	
Designation and Professional Registrations	Director of Environmental Licensing Pr.Sci.Nat; Reg EAP (EAPASA)	
Date	19 June 2023	
UPDATE FOLLOWING PUBLIC REVIEW		
Name	Nosipho Sithole	Chantal Uys
Designation	Environmental Assessment Practitioner, Cand. EAP (EAPASA)	Assistant Director Operations, Reg. EAP (EAPASA)
Date	01 August 2023	07 August 2023
CLIENT APPROVAL		
Name	Patrick Sibuyi	
Designation	Environmental Coordinator	
Date	07 August 2023	

PLEASE NOTE:

The outline of this report was compiled in terms of the official scoping report template provided by the Department of Mineral Resources and Energy (DMRE). Where repetition occurs as a result of the template being used, the relevant information will be cross referenced. An executive summary of the most important aspects of the report is provided in order to assist the reader. The DMRE template furthermore requires the report to contain preliminary impacts and provide mitigation measures for the impacts identified. It should be noted that the identified impacts and mitigation measures will be subject to change in the Environmental Impact Assessment and Environmental Management Programme Report (EIA&EMPr) once the environmental specialist studies become available and input from Interested and/or Affected Parties (I&APs) are taken into consideration.

OBJECTIVES OF THE SCOPING PROCESS

The objectives of the scoping process are to, through a consultative process:

(a) identify the relevant policies and legislation relevant to the activity;

(b) motivate the need and desirability of the proposed activity, including the need and desirability of the activity in the context of the preferred location;

(c) identify and confirm the preferred activity and technology alternative through an impact and risk assessment and ranking process;

(d) identify and confirm the preferred site, through a detailed site selection process, which includes an impact and risk assessment process inclusive of cumulative impacts and a ranking process of all the identified alternatives focusing on the geographical, physical, biological, social, economic, and cultural aspects of the environment;

(e) identify the key issues to be addressed in the assessment phase;

(f) agree on the level of assessment to be undertaken, including the methodology to be applied, the expertise required as well as the extent of further consultation to be undertaken to determine the impacts and risks the activity will impose on the preferred site through the life of the activity, including the nature, significance, consequence, extent, duration and probability of the impacts to inform the location of the development footprint within the preferred site; and

(g) identify suitable measures to avoid, manage, or mitigate identified impacts and to determine the extent of the residual risks that need to be managed and monitored.

EXECUTIVE SUMMARY

INTRODUCTION AND BACKGROUND

OMI Solutions (Pty) Limited (OMI) was appointed by Tharisa Minerals (Pty) Ltd (Tharisa) to undertake the Environmental Authorisation (EA) Process for the proposed extension of the Tharisa Mine Waste Rock Dump (WRD) at Tailings Storage Facility (TSF) 3 (hereafter referred to as "TSF 3 WRD Extension 1" Project).

Tharisa has an opencast Chrome and Platinum Group Metals (PGM) mining operation located on Farms K/Kraal 342 JQ, Rooikoppies 297 JQ and Elandsdrift 467 JQ, south of Marikana in the North West Province. Tharisa has been in operation since November 2009 having an initial Mining Right 49/2009 (MR) effective 19 September 2008, issued on 13 August 2009 by the then Department of Mineral and Energy (DME)[1]. Tharisa subsequently applied for an amendment of the MR with the Reference Number: NW/30/5/1/2/2/358 MR, stamped 28 July 2011 however registered in 2016. Current approvals allow for a Life of Mine (LoM) for the open pit mining of 17 years. The planned future underground mining may increase the LoM to approximately 40 years.

SUMMARY OF THE PROJECT

As part of its ongoing mine planning, Tharisa has identified the need for an additional mine residue stockpile for waste rock, which consists of a WRD extension to West WRD 1 at TSF 3. The WRD will be able to store 4.78 Mm^3 of waste from the West open pit area. The final height of the WRD will be 68 m with an estimated total footprint of approximately 23 ha. The WRD will have associated toe drainage, access roads and stormwater diversions.

REQUIRED ENVIRONMENTAL APPROVALS

Before Tharisa may commence with the proposed TSF 3 WRD Extension 1 the following EA and licence applications must be approved in accordance with the relevant national legislation:

- An Integrated application for Environmental Authorisation (IEA) in terms of the National Environmental Management Act 1998 (Act 107 of 1998) (NEMA) and for a Waste Management Licence (WML) in terms of the National Environmental Management: Waste Act, 2008 (Act 59 of 2008)[2] (NEMWA);
- Application for amendment to the current Environmental Management Programme (EMPr) approved by the Department of Mineral Resources and Energy DMRE in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002) (MPRDA) on 16 October 2013; and
- An Integrated Water Use Licence Application (IWULA) under the National Water Act, 1998 (Act 36 of 1998 (NWA) will be submitted for approval to the Department of Water and Sanitation (DWS).

OMI has been appointed as the independent Environmental Assessment Practitioner (EAP) to undertake the Scoping and Environmental Impact Assessment (EIA) process which is aimed at critically evaluating the potential environmental and social impacts of the proposed TSF 3 WRD Extension 1.

[1] Now known as the Department of Mineral Resources and Energy (DMRE).

2 As amended by the National Environmental Management: Waste Amendment Act 26 of 2014.

NEED AND DESIRABILITY

The Tharisa Mine is expanding its mining output and as such, additional waste rock and tailings is being produced. The current facilities are nearing their full capacity hence the need to develop new and expanding facilities. Several options were considered, and the most viable option as presented in **Section 8** of this report was selected.

The proposed TSF 3 WRD Extension 1 will occur within the approved MR area and existing access roads will be utilised, thereby reducing the environmental footprint while resulting in increased job security to employees. The main benefits of the Tharisa Mine TSF 3 WRD Extension 1 project are:

- Direct economic benefits will be derived from wages, taxes and profits (although to a smaller scale);
- Indirect economic benefits will be derived from the procurement of goods and services and the spending power of employees;
- Increased job security for employees;
- Continued economic mining of a known resources; and
- Contribution to the economic welfare of the surrounding community by creating working opportunities.

Furthermore, the project is aligned with the objectives of the MPRDA:

- To promote economic growth and mineral development in the Republic;
- To promote employment and advance the social and economic welfare of all South Africans;
- To ensure that the nation's mineral resources are developed in an orderly and ecologically sustainable manner while promoting justifiable social and economic development; and
- To ensure that holders of mining rights contribute towards the social-economic development of the area in which they are operating.

The Department of Forestry, Fisheries and the Environment (DFFE)[3] published an updated Guideline on Need and Desirability (2017) in terms of the Environmental Impact Assessment (EIA) Regulations of 2014 (GN R982 as amended). The key components are listed below and discussed in **Section 6** of this report.

- Securing ecological sustainable development and use of natural resources; and
- Promoting justifiable economic and social development.

ALTERNATIVES

The DFFE guidelines for an Integrated Environmental Management (IEM) procedure requires that an environmental investigation considers feasible alternatives for any proposed development. Furthermore, the EIA Regulations of 2014 (as amended) require that a number of alternatives for accomplishing the same objectives shall be considered.

Various alternatives have been assessed for the proposed TSF 3 WRD Extension 1 at scoping level, and workshopped during applicant, and engineering team interactions. The alternatives were also influenced by the existing baseline environmental data and specialist inputs. Alternatives investigated for this proposed TSF 3 WRD Extension 1 were as follows:

[3] At the time of publication, the Department of Environmental Affairs (DEA).

Site Location Alternatives

The proposed TSF 3 WRD Extension 1 is situated on various portions of the Farm K/Kraal 342JQ. As part of Tharisa's ongoing mine planning, the need for an additional mine residue stockpile for waste rock, which consists of a WRD extension to West WRD 1 at TSF 3 has been identified. Site location alternatives where limited. The proposed TSF 3 WRD Extension 1 will be located within the existing Mining Right boundary which is constrained for open space by surrounding uses mainly comprising mining activities. The N4 highway creates a barrier to the south of the TSF 3 WRD Extension 1 project area. Therefore, no other feasible site locations could be evaluated.

Layout Alternatives

The proposed TSF 3 WRD Extension 1 will be located within the existing MR boundary which is constrained for open space by surrounding uses mainly comprising mining activities. The N4 highway creates a barrier to the south of the TSF 3 WRD Extension 1 project area.

Some layout options have been evaluated during the initial phases of the project for the expansion of the WRD. These options are shown in **Figure 4** of this report. The alternative extension of the WRD would have been placed over a larger footprint and would have required the diversion of the Sterkstroom River. Therefore, after detailed evaluation, the Preferred Alternative WRD outside of the Sterkstroom floodline, was proposed and will be further evaluated throughout this EIA process.

Technology Alternatives

The following technology/activity alternatives were considered as part of the proposed TSF 3 WRD Extension 1. These include the following:

- Trucking waste rock to a different location: Open pit mining consists primarily of the removal of topsoil and overburden, drilling and blasting of ore, and the transportation of waste rock by haul trucks. Transportation of waste rock is cyclic in nature and requires the dispatch of a large number of trucks per month. Reducing the cycle time for transportation of waste rock results in increased productivity and reduces the operational costs. The proximity of the proposed TSF 3 WRD Extension 1 to the open pits allows for increased productivity, minimisation of transportation costs as well as minimisation of noise and traffic impacts associated with transportation of waste rock; and
- Waste rock backfill of open pits. The mine is currently in possession of authorisations for backfilling into the open pits, with waste rock, concurrent with mining. This is currently being undertaken; however the concurrent backfilling of the open pits has limitations resulting from unavailability of areas to backfill because mining is still continuing and also due to the fact that a portion of the open pits needs to remain open during operation, to allow for safe working within the open pits. Therefore, alternative space for WRD had to be evaluated and applied for.

No-Go Alternative

The assessment of this option requires a comparison between proceeding with the proposed TSF 3 WRD Extension 1 and not proceeding with the proposed TSF 3 WRD Extension 1. The "no-go" alternative would mean that the proposed TSF 3 WRD Extension 1 would not be established.

Not proceeding with the proposed TSF 3 WRD Extension 1 will leave the status quo as is with no additional negative social or environmental impacts than what is currently experienced, but will also not result in any possible positive impacts from the project being realised.

Not proceeding with the proposed TSF 3 WRD Extension 1 would create a restriction on mining leading to a temporary and/or permanent stopping of mining. The mine is continually generating more waste rock from

mining activities, than previously anticipated. Originally the mine designs allowed for backfill into the open pits. The pits have however reached capacity and the balance of waste rock which cannot be backfilled into the pits will require dumping on surface as no other feasible alternatives exist for waste storage. The proposed TSF 3 WRD Extension 1 will assist in providing time for Tharisa to better model and apply for additional required waste rock dumps going forward. The "no-go" option would not allow for the optimisation of the current mining operations and could potentially result in the closure of the mine.

PUBLIC PARTICIPATION

The Public Participation Process (PPP) is undertaken in line with Chapter 6 of the EIA Regulations (2014) (as amended). The process will be undertaken to ensure compliance with the requirements in terms of the MPRDA (as amended), EIA Regulations (2014) (as amended), as well as the IWULA requirements in terms of the NWA.

The PPP as required by the environmental laws and regulations specified therein will be followed as best practice.

The PPP will be undertaken in line with the statutory requirements for public participation. The following legislation will be considered when developing and implementing the PPP:

- National Environmental Management Act, 1998 (Act No. 107 of 1998)
- Public Participation guideline in terms of NEMA;
- The EIA Regulations, 2014 (as amended);
- The Constitution of the Republic of South Africa, 1996;
- Protection of Personal Protection Act, 2013 (Act No. 4 of 2013) (POPIA);
- Promotion of Access to Information Act, 2000 (Act No. 2 of 2000) (PAIA); and
- International good-practice guidelines for public participation and the Core Values of the International Association for Public Participation.

The table below provides an overview of communication and engagement tools that supported the implementation of this public participation for the project.

Engagement Tool	Description
Background Information Document (BID)	The BID provided important information regarding the following: • A project description of the proposed TSF 3 WRD Extension 1 project; • The Scoping and EIA and the PPP to be undertaken in support of the relevant environmental authorisations/licences and the contact details of the EAP and the stakeholder engagement consultants; • Details about how stakeholders can register as an Interested and Affected Party (I&AP) and be kept informed about the project developments; and • The public review and comment period for environmental reports. The BIDs were emailed on 29 June 2023, and hand delivered to project stakeholders registered in the stakeholder database. An I&AP Comment and Registration form was sent out to stakeholders to register formally and/or to submit comments.
Newspaper Advertisements	Advertisements notifying the public of the submission of the IEA Application as well as the process to be followed; and requesting I&APs to register their comments with the EAP, were placed in English in two (2) local newspapers on 29 June 2023 in accordance with regulation 41(2)(c) and (d) of the EIA Regulations 2014 (as amended).

Engagement Tool	Description
Site Notices	To inform surrounding communities and adjacent landowners of the proposed TSF 3 WRD Extension 1, notice boards (in accordance with regulation 41(2) (a) of the EIA Regulations 2014 (as amended) were erected at key locations surrounding the MR area and at the entrance to the mine. Notices were placed in English, Afrikaans and Setswana and included a locality map of the project site.
Notification Letters	Notification letters were distributed in English to the identified organs of state and potential I&APs as discussed above. An email was sent to stakeholders to inform them about the proposed TSF 3 WRD Extension 1. A Comment and Registration Form was also provided for stakeholders to use for formal registration and to submit their comments or concerns. Comments received were responded to telephonically or via email depending on the contact details provided.
Public Open day	A public open day was held during the review period of the Draft Scoping Report (DSR) to provide I&APs with the opportunity to raise issues and comments and ask specific questions in the presence of the relevant consultants on the project as well as to explain the authorisation process and associated timelines. The public open day took place on Wednesday, 12 July 2023, at the Mmaditlhokwa Community Centre from 11:00 am to 16:00 pm. A separate Focus Group meeting was also held with the directly affected community of Lapologang on Tuesday, 18 July 2023, from 11:00 am to 15:00 pm, at the Lapologang Sportsground.

The DSR was placed on public review for a period of 30 days from **29 June 2023 to 28 July 2023**. The comments received are included in this Final Scoping Report (FSR). All comments received from I&APs and organs of state and responses are included in this FSR and will also be included in the Draft and Final Environmental Impact Assessment Reports to be submitted to the Competent Authority (CA), the DMRE.

ENVIRONMENTAL BASELINE

Climate

The Tharisa Mine falls within the Highveld Climatic Zone (semi-tropical region) which is characterised by moderately warm temperatures, with mild dry winters and hot summers. The area experiences hot temperatures during summer, with maximum of 36.4°C for the month of October. Winter temperatures are relatively low especially in the months of May to July. The average annual precipitation in the region ranges from 650mm (west) to 900mm (east) (WRC, 1994). Rainfall is generally in the form of thunderstorms and these can be of high intensity with lightening and strong gusty south-westerly winds.

Topography and Drainage

The Tharisa Mine is situated on slightly undulating plains and located to the west of the perennial Sterkstroom River. The Tharisa Mine is in the in the Crocodile (West) and Marico Water Management Area (WMA) and is located mainly in the Quaternary Catchment Area (QCA) A21K. The Crocodile River is a major tributary of the Limpopo River (Drainage Region A) which discharges into the Indian Ocean (Mozambique). The Pienaars, Apies, Moretele, Jukskie, Hennops, Magalies and Elands rivers are all major tributaries of the Crocodile River which make up the A20 tertiary hydrological catchment with its 39 quaternary catchments (GCS, 2022). The project area is drained mainly by means of surface run-off (sheetflow) with storm water collecting along roads and footpaths cutting through the area, to drain into the perennial rivers that occur to the east of the proposed TSF 3 WRD Extension 1 area.

Geology

The project site's geological and hydrogeological setting consists mainly of a shallow weathered bedrock aquifer with intergranular porosity and permeability. According to the 1:500 000 Hydrogeological map series 2526 Johannesburg (Barnard and Baran, 1999), the project site is underlain by fractured (b3) and intergranular and fractured (d3) aquifers. The surface lithology is characterised by quartzite and dolerite, anorthosites and pyroxenite.

Soil and Land Capability

Two types of soil forms were identified on site as follows:

- Shallow rocky soil of the Mispah / Glenrosa soil form /.exposed bedrock on slightly undulating plains; and
- Deep, red apedal soils of the Hutton soil form.

A third classification was identified as "degraded areas" where the topsoil has been disturbed and often removed (mining areas – not described).

The current vegetation at the proposed TSF 3 WRD Extension 1 site of development consists mainly of areas of native woody perennial species (often encroached) and unpalatable grasses (low quality grazing grass species due to previous overgrazing) on the red apedal soils. Mixed quality grazing (highly palatable and unpalatable grasses) occurs in the low-lying areas that can support limited grazing by livestock. The nature of the vegetation and size of the properties make the area marginal for extensive livestock production. Using planted pasture to supplement livestock production is also not an option, considering the limited water availability for extensive irrigation. Overall, the project site is classified as Moderate potential arable with Moderate to Low potential grazing land.

Hydrogeology

A hydrogeological risk-based approach was undertaken for the proposed TSF 3 WRD Extension 1, considering the Source-Pathway-Receptor model as follows:

<u>Source</u>

- The 2022 geochemical leach tests and waste assessment results classified as Type 3 based on the Total Concentration Thresholds (TCT) (solid phase), but no Leachable Concentration Threshold (LCT0) (liquid phase or leachable concentrate) exceedances were observed. Therefore, the waste can be considered as equivalent to Type 4 with a low impact to the surface water and groundwater pathways (Risk Based Approach).
- The Long-term monitoring data spanning over 10 years (± 1 300 analyses) providing more accurate real-time data compared to laboratory short term tests, show that:
    - Manganese concentrations exceeded the South African Nation Standard (SANS) 241 (2015) limit for upstream surface water and off-site groundwater. The upstream surface water exceeds the manganese SANS 241 (2015) limit 11.9% of the time with the ≥P95 values only marginally exceeding (P95 = 0.16mg/l, max= 0.71 mg/l), the upstream groundwater exceeding the SANS 241 (2015) limit 7.4% of the time (P95=0.2mg/l and max=0.578mg/l) and the downstream groundwater only marginally exceeding in the 3 samples (max = 1.04 mg/l). It does not originate from the mine residue and is inferred to occur naturally in the geology.
    - Nitrate concentrations did not exceed the leach tests LCT0 but exceeded the SANS 241 Drinking Water Standard for upstream groundwater, on-site groundwater, downstream surface water and process water. Nitrate originates from mining explosives (ammonia nitrate based) and is not from the mine residue. Nitrate degrades with time due to denitrification and has a

proven half-life of ± 100 - 150 days. The water quality impacts from groundwater are insignificant due to the slow migration rates. Nitrate impacts and concentrations >11 mg/L are confined to <500 m from mine residue facilities (SANS 241 Drinking Water Standard).

- The monitoring results confirmed that only Nitrate is a potential mass migration parameter. The fact that it degrades means that it is an operational impact as it would decay completely after 5 - 10 years of operations in the sources.

Pathway

- The mean onsite groundwater levels are 15.8 mbgl and the mean off-site upstream groundwater levels are 11.8 mbgl. Off-site groundwater levels are shallower than onsite groundwater levels which is expected based on the localised groundwater dewatering cone.
- The pathway consists of low permeability weathered/fractured rock with two known fault structures and a dyke that could act as preferential pathway zones.
- Based on the Aquifer testing results, the aquifer classifies as a minor aquifer, with moderate to low permeability (1 – 1e-03 m/d) and typical low borehole yields of 0.1 - 1 L/s.

Receptors

- The proposed TSF 3 WRD Extension 1 site is a brownfield site, with existing impacts of 10 years' monitoring data that were analysed, and impacts verified. The data could also be used to calibrate the flow and transport models to result in high confidence outputs.
- The downstream receiving environment land use is mostly mining and industrial with the Sterkstroom River as the main receptor.
- From previous mass migration modelling conducted within the area (Artesium Consulting Services, 2022a; Artesium Consulting Services, 2022b) and current monitoring data analysed, Nitrate mass migration does not exceed ± 500 m from mining sources.

Surface Water

The following watercourse is located within the vicinity of the proposed TSF 3 WRD Extension 1 area:

- The Sterkstroom River which is a perennial watercourse that flows from the Buffelspoort Dam, south of the N4, in a northerly direction through the centre of the project area.

No wetland was identified within the area. The Sterkstroom River represents a perennial floodplain river channel with riparian woodland. The perennial Sterkstroom River can be described as a floodplain river or a lowland river and is not classified as a floodplain wetland, but a river with some wetland characteristics in the channel and its banks.

The vegetation associated with the floodplain is mostly microphyllous woodland and hygrophilous grasses in the project area. Species such as *Searsia lancea*, *Combretum erythrophyllum*, *Vachellia karroo*, *Ziziphus mucronata* and *Searsia pyroides* mostly grow in the riparian floodplain area, together with grass species such as Sporobolus africanus and Eragrostis rotifer. Small depressions have formed on the floodplains where water "takes a short-cut" over the floodplain during flood events.

Evidence was observed on site of transformation of the floristic characteristics of the site at least to some extent. Impacting activities which may have altered the expected floristic composition include alien infestation, mining activities and road crossings.

Anthropogenic disturbance of soil and primary vegetation have altered the natural hydrological functioning of the drainage systems associated with the proposed TSF 3 WRD Extension 1 project area.

The reference state of the Sterkstroom River was probably Class B that changed to a Class C. The drainage system as an entity has a Class C Present Ecological State (PES) (Moderately Modified). The riparian woodland plays an important role as a corridor for fauna in the area and has been impacted by upstream agricultural activities and road crossings. The state of the individual hydrologic component functions is as follows:

- Hydrologic: Class D – Largely Modified;
- Water quality: Class C: Moderately Modified;
- Hydraulic / Geomorphic: Class C: Moderately Modified; and
- Biota: Class C: Moderately Modified.

Considering the importance of the fauna corridor as well as the red data species associated with the wetlands, the area has a Moderate Ecological Importance and Sensitivity (EIS). This Hydrogeomorphic (HGM) unit is therefore considered to be ecologically sensitive and important. The biodiversity of this riparian zone may be sensitive to flow and habitat modification, while the channel plays a significant role in moderating the quantity and quality of water entering downstream areas.

Terrestrial Biodiversity (Flora and Fauna)

Desktop Assessment

- The proposed TSF 3 WRD Extension 1 falls within the Critical Biodiversity Area (CBA) 2 and Ecological Support Area (ESA) 2 areas. Although the actual WRD footprint is in CBA 2 and ESA 2, these areas represent zero sensitivity (due to the already established mining infrastructure), low sensitivity and Medium-Low sensitivity areas characterised only by a few pockets of woodland, old fields and degraded grassland. These areas do not represent land that will contribute towards ecosystem functioning and should subsequently be classified as “Other Natural Areas” or “No Natural Habitat Remaining”.
- The Magaliesberg Protected Environment and Kgaswane Nature Reserve is located about 7.5 km to the South and South West of the project area. Furthermore, the project area is in the Magaliesberg Biosphere Reserve transition zone, although mining is a confirmed land-use for the transition zone.
- No National Protected Area Expansion Strategy (NPAES) occur within the project area, with the closest located roughly 10 km North East of the area, representing North West / Gauteng Bushveld.
- The Magaliesberg Important Bird Area (IBA) is located within the project area, although the actual Magaliesberg habitat is not represented on site.

Flora

- The proposed TSF 3 WRD Extension 1 falls within the Marikana Thornveld vegetation type which is considered Endangered.
- The state of the vegetation of the proposed project area varies from being slightly degraded to completely degraded. The vegetation units identified on the project site (TSF 3 WRD Extension 1) are as follows:
    - Mixed *Senegalia caffra – Combretum molle* woodland.
    - Secondary old fields
        - Degraded *Vachellia karroo* woodland.
        - Degraded grasslands.

- Degraded woodland / old farmstead / gardens.

- No red data species / species of conservation concern or protected plant species were documented during the site surveys.

- A few individuals of the protected tree *Sclerocarya birrea* (marula) occurred in isolated sections of the proposed TSF 3 WRD Extension 1 site and thus require a National Forest Act (NFA) (Act 84 of 1998) permit should they be removed.

Fauna

- There are two main faunal habitat types present on the site that might be impacted on by the proposed TSF 3 WRD Extension 1 namely:
  - Mixed woodland; and
  - Degraded grassland.
- Species observed on site include Single-striped Mouse, Scrub Hare, Common Mole-rat, Multimammate Mouse and Slender Mongoose. Mine shafts in the vicinity may provide suitable habitat for a few bat species.
- The mammals are mostly represented by generalised species such as rodents, scrub hares and smaller antelope (steenbok, common duiker) that will move through the area while foraging. The proximity of the informal settlements does however place constant pressure on these mammal populations and many of these populations will eventually disappear from the area completely. The natural habitats associated with the area will still support populations of herbivores such as duiker and steenbok. Most of the habitat types are degraded and fragmented, although the habitat that will still be utilised by small mammals, such as rodents, is still intact.
- Most bird species identified within the project area are common species known to nest within or utilise the degraded grassland and woodland habitat in the region and may be either permanently or occasionally present within the project area. According to Birdlife South Africa, the project area falls inside the Magaliesberg IBA, although in terms of habitat the site is not typical of the Magaliesberg habitat type for avifauna. The plains area where the proposed TSF 3 WRD Extension 1 is planned, represents microphyllous woodland and supports many smaller bird species such as Ashy Tit, Pied Babbler, Kalahari Robin, Burntnecked Eremomela, Desert Barred Warbler, Marico Flycatcher, PriritBatis, Crimsonbreasted Shrike, Longtailed Shrike, Threestreaked Tchagra, Great Sparrow, Whitebrowed Sparrowweaver, Scalyfeathered Finch, Violeteared Waxbill and Blackcheeked Waxbill. In general terms the open grassland patches in between the microphyllous woodland could attract the Secretarybird, White-bellied Korhaans, and White Stork and Abdim's Stork. However, the proximity to various mining areas and informal settlements means that disturbance levels in these areas are likely to be high due to humans, and hunting by dogs, and therefore the potential to find these species in the area are considered very low.
- There is a potential presence of some toads and sand frogs in the perennial river east of the site, as they only need temporary pools for reproduction and the riverine area may provide suitable habitat. Amphibian species potentially occurring in the area include Common River Frog, Natal Sand Frog, Gutteral Toad, Raucous Toad and Bubbling Kassina. Reptile species such as the Southern Rock Python, the Black Mamba, Puff Adder, Snouted Cobra, Boomslang, Vine Snake, Spotted Bush Snake and several members of the green snakes (*Philothamnus* spp.) is expected to occur in the larger area, although the potential to find these species in the project area is low due to the anthropogenic influences.

Overall, the ecological sensitivity of the TSF 3 WRD Extension 1 has been rated to be of Medium-Low sensitivity.

Air Quality Baseline

The Tharisa mine is surrounded by communities and settlements, with the Mmaditlhokwa community directly to the North and the Lapologang community directly to the West. The town of Marikana is located approximately 1.5 km to the north of the MR boundary, with a number of households, farmsteads, and schools in the immediate vicinity of the mine.

A dustfall network is currently in place comprising of 15 single dust buckets located at and around Tharisa Mine, and passive sampling is conducted at three locations to determine background SO_2 and NO_2 concentrations. SO_2 and NO_2 data available for inclusion in this study was limited to the period January to March 2021. Dustfall results covered the period January 2021 to April 2023. Results from the sampling campaigns are as follows:

- Results obtained for NO_2 and SO_2 for the months in review were well below the National Ambient Air Quality Standards (NAAQS).
- From the results of the monitoring period January 2021 – April 2023, it was found that dustfall at Sites 2 (toll gate), 3 (North of West Open Pit), 8 (school) 12 (Mmaditlhokwa 1), 13 (Mmaditlhokwa 2) and 20 (Mmaditlhokwa 3) exceeded the National Dust Control Regulations (NDCR) for residential areas (exceed 600 mg/m²/day). The NDCR allow for a permitted frequency of exceeding the dustfall rate of two exceedances within a year (not sequential months). Mmaditlhokwa 1 exceeded the NDCR four times during the 2021 year (with three sequential months during May, June and July) and is therefore not compliant, whereas during the year 2022 the exceedances at Site 3 (North of West Open Pit), 13 (Mmaditlhokwa 2) and 20 (Mmaditlhokwa 3) were within the permitted frequency of exceedances within a year. All sequential non-compliances exceedances were communicated to relevant departments as incidents and all applicable documentation in this regard were provided to the authorities.

Noise Baseline

The main findings of the noise scoping assessment were as follows:

- The closest potential sensitive receptors to the proposed TSF 3 WRD Extension 1 consist of the Mmaditlhokwa Community, Lapologang Community, Piet Retief Primary School and farmers.
- The surveyed baseline noise levels (during 2021 and 2022) were between 53 and 60 dBA during the day and between 48 and 59 dBA during the night.
- The estimated background noise levels were between 50 and 60 dBA during the day and between 45 and 50 dBA during the night.
- Tharisa is currently conducting noise surveys on a monthly basis following concerns from the nearby communities of Mmaditlhokwa and Lapologang.

Visual Landscape

The landscape character of the study is dominated by mining infrastructure. Mining activities occur to the north, and immediate West and East of Tharisa Mine. Amongst the mining activities North of the mine is open land mostly owned by mining companies and the community of Marikana. North of the project site, in the MR area, is the Mmaditlhokwa community, and East of the MR area is the Bokamoso community. The development of the TSF 3 WRD Extension 1, which is immediately adjacent to an approved TSF (TSF 3) and the existing West WRD 1, will not cause a major change to the existing character of the landscape.

The project area's scenic quality has been rated low within the context of the sub-region, and sensitive viewing areas and landscape types were identified and mapped, indicating potential receptor sensitivity to the project from properties West, South and East of the mine.

Impacts on views are the highest when receptors are identified as being sensitive to change in the landscape, and their views are focused on and dominated by the changes to the landscape. It is anticipated that a few I&APs might be sensitised to the proposed TSF 3 WRD Extension 1.

The proposed TSF 3 WRD Extension 1 will introduce a land uses currently occurring in the sub-region and within the mine itself and will cause a minor loss and alteration to the baseline's key features and characteristics (i.e. existing and approved infrastructure). The pre-development landscape and views will be slightly affected, but in a minor way, through the introduction of elements considered characteristic when set within the attributes of the receiving landscape. Low visual and sense of place impacts would result.

Socio-Economic Environment

The proposed TSF 3 WRD Extension 1 site is located in the Rustenburg Local Municipality (LM), a Category B municipality in the North West Province. It is one of five LMs together with Moses Kotane LM, Kgetlengrivier LM, Madibeng LM, and Moretele LM that forms part of the Bojanala Platinum District Municipality (DM).

In 2021, Rustenburg LM had a population of around 734 613 individuals residing in 263 700 households. This population represents approximately 37.8% of the total population of Bojanala Platinum DM and approximately 17.9% of the total population of the North West province. Furthermore, the average household size in Rustenburg LM is 2.8 people per household, which is lower than the district average of 3.0, the provincial average of 3.3, and the national average of 3.6. From 2018 to 2021, the municipality witnessed a significant average annual decline of 31.3% in serious crimes. However, it is noteworthy that in the year 2022, there was a notable increase of 18.3% in reported crimes. The exact reasons for this increase in crime during the specified period are uncertain. However, it is worth considering that the introduction of a new development project could potentially contribute to an increase in crime rates. The construction and operation of a project often attract a transient population, which can introduce new dynamics and challenges related to crime.

In 2020, approximately 15.0% of households in Rustenburg LM were estimated to have an annual income of R30,000 or less. This represents a slight decrease compared to the 2010 figure of 26.4% (Rustenburg LM, 2022). According to the Rustenburg LM's Integrated Development Plan (IDP), a majority of the population in the municipality falls within the low-income bracket, with average household incomes ranging between R192,000 and R360,000 per annum.

In 2021, the employed population in Rustenburg LM accounted for approximately 51% of Bojanala Platinum DM's total employed population. The working-age population (WAP) constituted 74% of Rustenburg LMs' total population, which translates to about 259 890 people. Only 67% of the WAP is economically active while 33% of the WAP is not economically active.

Heritage Resources

The proposed TSF 3 WRD Extension 1 area is situated in environments that have been transformed and degraded as a result of rural farming and mining and it might be assumed that these areas have largely been sterilised of heritage remains, especially those dating to prehistorical times. This inference was confirmed during an archaeological site assessment which identified poorly preserved heritage receptors. The following observations are made for the proposed TSF 3 WRD Extension 1:

- The remains of two Historical Period farmstead compounds (TWRD-HP01, TWRD-HP02) occur within the proposed TSF 3 WRD Extension 1 area and impact on the sites is likely. However,

dwellings and buildings at the sites have been demolished and only foundations structures and building rubble remain and the sites are of low heritage significance even though they are generally protected under the National Heritage Resource Act (Act 25 of 1999). It is recommended that the sites be monitored throughout all phases of the project since human burials occur in the general vicinity of the farmsteads outside the project area.

- A previous Heritage Impact Assessment undertaken in 2007 by Pistorius documented a small "unmarked" cemetery in the project area (TWRD-BP01, previously coded "GY05"). The Tharisa Environmental Officer indicated that all graves within mining areas had previously been relocated and Site GY05 could not be located during the site survey subject to the current assessment. It is nonetheless recommended that the relocated status of the burials be confirmed during the preconstruction phase by means of the perusal of the necessary accompanying documents and heritage permits in order to ensure that human remains are not damaged or lost.
- A partially intact concrete building foundation structure (TWRD-FT01) was noted in the project area. The structure remains are not of heritage significance and no further action in terms of heritage management or mitigation is required.

IMPACT AND MITIGATION

Key aspects identified by the EAP, specialists and I&AP's to be assessed as part of the EIA include inter alia:

- Groundwater and surface water impact and pollution;
- Stormwater management;
- Air quality pollution (dust and emissions);
- Noise pollution;
- Biodiversity impacts (Fauna and Flora);
- Impact on land use and land capability;
- Soil degradation and pollution;
- Visual impacts and sense of place;
- Heritage resource impacts;
- Socio-economic impacts; and
- WRD closure and rehabilitation.

Preliminary impacts without mitigation have been identified and management measures have been proposed by various specialists and are provided in **Section 13** and **Section 16** of this report. These impacts and management measures will be refined during the EIA phase.

WAY FORWARD

As part of the EA Process, a number of investigations will be undertaken and updated by suitably qualified specialists to gather baseline information pertaining to the current state of the environment as well as to identify the environmental impacts that may be associated with the proposed TSF 3 WRD Extension 1. The specialist studies to be undertaken include the following:

- Air Quality Impact Assessment;
- Terrestrial Biodiversity Impact Assessment;
- Wetland / Riparian Impact Assessment;

- Hydrogeological Impact Assessment;
- Phase 1 Heritage Impact Assessment;
- Noise Impact Assessment;
- Socio-economic Impact Assessment;
- Agro-Economic Impact Assessment;
- Visual Impact Assessment; and
- Stormwater Management Plan.

The following actions will be conducted for the process going forward:

- **Appointment of Specialists:** The identified specialists were appointed to undertake the specialist studies as identified in this SR for the EIA.
- **Completion of the PPP:** The comments received from I&APs on the DSR will be included and assessed in the Environmental Impact Assessment and Environmental Management Programme Report (EIA&EMPr).
- **Draft EIA&EMPr:** The results of the specialist studies will be synthesised by the project team to provide a draft EIA&EMPr.
- **Draft EIA&EMPR published:** The draft EIA&EMPr will be circulated to key I&APs for comment for a period of 60 days.
- **Revise Draft EIA&EMPr:** The draft report will be updated by addressing and responding to the issues raised by I&APs.
- **Final EIA&EMPr:** The revised final report will be published with the various specialist reports appended. This will be submitted to the DMRE for consideration.

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LIST OF ABBREVIATIONS

ABBREVIATION	DESCRIPTION
µg	Microgram
AIS	Alien Invasive Species
AQSR	Air Quality Sensitive Receptors
BID	Background Information Document
CA	Competent Authority
CBA	Critical Biodiversity Area
CRR	Comments and Responses Register
dBA	decibels A
DEA	Department of Environmental Affairs
DEAT	Department of Environmental Affairs and Tourism
DFFE	Department of Forestry, Fisheries, and the Environment
DM	District Municipality
DME	Department of Mineral and Energy
DMRE	Department of Mineral Resources and Energy
DSR	Draft Scoping Report
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EAPASA	Environmental Assessment Practitioners Association of South Africa
ECA	Environmental Conservation Act (Act 73 of 1989)
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EIA&EMPr	Environmental Impact Assessment and Environmental Management Programme Report
EIS	Ecological Importance and Sensitivity
EMPr	Environmental Management Programme Report
ESA	Ecological Support Area
FSR	Final Scoping Report
GIS	Geographic Information Systems
GLCs	Ground Level Concentrations
GN	Government Notice
GN704	Government Notice 704
GNR	Government Notice Regulation
GVA	Gross Value Added
ha	Hectare
HGM	Hydrogeomorphic
HIA	Heritage Impact Assessment
I&APs	Interested and Affected Parties
IAIAsa	International Association for Impact Assessment – South Africa
IBA	Important Bird Areas
IDP	Integrated Development Plan
IEA	Integrated Environmental Authorisation
IEM	Integrated Environmental Management
IUCN	International Union for Conservation of Nature
IWUL	Integrated Water Use Licence
IWULA	Integrated Water Use Licence Application

ABBREVIATION	DESCRIPTION
IWWMP	Integrated Water and Waste Management Plan
km	kilometres
L	Litre
LCT	Leachable Concentrate Thresholds
LM	Local Municipality
LoM	Life of Mine
m	metre
M^2	Square metre
M^3	Cubic metre
mbgl	metres below groundwater level
MG	Middle Group
mg	milligrams
MLM	Madibeng Local Municipality
Mm	millimetre
MPRDA	Mineral and Petroleum Resources Development Act
MR	Mining Right
NAAQS	National Ambient Air Quality Standards
NDCR	National Dust Control Regulations
NEMBA	National Environmental Management: Biodiversity Act (Act 10 of 2004)
NEMA	National Environmental Management Act (Act 107 of 1998)
NEMAQA	National Environmental Management: Air Quality Act, 39 of 2004
NEMWA	National Environmental Management: Waste Act (Act 59 of 2008)
NFA	National Forest Act (Act 84 of 1998)
NHRA	National Heritage Resources Act (Act 25 of 1999)
NPAES	National Protected Area Expansion Strategy.
NSR	Noise Sensitive Receptors
NWA	National Water Act (Act 36 of 1998)
OMI	OMI Solutions (Pty) Ltd
PAIA	Promotion of Access to Information Act (Act 2 of 2000)
PES	Present Ecological State
PGMs	Platinum-Group Metals
PM10	Thoracic Particulate Matter
PM2.5	Inhalable Particulate Matter
POPIA	Protection of Personal Information Act (Act 3 of 2014)
PPP	Public Participation Process
PW	Process Water
QDS	Quarter Degree Grid Square
ROD	Record of Decision
ROM	Run of Mine
SACNASP	South African Council for Natural Scientific Professions
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System
SANAS	South African National Accreditation System
SANRAL	South African National Roads Agency
SANS	South African National Standard
SCC	Species of Conservation Concern
TCT	Total Concentrate Thresholds
TDS	Total Dissolved Solids
TSF	Tailings Storage Facility

ABBREVIATION	DESCRIPTION
TSP	Total Suspended Particulates
US EPA	United States Environmental Protection Agency
WAP	Working-Age Population
WMA	Water Management Area
WML	Waste Management Licence
WRD	Waste Rock Dump
WRF	Weather Research and Forecasting
WUL	Water Use Licence
WULA	Water Use Licence Application

SCOPING REPORT

1 CONTACT PERSON AND CORRESPONDENCE ADDRESS

1.1 DETAILS OF THE EAP WHO PREPARED THE REPORT[4]

Name of the Registered Environmental Assessment Practitioner (EAP): Reneé Kruger

E-mail address: renee@omisolutions.co.za

1.2 EXPERTISE AND QUALIFICATIONS OF THE EAP

1.2.1 THE QUALIFICATIONS OF THE MAIN EAP

Reneé Kruger has a master's degree in Environmental Management from North West University. Preceding this Degree, she obtained a BSc Honours in Geography and Environmental Management and BSc in Geography and Zoology. She is registered as an Environmental Assessment Practitioner at Environmental Assessment Practitioners Association of South Africa (EAPASA) and as a Professional Natural Scientist with South African Council for Natural Scientific Professions (SACNASP). Reneé is also a voluntary member of International Association for Impact Assessment South African branch (IAIASA).

She has 15 years' experience working as an EAP, conducting and implementing the EIA Process throughout all phases – specialising in residential, mine, industrial, and commercial developments. Her experience also includes water and waste licence applications, integrated waste and water management plans and assisting with air emissions licences. She has extensive experience in conducting public participation processes and liaison with government departments. Furthermore, her experience is complemented by project management and geographic information systems (GIS) skills.

Please also refer to **ANNEXURE A: EAP'S QUALIFICATIONS**.

1.2.2 SUMMARY OF THE EAP'S PAST EXPERIENCE

A summary of the EAP project team is provided in **Table 1** below. A company profile with summary information of the OMI team's qualifications and experience is included in **ANNEXURE B.**

Table 1: Summary of the Details of the Team who Compiled the Report

Name	Designation	Input into Project	Qualifications & Professional Registrations
Reneé Kruger	Assistant Director of Environmental Licensing	Authority and client liaison, Specialist Management and input into Public Consultation	M Environmental Management, North West University Pr. Sci Nat. (SACNASP): 115667 Reg. EAP (EAPASA): 2019/854 IAIASA Membership: 6444
Annechris Sewards	Head of Project Management	Project Management	MSc (Comp Sci), Victoria University of Manchester BSc (Eng.) (Minerals Processing), University of the Witwatersrand IAIASA Membership: 6648

[4] Required as per the EIA regulations Appendix 2: 1. (a) details of- (i) details of-(i) the EAP who prepared the report; and (ii) the expertise of the EAP, including a curriculum vitae.

Name	Designation	Input into Project	Qualifications & Professional Registrations
Chantal Uys	Assistant Director Operations	Report Writing and Specialist Report review and Liaison	BSc Hons Archaeology Reg. EAP (EAPASA): 2019/2017 IAIASsa Membership: 5608
Nosipho Sithole	Environmental Assessment Practitioner	Report Writing, Specialist Report review and Liaison and input into Public Consultation	MSc Environmental Science, University of KwaZulu-Natal Reg. Cand. EAP (EAPASA) 2019/365 IAIASA Membership: 4003

DETAILS OF THE TEAM

ASSISTANT DIRECTOR OPERATIONS

Chantal Uys has an Honours degree in Archaeology from the University of Pretoria; subsequent to this degree she completed qualifications in Geographical Information Systems at the University of Pretoria and Environmental Management at the University of North-West. She is a voluntary member of the IAIASA and the Water Institute of South Africa (WISA).

Chantal has over 13 years' experience working in the environmental management field. She is experienced in the facilitation of Environmental Authorisation processes and the compilation of Environmental Management Programmes. She has experience in various other environmental authorisation processes such as Mining Right Applications, Water Use Licensing, Waste Licensing and assisting with Atmospheric Emission License Applications. She is also experienced in GIS Mapping, Environmental and Legal Compliance Audits, compiling Integrated Waste and Water Management Plan, public participation processes and project management. Her project experience is extensive in scope and covers all aspects of development from structures, roads, dams, bridges, bulk water and sewerage services to industrial, residential, and mining developments. She has project experience in South Africa as well as other African countries.

ENVIRONMENTAL ASSESSMENT PRACTITIONER

Nosipho Sithole has a master's degree in Environmental Science from the University of KwaZulu-Natal; subsequent to obtaining this degree she completed qualifications in Geography and Environmental Management at the University of KwaZulu-Natal. She currently registered as a Candidate Environmental Assessment Practitioner with the EAPASA and is a voluntary member of the IAIASA as well as a member Institute of Waste Management Southern Africa (IWMSA).

Nosipho has over 4 years' experience working in the environmental management field. She is experienced in the facilitation of Environmental Authorisation processes and the compilation of Environmental Management Programmes. She has experience in various other environmental authorisation processes such as Mining Right Applications, Water Use Licensing, Waste Licensing. She is also experienced in GIS Mapping, Environmental and Legal Compliance Audits, compiling Integrated Waste and Water Management Plan, public participation processes and project management. Her project experience is extensive in scope and covers all aspects of development from industrial, residential, mining and renewable energy developments.

HEAD OF PROJECT MANAGEMENT

Annechris Sewards holds an MSc in Computer Science and a BSc in Metallurgical Engineering. She has more than thirty years' experience in the mining/minerals processing sector, during which time she held senior positions in different functional units, including plant operations, projects, asset management & maintenance planning, IS&T, and strategic planning. She also has experience in the manufacturing industry, both in South Africa and in the United Kingdom. In the 12 years before joining OMI in 2020, she managed

projects as an independent consultant, in both mining/minerals processing and public sectors. Since February 2020 she has co-authored a variety of reports related to environmental licencing and compliance. Her practical experience in the mining and manufacturing sectors has provided insight into the day-to-day issues facing operations, the possible solutions and the obstacles to successful implementation of measures to limit environmental damage. This includes underground and surface operations.

2 DESCRIPTION OF THE PROPERTY[5]

The Tharisa Mine is situated within the Rustenburg Local Municipality (LM) and Madibeng LM which form part of the Bojanala Platinum District Municipality (DM) in the North-West Province.

Tharisa Minerals (Pty) Ltd is the owner of various portions of the farm K/Kraal[6] 342 JQ, Rooikoppies 297 JQ and Elandsdrift 467 JQ. These properties have been rezoned for mining and quarrying. The proposed Tailings Storage Facility Waste Rock Dump Extension 1 (TSF 3 WRD Extension 1) is situated on various portion of the Farm K/Kraal 342JQ as elaborated on in **Table 2**. The site is situated within the Tharisa Mining Right (MR) to the South East of the Lapologang Community and to the North of the N4 National Road connecting Pretoria and Botswana.

Table 2: Property Details

Farm Name:	K/Kraal 342 JQ	
Application Area (ha):	25 Ha	
Magisterial District:	Bojanala Platinum District Municipality	
Distance and Direction from Nearest Town	• 4.5 km South of Marikana • 1.3 km South east of Lapologang Village • 33 km West of Brits	
Farm Names and Portions and 21 digit reference number	**Portion**	**21 Digit Number**
	144	T0JQ00000000034200144
	145	T0JQ00000000034200145
	354	T0JQ00000000034200354
	352	T0JQ00000000034200352
	230	T0JQ00000000034200230
	Portion	**21 Digit Number**
	10	T0JQ00000000034200010
	235	T0JQ00000000034200235
	386	T0JQ00000000034200386
	234	T0JQ00000000034200234
	RE 146	T0JQ00000000034200146
	229	T0JQ00000000034200229
	RE 38	T0JQ00000000034200038

[5] Required as per the EIA regulations Appendix 2: (b) the location of the activity, including-(i) the 21-digit Surveyor General code of each cadastral land parcel; (ii) where available, the physical address and farm name; (iii) where the required information in items (i) and (ii) is not available, the coordinates of the boundary of the property or properties;

[6] The farm name has been abbreviated as K/Kraal. The full name of the farm is K/Kraal.

3 LOCALITY MAP[7]

The proposed TSF 3 WRD Extension 1 is situated on various portions of the Farm K/Kraal 342JQ. The regional locality and portions directly affected are shown in **Figure 1** and **Figure 2** respectively.

[7] Required as per the EIA regulations Appendix 2 (c): a plan which locates the proposed activity or activities applied for at an appropriate scale, or, if it is-(i) a linear activity, a description and coordinates of the corridor in which the proposed activity or activities is to be undertaken; or (ii) on land where the property has not been defined, the coordinates within which the activity is to be undertaken;

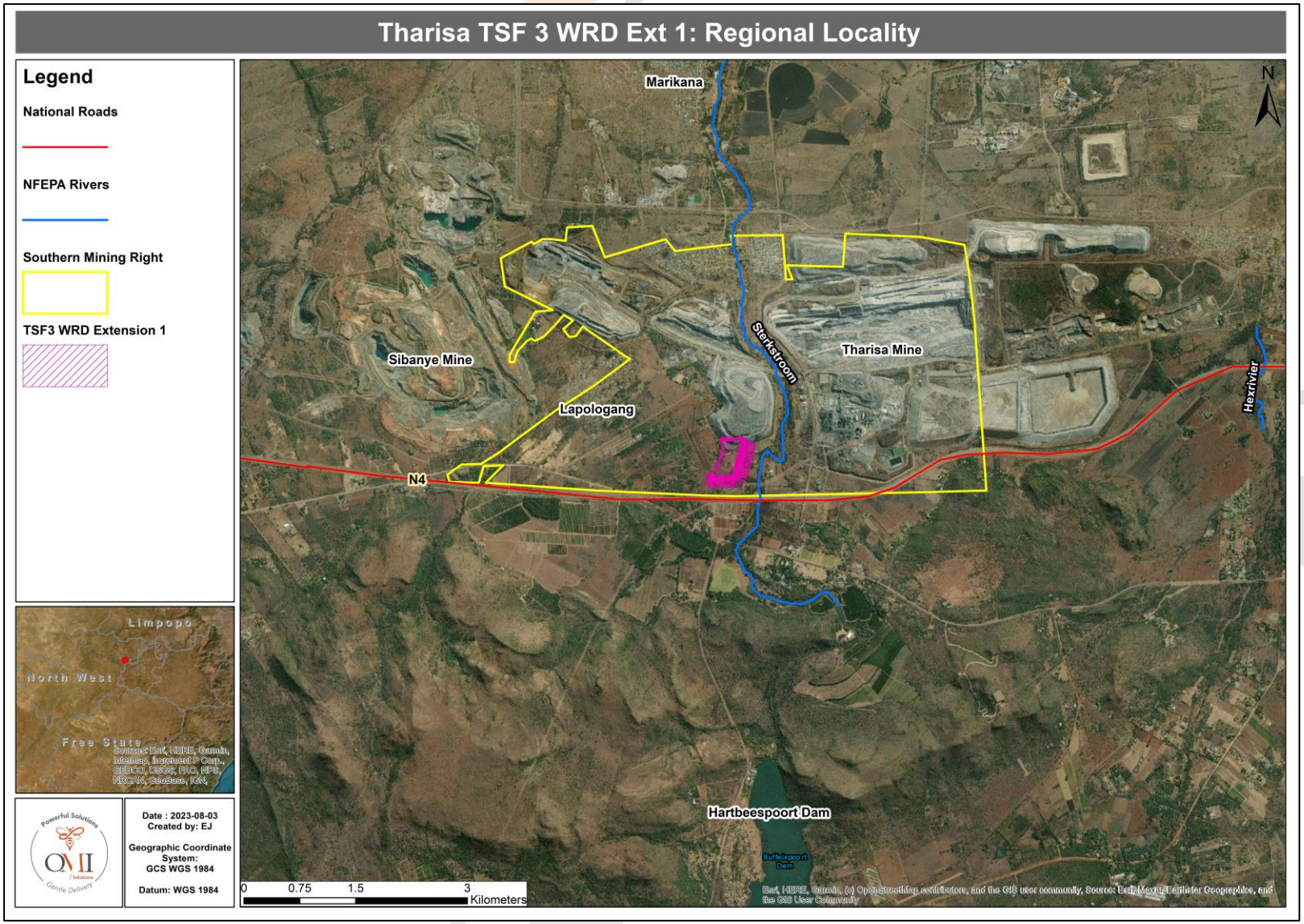


Figure 1: Regional Location of Tharisa Mine

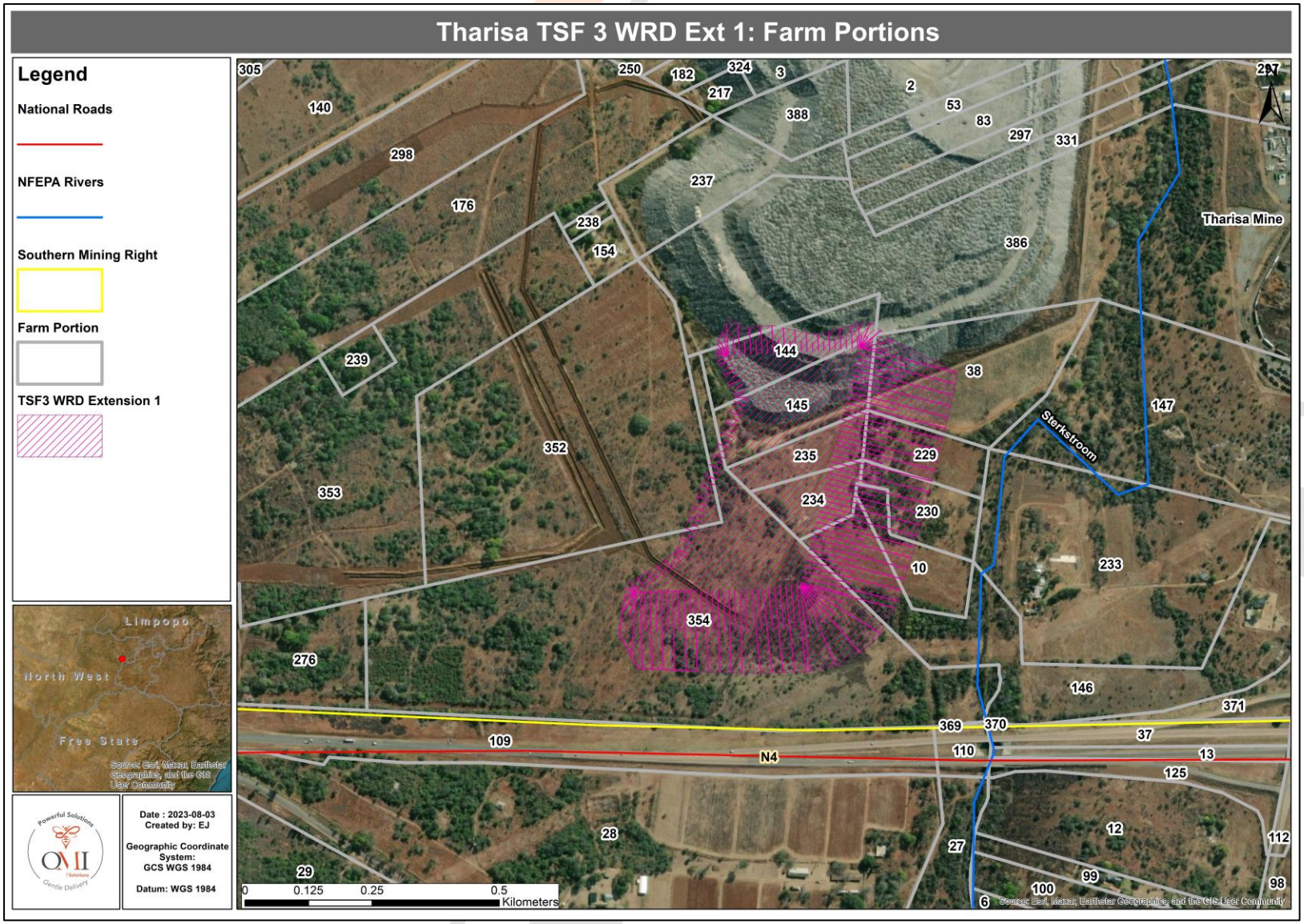


Figure 2: Farm Portion Map of the Waste Rock Dump Location

4 PROJECT DESCRIPTION[8]

4.1 BACKGROUND

Tharisa has an opencast Chrome and Platinum Group Metals (PGM) mining operation located on Farm K/Kraal 342 JQ, Rooikoppies 297 JQ and Elandsdrift 467 JQ, South of Marikana in the North West Province.

Tharisa has been in operation since November 2009 having an initial Mining Right 49/2009 (MR) effective 19 September 2008, issued on 13 August 2009 by the then Department of Mineral and Energy (DME). Tharisa subsequently applied for an amendment of the MR with the Reference Number: NW/30/5/1/2/2/358 MR, stamped 28 July 2011, however registered in 2016. Current approvals allow for a Life of Mine (LoM) for the open pit mining of 17 years. The planned future underground mining may increase the LoM to approximately 40 years.

4.2 LISTED AND SPECIFIC ACTIVITIES

The site plan of the existing infrastructure is shown in **Figure 3** which includes reference to the proposed TSF 3 WRD Extension 1 site.

Before Tharisa may commence with the proposed TSF 3 WRD Extension 1 the following Environmental Authorisation (EA) and licence applications must be approved in accordance with the relevant national legislation:

- An Integrated application for Environmental Authorisation (IEA) in terms of the National Environmental Management Act 1998 (Act 107 of 1998) (NEMA) and for a Waste Management Licence (WML) in terms of the National Environmental Management: Waste Act, 2008 (Act 59 of 2008)[9] (NEMWA);
- Application for amendment to the current Environmental Management Programme (EMPr) approved by the Department of Mineral Resources and Energy (DMRE) in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002) (MPRDA) on 16 October 2013; and
- An Integrated Water Use Licence Application (IWULA) under the National Water Act, 1998 (Act 36 of 1998 (NWA) will be submitted for approval to the Department of Water and Sanitation (DWS).

Activities listed in the NEMA Environmental Impact Assessment (EIA) Regulations, 2014 (as amended)[5] Listing Notices 1-3[10], NEMWA List of Waste Management Activities [11](GN 921 of 2013, as amended)

[8] Required as per the EIA regulations Appendix 2: (d) a description of the scope of the proposed activity, including (i) all listed and specified activities triggered; (ii) a description of the activities to be undertaken, including associated structures and infrastructure;

9 As amended by the National Environmental Management: Waste Amendment Act 26 of 2014.

10 GN R982 of 4 December 2014 as amended by GN R326 of 7 April 2017, GN 706 of 13 July 2018, GN 599 of 29 May 2020 and GN 517 of 11 June 2021.GN R983, GN R 984 and GN R985 in GG 38282 of 4 December 2014, as amended

11 List of waste management activities that have, or are likely to have, a detrimental effect on the environment published under GN 921 in GG 37083 of 29 November 2013 as amended by GN 332 in GG 37604 of 2 May 2014; GN R633 in GG 39020 of 24 July 2015; and GN 1094 in GG 41175 of 11 October 2017.

and section 21 of the NWA require authorisation prior to commencement of the activities. These activities are provided in **Table 3** below.

Table 3: Listed Activities to be Authorised under NEMA, NEMWA and NWA

Activity	Aerial Extent of Activity (ha or m²)	Listed Activity	Applicable Listing Notice	Waste Management Activity	Water Use Licence
Construction and operation of a Waste Rock Dump with the associated toe drain	Approximately 23 Ha Approximately 23 Ha Approximately 23 Ha	Activity 34 Listing Notice 1	The expansion of existing facilities or infrastructure for any process or activity where such expansion will result in the need for a permit or licence or an amended permit or licence in terms of national or provincial legislation governing the release of emissions, effluent or pollution, excluding- (i) where the facility, infrastructure, process or activity is included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case the National Environmental Management: Waste Act, 2008 applies; (ii) the expansion of existing facilities or infrastructure for the treatment of effluent, wastewater, polluted water or sewage where the capacity will be increased by less than 15 000 cubic metres per day; (iii) the expansion is directly related to aquaculture facilities or infrastructure where the wastewater discharge capacity will be increased by 50 cubic meters or less per day.	Category B • Activity 10 - "The construction of a facility for a waste management activity listed in Category B of this Schedule (not in isolation to associated waste management activity)." • 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)."	• Section 21 g - Disposing of waste in a manner which may detrimentally impact on a water resource • Section 21 c - Impeding or diverting the flow of water in a watercourse • Section 21 i - Altering the bed, banks, course or characteristics of a watercourse
		Activity 15 Listing Notice 2	The clearance of an area of 20 hectares or more of indigenous vegetation, excluding where such clearance of indigenous vegetation is required for- i. the undertaking of a linear activity; or	None	None

Activity	Aerial Extent of Activity (ha or m²)	Listed Activity	Applicable Listing Notice	Waste Management Activity	Water Use Licence
			ii. maintenance purposes undertaken in accordance with a maintenance management plan.		
		Activity 12 Listing Notice 3	The clearance of an area of 300 square meters or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan. **(h) North West Province** i. World Heritage Sites; core of biosphere reserve; or sites or areas identified in terms of an international convention; ii. A protected area including municipal or provincial nature reserves as contemplated by NEMPAA or other legislation; iii. All Heritage Sites proclaimed in terms of National Heritage Resources Act, 1999 (Act 25 of 1999); iv. Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority; v. Sensitive areas as identified in an Environmental management framework as contemplated in Chapter 5 of the Act and as adopted by the competent authority; or	None	None

Activity	Aerial Extent of Activity (ha or m²)	Listed Activity	Applicable Listing Notice	Waste Management Activity	Water Use Licence
			vi. Areas within a watercourse or wetland, or within 100 metres from the edge of a watercourse or wetland.		
Access roads	Current roads approved, to be used as far as possible	None	None	None	None

4.3 DESCRIPTION OF CURRENT AND PROPOSED ACTIVITIES

4.3.1 MINERAL AND SURFACE RIGHTS

The following is a summary of the surface rights applicable to the TSF 3 WRD Extension 1 site.

Table 4: Mineral Rights Applicable to Tharisa Mine

Farms and Portions	Minerals
K/kraal 342 JQ Portions: 2, 3, 5, 6, 7, 9, 10,11,12,13,15,16,19, 20, 22, 23, 25, 26, 27, 28, 29, 30,33,38,39,40,41,47,48,53,74,76,83,84,90,91,100,101,104,105,108,109,110,111,114,116,117,118,119,120,122,123,127,132,133,135, 137,138,139,140,142,144,145,146,147,148,149,150,151,152,153,154,155,156,157,158,159,166,175,176,182,184,185,186,187,188,189,190,191,192,193,196,205,206,207,208,212,213,214,215,216,217, 218,219,220,221,222,224,225,226,227,229,230,233,234,235,236,237,238, 239,240,241,242,243,250,251,256,257,259,262,265, 266,276,283,285,289,297,298,301,303,304,305,314,317,318,319,324,329,330,331,335,336, 342, 344, 350, 352, 353, 354, 356, 357, 358, 361, 362 and 365	Platinum Group Metals (PGM), Copper ore, Nickel ore and Chrome ore.
Rooikoppies 297 JQ portions: 1, 2, 3,5,6, 7,8,9, 10, 11, 14, 15, 16, 19,20, 22, 23, 24,26, 27,28,29,30,32,33,35,36,37, 38,39,40,41,42,43,44,46,47,48,49, 50,52,53,54,55,56,57,58, 60, 61, 62, 63,64, 65,66,67,68,69, 70, 71, 72, 73, 74, 75, 76, 77, 78,80, 81,82,83,84,85,86,87,88, 95, 96, 97,98,99, 101,102,103,104,105,106,107,108,109,111,113,114,116, 117,118,120,121,122,123,124,125,126,130,134,135,136, 137,138,139,141,142,143,144,145,146,147,149,150,151,152,153,154,156,157,158,159,160,161,162,163,164,165,166,167,168,169,170,171,173,176,177,179,182,183,184,185,189,190,194,195,196,197, 198,199,200,201,202,203,204,205,206,207,208,212,213,216,217,218,219,220,221,222,223,224,225,226,227,228,229,230,231,232,233,234,235,236,237,238,239,240,241,242,243,244,245,246,247,248, 249,250,251,252,253,276,277,278,279,280,281,282,283,292,297,307,308,312,313,314,315,316,317,318,320,322,323,326,327,328,329,330,331,332,333,335,336,337,338,339,343,344,345,347,348,349, 351,354,357,358,359,360,361,362,364,365,366,367,368,369,370,371,372,387,388,399 and 400	

Table 5: Tharisa WRD Footprint Area- Surface Rights Owners

Portion of K/Kraal	Landowner
144	Tharisa Minerals Pty Ltd
145	Tharisa Minerals Pty Ltd
354	Tharisa Minerals Pty Ltd
352	Tharisa Minerals Pty Ltd
230	Tharisa Minerals Pty Ltd
10	Tharisa Minerals Pty Ltd
235	Tharisa Minerals Pty Ltd

Portion of K/Kraal	Landowner
386[12]	Tharisa Minerals Pty Ltd
234	Tharisa Minerals Pty Ltd
RE 146	Tharisa Minerals Pty Ltd
229	Tharisa Minerals Pty Ltd
RE 38	Tharisa Minerals Pty Ltd

4.3.2 EXISTING AUTHORISATIONS

The following approvals have been obtained by Tharisa:

Table 6: Tharisa Mine's Existing Authorisations

Approval	Reference	Approval Date
Approval of Environmental Management Programme for the Mining Right in respect of Various Portions of the Various Farms K/Kraal 342 JQ and Rooikoppies 297 JQ situated in the Magisterial District of Rustenburg (North West regions) Tharisa Minerals (Pty) Ltd	DMRE ROD Reference Number: (NW) 30/5/1/2/3/2/1/358EM	19 September 2008
Environmental Impact Assessment Report and Environmental Management Programme (EMPr)	DMRE Reference Number: NW30/5/1/2/3/2/1/358	13 August 2009
Environmental Authorisation For Tharisa Opencast Mine on the Farms K/Kraal 342 JQ, Rooikoppies 297 JQ and Possibly Elandsdrift 467 JQ near the town Marikana, Listed Activities 1(b), 1(m), 1(n), 1(p), 1(q), 1(s), 7, 12, 12, 14, 15 in government Notice Number R. 386, including Listed Activities 1(c), 1€, 1(h), 1(j), 1(p), 2, 5, 6 and 10 In Government Notice Number R. 387, within Rustenburg Local Municipality, North Qwest Province (NWP/EIA/159/2006)	DACE[13] ROD Reference Number: NWP/EIA/159/2007	23 October 2009
Environmental Impact Assessment Report and Environmental Management Programme (EMPr) Amendment 1: Inclusion of Portions 96, 183 and 286 of the Farm K/Kraal 342 JQ Rustenburg Local Municipality	DMRE Reference Number: NW30/5/1/2/3/2/1/358	14 July 2011
Environmental Authorisation for the Diversion of an Existing 275kV Powerline and Associated Infrastructure at Tharisa Mine, within the Rustenburg Local Municipality, North West Province.	DEA ROD Reference Number: 14/12/16/3/3/3/408	15 November 2012
Environmental Authorisation for the Construction and Operation of a Chrome Sand Drying Plant, Storage Fuel, Changes in Footprint, Size and Design of the Tailings Storage facility and Waste Rock Dumps,	READ[14] Reference Number: NWP/EIA/50/2011	29 April 2015

[12] Tharisa own portions 356 and 148 by default also own portion 386

[13] North West Department of Agriculture, Conservation and Environment (now known as the Department of Economic Development, Environment, Conservation and Tourism)

[14] North West Department of Rural Development, Environment and Agricultural Development (now known as the Department of Economic Development, Environment, Conservation and Tourism)

Approval	Reference	Approval Date
Construction and Operation of a New Waste Rock Dump and Disturbance of Waster Courses at Tharisa Maine on the Farms K/Kraal 342 JQ and Elandsdrift 467 JQ near Marikana, listed Activities Number 11(xi), 13 and 18 in GN No. R.544, Listed Activities Number 5, 15 and 26 in GN No. R545 and Listed Activity Number 14 in GN No. R546, Rustenburg and Madibeng Local Municipality, North Wet Province		
Environmental Management Programme (EMPr) Amendment 2: Construction of [1] Genesis Plant 4th State Crusher Circuit [2] Vulcan Optimisation Circuit	DMRE Reference Number: NW20/5/1/2/3/2/1/358	24 June 2015
Approval of addendum to the approved Environmental Impact Assessment/Environmental Management Programme (EIA/EMPr) to include Changes to the Pit, Tailings Dam and Waste Rock facilities, a Chrome Sand Drying Plant in Respect of Various Properties, Situated in the Magisterial District of Rustenburg	DMRE Reference Number: (NW) 30/5/1/2/3/2/1/358EM	24 June 2015
Water Use Licence	DWS Reference Number: 03/A21K/ABCGIJ/1468	16 July 2012
Amendment of an Environmental Authorisation in respect of the Upgrade of the Existing Waste Water Treatment Plant in respect of the Farm Rooikoppies JQ 297, Elandsdrift JQ 467 and K/kraal JQ 342 JQ within the Magisterial District of Rustenburg North West Province	DMRE ROD Reference Number: NW 30/5/1/2/3/2/1/358EM	14 August 2020
Environmental Impact Assessment Report and Environmental Management Programme (EMPr) Amendment 3: Inclusion of Portion 113 of the Farm K/Kraal 342 JQ and Increase of Waste Rock Quantities	DMRE Reference Number: NW30/5/1/2/3/2/1/358	1 September 2020
Water Use Licence Amendment	DWS Reference Number: 03/A21K/ABCGIJ/1468	12 November 2020
Amendment of Tharisa Mine Impact Assessment Report and Environment Management Programme	DMRE Reference Number: NW30/5/1/2/2/1358 and DEDECT Reference Number: NWP/EIA/50/2011	3 August 2021
Amendment of Environmental Authorisation in respect of the application for environmental Authorisation together with a Waste Licence for Increase Storage Capacity of Tailings Facility and Waste Rock Dump and Increase the Authorised Fuel Storage capacity in Respect of Farm Rooikoppies JQ 297, Elandsdrift JQ 467 and K/kraal JQ 342, within the Magisterial District of Bojanala, North West Province	DMRE Reference Number: (NW) 30/5/1/2/3/2/1/358EM	3 August 2021
Rectification of an Unlawful Commencement with a Listed Activity as Contemplated in Section 24G of the National Environmental Management Act, 1998 (Act No. 107 of 1998) as Amended Listing Notice 1 Activity Number 14 “the development and Related Operation	DMRE Reference Number: NW 30/5/1/2/3/2/1 (358) EM	10 August 2021

Approval	Reference	Approval Date
of facilities or Infrastructure, for the Storage, or for the storage and Handling of a dangerous Good, where such Storage Occurs in Containers with a Combined capacity of 80 Cubic metres or more but not Exceeding 500 Cubic Metres		
Environmental Authorization for the establishment of a mixed-use township development on portion 149 of the farm Rooikoppies 297, Rustenburg Local Municipality	NWP-EIA-60-2022 EA	25 April 2023
Amendment of an Environmental Authorization in terms of the National Environmental Management Act, 1998 (NEMA) as amended, and the Environmental Impact Assessment (EIA) regulations, 2013 in respect of the application for Environmental Authorisation together with a Waste License for the Expansion of the existing and approved far west waste rock dump 1 by a footprint of 109 HA and the establishment of a waste rock dump on backfilled portions of the east pit by a footprint of 72 ha.	NW 30/5/1/2/3/2/1/358EM	31 May 2023

4.3.3 MINING METHOD

Mining at Tharisa is performed by a conventional truck and shovel open pit method. The mine produces a platinum concentrate containing platinum group metals (PGMs) with chrome concentrate as a co-product. Tharisa has two opencast sections namely the East Mine and the West Mine. The two sections are separated by the Sterkstroom River and the D1325 (Marikana) road.

The ore that is extracted from the opencast pits is processed at the concentrator plant located on the mine. The concentrator complex consists of two processing plants (Genesis and Voyager) which are independent of each other. Both plants first remove chrome from the feed ore, and then the PGMs. The tailings from both plants is then processed through the ultra-fine chrome recovery and beneficiation plant (Vulcan), which became operational in February 2022. The Vulcan plant was designed for further beneficiation of the tails while reducing the unit output of carbon emissions (GCS (Pty) Ltd, 2022).

4.3.4 MINERAL PROCESSING

Tharisa's two independent processing plants are designed to treat five Middle Group (MG) Chromitite Layers of the Bushveld Complex, namely MG1, 2, 3, 4a and 4b. The plants have a similar process flow that includes crushing and grinding, primary removal of chrome concentrate by spirals, followed by PGM flotation from the chrome tails and a second spiral recovery of chrome from the PGM tails. The tails from these plants are processed further in the fine-chrome recovery plant (Vulcan), before deposition of final tails to the TSFs.

4.3.5 EXISTING INFRASTRUCTURE

The total extent of the Tharisa Mine is 1,795 ha. The following surface infrastructure is present:

- West WRD (64.89 ha);
- Far-west WRD (32.90 ha);
- Far-west Pit (48.03 ha);
- West Pit (39.47 ha);

- Central WRD/Eastern WRD 1 (76.3 ha);
- Eastern WRD (63.23 ha);
- East Pit (211.43 ha);
- ROM Pad (15.84 ha);
- Concentrator Plant (Genesis and Voyager) (28.43 ha);
- Vulcan Plant (3.29 ha);
- Tailing Storage Facility (TSF) 1 Phase 1 & 2 (115.99 ha); and
- TSF 2 Phase 1 & 2 (101.91 ha).

A layout of the current infrastructure is provided in **Figure 3**.

A network of roads exists within the Tharisa area. A 275 kV power line and associated Eskom servitude cross through the eastern part of the mining area in a north-south direction. Smaller rural power lines and telephone lines currently service the residential areas within the western and eastern sections of the project area. Infrastructure (pipes and canals) associated with the Buffelspoort Irrigation Board traverse various sections of the project area in a South North direction.

4.3.5.1 PROPOSED ACTIVITY AND INFRASTRUCTURE

As part of its ongoing mine planning, Tharisa has identified the need for an additional mine residue stockpile for waste rock, which consists of a WRD extension to West WRD 1 at TSF 3 (the project is thus named the TSF 3 WRD Extension 1 Project). The additional WRD was designed by Epoch Resources (Pty) Ltd.

The WRD will be able to store 4.78 Mm^3 of waste from the West open pit area. The final height of the WRD will be 68 m and a total footprint of approximately 23 ha is currently designed. The WRD will have associated toe drainage, access roads and stormwater diversions.

A layout of the proposed infrastructure is provided in **Figure 3**.

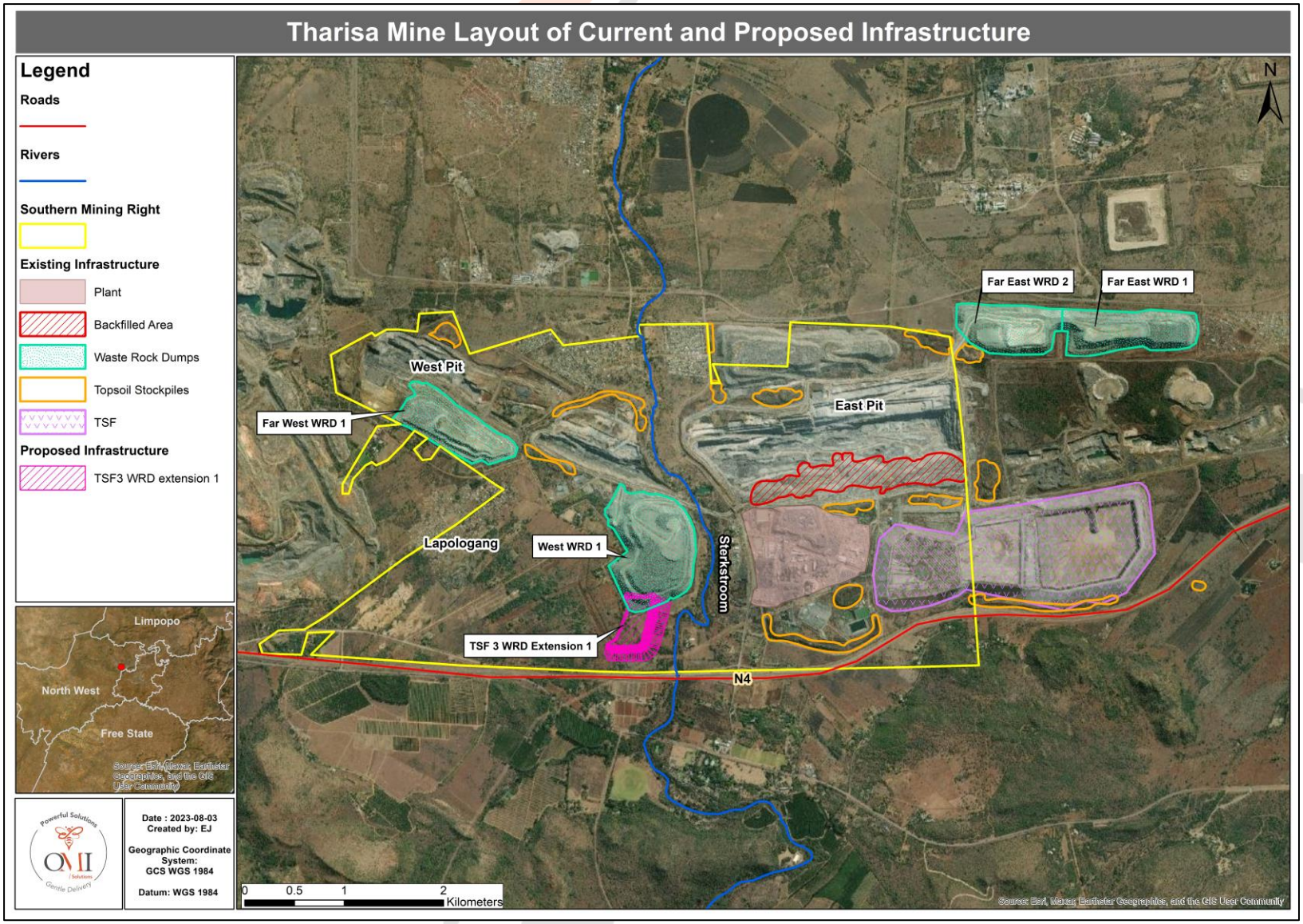


Figure 3: Tharisa Mine General listed act Showing Current and Proposed Activities (Refer to ANNEXURE D for A3 format)

5 POLICY AND LEGISLATIVE CONTEXT

The following table summarises some of the important legislative requirements for this assessment.

Table 7: Legislative and Policy Context

Applicable Legislation and Guidelines used to compile the Report	Reference Where Applied
Constitution of the Republic of South Africa, 1996 (the Constitution)	The report was prepared, submitted and considered within the constitutional framework set by *inter alia* sections 24, 32 and 33 of the Constitution. The mitigation/management measures recommended in **Section 16** of this report aim to ensure that the potential impacts are managed to acceptable levels to support the rights as enshrined in the Constitution.
Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002) (MPRDA) • Mineral and Petroleum Resources Development Regulations (GN R527 of 2004, as amended)[15]	The EIA&EMPr and Section 102 of the MPRDA consent application for this project are based on the requirements of the MPRDA and its Regulations.
National Environmental Management Act, 1998 (Act 107 of 1998)[16] (NEMA) • EIA Regulations, 2014 (as amended)[17] • EIA Regulations Listing Notice 1 of 2014 (GN R983 of 2014, as amended)[18] • EIA Regulations Listing Notice 2 of 2014 (GN R984 of 2014, as amended)[19]	The Environmental Impact Assessment (EIA) process was undertaken in respect of the authorisation process of the proposed TSF 3 WRD Extension 1, and is in compliance with the MPRDA, as well as the NEMA and NEMWA read with the Environmental Impact Assessment Regulations of 2014, as amended. The proposed TSF 3 WRD Extension 1 involves 'listed activities', as identified in terms of the NEMA. In terms of section 24(1) of the NEMA, the potential consequences for or impacts on the environment of inter alia listed activities

[15] GN 527 in GG 26275 of 23 April 2004 as amended by GN R 1288 in GG 26942 of 29 October 2004; GN R 1203 in GG 29431 of 30 November 2006; GN R349 in GG 34225 of 18 April 2011; GN R466 in GG 38855 of 3 June 2015; and GN R420 in GG 43172 of 27 March 2020.

[16] The National Environmental Laws Amendment Act, 2022 (Act No 2 of 2022) was signed into law on 24 June 2022 and will come into operation on a date to be fixed and proclaimed by the President. Once the amendment act comes into operation it will amend the NEMA, NEM:AQA and NEMWA.

[17] GN R982 in GG 38282 of 4 December 2014 as amended by GN R326 of 7 April 2017, GN 706 of 13 July 2018, GN 599 of 29 May 2020 and GN 517 of 11 June 2021.

[18] GN R983 in GG 38282 of 4 December 2014 as amended by GN R327 in GG 40772 of 7 April 2017, GN 706 in GG 41766 of 13 July 2018 and GN 517 in GG 44701 of 11 June 2021.

[19] GN R984 in GG 38282 of 4 December 2014, as amended by GN R325 in 40772 of 7 April 2017 and GN 517 in GG 44701 of 11 June 2021.

Applicable Legislation and Guidelines used to compile the Report	Reference Where Applied
• EIA Regulations Listing Notice 3 of 2014 (GN R985 of 2014, as amended)[20] • Financial Provisioning Regulations, 2015[21] • DEA (2017), Guideline on Need and Desirability, Department of Environmental Affairs	must be considered, investigated, assessed and reported on to the Minister responsible for mineral resources, except in respect of those activities that may commence without having to obtain an Environmental Authorisation in terms of the NEMA. **Table 3** provides the listed activities triggered by the proposed TSF 3 WRD Extension 1 that requires an EA in terms of the NEMA and NEMWA. An application for Environmental Authorisation in line with the provisions contained in GNR 982 (as amended) was submitted to the Department of Mineral Resources and Energy: North West Region (DMRE), in terms of section 24 of the NEMA for consideration (Application submitted to DMRE on 23 June 2023). The Financial provision for the project will comply to the Financial Provisioning Regulations. The need and desirability of the project are addressed in **Section 6**.
Department of Environmental Affairs, Pretoria, South Africa. • Department of Environmental Affairs (2017), Public Participation guideline in terms of NEMA EIA Regulations, Department of Environmental Affairs, Pretoria, South Africa.	Public Participation will be conducted throughout the Scoping and EIA phase according to NEMA, Chapter 6 of the EIA Regulations, 2014 (as amended) and the Public Participation guideline. Refer to **Section 9** of this Report for the details of the Public Participation Process (PPP) that was followed.
National Environmental Management: Air Quality Act, 2004 (Act 39 of 2004) (NEMAQA) • Listed Activities and Associated Minimum Emission Standards Identified in terms of section 21 of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) (GN R893 of 2013, as amended)[22]	The TSF 3 WRD Extension 1 does not require an Air Emissions Licence (AEL). An air quality assessment, guided by the NEMAQA and its incorporated regulations is however being undertaken as part of the EIA phase to establish a clear baseline of current air quality in the projects' vicinity, quantify anticipated impacts from the proposed new activities and prescribe mitigation and management measures for the impacts that may be deemed significant.

[20] GN R985 in GG 38282 of 4 December 2014, as amended by GN R324 in 40772 of 7 April 2017, GN 706 in GG 41766 of 13 July 2018 and GN 517 in GG 44701 of 11 June 2021.

[21] The *Regulations Pertaining to the Financial Provision for Prospecting, Exploration, Mining or Production Operations* published in GN R1147 in GG 39425 of 20 November 2015 as amended by GN 1314 in GG 40371 of 26 October 2016; GN R452 in GG 41584 of 20 April 2018; GN 991 in GG 41921 of 21 September 2018; GN 24 in GG 42956 of 17 January 2020; GN 495 in GG 44698 of 11 June 2021; and GN 2087 in GG 46378 of 19 May 2022.

[22] GN R893 in GG 37054 of 22 November 2013, as amended by GN 551 in GG 38863 of 12 June 2015; GN 1207 in GG 42013 of 31 October 2018; GG 687 in GG 42472 of 22 May 2019; GN 421 in GG 43174 of 27 March 2020.

Applicable Legislation and Guidelines used to compile the Report	Reference Where Applied
• National Dust Control Regulations, 2013 (R827 of 2013)[23] • National Atmospheric Emission Reporting Regulations, 2015 (GN R283 of 2015)[24] • National Greenhouse Gas Emission Reporting Regulations (GN 275 of 2017 as amended)[25]	
National Environmental Management: Biodiversity Act, 2004 (Act 39 of 2004) (NEMBA) • Threatened or Protected Species Regulations, 2007 (GN R152 of 2007)[26] • Alien and Invasive Species Regulations (GN R1020 of 2020)[27] • Alien and Invasive Species Lists, 2020 (GN 1003 of 2020)[28]	The Terrestrial and Aquatic specialist assessments were conducted in terms of the requirements of the NEMBA and its regulations. The management and control of Alien Invasive Plants will be governed by the NEMBA during all the phases of the project.
National Environmental Management: Waste Act, 2008 (Act 59 of 2008)[29] • List of waste management activities that have, or are likely to have, a detrimental effect on the environment (GN 921 of 2013, as amended)[30]	The EIA process was undertaken in respect of the authorisation process of the proposed mining operations, and is in compliance with the MPRDA, as well as the NEMA and NEMWA read with GN 921 of 2013, as amended. The proposed TSF 3 WRD Extension 1 triggers activities listed in GN 921 of 2013 (Category

[23] R827 in GG 36974 of 1 November 2013.

[24] GN R283 in GG 38633 of 2 April 2015.

[25] GN R275 in GG 40762 of 3 April 2017 as amended by GN R994 in GG 43712 of 11 September 2020.

[26] GN R152 in GG 29657 on 23 February 2007.

[27] GN R1020 in GG 43735 of 25 September 2020.

[28] GN 1003 in GG 43726 of 18 September 2020. Notice replaced the previous Alien and Invasive Species Lists (GN 864 in GG 40166 of 29 July 2016).

[29] As amended by the National Environmental Management: Waste Amendment Act 26 of 2014. As stated above, the National Environmental Laws Amendment Act, 2022 (Act No 2 of 2022) was signed into law on 24 June 2022 and will come into operation on a date to be fixed and proclaimed by the President. Once the amendment act comes into operation residue stockpiles and residue deposits will be removed from NEMWA and regulated in terms of the provisions of NEMA. Residue stockpiles and residue deposits will therefore no longer be regarded as waste for which a waste management licence is required. Residue stockpiles and residue deposits will in future be authorized in terms of the NEMA under the EIA Listing Notices. In terms of the transitional provisions any approval granted or waste management licence issued in relation to residue deposits and residue stockpiles remain valid until it lapse or replaced under the provisions of the NEMA.

[30] GN 921 in GG 37083 of 29 November 2013 as amended by GN 332 in GG 37604 of 2 May 2014; GN R633 in GG 39020 of 24 July 2015; and GN 1094 in GG 41175 of 11 October 2017.

Applicable Legislation and Guidelines used to compile the Report	Reference Where Applied
• National Waste Information Regulations, 2012 (GN R625 of 2012)[31] • Regulations regarding the planning and management of residue stockpiles and residue deposits, 2015 (GN R632 of 2015, as amended)[32] • Waste Classification and Management Regulations, 2013 (GN R634 of 2012)[33]. • National Norms and Standards for the Assessment of Waste for Landfill Disposal (GN R635 of 2012)[34] • National Norms and Standards for the Disposal of Waste to Landfill (GN R636 of 2012)[35] • National Norms and Standards for the Storage of Waste (GN 926 of 2013)[36]	B) and will require a WML. **Table 3** provides waste management activities to be authorised. All mine residue designs were developed in compliance with the NEMWA regulations and national norms and standards.
National Environmental Management: Protected Areas Act (Act 57 of 2003) (NEM:PAA)	The NEMPAA was promulgated, *inter alia*, to provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes. The legislation will be heeded throughout the proposed TSF 3 WRD Extension 1 and was considered in the Terrestrial Biodiversity Impact Assessment.
National Forests Act, 1998 (Act 84 of 1998) (NFA) • Regulations under the National Forests Act 84 of 1998 (GN R466 of 2009)[37]	The NFA, *inter alia*, protects against the cutting, disturbance, damage, destruction or removal of protected trees. The Terrestrial Biodiversity Impact Assessment conducted as part of the process will identify any protected trees

[31] GN R625 in GG 35583 of 13 August 2012.

[32] GN R632 in GG 39020 of 24 July 2015 as amended by the Planning and Management of Residue Stockpiles and Residue Deposits Amendment Regulations, 2018 published under GN 990 in GG 41920 of 21 September 2018. Once the relevant sections in the National Environmental Laws Amendment Act, 2022 (Act No 2 of 2022) comes into effect, residue stockpiles and residue deposits will be excluded from NEMWA and will be regulated in terms of the provisions of NEMA. The Residue Regulations will remain operational and will be deemed to have been made under NEMA.

[33] GN R634 in GG 36784 of 23 August 2012.

[34] GN R635 in GG 36784 of 23 August 2012.

[35] R636 in GG 36784 of 23 August 2012.

[36] GN 926 in GG 37088 of 29 November 2013.

[37] GN R466 in GG 32185 of 29 April 2009.

Applicable Legislation and Guidelines used to compile the Report	Reference Where Applied
	that may be affected by the proposed TSF 3 WRD Extension 1. The legislation will be heeded throughout the proposed TSF 3 WRD Extension 1 and was considered in the Terrestrial Biodiversity Impact Assessment.
National Heritage Resources Act, 1999 (Act 25 of 1999) (NHRA) The World Heritage Convention Act, 1999 (Act 49 of 1999)	An Archaeological Impact Assessment was conducted for the project. This assessment is uploaded on the South African Heritage Resources Agency (SAHRA) site. A Heritage Resource Management (HRM) process has been initiated with the SAHRA in accordance with Section 38 of NHRA.
Environment Conservation Act, 1989 (Act 73 of 1989) • Noise Control Regulation (GN R154 of 1992)[38]	The legislation will be heeded throughout the proposed mining operations and has been addressed in the Noise Impact Assessment.
Mine Health and Safety Act, 1996 (Act 29 of 1996) • Mine Health and Safety Regulations (GN R93 of 1997, as amended)[39] • Mines and Works Regulations (GN R992 of 1970, as amended)[40]	The proposed TSF 3 WRD Extension 1 is located within a MR area and Tharisa will have to ensure that employees, contractors, sub-contractors and visiting personnel, adhere to the requirements of this Act and its regulations.
National Water Act, 1998 (Act 36 of 1998) • Regulations on the use of water for mining and related activities aimed at the protection of water resources (GN 704)[41] • Water Use Licence Application and Appeals Regulations, 2017 (GN R267 of 2017)[42] • Regulations regarding the safety of dams in terms of section 123(1) of the National Water Act, 1998 (GN R139 of 2012)[43]	Various section 21 water uses are triggered by the proposed TSF 3 WRD Extension 1 activities. **Table 3** provides the water use activities to be authorised. An IWULA and an associated Integrated Water and Waste Management Plan (IWWMP) will be based on the requirements of the NWA and GN R 267 of 2017.

[38] GN R154 of January 1992.

[39] GN R93 in GG 17725 of 15 January 1997.

[40] GN R992 in GG 2741 of 26 June 1970, was published under the Mines and Works Act, but remain in force in terms of Schedule 4 of the MHSA.

[41] GN 704 in GG 20119 of 4 June 1999.

[42] GN R267 in GG 40713 of 24 March 2017.

[43] GN R139 in GG 35062 of 24 February 2012.

Applicable Legislation and Guidelines used to compile the Report	Reference Where Applied
• Regulations in terms of section 26 read in conjunction with section 12A for the erection, enlargement, operation and registration of water care works (GN R 2834 of 1985)[44] • General Authorisations General Authorisation: 21(c) and (i) water use for the purpose of rehabilitating a wetland for conservation purposes (GN 1198 of 2009)[45] General Authorisation: 21(c) and (i) water uses (GN 509)[46] Revision of General Authorisation for the Taking and Storing of Water (GN 538 of 2016)[47] Revision of General Authorisation in terms of section 39 of the National Water Act 36 of 1998 (GN 665 of 2013)[48]	A Hydrogeological Impact Assessment will be conducted as part of the EIA phase to assess potential impacts of the project on groundwater resources. Mitigation/management measures to ensure that the potential impacts are managed will be included in the EIA&EMPr. A water management system based on the principles of GN 704 will be designed. All dirty/polluted water will be contained and re-used in the system. Clean water will be diverted away from the designated dirty areas as far as possible. No dirty/ polluted water will be discharged into the environment.
Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983)	The legislation was considered in the Agro-Ecosystem Impact Assessment. Mitigation/management measures to control, inter alia, soil erosion and Alien Invasive Plants are included in this report.
Spatial Planning and Land Use Management Act 2013 (Act 16 of 2013)	The Spatial Planning and Land Use Management Act 2013 (Act 16 of 2013) was promulgated in May 2015 and assist municipalities to address historical spatial imbalances and the integration of the principles of sustainable development into land use and planning regulatory tools and legislative instruments.
Broad-based Socio-economic Empowerment Charter for the Mining and Minerals Industry (2018)	Due to its ability to empower the community through continual employment, local procurement, and local development, the proposed TSF 3 WRD

[44] The regulations were published in GN R 2834 in GG 10048 of 27 December 1985 under the Water Act 54 of 1956 and are still applicable until such time as new regulations are promulgated under section 26 of the NWA.

[45] GN 1198 in GG 32805 of 18 December 2009.

[46] GN 509 in GG 40229 of 26 August 2016.

[47] GN 538 in GG 40243 of 2 September 2016.

[48] GN 665 in GG 36820 of 6 September 2013.

Applicable Legislation and Guidelines used to compile the Report	Reference Where Applied
	Extension 1 is in alignment with the Broad-Based Socio-economic Empower Charter for the Mining and Mineral Industry. (The Mining Charter, 2018)
New Growth Path Framework (NGPF), 2010	The proposed TSF 3 WRD Extension 1 shows alignment to the New Growth Path regarding its potential to increase employment. (Department of Economic Development, 2010)
North West Provincial Spatial Development Framework (PSDF) (2017)	The proposed TSF 3 WRD Extension 1 is aligned with the PSDF since it will utilise vacant land, in terms of the potential use of the land for other purposes. However, it goes against its objectives to combat deforestation, enhance environmental sustainability and biological divarication. (North West Provincial Government, 2017)
Bojanala Platinum District Municipality Integrated Development Plan (2022/2027)	The proposed TSF 3 WRD Extension 1 is partially aligned with the Bojanala DM Integrated Development Plan (IDP) through its potential of creating employment opportunities and its potential to contribute to the development of the local economy (Bojanala Platinum District, 2022)
Rustenburg Local Municipality Integrated Development Plan (2022-2027)	The proposed TSF 3 WRD Extension 1 aligns with the goals promoting the social and economic landscape of the local municipality with the IDP goal of generating employment or the growth and development of the township or rural economies (Rustenburg LM, 2022)
Rustenburg Local Municipality Spatial Development Framework (2010) (SDF)	The proposed TSF 3 WRD Extension 1 is aligned with the objectives of the SDF as the development will contribute to increasing the standards of living and creating jobs through its economic and social development plans. However, it does not align with the objective of protecting the biodiversity (Rustenburg LM, 2010)

6 NEED AND DESIRABILITY OF THE PROPOSED ACTIVITIES[49]

The Tharisa Mine is expanding its mining output and as such, additional waste rock and tailings is being produced. The current facilities are nearing their full capacity hence the need to develop new and expanding facilities. Several options were considered, and the most viable option as presented in **Section 8** of this report was selected.

The proposed TSF 3 WRD Extension 1 will occur within the approved MR area and existing access roads will be utilised, thereby reducing the environmental footprint while resulting in increased job security to current employees. The main benefits of the Tharisa Mine TSF 3 WRD Extension 1 Project are:

- Direct economic benefits will be derived from wages, taxes and profits (although to a smaller scale);
- Indirect economic benefits will be derived from the procurement of goods and services and the spending power of employees;
- Increased job security for employees;
- The project will result in the continued economic mining of a known resources; and
- Contribution to the economic welfare of the surrounding community by creating working opportunities.

The project is aligned with the objectives of the MPRDA:

- To promote economic growth and mineral development in the Republic;
- To promote employment and advance the social and economic welfare of all South Africans;
- To ensure that the nation's mineral resources are developed in an orderly and ecologically sustainable manner while promoting justifiable social and economic development; and
- To ensure that holders of mining rights contribute towards the social-economic development of the area in which they are operating.

Moreover, the Department of Forestry, Fisheries and the Environment (DFFE)[50] published an updated Guideline on Need and Desirability (2017) in terms of the EIA Regulations, 2014 (as amended). The key components are listed below and will be discussed in detail in the EIA Report:

- Securing ecological sustainable development and use of natural resources; and
- Promoting justifiable economic and social development.

6.1 SECURING ECOLOGICAL SUSTAINABLE DEVELOPMENT AND USE OF NATURAL RESOURCES

Due to the nature of mining projects, impacts on sensitive biodiversity areas, linkages between biodiversity areas and related species, and the role that they play in the ecosystem, are probable. The proposed site for the TSF 3 WRD Extension 1 project occurs largely in a slightly degraded environment with red data and endemic plant species throughout the area. The project area consists of mixed woodland and degraded grassland providing a unique habitat for a variety of plant species to establish as well as perching and breeding areas for larger birds of prey. The Sterkstroom River that occur further east of the site provide a valuable corridor and feeding and breeding areas for red data and other birds, reptiles, and amphibians.

[49] Required as per the EIA regulations Appendix 2: (f) a motivation for the need and desirability for the proposed development including the need and desirability of the activity in the context of the preferred location.

[50] At the time of publication, the Department of Environmental Affairs (DEA).

The proposed TSF 3 WRD Extension 1 will likely result in the general disturbance of biodiversity, particularly if unmitigated.

Furthermore, although the proposed TSF 3 WRD Extension 1 footprint is in CBA 2 and ESA 2, these areas represent zero sensitivity (due to the existing mining infrastructure i.e. WRDs). Low sensitivity and Medium-Low sensitivity areas characterised only by a few pockets of woodland, old fields and degraded grassland. These areas do not represent land that will contribute towards ecosystem functioning and should subsequently be classified as “Other Natural Areas” or “No Natural Habitat Remaining”.

It must be noted that the preferred site for the TSF 3 WRD Extension 1 was chosen to be at the least ecologically sensitive areas according to the sensitivity analysis (refer to Section 10.7.3).

Considering the cumulative impacts of the mining phases on the fauna and flora of the area, it can be concluded that the current state of the vegetation and fauna habitats, will cause some negative impacts, although the implementation of a rehabilitation and revegetation plan will allow the vegetation to recover over time and the fauna to return to the area. The TSF 3 WRD Extension 1 can be considered as viable, although strict mitigation and monitoring will need to be implemented throughout all the mining phases to ensure the impacts are kept to a minimum.

6.2 PROMOTING JUSTIFIABLE ECONOMIC AND SOCIAL DEVELOPMENT

The strategic documents at the national, provincial, and local levels share a common focus on enhancing the well-being of communities through various means. These include promoting decent work and economic development, improving and expanding infrastructure, and prioritising environmental considerations. In the case of Rustenburg LM, the municipality places emphasis on the mining and quarrying sector while simultaneously advocating for sustainable land use management. This is due to its high contribution to the employment of semi-skilled and low-skilled workers in the region and its high contribution to the LM’s Gross Value Added (GVA).

The proposed TSF 3 WRD Extension 1 is considered a sub-activity within the broader scope of mining operations, specifically designed to support the successful functioning of the mine. As such, it aligns with the priorities of Rustenburg LM, which places importance on the sustainable and efficient operation of mining activities. Considering the potential to generate employment opportunities (although small), the proposed TSF 3 WRD Extension 1 project appears to be in line with the objectives outlined in the national, provincial, and local strategic documents.

Moreover, the proposed TSF 3 WRD Extension 1 project is strategically located within a mining belt near the Marikana mining area. In close proximity to the site, there are various land uses, including residential and commercial areas, as well as woodland. The nearest residential area is the informal settlement of Lapologang, but it is important to note that there is no direct visibility between the settlement and the proposed site due to the presence of the existing West WRD 1.

The proposed TSF 3 WRD Extension 1 is planned to be operational for the duration of the Tharisa Mine’s lifespan, which encompasses approximately 13 to 20 years of open pit mining and around 40 years of underground operations (Mining Technology, 2022). It is crucial to recognise that this project will have both immediate and long-term effects on economic and social sustainability, as well as considerations for social and economic well-being.

Among the identified preliminary impacts, there are certain positive aspects to highlight, albeit on a smaller scale. The construction phase of the TSF 3 WRD Extension 1 is anticipated to create short-term employment opportunities, while the operational phase is expected to provide long-term employment security for households in the region, which are already benefitting from the mining. These employment security could have a positive impact on the local economy and contribute to the well-being of the community. The proposed TSF 3 WRD Extension 1 is not anticipated to have a substantial impact on

employment opportunities across various skill levels. However, it is important to note that the limited employment opportunities that may arise from the project are likely to benefit individuals residing in the neighbouring communities. While the anticipated socio-economic outcomes of the project may be limited, there are still potential positive effects that can be generated, particularly in terms of localised employment generation. Certain benefits will extend beyond the immediate vicinity, promoting a wider distribution of advantages. Conversely, negative impacts will predominantly affect the project site and local communities in close proximity.

7 PERIOD FOR WHICH THE ENVIRONMENTAL AUTHORISATION IS REQUIRED

Current approvals allow for a LoM for the open pit mining of 17 years. The planned future underground mining may increase the LoM to approximately 40 years. It is therefore proposed that the WRD authorisation aligns to the current LoM of 17 years.

8 DESCRIPTION OF THE PROCESS FOLLOWED TO REACH THE PROPOSED PREFERRED SITE [51]

8.1 PROCESS TO ASSESS ALTERNATIVES

The DFFE[52] guidelines for an Integrated Environmental Management (IEM) procedure requires that an environmental investigation considers feasible alternatives for any proposed development. Furthermore, the EIA Regulations (2014) (as amended) require that a number of alternatives for accomplishing the same objectives shall be considered.

Various alternatives have been assessed for the project at scoping level, and workshopped through applicant and engineering team interactions. The alternatives were also influenced by the existing baseline environmental data and specialist inputs.

Alternatives relevant to this proposed TSF 3 WRD Extension 1 can be categorised into the following and discussed below:

- Site location alternatives;
- Layout alternatives;
- Technology alternatives; and
- The “no-go” alternative.

8.2 SITE LOCATION ALTERNATIVES

The proposed TSF 3 WRD Extension 1 is situated on various portions of the Farm K/Kraal 342JQ. As part of Tharisa’s ongoing mine planning, the need for an additional mine residue stockpile for waste rock, which consists of a WRD extension to West WRD 1 at TSF 3 has been identified. Site location alternatives where limited. The Proposed TSF 3 WRD Extension 1 will be located within the existing Mining Right boundary which is constrained for open space by surrounding uses mainly comprising mining activities. The N4 highway creates a barrier to the south of the project area. Therefore no other feasible site locations could be evaluated.

[51] Required as per the EIA regulations Appendix 2 (g) a full description of the process followed to reach the proposed preferred activity, site and location of the development footprint within the site, including (i) details of all the alternatives considered.

[52] At the time the Department of Environmental Affairs and Tourism (DEAT).

8.3 LAYOUT ALTERNATIVES

The proposed TSF 3 WRD Extension 1 will be located within the existing MR boundary which is constrained for open space by surrounding uses mainly comprising mining activities. The N4 highway creates a barrier to the South of the project area.

Some layout options have been evaluated during the initial phases of the project for the expansion of the WRD. These options are shown below in **Figure 4**. The alternative extension of the WRD would have been placed over a larger footprint and would have required the diversion of the Sterkstroom River. Therefore, after detailed evaluation, the Preferred Alternative WRD outside of the Sterkstroom floodline was proposed and will be further evaluated throughout this EIA process.

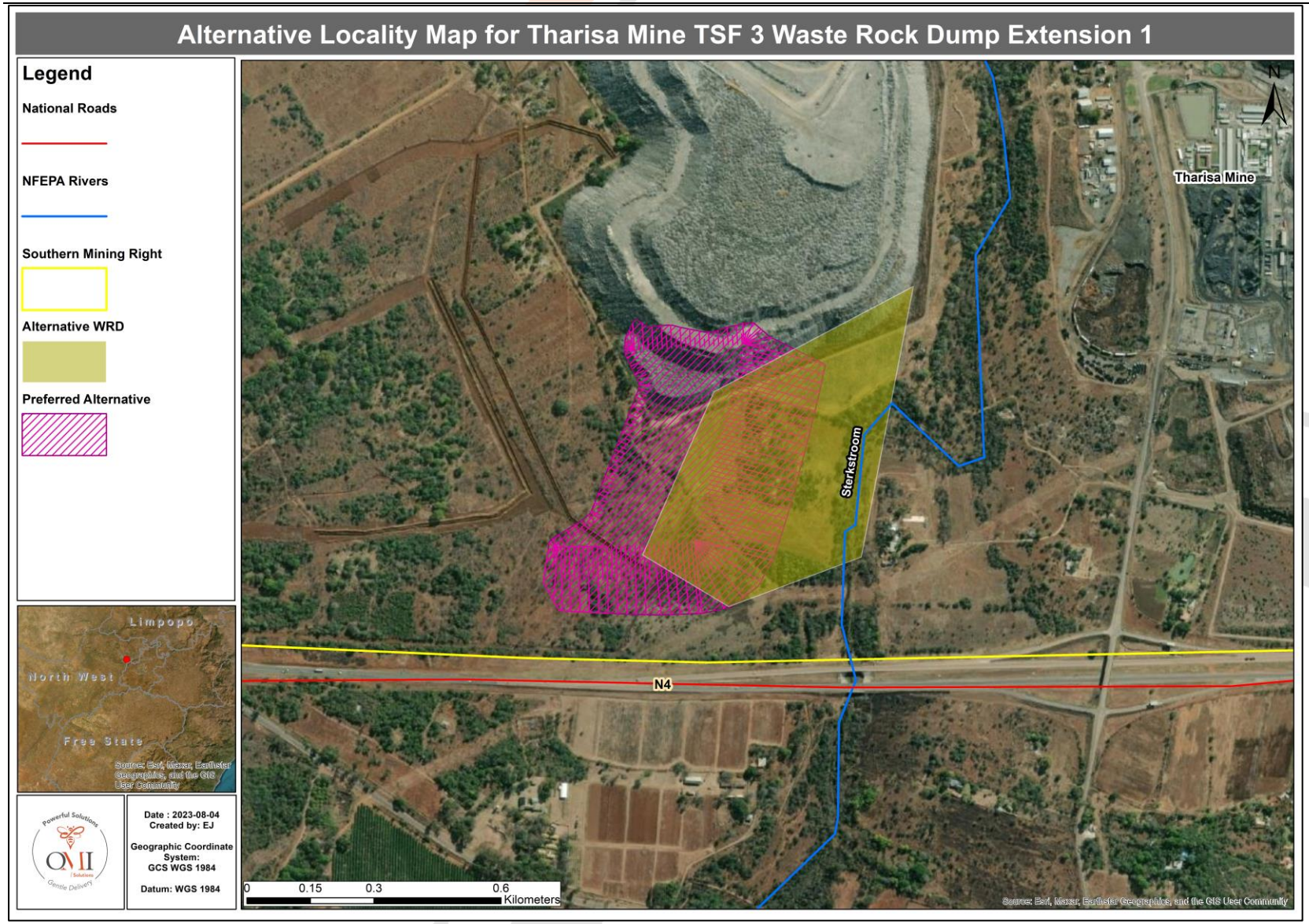


Figure 4: Alternative Layout vs Preferred Alternative Layout Considered

8.4 TECHNOLOGY ALTERNATIVES

The following technology/activity alternatives were considered as part of the proposed TSF 3 WRD Extension 1. These include the following:

- Trucking waste rock to a different location: Open pit mining consists primarily of the removal of topsoil and overburden, drilling and blasting of ore, and the transportation of waste rock by haul trucks. Transportation of waste rock is cyclic in nature and requires the dispatch of a large number of trucks per month. Reducing the cycle time for transportation of waste rock results in increased productivity and reduces the operational costs. The proximity of the proposed TSF 3 WRD Extension 1 to the open pits allows for increased productivity, minimisation of transportation costs as well as minimisation of noise and traffic impacts associated with transportation of waste rock; and
- Waste rock backfill of open pits. The mine is currently in possession of authorisations for backfilling into the open pits, with waste rock, concurrent with mining. This is currently being undertaken; however the concurrent backfilling of the open pits has limitations resulting from unavailability of areas to backfill because mining is still continuing and also due to the fact that a portion of the open pits needs to remain open during operation, to allow for safe working within the open pits. Therefore, alternative space for TSF 3 WRD Extension 1 had to be evaluated and applied for.

8.5 NO-GO ALTERNATIVE

The assessment of this option requires a comparison between proceeding with the proposed TSF 3 WRD Extension 1 and not proceeding with the proposed TSF 3 WRD Extension 1. Extension 1 The “no-go” alternative would mean that the proposed TSF 3 WRD Extension 1 would not be established.

Not proceeding with the proposed TSF 3 WRD Extension 1 will leave the status quo as is with no additional negative social or environmental impacts than what is currently experienced, but will also not result in any possible positive impacts from the project being realised.

Not proceeding with the proposed TSF 3 WRD Extension 1 would create a restriction on mining leading to a temporary and/or permanent stopping of mining. The mine is continually generating more waste rock from mining activities, than previously anticipated. Extension 1Originally the mine designs allowed for backfill into the open pits. The pits have however reached capacity and the balance of waste rock which cannot be backfilled into the pits will require dumping on surface as no other feasible alternatives exist for waste storage. The proposed TSF 3 WRD Extension 1 will assist in providing time for Tharisa to better model and apply for additional required waste rock dumps going forward. The “no-go” option would not allow for the optimisation of the current mining operations and could potentially result in the closure of the mine.

9 DETAILS OF THE PUBLIC PARTICIPATION PROCESS FOLLOWED[53]

This section describes the public participation process (PPP) to be undertaken in line with Chapter 6 of the EIA Regulations (2014) (as amended). The process will be undertaken to ensure compliance with the requirements in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (as amended) (MPRDA) and the Environmental Impact Assessment Regulations (2014) (as amended).

[53] Required as per the EIA regulations Appendix 2 (g) a full description of the process followed to reach the proposed preferred activity, site and location of the development footprint within the site, including (ii) details of the public participation process undertaken in terms of regulation 41 of the Regulations, including copies of the supporting documents and inputs;

The PPP was conducted in line with the statutory requirements for public participation. The following legislation was considered when developing and implementing the PPP:

- Public Participation guideline in terms of NEMA;
- The EIA Regulations, 2014 (as amended);
- The Constitution of the Republic of South Africa, 1996;
- Protection of Personal Information Act, 2013 (Act 4 of 2013) (POPIA);
- Promotion of Access to Information Act, 2000 (Act 2 of 2000) (PAIA); and
- International good-practice guidelines for public participation and the Core Values of the International Association for Public Participation.

9.1 IDENTIFICATION OF STAKEHOLDERS

Tharisa has an existing stakeholder database in its possession and thus to ensure a proper representation of all stakeholders, the existing stakeholder database was updated, and the following identification methods were used as part of the stakeholder identification and analysis process:

- Desktop and online research;
- Developing a list of relevant community authorities;
- Identifying the relevant ward councilors for the affected wards;
- Land claimants (if any); and
- Consulting government departments relevant to the project.

A stakeholder database was compiled, and the identified stakeholders and Interest and Affected Parties (I&APs) were engaged with throughout the following process:

9.2 LANDOWNER ENGAGEMENT

According to Regulation 39(2) of the EIA Regulations (GN R982 of 2014, as amended), the Applicant must obtain written consent from the landowner or person in control of the land which is included in the investigation. In the case of Tharisa, the land to which the TSF 3 WRD Extension 1 project is proposed is owned by Tharisa, thus landowner engagement will not be required.

9.3 SITE NOTICES

In order to inform surrounding communities and adjacent landowners of the proposed TSF 3 WRD Extension 1, eight (8) notice boards (in accordance with regulation 41(2) (a) of the EIA Regulations 2014, as amended) were placed at key locations surrounding the MR area and at the entrance to the mine on 29 June 2023. Notices were placed in English, Afrikaans and Setswana. Please refer to **ANNEXURE F** for a copy of the site notice as well as proof of site notice placement.

The site notice provided an overview of the project and highlights the applicable legislation, environmental authorisation/ licence applicable to the project. It also outlined the stakeholder engagement process to be followed and where relevant information could be obtained from. A locality map of the project site was included in the site notice. Details of the open day and how stakeholders can register as I&APS were included in the site notice. Pictures and co-ordinates of where the site notices were placed were also recorded in the proof of site notice register.

9.4 NEWSPAPER ADVERTISEMENT

An Advertisement notifying the public of the submission of the EA Application, as well as the process to be followed; and requesting I&APs to register their comments with the EAP, was placed, in English in the Rustenburg Herald and the Brits Pos newspapers, on Thursday, 29 June 2023, in accordance with regulation 41(2)(c) and (d) of the EIA Regulations of 2014 (as amended).

The advert included the following details:

- Brief project description;
- Legal framework and competent authorities;
- How stakeholders can access the Draft Scoping Report for public review and comment;
- The details of the open day;
- Registration as I&APs; and
- The contact details of the stakeholder engagement consultants.

Please refer to **ANNEXURE F** for a copy of the newspaper advertisement as well as the proof of newspaper advertisement placement.

9.5 DIRECT NOTIFICATION OF IDENTIFIED I&AP'S

To ensure a proper representation of all stakeholders, the following identified stakeholders inter alia were directly informed of the proposed TSF 3 WRD Extension 1 via email and/or SMS and provided with Background Information Documents (BIDs):

- Landowners: Directly or indirectly affected and adjacent;
- Land occupiers: Directly or indirectly affected and adjacent;
- Host communities;
- Rustenburg Local Municipality including ward councillors;
- Bojanala Platinum District Municipality;
- Department of Forestry, Fisheries and the Environment (DFFE);
- Department of Water and Sanitation (DWS): North West Province
- Department of Agriculture, Forestry and Fisheries (DAFF);
- Department of Mineral Resources and Energy (DMRE): North West Province;
- North West Department of Economic Development, Environment, Conservation and Tourism (DEDECT);
- Department: Agriculture, Rural Development and Land Reform (DRDLR);
- South African Heritage Resources Agency (SAHRA);
- Eskom SOC Ltd ;
- Transnet SOC Ltd;
- South African National Roads Agency (SANRAL)
- South African National Roads Agency SOC Ltd (SANRAL);
- Persons and Organisations of Interest (Federation for Sustainable Environment; Marikana Eco Forum, Magaliesburg Protection Association etc.); and

- Business and industry: Small, Medium and Micro Enterprises (SMMEs), mines, industrial and large business organisations.

BIDs were distributed in English. A copy of the BID together with the delivery register as well of proof of email and SMS notifications are provided in **ANNEXURE F**.

9.6 DRAFT REPORT FOR REVIEW

The EIA Regulations 2014 (as amended) specify that the Draft Scoping Report (DSR) must be subjected to a public participation review process of at least 30 days. The report was made available for review from 29 June 2023 to 28 July 2023. The proposed TSF 3 WRD Extension 1 and availability of the DSR was announced to the public as detailed in **Section 9.3** to **Section 9.5**.

The DSR was distributed for comment as follows:

- An electronic copy was made available on the OMI website:

  OMI Website Link: https://omisolutions.co.za/public-review-projects/

- A hard copy was also made available at the following venue:

  Mmaditlhokwa Community Centre and Lapologang Village.

9.7 PUBLIC OPEN DAY

A public open day was held during the review period of the DSR to provide I&APs with the opportunity to raise issues and comments and ask specific questions in the presence of the relevant consultants on the project as well as to explain the authorisation process and associated timelines. The public open day was advertised in the Rustenburg Herald and in the Brits Pos newspapers as per **Section 9.4** above. All issues raised by the I&APs during the public open day are included to the Comments and Responses Register (CRR) in **section 9.10**. The public open day took place on Wednesday, 12 July 2023, at the Mmaditlhokwa Community Centre from 11:00 am to 16:00 pm.

A separate Focus Group Meeting was also held with the community of Lapologang on Tuesday, 18 July 2023, at the Lapologang Sportsground from 11:00 am to 15:00 pm, as they are the directly affected I&APs.

A copy of the public open day posters together with the relevant attendance registers and a photo register of the public open days are provided in **ANNEXURE F**.

9.8 WAY FORWARD

All comments received from I&APs and organs of state and responses are included in this Final Scoping Report (FSR) and will also be included in the Draft and Final Environmental Impact Assessment Reports to be submitted to the Competent Authority (CA), the DMRE.

9.9 PROTECTION OF PERSONAL INFORMATION ACT 4 OF 2013

In compliance with the Protection of Personal Information Act (Act No. 4 of 26 November 2013) (POPIA), any personal information provided to OMI was exclusively used as part of the above public participation process and will therefore not be utilised for any other purpose, other than that for which it was provided. No additional copies will be made of documents containing personal information unless consent has been obtained from the owner of said information. Records of personal information will be retained no longer than reasonably required for lawful purposes. OMI's privacy statement is available to view on www.omisolutions.co.za.

9.10 SUMMARY OF ISSUES RAISED BY I&APS[54]

The following provides a summary of issues and comments raised by I&APs during the Scoping phase. Please refer to **ANNEXURE F** for the complete Comments and Responses Register providing details on the issues and comments raised by I&APs and responses provided by the EAP.

The following is a list of the main comments and concerns raised as part of the scoping public consultation process:

- The Regional Land Claims Commissioner Office of the North West Department of Agriculture, Rural Development and Land Reform provided correspondence indicating that there is an existing land claim against the farm K/kraal. The claim was lodged under Rustenburg Local Municipality within Bojanala District. The information reflects on the database of claims lodged between 1 July 2014 and 27 July 2016 in terms of the Restitution of Land Rights Amendment Act, of 2014. However, upon further consultation with the regional office, it was confirmed that:
    - According to the database of claims lodged by 31 December 1998 (Restitution of Land Rights Act, 1994 (Act No. 22 of 1994) there is no land claim against K/kraal 342 JQ).
    - The claim/s lodged on K/K/Kraal which appear on the database of the new order claims have not been validated and gazetted.
    - The commission is at this stage not in the position to provide a specific time frame as to when will the claims lodged between 1 July 2014 and 27 July 2016 be validated or researched due to the LOMOSA Judgement.

  As such, OMI understands that currently there is no land claim against the farm K/kraal 342 JQ until such a time when the new claims have been validated and gazetted.
- The SANRAL is a key stakeholder as the proposed TSF 3 WRD Extension 1 affects the N4-13 which is under the management of the Bakwena Toll Concession. The Bakwena Toll Concession has enquired on the possibility of using some of the waste rock material for road construction purposes.
- Rand Water services are not affected by the proposed TSF 3 WRD Extension 1.
- I&APs expressed their mistrust as they are of the opinion that they previously provided their concerns on other projects to numerous consultants and mine representatives and yet no feedback or action is provided.
- Queries on whether OMI is responsible for the other projects being facilitated by Tharisa and if community members will have an opportunity to work with OMI.
- Various queries regarding controls for dust and noise impacts of the proposed TSF 3 WRD Extension 1 especially with regards to the Lapologang community.
- Concerns on whether the proposed TSF 3 WRD Extension 1 will be operational during daytime and nighttime as I&APs have expressed concerns with noise levels.
- Query on how long the project will take.
- Queries on who will be employed by the mine and when will employment commence.
- Queries on whether the proposed TSF 3 WRD Extension 1 is the one that Tharisa has started to construct and whether Tharisa will remove the existing WRD.

[54] Required as per the EIA regulations Appendix 2 (g) a full description of the process followed to reach the proposed preferred activity, site and location of the development footprint within the site, including (iii) a summary of the issues raised by interested and affected parties, and an indication of the manner in which the issues were incorporated, or the reasons for not including them;

- Query on why the proposed extension is small in extent.
- Query on what will happen to the Lapologang community after or as the waste rock is being dumped and a suggestion that Tharisa perhaps only extend the proposed TSF 3 WRD Extension 1 after the community has been relocated.
- Query on the way forward should the Scoping and EIA phases of the project have negative results.
- Query on why Tharisa is not focusing on the nearest dumping site which is north east of Lapologang since it is too close to the community.
- Query on whether this process will affect the relocation process related to the new TSF.
- The following concerns were made regarding the existing mining activities/operation:
    - I&APs struggle with network in the area which is perceived to be a result of the height of the existing WRDs. There was another concern that the proposed TSF 3 WRD Extension 1 may also have an impact on the network.
    - Query on why Tharisa does not relocate people within the communities as they are affected by dust and noise, especially at nighttime.
    - Issue of blasting and its impacts on the surrounding houses. An incident of cracking was reported to the mine and no action has been taken by the mine.
    - Dust and noise impacts from the current operations particularly at nighttime. When community members report these issues to the mine, nothing happens. There is also a perception that the dust from the operations has affected their health.
    - The construction of the new TSF has created concerns and I&APs have expressed that there are outstanding issues that should have been addressed with them prior to construction.
    - Relocation process connected to the new TSF construction is taking long.
    - There is a plant close to the Lapologang community which has been affecting the community with noise. I&APs have reported this to the mine and yet nothing has been done.
    - During the grave relocation the Lapologang community members were hired to assist with grave relocation and were told that they would be compensated when the process is done however, compensation was never received.
    - An I&AP expressed that Tharisa placed a fence at D23 and did not notify them yet the land owner had previously told them that he was selling the land and he had given that land to them but now Tharisa have put up a fence and want to relocate them.

10 THE ENVIRONMENTAL ATTRIBUTES ASSOCIATED WITH THE DEVELOPMENT FOOTPRINT ALTERNATIVES[55]

This section provides a general description of the environment in which the project is located. The purpose of this section is to provide a perspective of the local environment within which the proposed Tharisa TSF 3 WRD Extension 1 project is located, with a view to identify sensitive issues/areas, which need to be considered when conducting the impact assessment. Existing baseline information and specialist studies, as well as the studies undertaken specifically for this project that have been used to describe the current environment, are listed below.

- GCS (Pty) Ltd. 2022. Tharisa Minerals 2022 Integrated Water and Waste Management Plan (IWWMP) Update.
- Green Gold Group (Pty) Ltd. 2020. Amendment of Tharisa Mine Environmental Impact Assessment Report. DMR Reference Number: NW/30/5/1/2/3/2/1/358, DEDECT Reference Number: NWP/EIA/50/2011. Report Number: GGG19/02.
- Aquatico Scientific. 2022. Tharisa Minerals Monthly Dust Fall-Out Monitoring Report for the Period 10 November 2022 to 10 December 2022.
- AGES. 2023a. An Agricultural Agro-Ecosystem Specialist Report for The Tailings Storage Facility 3 Waste Rock Dump Extension 1 Project That Forms Part of The Tharisa Mine Operations on A Portion of The Farm 342 JQ, Near Marikana, Rustenburg Local Municipality, Bojanala District Municipality, North West Province.
- AGES. 2023b. A Wetland / Riparian Impact Assessment for The Tailings Storage Facility 3 Waste Rock Dump Extension 1 Project That Forms Part of The Tharisa Mine Operations on A Portion of The Farm 342 JQ, Near Marikana, Rustenburg Local Municipality, Bojanala District Municipality, North West Province.
- AGES. 2023c. A Terrestrial Biodiversity Impact Assessment (Including Plant and Animal Species Assessment) For the Tailings Storage Facility 3 Waste Rock Dump Extension 1 Project That Forms Part of The Tharisa Mine Operations on A Portion of The Farm 342 JQ, Near Marikana, Rustenburg Local Municipality, Bojanala District Municipality, North West Province.
- GLYA. 2023. Visual Impact Assessment Report Tharisa Mine: TSF 3 WRD Extension 1. Report 103_2023.
- Airshed Planning Professionals. 2023a. Air Quality Baseline Assessment for the proposed Tharisa TSF3 Waste Rock Dump Extension 1. Report No: 22OMI04.
- Airshed Planning Professionals. 2023b. Environmental Noise Scoping Assessment for the proposed Tharisa TSF3 Waste Rock Dump Extension 1. Report No: 22OMI05.
- Artesium Consulting Services. 2023. Tharisa Minerals Hydrogeological Baseline and Impact Assessment – TSf3 WRD Extension 1 Scoping Report. Project no: 2022-0058.
- Urban-Econ Development Economists. 2023. Socio-Economic Impact Assessment for the Tharisa Mine TSF3 WRD Extension 1.

[55] Required as per the EIA regulations Appendix 2 (g) a full description of the process followed to reach the proposed preferred activity, site and location of the development footprint within the site, including (iv) the environmental attributes associated with the alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;

- CES Environmental and Social Advisory Services. 2023. Heritage Impact Assessment Report for The TSF3 WRD Extension 1 Project at The Tharisa Mine, Bojanala District Municipality, North West Province.

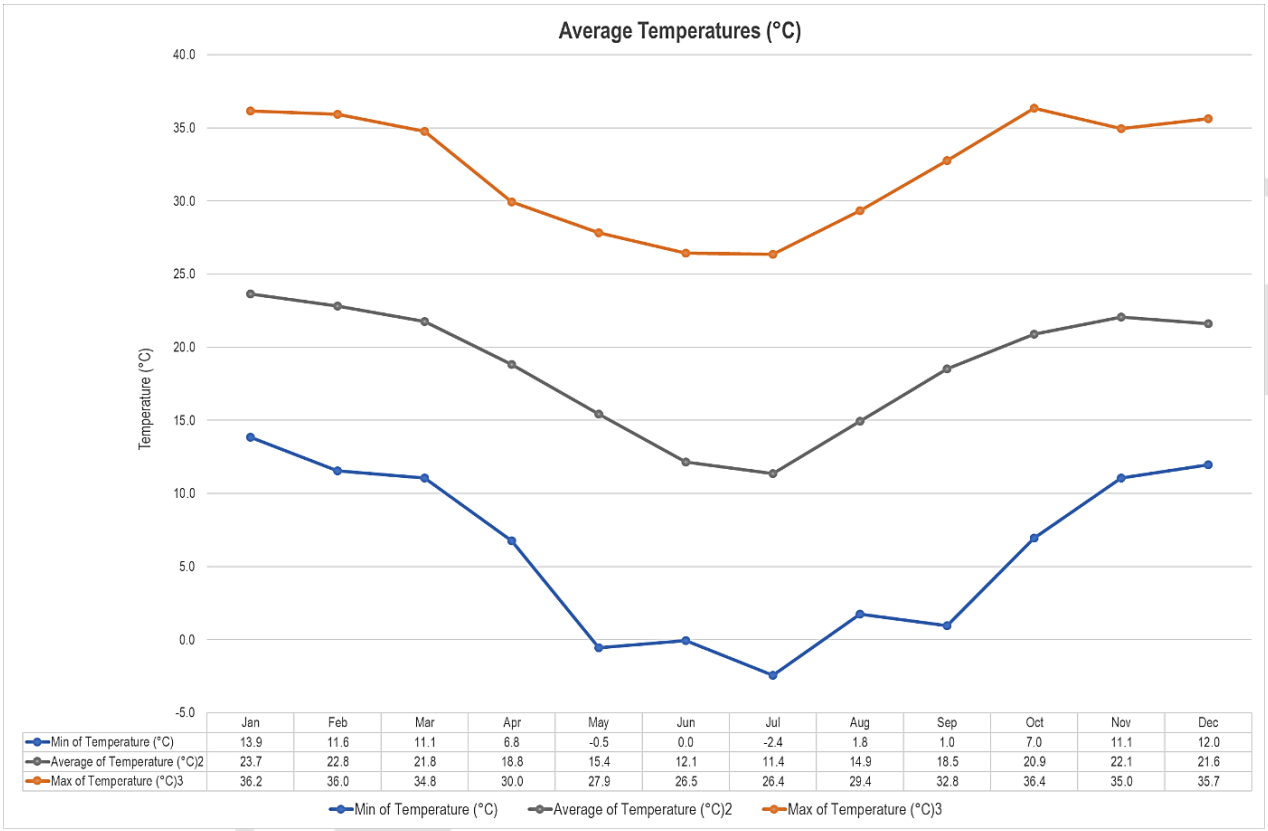
10.1 CLIMATE

10.1.1 REGIONAL CLIMATE

The Tharisa Mine falls within the Highveld Climatic Zone (semi-tropical region) which is characterised by moderately warm temperatures, with mild dry winters and hot summers. The Buffelspoort weather station (Station No. 0511 855 W) is the closest station to Tharisa. The rainy season typically occurs in summer during the months of October to March, with afternoon thundershowers occurring often from August to March (GCS, 2022).

10.1.2 AMBIENT TEMPERATURE

The area experiences hot temperatures during summer, with maximum of 36.4°C for the month of October. Winter temperatures are relatively low especially in the months of May to July. The monthly temperature pattern is provided in **Figure 5** (Airshed Planning Professionals, 2023a).



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Min of Temperature (°C)	13.9	11.6	11.1	6.8	-0.5	0.0	-2.4	1.8	1.0	7.0	11.1	12.0
Average of Temperature (°C)2	23.7	22.8	21.8	18.8	15.4	12.1	11.4	14.9	18.5	20.9	22.1	21.6
Max of Temperature (°C)3	36.2	36.0	34.8	30.0	27.9	26.5	26.4	29.4	32.8	36.4	35.0	35.7

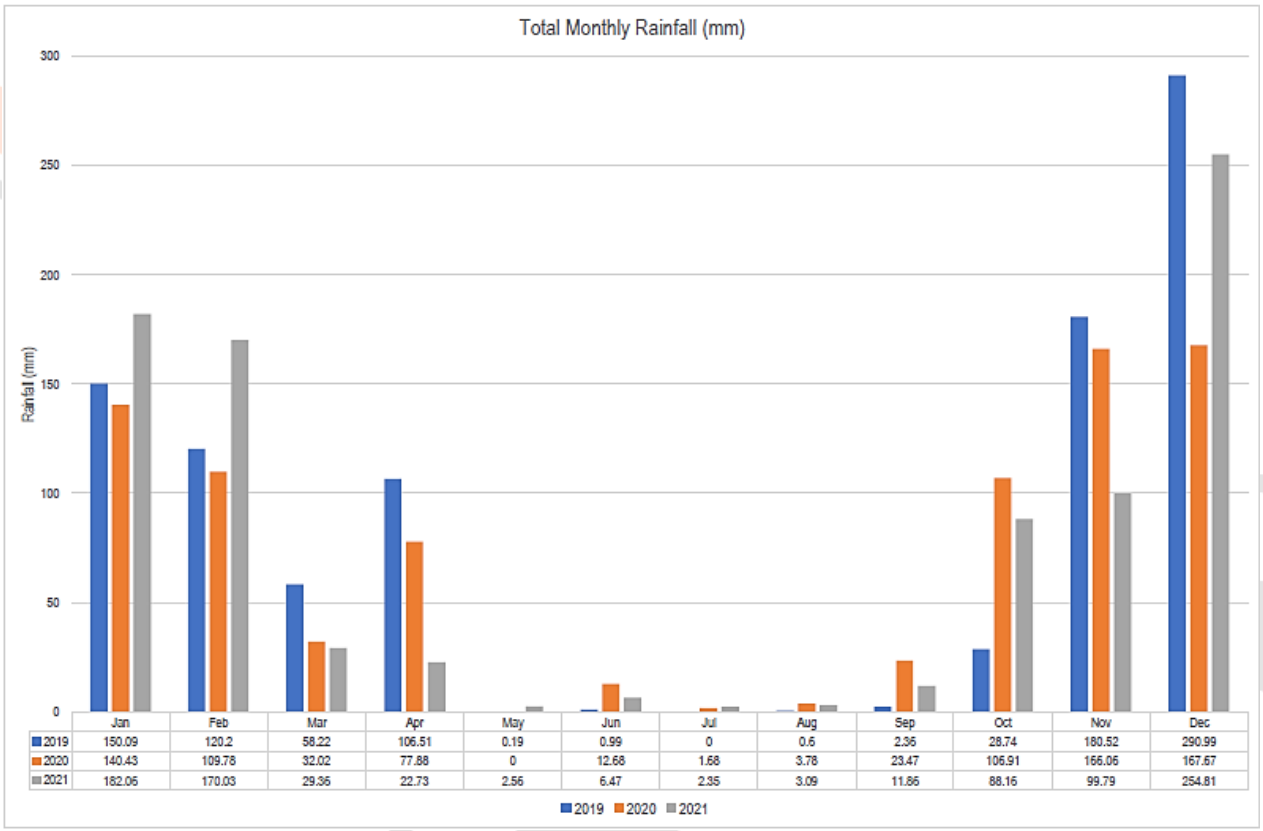
Figure 5: Minimum, Average and Maximum Temperatures over the Project Area (WRF Data; 2019 to 2021)

10.1.3 RAINFALL AND EVAPORATION

The average annual precipitation in the region ranges from 873 mm and 939 mm (Airshed Planning Professionals, 2023a). Rainfall is generally in the form of thunderstorms. These can be of high intensity with lightening and strong gusty south-westerly winds. The frequency of hail is also high with approximately 4-7 hailstorms per season (GCS, 2022).

Precipitation is important to air pollution studies since it represents an effective removal mechanism for atmospheric pollutants and inhibits dust generation potentials. Monthly rainfall for the Project site (based on Weather Research and Forecasting (WRF) data for 2019 – 2021) is given in **Figure 6**. Months wherein the most rain occurred stretched from October to April (Airshed Planning Professionals, 2023a).

Relatively high levels of evaporation occur because of the elevated solar radiation levels experienced. The maximum evaporation rate occurs in December, with a mean rate of more than 7mm per day. Evaporation is greater than rainfall for all months of the year resulting in a marked moisture deficit in the region (GCS, 2022).



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2019	150.09	120.2	58.22	106.51	0.19	0.99	0	0.6	2.36	28.74	180.52	290.99
2020	140.43	109.78	32.02	77.88	0	12.68	1.68	3.78	23.47	106.91	166.06	167.67
2021	182.06	170.03	29.36	22.73	2.56	6.47	2.35	3.09	11.86	88.16	99.79	254.81

Figure 6: Monthly Precipitation over the Project Area (WRF Data; 2019 to 2021)

10.1.4 WIND

A wind station situated at the Tharisa Minerals' property at coordinates, S25° 44' 25.5", E27° 29' 29.0" was used to determine the general and average wind direction over a monthly period (Aquatico, 2022). At the time of the monitoring, the wind distribution and wind rose indicates that the wind predominantly blew from the South East direction (Figure 30**Figure 7**).

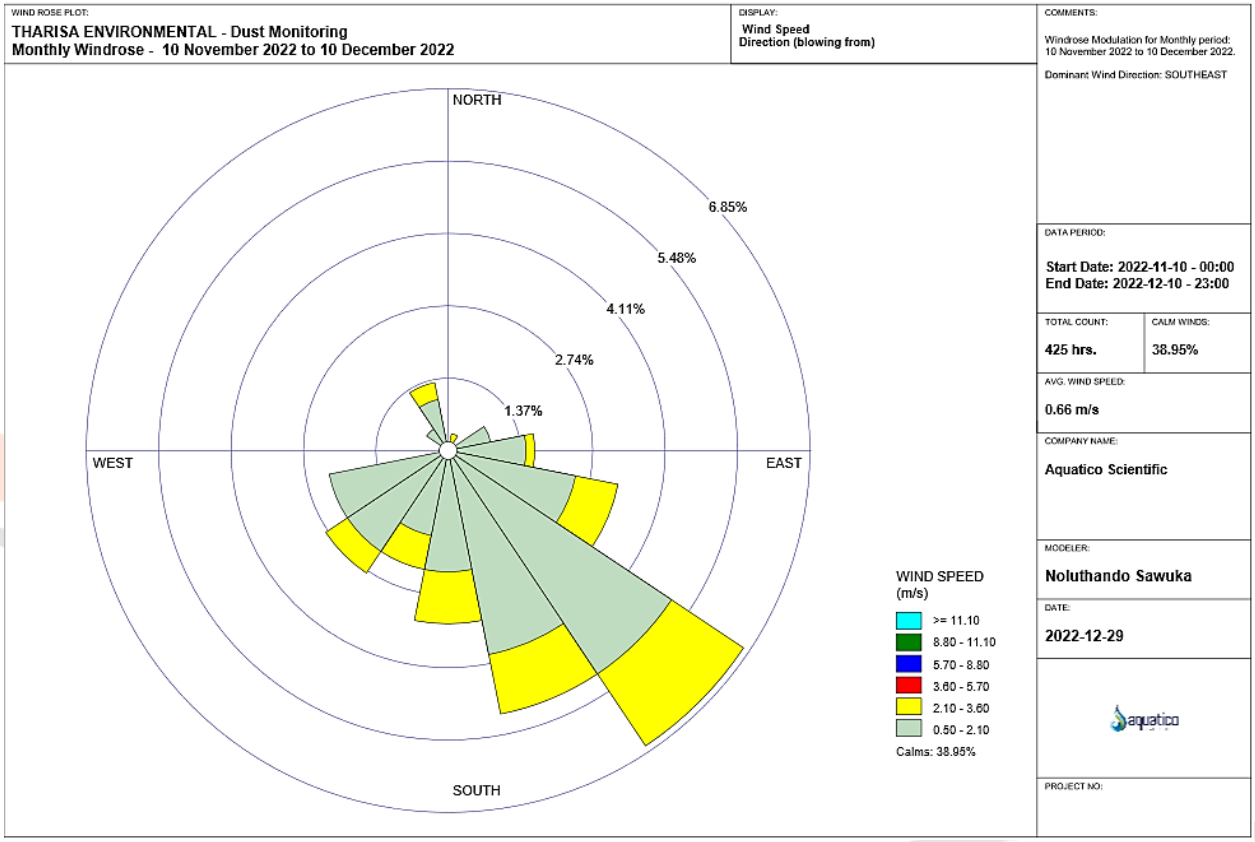


Figure 7: Tharisa Mine Wind Rose Plot (Aquatico, 2022)

10.2 TOPOGRAPHY AND DRAINAGE

The Tharisa Mine is situated on slightly undulating plains and located to the west of the perennial Sterkstroom River. Small sections of original vegetation remain intact on the site, although most of the site represent old, cultivated land. A section of the project site has already been modified by a WRD to the north. The major land uses of the project area as classified by the Environmental Potential Atlas of South Africa (2000) are mining and vacant / unspecified land (AGES, 2023b).

The Tharisa Mine is in the in the Crocodile (West) and Marico Water Management Area (WMA) and is located mainly in the Quaternary Catchment Area (QCA) A21K (**Figure 30**). The Crocodile River is a major tributary of the Limpopo River (Drainage Region A) which discharges into the Indian Ocean (Mozambique). The Pienaars, Apies, Moretele, Jukskie, Hennops, Magalies and Elands rivers are all major tributaries of the Crocodile River which make up the A20 tertiary hydrological catchment with its 39 quaternary catchments (GCS, 2022). The project area is drained mainly by means of surface run-off (sheetflow) with storm water collecting along roads and footpaths cutting through the area, to drain into the perennial rivers that occur to the East of the proposed TSF 3 WRD Extension 1 area (AGES, 2023b).

10.3 GEOLOGY

The site's geological and hydrogeological setting (**Figure 8** and **Figure 9**, respectively) consists mainly of a shallow weathered bedrock aquifer with intergranular porosity and permeability. According to the 1:500 000 Hydrogeological map series 2526 Johannesburg (Barnard and Baran, 1999) the project site is underlain by fractured (b3) and intergranular and fractured (d3) aquifers. The surface lithology is characterised by quartzite and dolerite, anorthosites and pyroxenite. The map indicates that to the West of the site area and the surrounding region large scale groundwater abstraction for irrigation purposes (>10 mil m^3/a) was done around 1999. Since then, the water uses have changed significantly to mining and industrial activities.

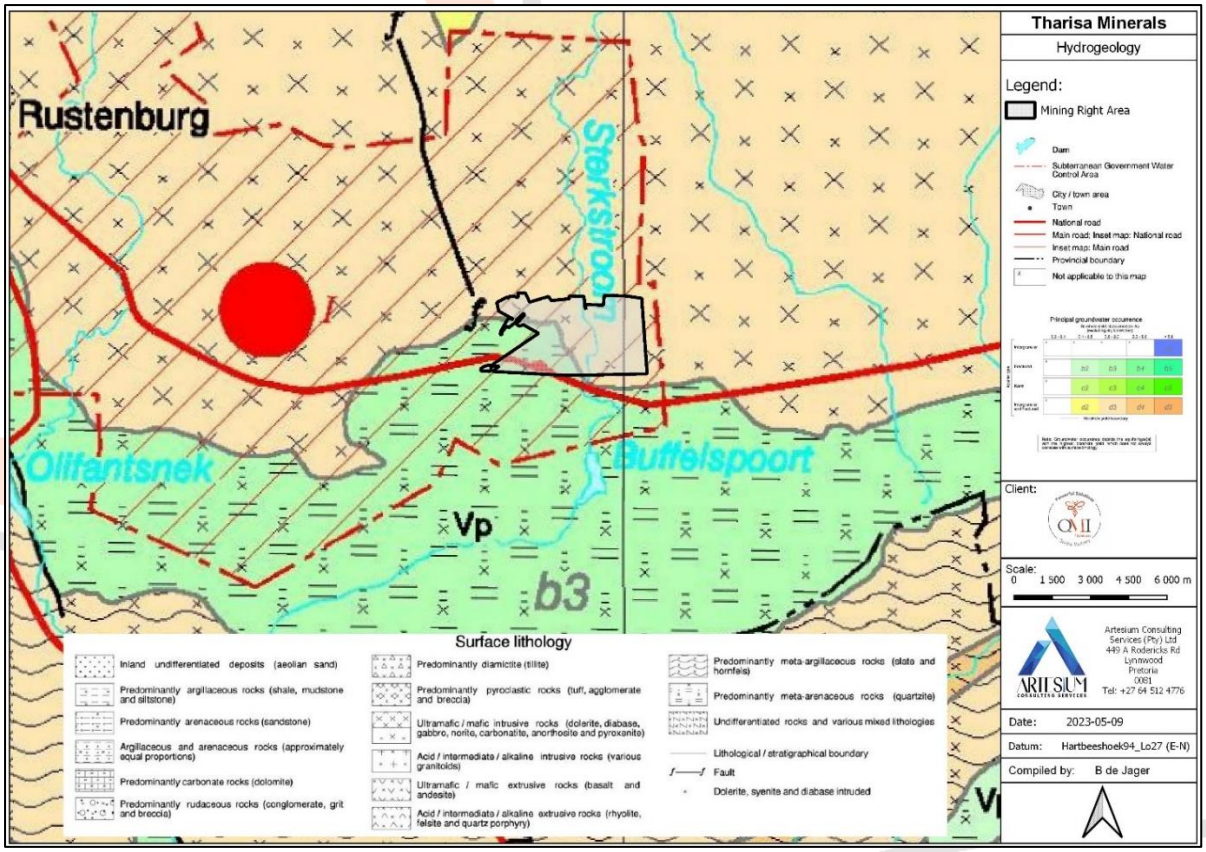


Figure 8: 1:500 000 Hydrogeological Map

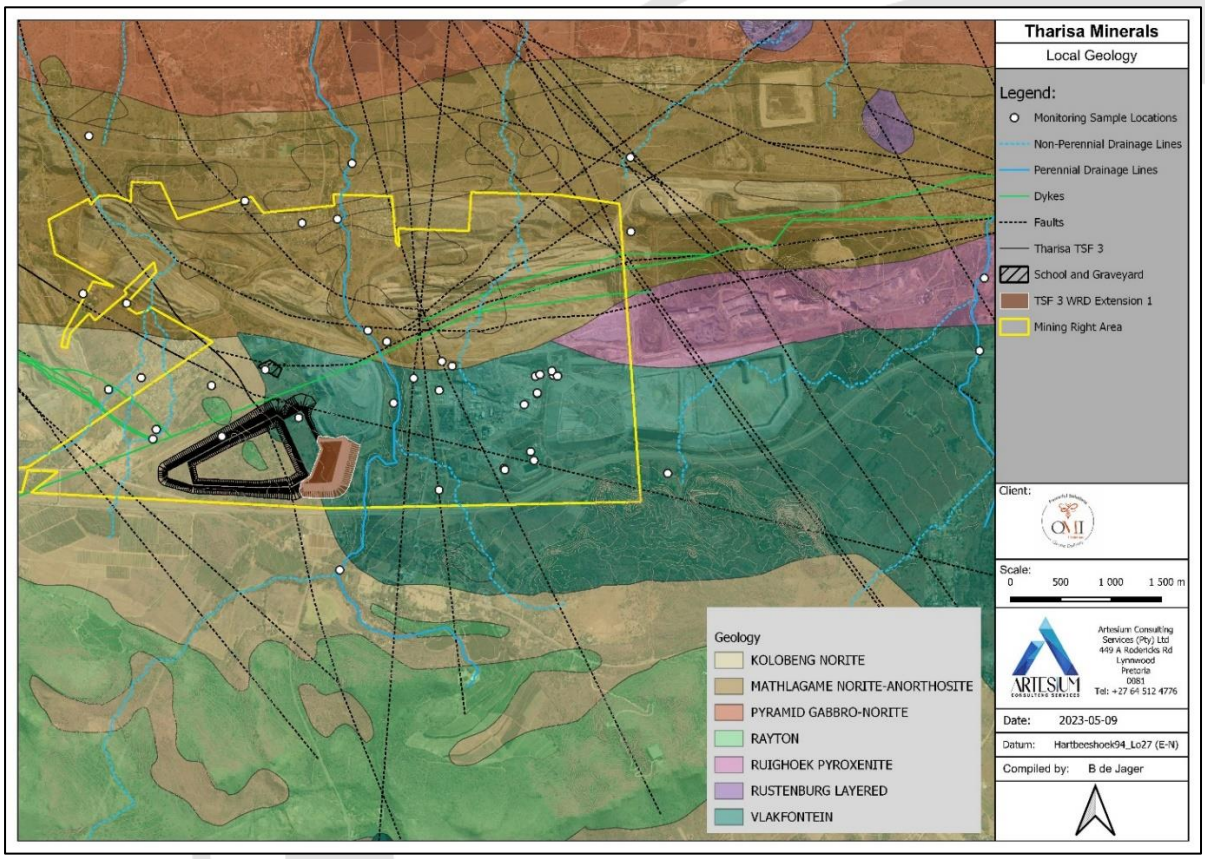


Figure 9: Geological Map

10.4 SOILS AND LAND CAPABILITY

10.4.1 SOIL AND LAND CAPABILITY

A land type unit is a unique combination of soil pattern, terrain and macroclimate, the classification of which is used to determine the potential agricultural value of soils in an area. The land type units represented within the study area include the Ea3 land type (Land Type Survey Staff, 1987) (ENPAT, 2001). The land type, geology and associated soil type is presented in **Table 8** below as classified by the Environmental Potential Atlas, South Africa (ENPAT, 2001).

Table 8: Land Types, Geology and Dominant Soil Types of the Proposed TSF 3 WRD Extension 1

Landtype	Soils	Geology
Ea3	One or more of: vertic, melanic, red structured diagnostic horizons, undifferentiated	Norite, gabbro, pyroxenite and anorthosite of the Bushveld Complex. Occasional dykes of syenite and diabase.

The soils are generally red clayey soils derived from Norite. The soils are derived from Norite and have a moderate (15-35%) clay content, depending on their position in the landscape.

Two types of soil forms were identified on site as provided in **Table 9**. A third classification was identified as “degraded areas” where the topsoil has been disturbed and often removed (mining areas – not described).

The spatial distribution of the soil forms shown in **Figure 10** and the land capability shown in **Figure 11**. Overall, the site is classified as Moderate potential arable with Moderate to Low potential grazing land.

Table 9: Soil Forms Identified on Site and the Associated Agricultural Potential and Land Capability

Soil Form	Description	Agricultural Potential	Land Capability
Shallow rocky soil of the Mispah / Glenrosa soil form /. exposed bedrock on slightly undulating plains	The soils are generally shallow and derived from NORITE in the project area. All three these soil forms can be categorised in the international classification group of lithic soil forms. In lithic soil forms the solum is dominated by rock or saprolite (weathered rock). These soils have sandy to sandyloam texture, while topsoil structure is apedal and the profiles are very shallow. Exposed rocks and boulders are spread on the soil surface throughout the area. The Mispah and Glenrosa soils found on this section of the site are widespread and shallow in depth, although it has a medium clay content.	Low potential soils, due to the shallow nature of the soils, making these areas not suitable for crop cultivation under arable conditions. The orthic A-horizon of the lithic soil group is unsuitable for annual cropping or forage plants (poor rooting medium since the low total available moisture causes the soil to be drought prone). These topsoils are not ideal for rehabilitation purposes for they are too shallow and/or too rocky to strip. Topsoil stripping and stockpiling of the “shallow" soils should only be attempted where the surface is not too rocky.	The grazing potential of these areas is moderate-low. The most suitable and optimal utilization of the area would be grazing by small livestock or game species.
Deep, red apedal soils of the Hutton soil form	The Hutton soil form on site is deep and has a medium to high clay content. The Hutton soil forms consist of an orthic A horizon on a red apedal B horizon overlying unspecified material. The red apedal soils B1-horizon has uniform "red" soil colours in both the moist and dry states and has weak structure or is structureless in the moist state. The range of red colours that is a key identification tool in differentiating between a red apedal and yellow-brown apedal is defined by the Soil Classification Working Group Book (1991). Some of the defining red soil colours identified on the sites are bleached (10R 3/6), while some are bright red. The relatively high magnesium and iron content of the parent	Soils not under irrigation (arable agriculture) have a Moderate Agricultural Potential. The Hutton soils are deep and often have a sandyloam structure that causes a medium water holding capacity, although the clay content of the soils is sufficient. However, under the prevailing climatic conditions these soils would not sustain arable crop production. The most viable option for crop production on the soil form is under irrigation considering the variable rainfall and moisture availability due to higher day temperatures. The high evaporation rates and high water demands by crops would render crop cultivation still a risky venture on some of the farm portions in the study area, with the size	Livestock and / or game grazing are viable due to the slightly higher nutrient and organic content of the topsoil in woodland areas that support a mixture of palatable and unpalatable species. Arable crop cultivation under the current climatic conditions is not considered a viable option.

Soil Form	Description	Agricultural Potential	Land Capability
	rocks from which these soils are derived, impart the strong red colours noted.	of the farm portion in combination with soil form (deep Hutton soils) and water availability for irrigation being the main factors contributing to soils being classified as High Potential Soils under irrigation or not. The many old, cultivated fields confirm that crop cultivation without irrigation on small pockets of land over the longer term is not a financially viable option under the prevailing climatic conditions. Sustainable crop cultivation can only be supported on large portions of land under irrigation as seen in the north-western section of the site.	

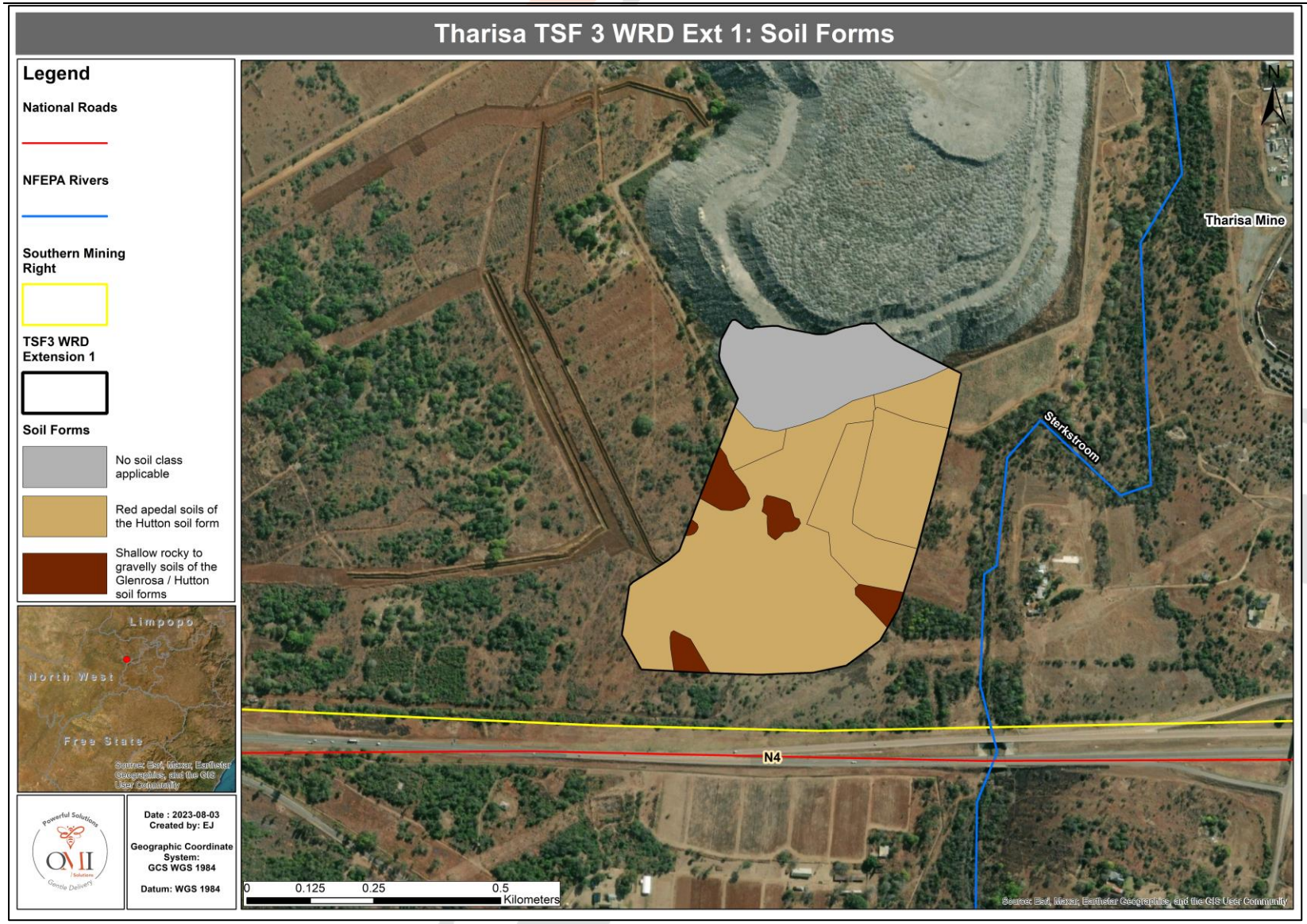


Figure 10: Soil Forms of the Project Site

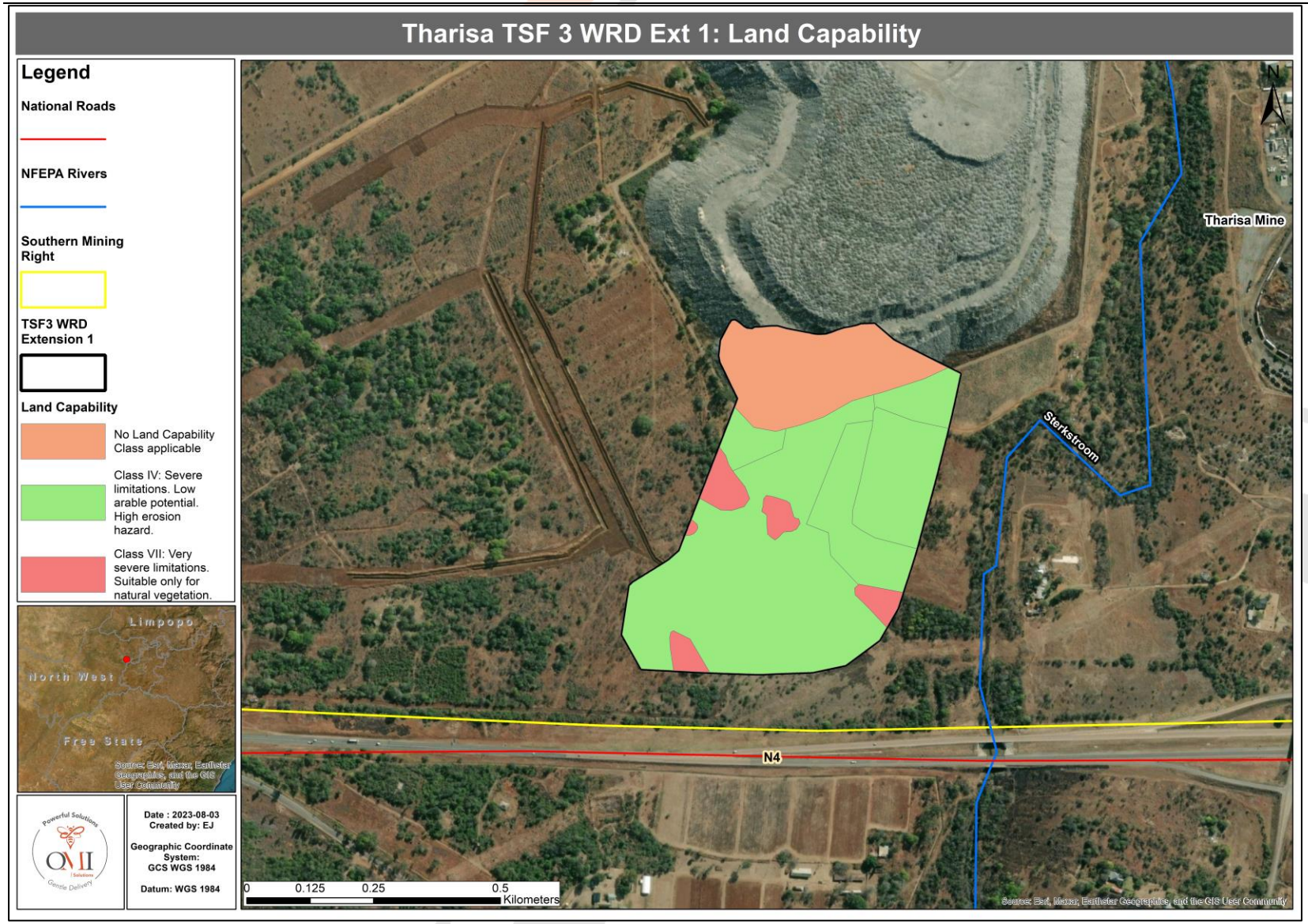


Figure 11: Land Capability of the Project Site

10.4.2 AGRO-ENTERPRISE AND LAND CAPABILITY

The site for the WRD has not been changed in the last 5 years. Other sections of the MR Area are used for various mining and industrial purposes. Moreover, in terms of employment from an agricultural point of view no changes occurred recently on the site considering that the site remains vacant land where the WRD is proposed.

The areas with a Low or Medium sensitivity from an agricultural point of view was considered suitable due to having shallow and rocky soils that is considered suitable for the placement of the WRD, while the areas with deeper soils are not considered suitable from an arable agricultural perspective due to climatic conditions. The long-term benefit of the development would be job creation, compared to the current usage from an agricultural point of view that is restricted to livestock grazing.

Economically viable farming is, restrictive to irrigated cropping due the high risk that could be associated with dry-land farming. At present no irrigation or centre pivots occur on the property. Furthermore, higher day temperatures and evaporation rates in summer months may hamper soil moisture storage for crop use.

The current vegetation at the proposed site of development consists mainly of areas of native woody perennial species (often encroached) and unpalatable grasses (low quality grazing grass species due to previous overgrazing) on the red apedal soils. Mixed quality grazing (highly palatable and unpalatable grasses) occurs in the low-lying areas that can support limited grazing by livestock. The nature of the vegetation and size of the properties make the area marginal for extensive livestock production. Using planted pasture to supplement livestock production is also not an option considering the limited water availability for extensive irrigation.

The nature of the vegetation at the farm is therefore marginal for extensive livestock production. The moderate agricultural potential of the soils and the Low to Moderate grazing capacity is further confirmed by the Agricultural Map.

10.5 HYDROGEOLOGY

10.5.1 AQUIFER TYPES

The project site's hydrogeological setting (**Figure 8**) consists mainly of a shallow weathered bedrock aquifer with intergranular porosity and permeability. The groundwater occurrence is reflected by the aquifer type and highest borehole yield; however, this does not always correlate to surface lithology (Artesium Consulting Services, 2023).

The shallow semi-confined aquifer formed because of weathering of the norites, anorthosites, dolerite dykes and pyroxenites (i.e., regolith). Differentially weathered and fractured bedrock underly the regolith, thus the aquifer is treated as a single weathered aquifer unit (SLR Consulting, 2021).

The deeper solid, fractured bedrock aquifer comprises of the fractured and faulted norites, anorthosites and pyroxenites. The intact bedrock matrix itself is assumed to have very low matrix permeability, while its effective bulk permeability is enhanced by faults and mine openings (SLR Consulting, 2021)

Most of the faults strike North West to South East, with a prominent dyke structure striking West to East. The dyke contacts are inferred to be more permeable, and therefore could act as preferential flow zones for potential mass migration towards the east pit. From the structural data obtained, there is no indication of geological structures intersecting or linking the proposed TSF 3 WRD Extension 1 with potential receptors (i.e., Sterkstroom River).

10.5.2 AQUIFER CLASSIFICATION AND VULNERABILITY

According to the Aquifer Classification of South Africa Map (2012), based on the locality and aquifer characteristics, it is inferred that the site is situated on a special aquifer region, characterised by poor to minor groundwater. The main water source in the region is surface water. Considering the Aquifer Vulnerability of South Africa Map (2013) the aquifer region is rated as least vulnerable.

Aquifer mass susceptibility can be determined by the product of the classification and vulnerability of an aquifer. The matrix below (**Table 10**) shows the different classes in aquifer susceptibility. Based on the description given in the table, the localised aquifer at Tharisa has low susceptibility to mass transport.

The findings align with aquifer testing conducted in 2022 (Artesium Consulting Services, 2022a; Artesium Consulting Services, 2022b) that concluded the aquifer is a minor aquifer system with moderate to low permeability of 1-1e-03 m/d and a borehole yield of 0.1 – 1 l/s.

Table 10: Aquifer Contamination Susceptibility Classes (Parsons and Conrad)

	Vulnerability Class		
Aquifer System Management Class	*low (1)*	*medium (2)*	*high (3)*
poor groundwater region (1)	low susceptibility (1)	low susceptibility (2)	medium susceptibility (3)
minor aquifer region (2)	low susceptibility (2)	medium susceptibility (4)	high susceptibility (6)
major aquifer region (3)	medium susceptibility (3)	high susceptibility (6)	high susceptibility (9)

10.5.3 GROUNDWATER LEVELS AND FLOW

By analysing the groundwater level monitoring data collected from 2013 to 2023, it was evident that the groundwater levels remained stable with some seasonal fluctuations observed (**Figure 13**).

Dewatering impacts of the open pits are localised considering the data set provided. **Figure 12** indicates a medium, positive correlation between groundwater levels and topography. It inferred that groundwater generally follows elevation and topography with only localised impacts from dewatering.

The mean onsite groundwater levels are 15.8 mbgl, with the P50 groundwater level similar at 14 mbgl. The mean off-site upstream groundwater levels are 11.8 mbgl and the P50 is at 13 mbgl.

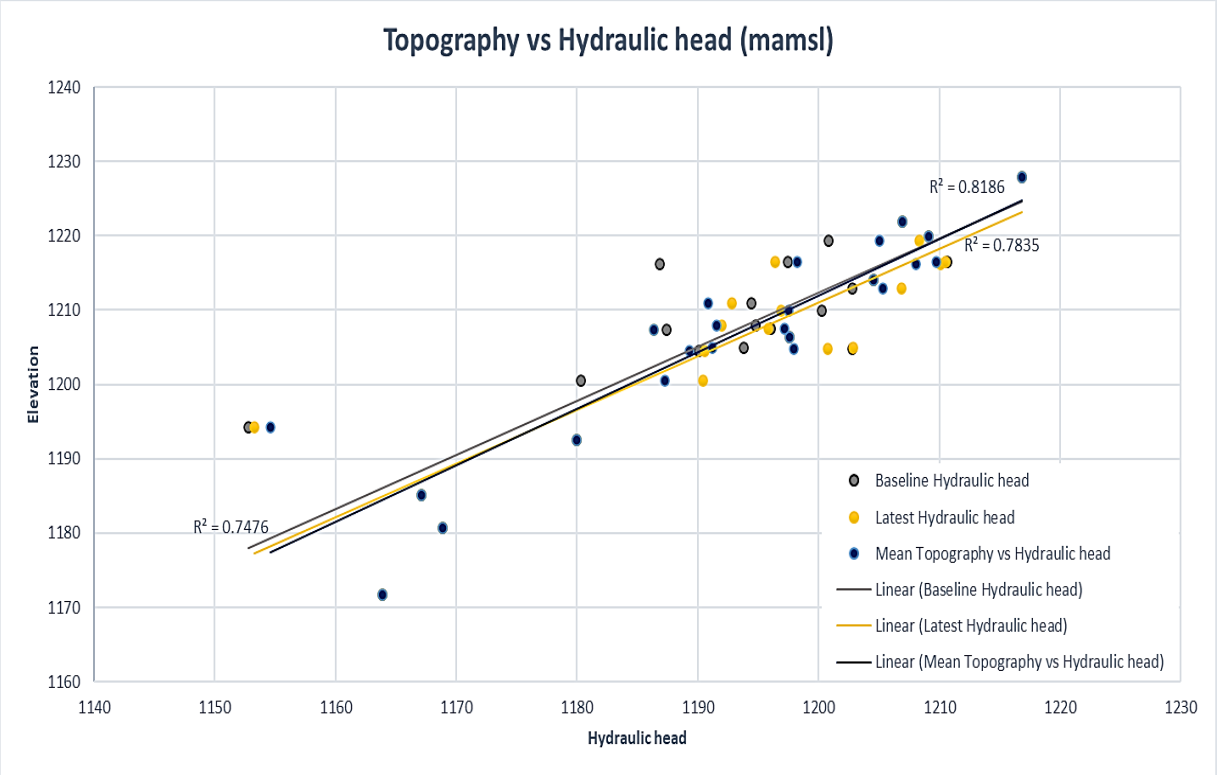


Figure 12: Topography Against Hydraulic Head Indicates that Dewatering Impacts are Minimal

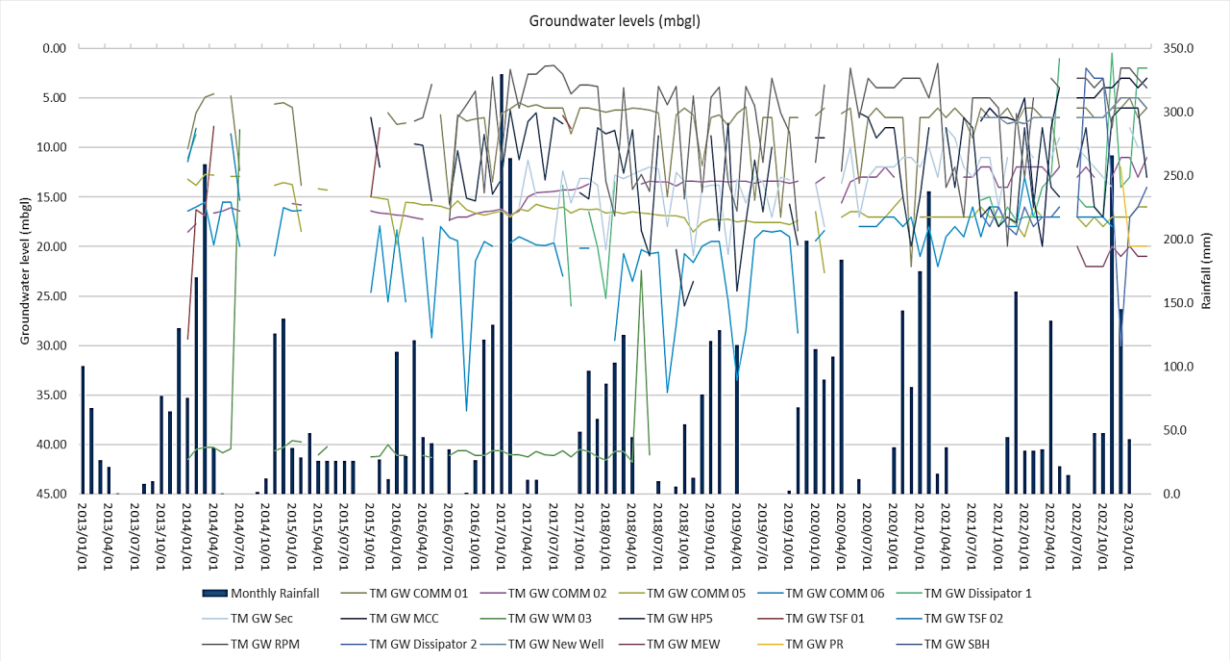


Figure 13: Groundwater Level Monitoring Data from 2013 to 2021

Figure 14 below indicates that deeper groundwater levels are found west of site, while shallower groundwater occurs onsite near the processing plant locations. This may be due to seepage from the TSF facilities towards the pit. Borehole data is until 2023 was available for TW GW Comm 01, TW GW Comm 02, TW GW Comm 05, TW GW Sec, TW GW HP5, RPM, TW GW Dissipator 1 and 2, TW GW MCC New Well, TW GW TSF 01, TW GW MEW, TW GW PR and TW GW SBH. Borehole TW GW Comm 06 has collapsed, and TW GW WM 03 has been decommissioned.

The onsite borehole, TM GW WM 03, had exceptionally deep groundwater levels reaching >40 mbgl. This can be attributed to agricultural abstraction until 2018 when it was decommissioned. No groundwater levels have since been measured at this borehole; however, it still being utilised as a monitoring borehole for groundwater quality. Upstream borehole, TM GW TSF 01, has shallow groundwater levels, at < 9 mbgl with only four measurements at > 15 mbgl measured from 2014 to 2015. The shallow groundwater could be due to mounding of the hydraulic head from the TSF, while the slightly deeper measurements are due to naturally occurring wet and dry cycles, as 2014 and 2015 followed a period of lower rainfall.

Data gaps in groundwater level measurements are evident downstream (north) and to the West of site (**Figure 14**). An updated monitoring protocol is proposed to ensure adequate site monitoring coverage due to surface infrastructural expansion.

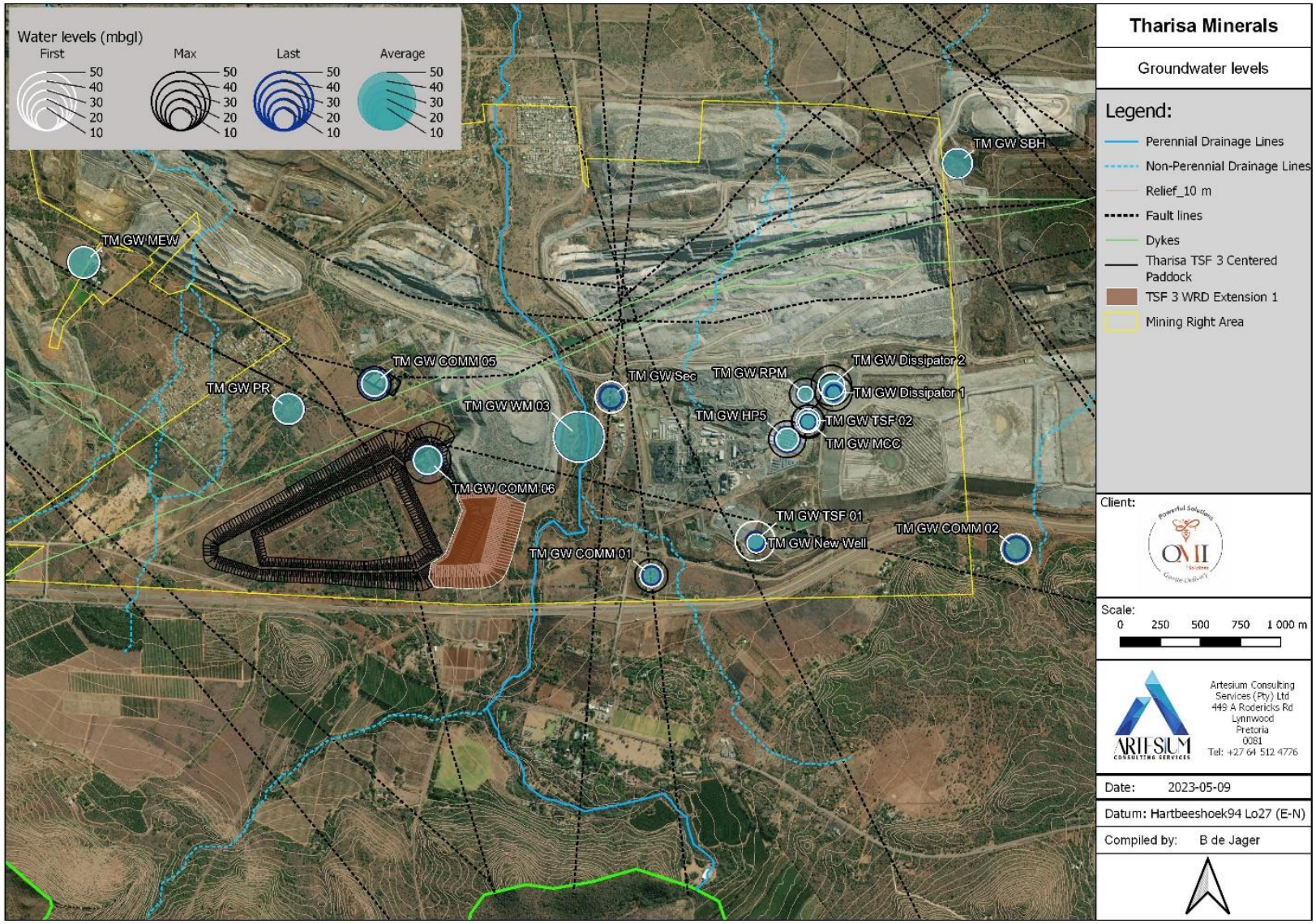


Figure 14: Bubble Plots of Measured Groundwater Levels and Their Spatial Distribution

10.5.4 HYDROGEOLOGICAL RISK-BASED APPROACH

The Risk Based Approach is used as part of the Hydrogeological Impact Assessment, with the risk assessment framework consisting of several inter-dependent steps. The Risk-Based Approach considered the following:

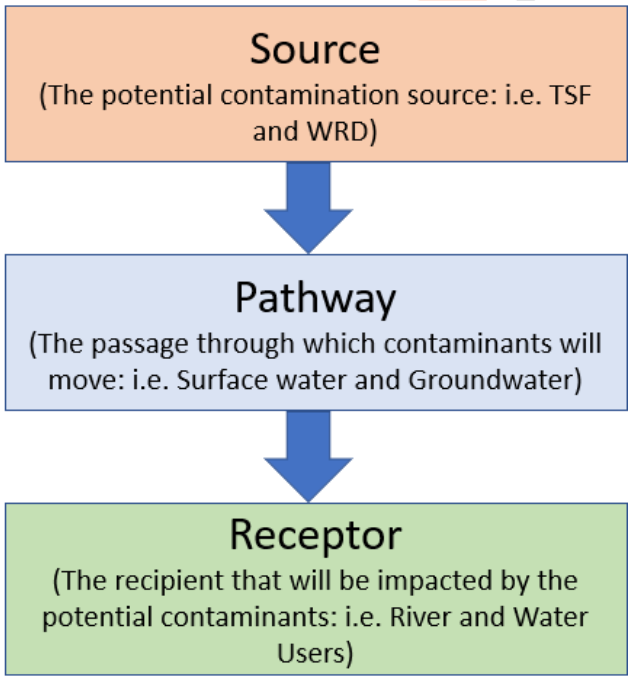


Figure 15: Source-Pathway-Receptor Analysis (Chang, 1999; Gyozo & Andrea, 2011)

10.5.4.1 SOURCE CHARACTERISATION

From previous studies at Tharisa (Artesium Consulting Services, 2022a; Artesium Consulting Services, 2022b), detailed analyses were conducted on the potential mining induced mass sources from the various mining infrastructure facilities.

Hydro-geochemical leach test and analysis on the solid and liquid (dissolved) potential was done at various South African National Accreditation System (SANAS) accredited laboratories in Gauteng (Artesium Consulting Services, 2022a; Artesium Consulting Services, 2022b). Geochemical samples (sampled in 2019, 2020 and 2022) representative of both TSF- and WRD facilities, were analysed and interpreted. A summary of the finding is presented below.

Long-term water quality monitoring data (2013 – 2023) was analysed together with the geochemical samples. The results for the long-term water quality data are also presented below, with a summary in **Table 21.**

2020 VULCAN TAILINGS WASTE ASSESSMENT (SLR, 2020)

- The solid phase (Total Concentrations Thresholds (TCT)) for Barium, Cobalt, Manganese, Nickle, and Vanadium exceeded the limits for the TCT0 threshold only and therefore classify the tailings as a Type 3 waste.
- The leachable phase (Leachable Concentrations Thresholds (LCT)) for Chromium exceeded the limits for the LCT0 threshold only and therefore classify as a Type 3 waste.

2020 VULCAN TAILINGS WASTE ASSESSMENT (SLR, 2020)

- The solid phase (TCT) for Cobalt, Copper, Manganese, Nickle, and Vanadium exceeded the limits for the TCT0 threshold only and therefore classify the tailings as a Type 3 waste.
- None of the parameters exceeded the limits for the liquid phase (LCT0) thresholds and classify as a Type 4 waste. In addition, it conforms to the SANS (241) Drinking Water Standards.

2019 and 2022 MINE WASTE ROCK WASTE ASSESSMENT (SLR, 2019 & 2022)

- 2019 – The solid phase (TCT) for Barium, Cobalt, Copper, Nickle, Fluorine, Manganese and Mercury exceeds the limits for the TCT0 threshold only and therefore classify the Waste Rock as a Type 3 waste.
- 2022 – The solid phase (TCT) for Cobalt, Copper, Nickle, and Chromium (VI) exceeds the limits for the TCT0 threshold only and therefore classify the Waste Rock as a Type 3 waste.
- 2019 & 2022 – None of the parameters exceeded the limits for the liquid phase (LCT0) thresholds and classify as a Type 4 waste. In addition, it conforms to the SANS (241) Drinking Water Standards.

Based on the geochemical analysis, all waste types (WRD and tailings), classify as Type 3 based on TCT0 exceedances. *The TCT0 exceedances are irrelevant for the surface and groundwater pathways as the crystalline structures seldomly react in solid phases and the reactions are limited to less reaction surface and larger particle sizes than that tested for*.

The 2020 Vulcan Tailings sample classified as Type 3 due to Cr exceedances on LCT0. For the 2022 Vulcan tailings and all WRD samples, there are no LCT0 exceedances, and the waste can be classified as equivalent to Type 4. Although geochemical analysis of the solids and leaching components are important, it can differ from the actual field conditions.

10.5.4.2 SOURCE PATHWAY ANALYSIS

AMBIENT WATER QUALITY (WATER GEOSCIENCE CONSULTING, 2008)

From the work conducted by Water Geoscience Consulting in 2008, a Groundwater Quality Reserve was determined. The study focussed on the analysis of only 6 DWS data sets available for the entire catchment (Table 11). The ambient groundwater quality falls under Class 0 (ideal) and I (acceptable, suitable for domestic use) of the DWAF water quality classification. Locally, groundwater quality falls in Class I due to elevated levels of magnesium, nitrate, and total dissolved solids (TDS).

Considering the piper diagram from the Water Geoscience Consulting report (2008), a calcium-magnesium-bicarbonate (Mg-Ca-HCO_3) water type is evident for both surface- and groundwater samples **Figure 16**.

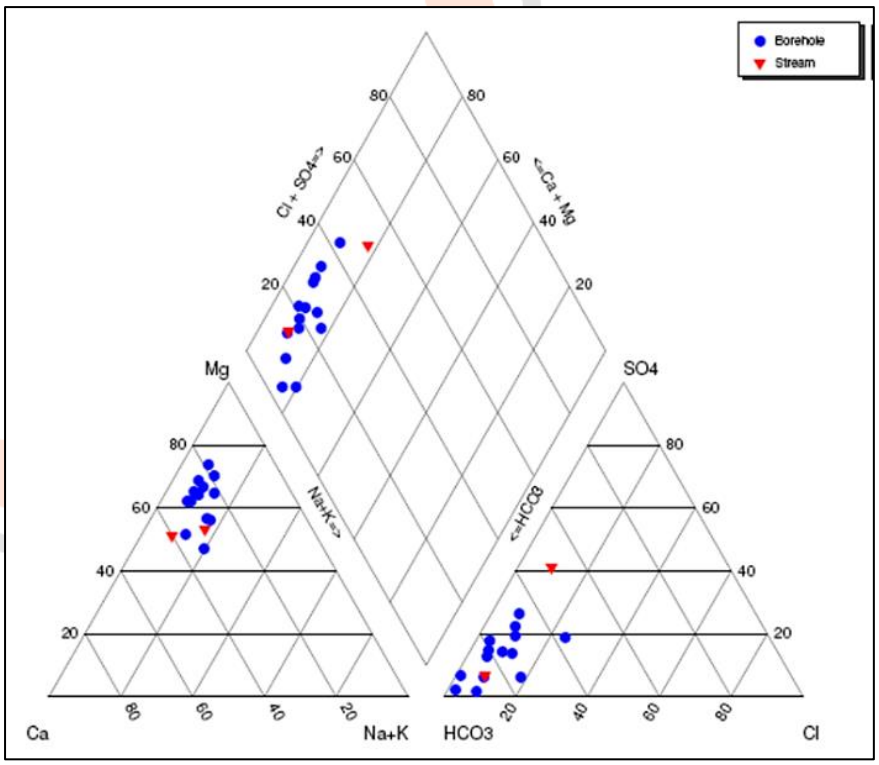


Figure 16: Piper Diagram Indicating the Surface- and Groundwater Types (Water Geoscience Consulting, 2008)

The dominant Mg-Ca-HCO_3 character of the groundwater samples indicate a recently recharged and shallow groundwater (chemical character attributed to silicate weathering processes). The surface water chemistry plots in line with the groundwater quality, which suggests some groundwater-surface water interaction does occur. Elevated NO_3 and SO_4 concentrations indicate that the groundwater may be impacted by anthropogenic sources i.e., agricultural and/or mining activities (Water Geoscience Consulting, 2008).

Table 11: Catchment A21K Groundwater Quality Data (adapted from Water Geoscience Consulting, 2008)

Sample ID	Station ID	Ca	Mg	K	Na	Mn	Fe	F	Cl	NO_3	NO_3 as N	SO_4	PO_4	Si	TDS	Cond
3444_1	Borehole	45.9	51.0	0.7	25.3	<0.5	0.1	0.1	8.8	27.2	6.1	14.8	<0.08	32.2	426.0	64.0
3444_2	Borehole	44.1	50.5	0.7	25.3	<0.5	0.1	0.1	8.3	26.1	5.9	13.7	<0.08	32.4	418.0	64.0
3444_3	Borehole	40.8	65.3	0.6	11.5	<0.5	<0.05	<0.1	8.7	9.3	2.1	80.9	<0.08	33.4	458.0	66.0
3444_4	Borehole	40.6	65.2	0.6	11.5	<0.5	0.1	<0.1	8.7	9.3	2.1	80.5	<0.08	33.2	458.0	67.0
8120_Stream 1B	Stream	13.8	14.6	44.3	6.2	0.8	1.3	<0.2	8.0	8.4	1.9	48.0	<0.08	8.4	81.0	126.0
8121 Breede River	Stream	97.2	74.4	1.0	23.5	<0.1	0.1	<0.2	29.0	34.0	7.7	32.0	<0.08	19.2	558.0	98.7
Colour formatting according to SABS 241 water classification																
Class 0 -ideal				**Class I - Acceptable**					**Class II - Allowable**				**>Class II - Unacceptable**			**No limits**

CURRENT THARISA WATER MONITORING NETWORK AND DATA

The current water quality monitoring network at Tharisa includes quarterly mine monitoring sampling locations, consisting of 6 surface water, 17 groundwater and 8 process water monitoring localities. In addition to these, 10 hydrocensus sampling locations were sampled once during a 2022 hydrocensus conducted by ACS (**Figure 17**). This hydrocensus was undertaken with specific reference to fill data gaps in the original monitoring network. An updated monitoring protocol is proposed to ensure adequate site monitoring coverage due to surface infrastructural expansion.

Water monitoring data sampled during mining operations is more accurate than the GNR635 and 636 laboratory tests and informs the source-pathway-receptor analysis as it is long-term and field scale data. A summary of the monitoring data analysed is indicated in **Table 12**.

Table 12: Summary of Monitoring data Reviewed

Monitoring Data Received*	Groundwater (Upstream)	Groundwater (On site)	Groundwater (Downstream)	Mine Water (Process, WWTW, and Stormwater)	Surface water (Rivers and Streams)	Total Monitoring
Number of sample locations	14	10	3	8	6	41
Number of samples taken**	253	350	3	581	309	1496
Max number of constituents**	54	54	54	56	56	[-]
Number of water levels taken	141	119	0	[-]	[-]	260
Data from-to	Sep 2013 to Mar 2023					
	* Monitoring data includes hydrocensus sample locations, sampled once **Number of constituent and number of samples for which parameters were analysed vary depending on the sampling period and sampling location. This number reflects the maximum number of constituents analysed from at least 2 samples.					

THARISA MINE 2013 SURFACE AND GROUNDWATER QUALITY BASELINE

The surface and groundwater baseline quality were determined based on chemistry data received from Tharisa Minerals. Mining commenced in 2008/2009 with the earliest monitoring data received for analysis being from September 2013. The P50 groundwater baseline was determined from 4 community boreholes (12 samples) upstream from the mining activities, and the results compare well with the mean regional baseline from analogue sites in the area (**Table 13**). The surface and groundwater considered to be drinking water standard as none of the chemical parameters exceed the SANS 241 Drinking Water Quality Standards.

The P50 surface water baseline was determined from 3 locations (17 samples) taken in 2013 (**Table 14**).

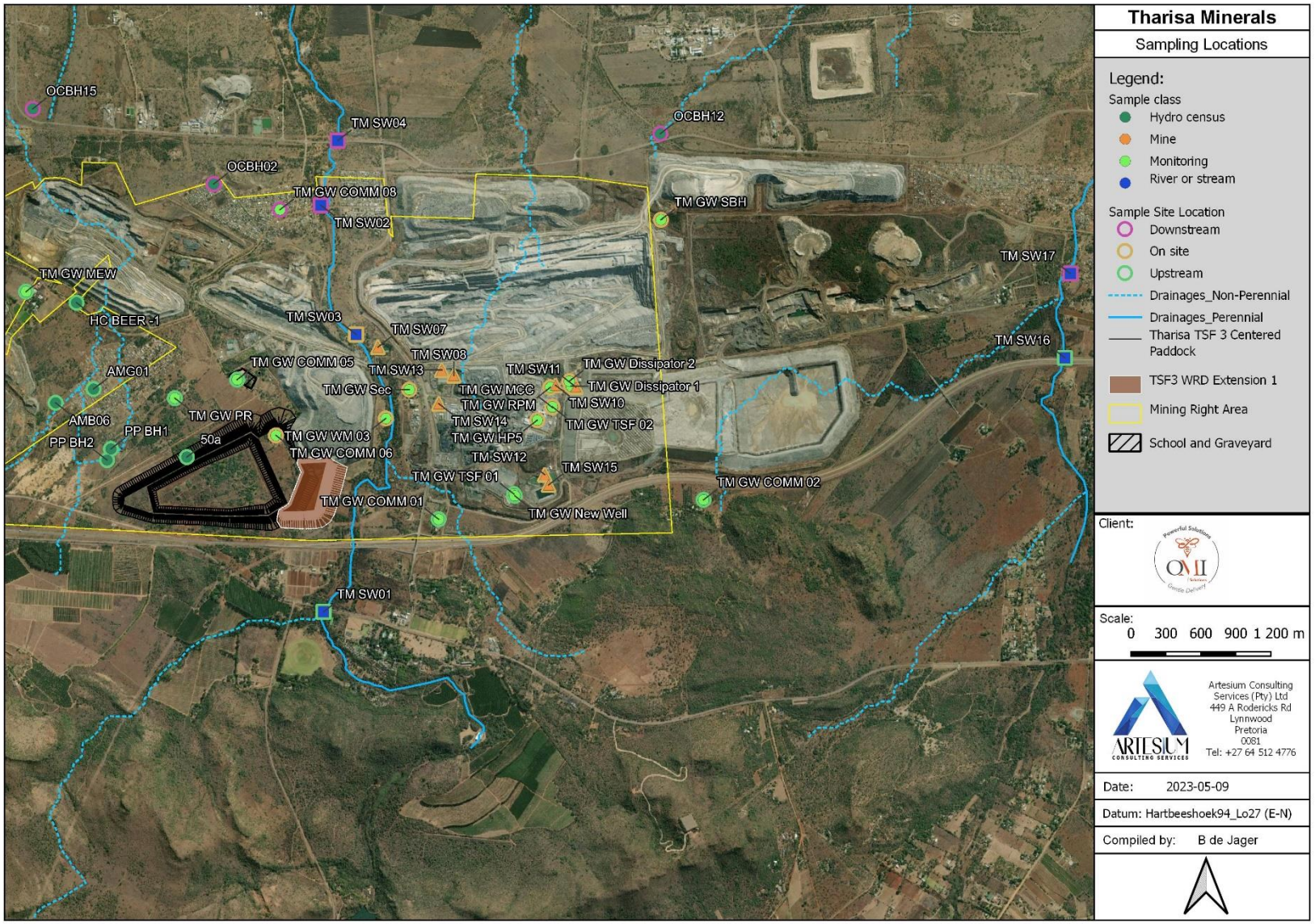


Figure 17: Existing Water Monitoring Localities

Table 13: 2013 Upstream Groundwater Baseline

2013 US GW Baseline	pH	EC mS/m	TDS mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	Cl mg/l	SO4 mg/l	NO3-N mg/l	F mg/l	Al mg/l	Fe mg/l	Mn mg/l
Sample count	12	12	1	11	11	11	11	12	11	12	11	11	11	11
Total Sample Count	12	12	12	12	12	12	12	12	12	12	12	12	12	12
SANS 241 Limit	9.7	170	1200	150		200	50	300	500	12	1.5	0.3	2	0.1
Regional Mean Baseline	7.4	34	440	42.9	58	11.1	0.65	9.2	14	2.1-6.1	0.3	<0.3	0.3	0.4
Mean	7.6	56.9		35.9	48.8	8.4	0.4	12.7	41.5	3.5	0.1	BDL	BDL	BDL
Min	7.2	39.5	566.7	27.4	33.1	0.01	0.02	2.3	19.3	0.2	0.1	BDL	BDL	BDL
Max	8.0	87.0	566.7	78.0	66.2	18.8	2.5	24.5	74.9	6.7	0.2	BDL	BDL	BDL
P5	7.3	40.2		27.6	33.6	0.8	0.02	2.4	19.6	0.4	0.1	BDL	BDL	BDL
P50	7.6	50.8		31.2	40.8	7.1	0.2	13.3	37.7	3.4	0.1	BDL	BDL	BDL
P95	7.9	85.7		59.5	65.3	17.6	1.7	22.8	67.3	6.5	0.2	BDL	BDL	BDL

2013 US GW Baseline	N_Amonia mg/l	NO2-N mg/l	PO4 mg/l	As mg/l	Cd mg/l	Cr mg/l	Cu mg/l	Hg mg/l	Pb mg/l	Se mg/l	Zn mg/l	CN (free) mg/l
Sample count	11	11	11	4	11	11	11	4	11	4	11	4
Total Sample Count	12	12	12	12	12	12	12	12	12	12	12	12
SANS 241 Limit	1.5	0.9		0.01	0.003	0.05	2	0.006	0.01	0.04	5	0.2
Regional Mean Baseline			<0.08								0.5	
Mean	0.03	0.10	0.02	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Min	0.003	0.07	0.004	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Max	0.1	0.11	0.07	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
P5	0.004	0.07	0.006	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
P50	0.02	0.1	0.02	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
P95	0.09	0.11	0.05	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

*BDL: Below Detection Limit

*TDS: Only 1 sample analysis was done.

Table 14: 2013 Surface Water Baseline

2013 SW Baseline	pH	TDS mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	Cl mg/l	SO4 mg/l	NO3-N mg/l	F mg/l	Al mg/l	Fe mg/l	Mn mg/l
Sample count	17	17	17	17	17	17	17	17	17	17	17	17	17
Total Sample Count	17	17	17	17	17	17	17	17	17	17	17	17	17
SANS 241 Limit	9.7	1200	150		200	50	300	500	11	1.5	0.3	2	0.1
Mean	7.99	116.28	13.08	13.14	2.31	0.50	5.98	9.09	0.75	0.14	BDL	0.05	0.01
Min	7.37	60.08	6.21	5.51	0.01	0.08	0.95	4.69	0.25	0.09	BDL	BDL	BDL
Max	8.49	165.97	18.50	20.50	8.66	1.16	13.48	17.28	1.61	0.20	BDL	0.52	0.13
P5	7.51	68.31	6.98	6.82	0.01	0.23	1.07	4.79	0.25	0.09	BDL	BDL	BDL
P50	8.03	114.45	13.94	11.19	0.58	0.49	5.53	6.93	0.56	0.13	BDL	BDL	BDL
P95	8.47	161.56	18.31	19.03	7.03	0.90	11.42	14.21	1.61	0.19	BDL	0.25	0.08
2013 SW Baseline	**N_Amonia mg/l**	**NO2-N mg/l**	**PO4 mg/l**	**As mg/l**	**Cd mg/l**	**Cr mg/l**	**Cu mg/l**	**Hg mg/l**	**Pb mg/l**	**Se mg/l**	**Zn mg/l**	**CN (free) mg/l**	**Phenol mg/l**
Sample count	17	17	17	3	17	17	17	3	17	3	17	3	3
Total Sample Count	**17**	**17**	**17**	**17**	**17**	**17**	**17**	**17**	**17**	**17**	**17**	**17**	**17**
SANS 241 Limit	**1.5**	**0.9**		**0.01**	**0.003**	**0.05**	**2**	**0.006**	**0.01**	**0.04**	**5**	**0.2**	**0.01**
Mean	**0.17**	**0.09**	**0.02**	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	**0.01**
Min	**0.01**	**0.04**	**0.00**	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	**0.01**
Max	**1.82**	**0.13**	**0.06**	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	**0.02**
P5	**0.01**	**0.04**	**0.01**	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	**0.01**
P50	**0.08**	**0.10**	**0.01**	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	**0.01**
P95	**0.49**	**0.12**	**0.06**	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	**0.02**

*BDL: Below Detection Limit

PROCESS WATER STATISTICAL WATER QUALITY ANALYSIS – SOURCE

Process water (PW) should typically not be compared to SANS 241 Drinking Water Standards unless it is being discharged to the natural environment. In this case, although water is not being discharged off-site into the natural environment, the SANS 241 Drinking water Quality standard are used here to show the limited extent of exceedances. From the monitoring data, only the constituents listed in **Table 15** exceed the SANS 241 Drinking Water Standards based on >5% exceedance percentage. It is important to note that since nitrite converts to nitrate; the focus will therefore be on nitrate.t

Table 15: Constituents with A Greater Than 5% Exceedance

Constituent	LCT0 Threshold (mg/l)	SANS 241 drinking water standard (mg/l)	P50 Concentration (mg/l)	P95 Concentration (mg/l)	Comment
Nitrate	11	11	47.39	82.49	Nitrate originates from explosives and naturally decays.
Nitrite	NA	0.9	2.29	15.73	Converts to Nitrate in groundwater pathway.

From the on-site data, nitrate is subject to natural decay with a calculated half-life of ± 100 - 150 days for this site (Artesium Consulting Services, 2022a). This was proven through the analysis of the TSF Dissipator's long-term water quality monitoring data where the concentration decayed from 74 mg/L to below SANS limits of 11 mg/L in 0.9 years (**Figure 18**). Analogue data from similar sites for nitrate decay is ± 160 days. From literature the nitrate half-life values of ± 400 days are given (Spitz and Moreno, 1996). The observed fluctuations/spikes in concentration over time is because of wet and dry cycles (rainfall) and the contribution of changes in production of current arisings (ore) and waste rock rate over time (not shown on graph below).

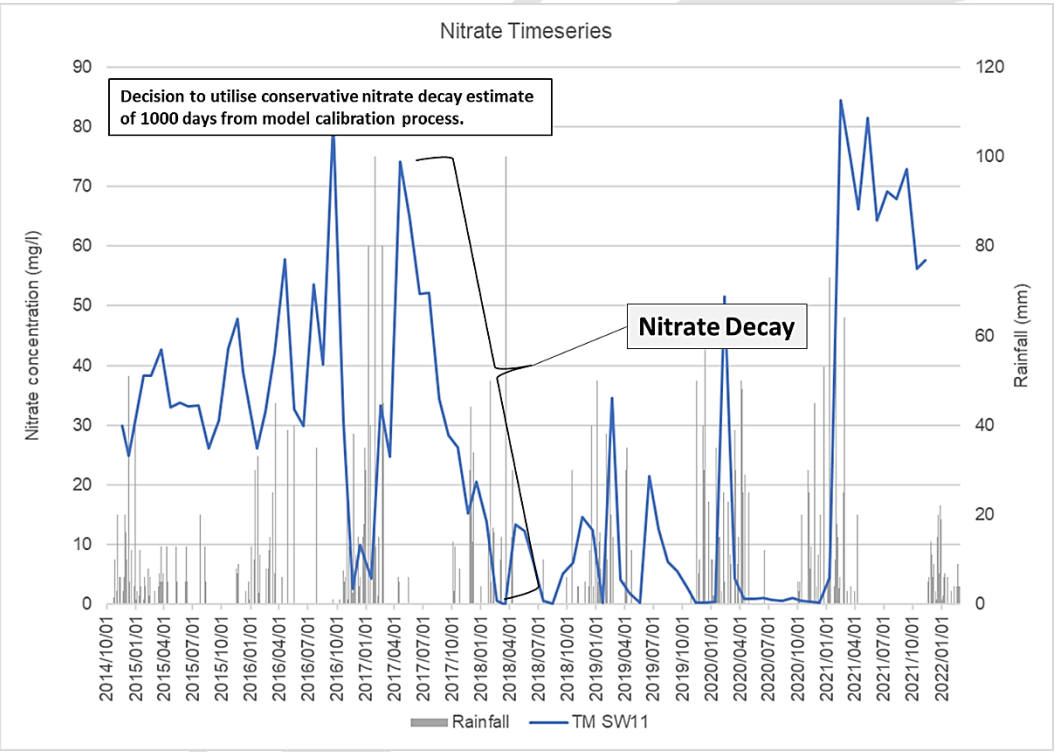


Figure 18: Time Series Data of TM SW11 Proving the Decay of Nitrate

Table 16: Statistical Analysis of Hydrochemical Long-Term Monitoring Data of Process Water

	pH	EC mS/m	TDS mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	Cl mg/l	SO4 mg/l	NO3-N mg/l	F mg/l	Al mg/l	Fe mg/l	Mn mg/l	N_Amonia mg/l
Sample count	414	414	405	414	414	414	414	414	414	414	328	342	329	341	290
Total Sample Count	416	416	416	416	416	416	416	416	416	416	416	416	416	416	416
SANS 241 Limit	9.7	170	1200	150		200	50	300	500	11	1.5	0.3	2	0.1	1.5
Exceedance Count	5	7	4	0	0	18	0	0	0	379	0	6	0	10	12
Exceedance %	1.2%	1.7%	1.0%	0.0%	0.0%	4.4%	0.0%	0.0%	0.0%	91.6%	0.0%	1.8%	0.0%	2.9%	4.1%
Mean	8.2	118.1	793.2	54.9	52.2	122.7	12.5	86.4	161.6	46.4	0.23	0.02	0.01	0.03	0.51
Min	7.3	22.0	143.3	13.4	10.7	11.4	1.3	0.4	21.2	0.001	0.001	0.001	0.001	0.001	0.001
Max	10.7	178.3	1294.1	98.9	110.6	284.2	35.2	202.3	344.5	102.7	0.75	1.41	1.17	3.47	3.65
P5	7.7	70.4	459.8	27.6	31.2	41.8	4.6	35.2	40.6	3.6	0.06	0.00	0.00	0.00	0.04
P50	8.2	120.7	807.6	55.1	50.5	118.0	12.3	87.5	165.7	47.4	0.21	0.002	0.001	0.001	0.35
P95	8.7	160.0	1092.1	83.5	81.6	198.9	22.0	150.7	271.4	82.5	0.45	0.07	0.00	0.08	1.34

	NO2-N mg/l	PO4 mg/l	Ag mg/l	As mg/l	Cd mg/l	Co mg/l	Cr mg/l	Cu mg/l	*Hg mg/l	Ni mg/l	Pb mg/l	Se mg/l	Zn mg/l	CN (free) mg/l	Cl2(free) mg/l
Sample count	287	287	16	164	327	246	327	331	164	249	328	164	328	124	287
Total Sample Count	416	416	416	416	416	416	416	416	416	416	416	416	416	416	416
SANS 241 Limit	0.9			0.01	0.003		0.05	2	0.006	0.07	0.01	0.04	5	0.2	
Exceedance Count	175	0	0	6	6	0	4	0	10	0	1	0	0	0	0
Exceedance %	60.98%	0.0%	0.0%	3.7%	1.8%	0.0%	1.2%	0.0%	6.1%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%
Mean	4.16	0.02	0.001	0.002	0.001	0.001	0.004	0.002	0.001	0.003	0.002	0.002	0.006	0.003	0.17
Min	0.00	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.00
Max	22.12	0.24	0.006	0.01	0.02	0.011	0.24	0.02	0.007	0.05	0.011	0.007	0.14	0.03	1.20
P5	0.06	0.008	0.001	0.00	0.001	0.001	0.001	0.001	0.001	0.001	0.004	0.001	0.001	0.001	0.01
P50	2.29	0.01	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.10
P95	15.73	0.08	0.002	0.01	0.002	0.001	0.006	0.002	0.007	0.003	0.004	0.007	0.03	0.01	0.60

*The laboratory detection limit was set above the SANS 241 Drinking Water Quality Standard; data can therefore not be used in analysis. All values were below the detection limit.

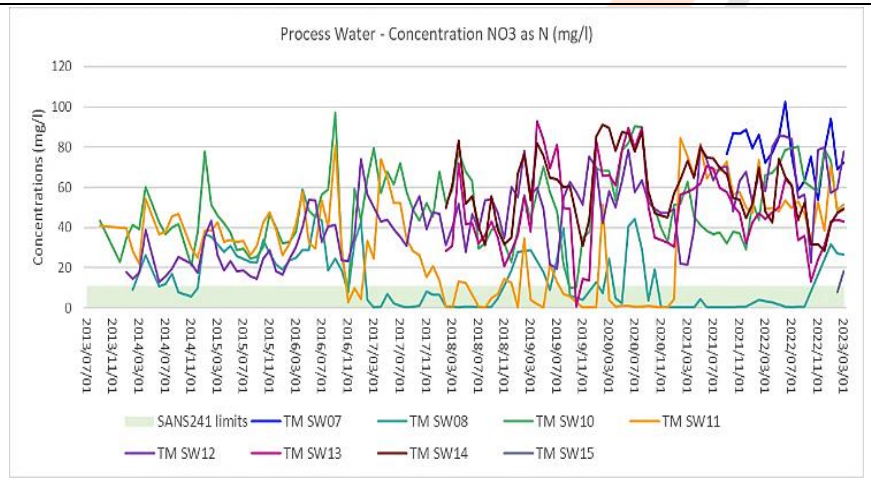
From the long-term process water quality monitoring data, only the nitrate concentrations are above the SANS 241 Drinking Water Standard ranging from 20 mg/L to more than 100 mg/L (**Figure 19**), which is expected from process water. If nitrite and nitrate which degrades with time is taken out of the equation, the process water quality conforms to the SANS 241 Drinking Water Standard.

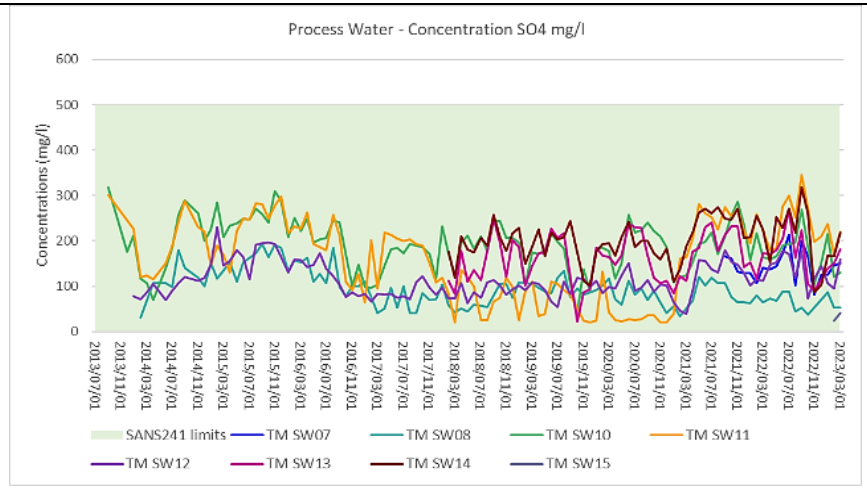
In addition to nitrate, the sulphate, TDS and pH long-term water quality trends were also analysed. Sulphate concentrations showed a decrease in 2016 to 200 (mg/L), from where an increasing trend is observed between 2021 to 2023 with values between 150 – 350 mg/L, never exceeding the SANS 241 Drinking Water Standard (**Figure 19**).

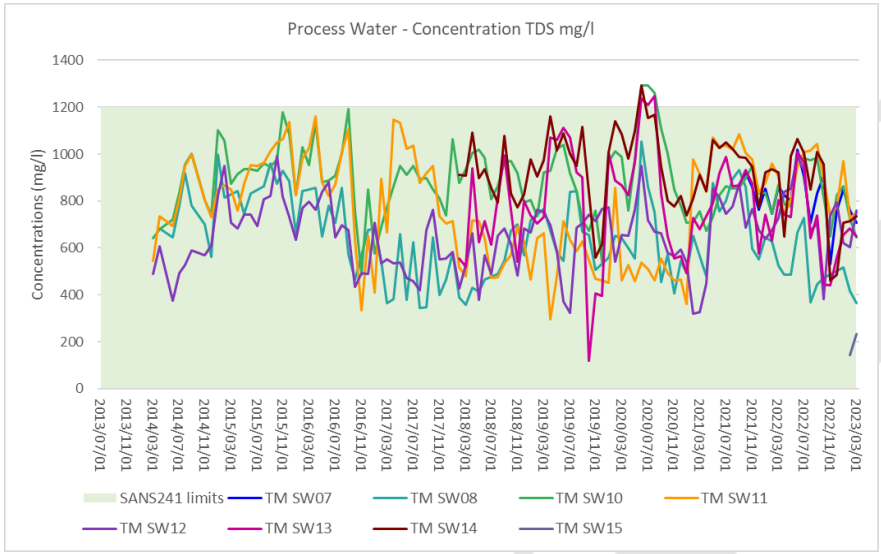
The TDS (**Figure 19**) and pH (**Figure 19**) are mostly stable and well within the SANS 241 Drinking Water Standard. SW10, SW13 and SW14 show an increase in TDS above SANS 241 Drinking Water Standard[56] between March and July 2020. SW10 has pH values just above the limit for July 2021 to March 2022, while SW08 displays a decrease in pH (within the SANS 241 limits) towards the end of the monitoring period. General trends are stable or decreasing.

The spatial distribution of the nitrate, sulphate and TDS process water concentrations as well as process water pH range are shown in **Figure 20** to **Figure 22**.

[56] Although SANS 241 Drinking Water can/should not be used as a comparison for process water, it gives context as to the overall process water quality.







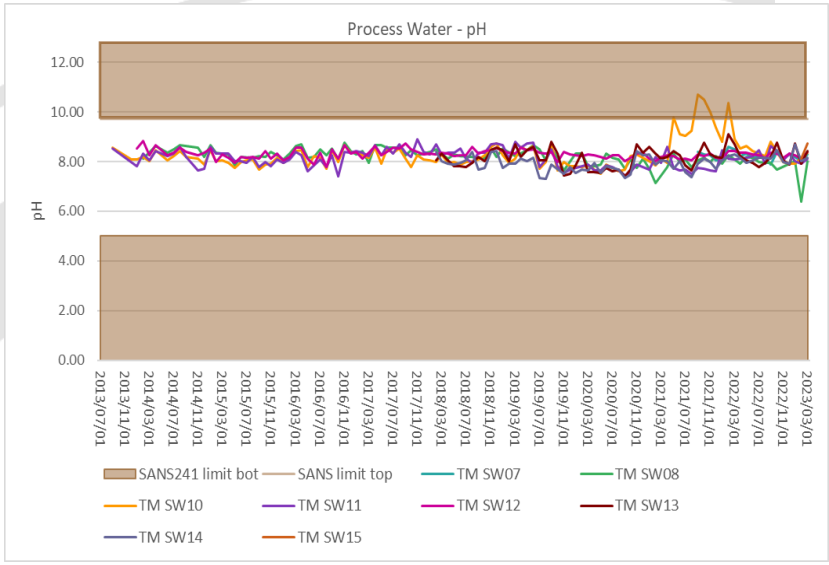


Figure 19: Process Water Nitrate Concentrations; Process Water Sulphate Concentrations; Process Water TDS Concentrations and Process Water pH Range

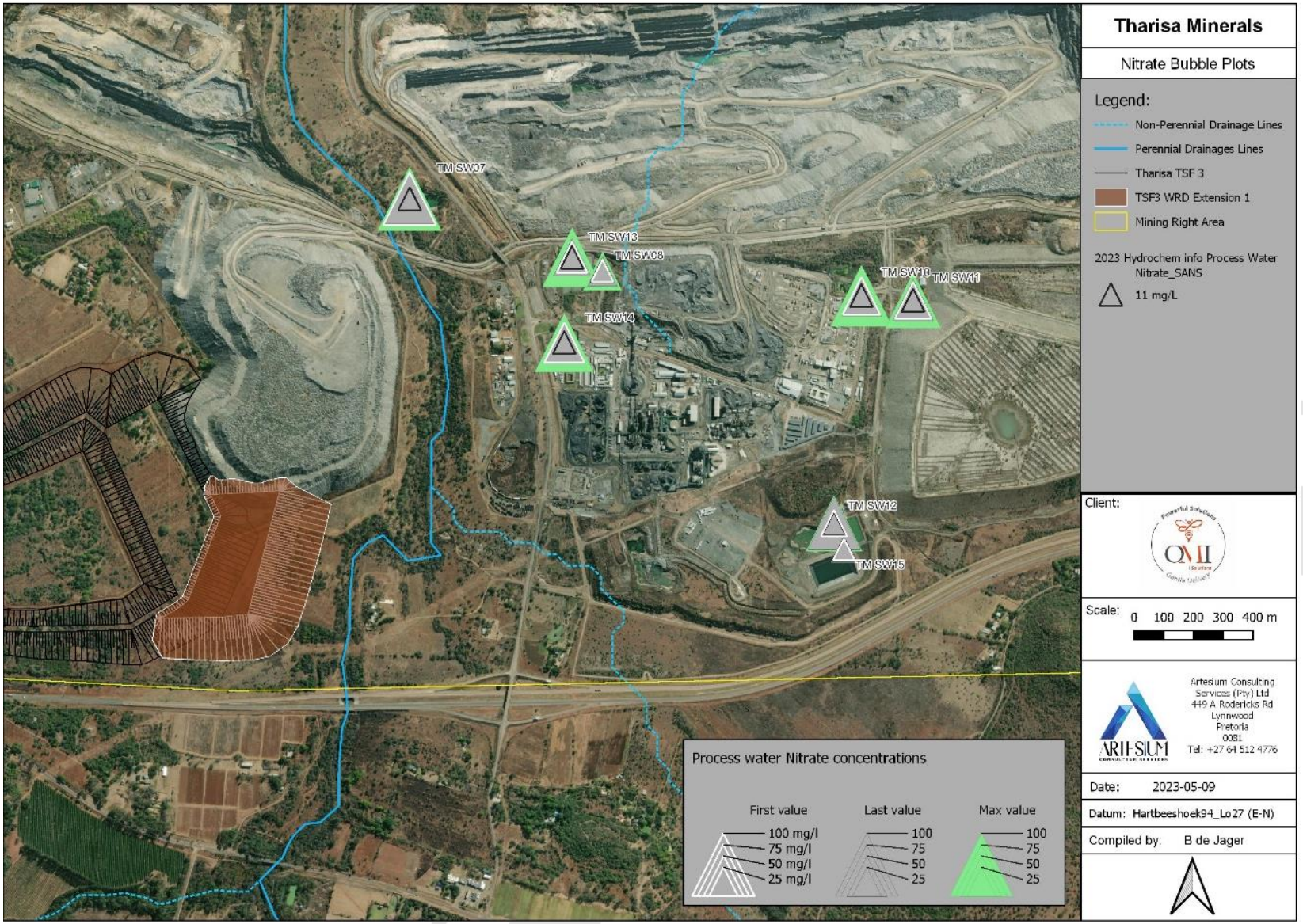


Figure 20: Spatial Distribution of Nitrate Concentrations Observed at Process Water Monitoring Localities

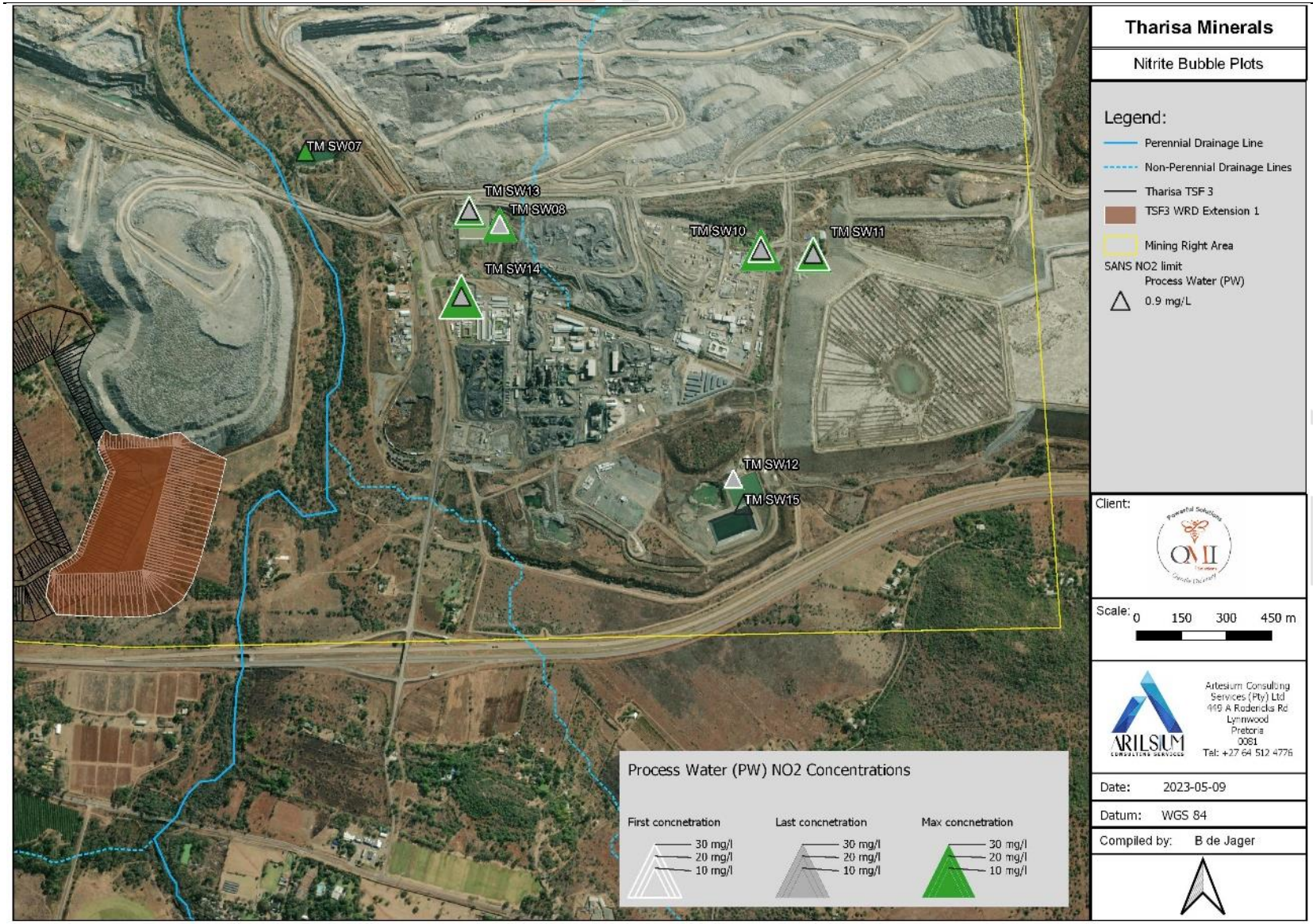


Figure 21: Spatial Distribution of Nitrite Concentrations Observed at Process Water Monitoring Localities

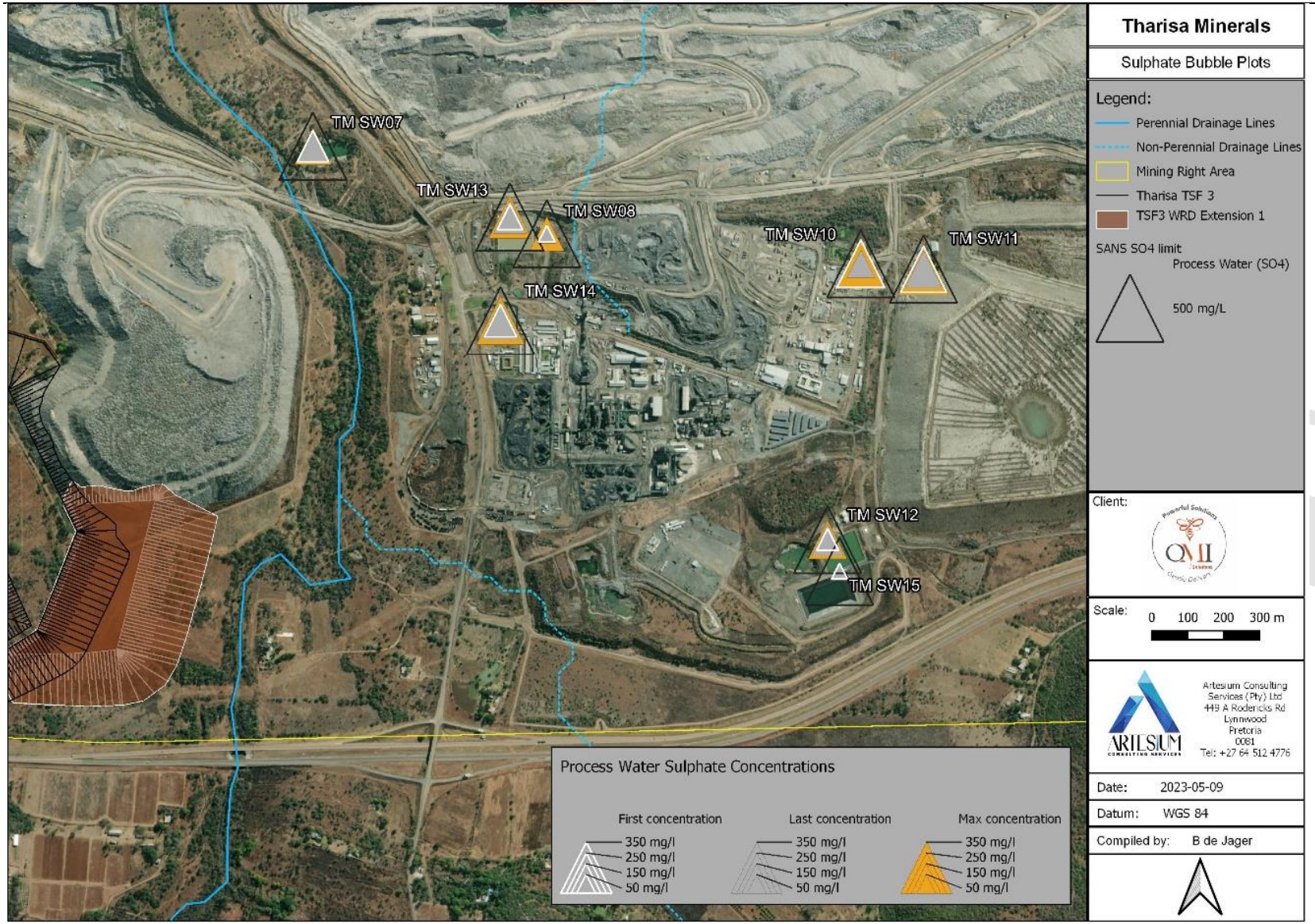


Figure 22: Spatial Distribution of Sulphate Concentrations Observed at Process Water Monitoring Localities

ON-SITE STATISTICAL ANALYSIS OF GROUNDWATER MONITORING DATA – SOURCE/PATHWAY

The 2013 baseline groundwater values determined are considered low, and therefore comparison to SANS 241 Drinking Water Standards gives an improved representation on the significance of mining impacts (refer to **Table 18**).

From the monitoring data, only the constituents listed in **Table 17** below exceed the SANS 241 drinking water standards based on >5% exceedance percentage. The mercury exceedance is influenced by a significant variance in detection limits that are above the SANS 241 Drinking Water limit, thus the data analysis for mercury (Hg) is inconclusive.

Table 17: Chemical Constituents with A Greater Than 5% Exceedance

Constituent	LCT0 Threshold (mg/l)	SANS 241 drinking water standard (mg/l)	P50 Concentration (mg/l)	P95 Concentration (mg/l)	Comment
Nitrate	11	11	22.8	61.9	Nitrate originates from explosives and naturally decays.

Table 18: Statistical Analysis of On-Site Groundwater Chemistry

	pH	EC mS/m	TDS mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	Cl mg/l	SO4 mg/l	NO3-N mg/l	F mg/l	Al mg/l	Fe mg/l	Mn mg/l	N_Ammonia mg/l	NO2-N mg/l	PO4 mg/l	As mg/l	Cd mg/l	Cr mg/l	Cu mg/l	Hg mg/l	Pb mg/l	Se mg/l	Zn mg/l
Sample count	304	304	296	304	303	304	298	304	304	304	300	294	294	296	267	281	282	191	294	300	294	201	294	201	294
Total Sample Count	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**
2013 US Baseline_P50	**7.6**	**50.8**	**566.7**	**31.2**	**40.8**	**7.1**	**0.2**	**13.3**	**37.7**	**3.4**	**0.1**	**0.003**	**0.003**	**0.001**	**0.02**	**0.1**	**0.02**	**0.007**	**0.001**	**0.001**	**0.001**	**0.007**	**0.004**	**0.007**	**0.002**
Exceedance Count	144	181	142	186	179	194	168	186	180	185	143	52	55	11	97	54	58	6	44	102	58	10	35	10	61
Exceedance %	47.4%	59.5%	48.0%	61.2%	59.1%	63.8%	56.4%	61.2%	59.2%	60.9%	47.7%	17.7%	18.7%	3.7%	36.3%	19.2%	20.6%	3.1%	15.0%	34.0%	19.7%	5.0%	11.9%	5.0%	20.7%

	pH	EC mS/m	TDS mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	Cl mg/l	SO4 mg/l	NO3-N mg/l	F mg/l	Al mg/l	Fe mg/l	Mn mg/l	N_Ammonia mg/l	NO2-N mg/l	PO4 mg/l	As mg/l	Cd mg/l	Cr mg/l	Cu mg/l	Hg mg/l	Pb mg/l	Se mg/l	Zn mg/l
Sample count	304	304	296	304	303	304	298	304	304	304	300	294	294	296	267	281	282	191	294	300	294	201	294	201	294
Total Sample Count	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**
2013 US Baseline_P95	**7.9**	**85.7**	**566.7**	**59.5**	**65.3**	**17.6**	**1.7**	**22.8**	**67.3**	**6.5**	**0.2**	**0.003**	**0.003**	**0.001**	**0.09**	**0.1**	**0.05**	**0.007**	**0.001**	**0.001**	**0.001**	**0.007**	**0.004**	**0.007**	**0.002**
Exceedance Count	104	144	142	78	156	116	32	171	166	171	122	52	55	11	17	43	6	6	44	102	58	10	35	10	61
Exceedance %	34.2%	47.4%	48.0%	25.7%	51.5%	38.2%	10.7%	56.3%	54.6%	56.3%	40.7%	17.7%	18.7%	3.7%	6.4%	15.3%	2.1%	3.1%	15.0%	34.0%	19.7%	5.0%	11.9%	5.0%	20.7%

	pH	EC mS/m	TDS mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	Cl mg/l	SO4 mg/l	NO3-N mg/l	F mg/l	Al mg/l	Fe mg/l	Mn mg/l	N_Ammonia mg/l	NO2-N mg/l	PO4 mg/l	As mg/l	*Cd mg/l	Cr mg/l	Cu mg/l	*Hg mg/l	Ni mg/l	Pb mg/l	Se mg/l
Sample count	304	304	296	304	303	304	298	304	304	304	300	294	294	296	267	281	282	191	294	300	294	201	243	294	201
Total Sample Count	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**	**350**
SANS 241 Limit	9.7	170	1200			200		300	500	11	1.5	0.3	2	0.1	1.5	0.9		0.01	0.003	0.05	2	0.006	0.07	0.01	0.04
Exceedance Count	0	5	3	0	0	0	0	0	0	149	5	0	0	0	0	3	0	6	21	1	0	14	5	11	0
Exceedance %	0.0%	1.6%	1.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	49.0%	1.7%	0.0%	0.0%	0.0%	0.0%	1.1%	0.0%	3.1%	7.1%	0.3%	0.0%	7.0%	2.1%	3.7%	0.0%

	pH	EC mS/m	TDS mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	Cl mg/l	SO4 mg/l	NO3-N mg/l	F mg/l	Al mg/l	Fe mg/l	Mn mg/l	N_Ammonia mg/l	NO2-N mg/l	PO4 mg/l	As mg/l	Cd mg/l	Cr mg/l	Cu mg/l	Hg mg/l	Pb mg/l	Se mg/l	Zn mg/l
Mean	7.9	101.7	682.2	55.89	95.07	36.6	1.4	59.3	110.6	25.14	2.292	0.006	0.003	0.002	0.053	0.185	0.017	0.004	0.002	0.007	0.005	0.005	0.008	0.003	0.006
Min	6.9	5.6	36.5	19.20	10.07	3.6	0.001	4.3	5.0	0.93	0.03	0.001	0.001	0.006	0.01	0.001	0.01	0.001	0.001	0.01	0.01	0.01	0.01	0.01	0.01
Max	8.9	186.5	1269.8	113.09	208.20	153.4	14.24	258.8	264.1	90.0	319.0	0.125	0.009	0.083	0.409	3.493	0.061	0.010	0.005	0.058	0.278	0.015	0.145	0.01	0.025
P5	7.1	45.6	271.4	30.48	35.00	12.0	0.04	12.5	21.7	3.0	0.1	0.001	0.001	0.001	0.015	0.025	0.01	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
P50	7.9	104.0	699.0	54.61	96.43	19.0	0.73	46.5	107.4	22.8	0.3	0.002	0.001	0.001	0.037	0.086	0.014	0.001	0.001	0.003	0.001	0.001	0.001	0.001	0.001
P95	8.7	153.4	1014.1	81.42	163.70	117.9	5.55	147.4	204.2	61.9	0.5	0.006	0.009	0.004	0.12	0.447	0.05	0.010	0.005	0.031	0.022	0.015	0.034	0.01	0.025

*The laboratory detection limit was set above the SANS 241 Drinking Water Quality Standard; data can therefore not be used in analysis. All values were below the detection limit.

ON-SITE STATISTICAL ANALYSIS OF GROUNDWATER MONITORING DATA – PATHWAY

The off-site groundwater statistical analysis was sub-divided into an upstream and a downstream analysis. From the 2013 baseline analysis, the threshold limits are low, and therefore comparison to SANS 241 Drinking Water Standards gives an improved representation on the significance of impacts from mining. From the statistical and spatial analysis (**Table 19** and **Table 20**), other impacts are also present i.e., agricultural, and informal settlements.

The concentration exceedances associated with mercury and cadmium is because laboratory detection limits were set above the SANS limit. Marginal exceedances (<20 mg/L) of P95 for calcium and electrical conductivity were noted in the downstream off-site groundwater.

Table 19: Chemical Constituents with a Greater than 5% Exceedance

Constituent	LCT0 Threshold (mg/l)	SANS 241 drinking water standard (mg/l)	P50 Concentration (mg/l)	P95 Concentration (mg/l)	Comment
Upstream off-site groundwater exceedances					
Nitrate	11	11	3.2	14.5	Only the P95 exceeds, with P50 being well below the SANS 241 Drinking Water Standards.
Manganese	0.1	0.1	0.001	0.197	Could originate from local weathered geology or anthropogenic sources as it is not found in process water. Exceedance observed on the P95 and Maximum concentration.
Downstream off-site groundwater exceedances					
Manganese	0.1	0.1	0.3	1	Could originate from local weathered geology or anthropogenic sources as it is not found in process water. Exceedance observed on the P95 and Maximum concentration.

Table 20: Statistical Analysis of The Off-Site Groundwater Chemistry

	pH	EC mS/m	TDS mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	Cl mg/l	SO4 mg/l	NO3-N mg/l	F mg/l	Al mg/l	Fe mg/l	Mn mg/l	N_Ammonia mg/l	NO2-N mg/l	PO4 mg/l	As mg/l	Cd mg/l	Cr mg/l	Cu mg/l	*Hg mg/l	Ni mg/l	Pb mg/l	Se mg/l	Zn mg/l
Sample count	211	211	202	210	210	210	210	210	210	205	186	189	187	192	177	177	177	125	185	186	188	125	157	185	125	187
Total Sample Count	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256
2013 US Baseline_P50	7.6	50.8	566.7	31.2	40.8	7.1	0.2	13.3	37.7	3.4	0.1	0.003	0.003	0.001	0.02	0.1	0.02	0.007	0.001	0.001	0.001	0.007	0.007	0.004	0.007	0.002
Exceedance Count	124	125	3	122	127	167	159	94	98	85	131	74	84	153	101	50	67	14	140	148	152	15	3	74	15	104
Exceedance %	58.8%	59.2%	1.5%	58.1%	60.5%	79.5%	75.7%	44.8%	46.7%	41.5%	70.4%	39.2%	44.9%	79.7%	57.1%	28.2%	37.9%	11.2%	75.7%	79.6%	80.9%	12.0%	1.9%	40.0%	12.0%	55.6%

	pH	EC mS/m	TDS mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	Cl mg/l	SO4 mg/l	NO3-N mg/l	F mg/l	Al mg/l	Fe mg/l	Mn mg/l	N_Ammonia mg/l	NO2-N mg/l	PO4 mg/l	As mg/l	Cd mg/l	Cr mg/l	Cu mg/l	*Hg mg/l	Ni mg/l	Pb mg/l	Se mg/l	Zn mg/l
Sample count	211	211	202	210	210	210	210	210	210	205	186	189	187	192	177	177	177	125	185	186	188	125	157	185	125	187
Total Sample Count	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256
2013 US Baseline_P95	7.9	85.7		59.5	65.3	17.6	1.7	22.8	67.3	6.5	0.2	0.003	0.003	0.001	0.09	0.1	0.05	0.007	0.001	0.001	0.001	0.007	0.007	0.004	0.007	0.002
Exceedance Count	71	4	0	19	25	33	7	8	15	68	97	74	84	153	30	29	15	14	140	148	152	15	3	74	15	104
Exceedance %	33.6%	1.9%	0.0%	9.0%	11.9%	15.7%	3.3%	3.8%	7.1%	33.2%	52.2%	39.2%	44.9%	79.7%	16.9%	16.4%	8.5%	11.2%	75.7%	79.6%	80.9%	12.0%	1.9%	40.0%	12.0%	55.6%

	pH	EC mS/m	TDS mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	Cl mg/l	SO4 mg/l	NO3-N mg/l	F mg/l	Al mg/l	Fe mg/l	Mn mg/l	N_Ammonia mg/l	NO2-N mg/l	PO4 mg/l	As mg/l	*Cd mg/l	Cr mg/l	Cu mg/l	*Hg mg/l	Ni mg/l	Pb mg/l	Se mg/l	Zn mg/l
Sample count	211	211	202	210	210	210	210	210	210	205	186	189	187	192	177	177	177	125	185	186	188	125	157	185	125	187

	pH	EC mS/m	TDS mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	Cl mg/l	SO4 mg/l	NO3-N mg/l	F mg/l	Al mg/l	Fe mg/l	Mn mg/l	N_Ammonia mg/l	NO2-N mg/l	PO4 mg/l	As mg/l	Cd mg/l	Cr mg/l	Cu mg/l	*Hg mg/l	Ni mg/l	Pb mg/l	Se mg/l	Zn mg/l
Total Sample Count	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256	256
SANS 241 Limit	9.7	170	1200	150		200	50	300	500	11	1.5	0.3	2	0.1	1.5	0.9		0.01	0.003	0.05	2	0.006	0.07	0.01	0.04	5
Exceedance Count	0	1	0	1	0	0	0	0	0	26	0	0	0	16	3	0	0	5	26	0	0	15	3	6	0	0
Exceedance %	0.0%	0.5%	0.0%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	12.7%	0.0%	0.0%	0.0%	8.3%	1.7%	0.0%	0.0%	4.0%	14.1%	0.0%	0.0%	12.0%	1.9%	3.2%	0.0%	0.0%
Mean	7.82	56.5	362.0	40.7	48.6	13.5	0.7	13.9	42.5	5.5	0.28	0.007	0.006	0.038	0.89	0.11	0.0	0.004	0.002	0.003	0.003	0.005	0.007	0.004	0.006	0.018
Min	6.86	6.9	45.2	4.6	4.1	0.0	0.0	1.4	1.0	0.1	0.03	0.001	0.001	0.001	0.003	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Max	8.83	192.0	1166.0	179.0	90.1	52.2	16.4	38.7	171.4	28.4	1.44	0.104	0.16	1.04	87.40	0.57	9.36	0.01	0.005	1	0.019	0.015	0.15	0.001	0.025	1.076
P5	7.23	32.2	228.2	23.3	19.4	6.1	0.0	4.0	6.3	0.3	0.11	0.001	0.001	0.001	0.01	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
P50	7.76	55.7	357.0	38.6	47.3	12.7	0.5	13.5	40.4	3.2	0.24	0.003	0.003	0.001	0.04	0.008	0.002	0.001	0.001	0.001	0.001	0.004	0.001	0.004	0.005	0.002
P95	8.61	78.2	495.2	72.9	69.6	20.7	1.4	21.8	72.3	14.5	0.47	0.003	0.009	0.207	0.58	0.24	0.008	0.001	0.005	0.007	0.016	0.015	0.024	0.009	0.025	0.057

*The laboratory detection limit was set above the SANS 241 Drinking Water Quality Standard; data can therefore not be used in analysis. All values were below the detection limit.

LONG-TERM GROUNDWATER MONITORING DATA ANALYSIS

From analysis of the long-term groundwater quality monitoring data, it was found that the nitrate concentrations for three of the upstream groundwater monitoring boreholes (TW GW Comm 01, 02 and 05) are consistently below the SANS 241 Drinking water quality limit. All 10 onsite boreholes regularly exceed the SANS 241 Drinking Water Standard. The exceedances are limited to nitrate (mining related source), and manganese, found in several geological formations.

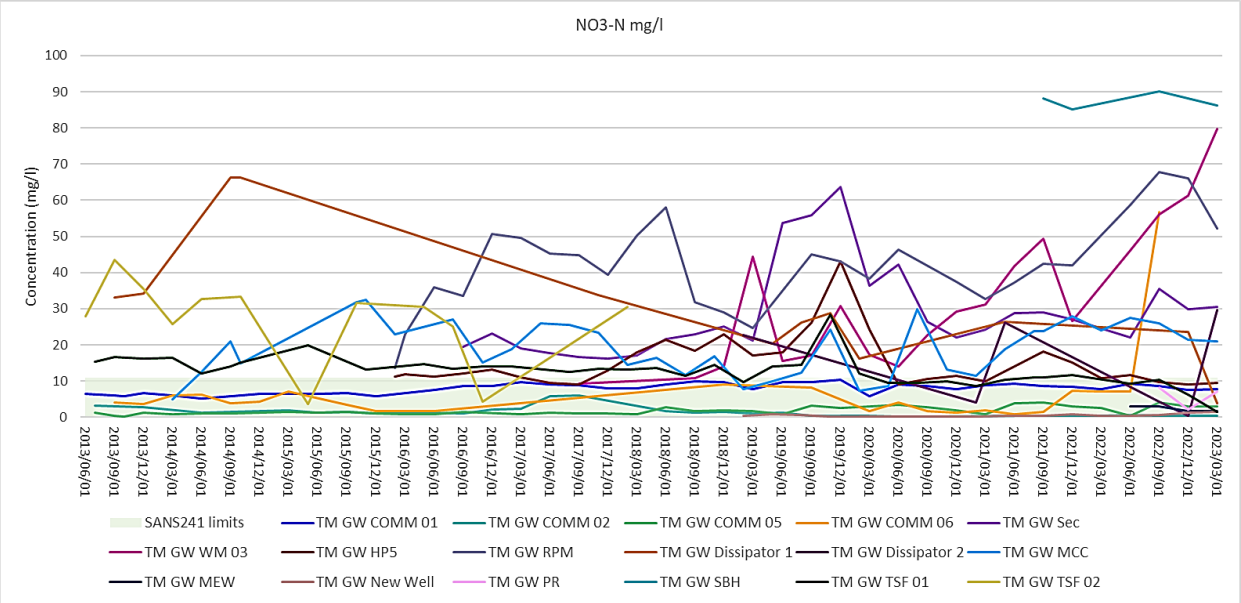


Figure 23: Groundwater Nitrate Concentrations with Time

In addition to nitrate the TDS (**Figure 24**) and pH (**Figure 25**) long-term groundwater quality trends were analysed. The TDS and pH trends are stable or decreasing and well within the SANS 241 Drinking Water Standard with only one on site borehole (TW GW Sec) exceeding the TDS limit a few times.

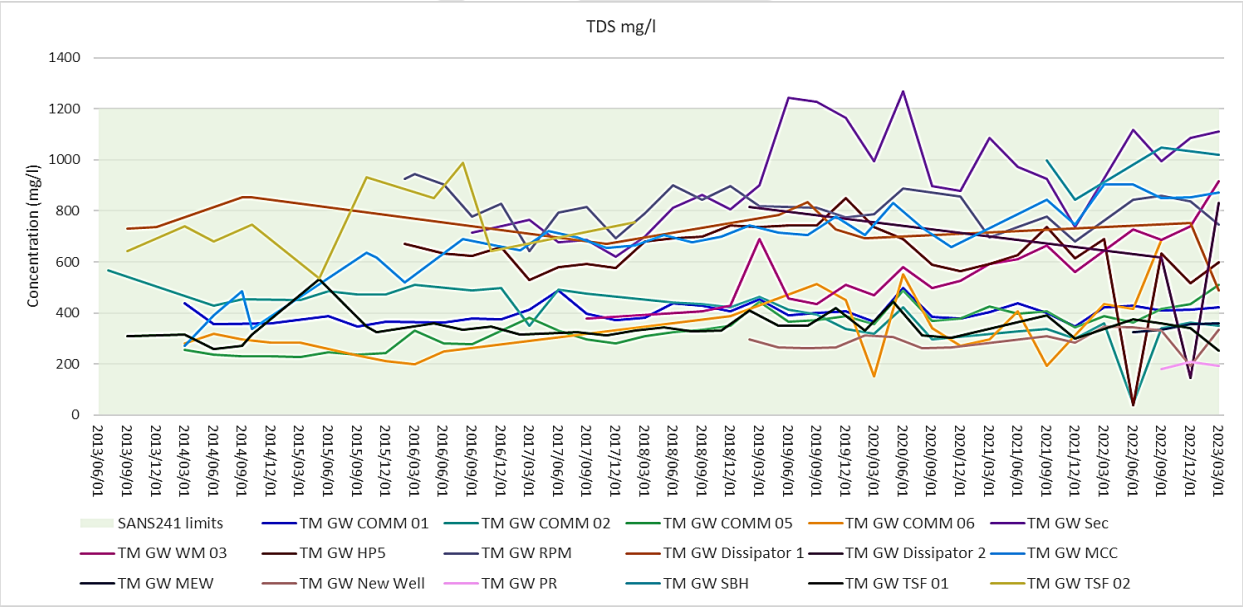


Figure 24: Groundwater TDS Concentrations with Time

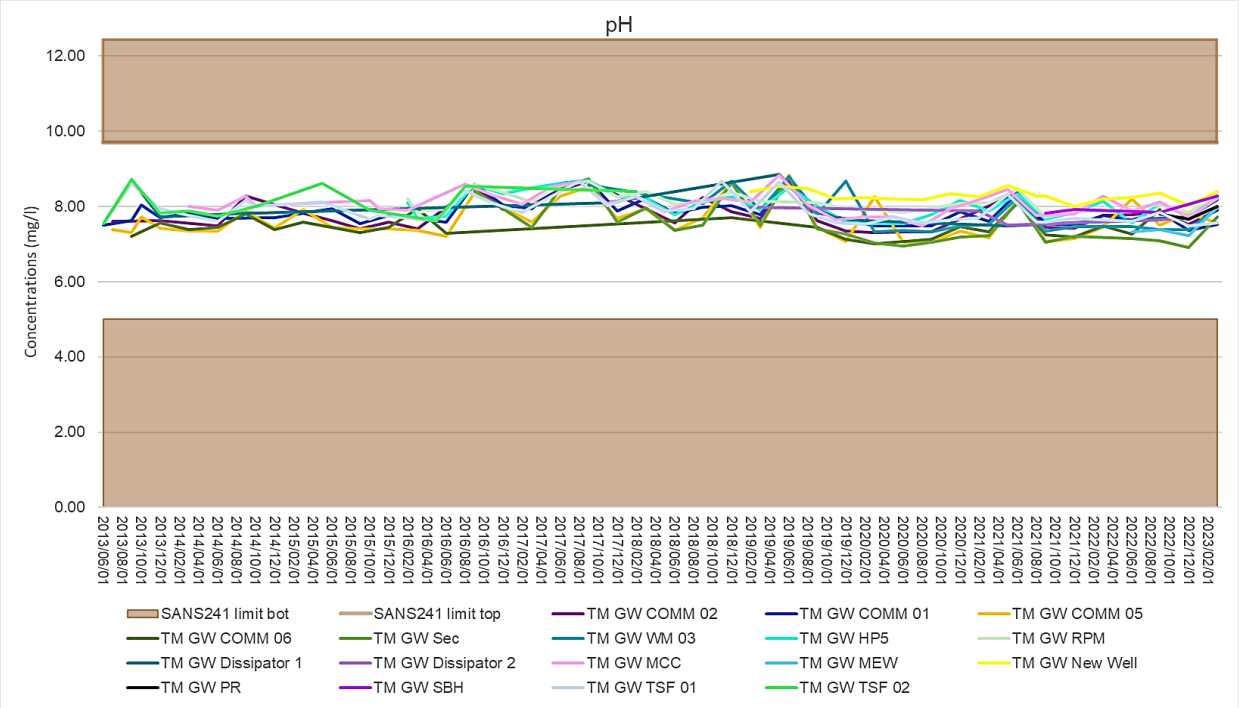


Figure 25: Groundwater pH Ranges with Time

HYDROCHEMICAL WATER SIGNATURE

The hydrochemical water signature is determined by analysing the plotted position of water samples on a Piper diagram. The following parameters are required to construct a piper plot: calcium (Ca), magnesium (Mg), sodium (Na) and potassium (K) as cations and bicarbonate (HCO_3), carbonate (CO_3), sulphate (SO_4) and chloride (Cl) as anions. Data from the first sampling period was compared to data collected from the last complete sampling period.

13 groundwater samples, 3 surface water samples and 6 process water samples were included in the Piper Diagram analysis. Hydrocensus single sampling analysis was also added to the piper plots, constituting of 10 offsite groundwater boreholes and 1 downstream surface water sample.

By analysing the hydrochemical signature of each monitoring locality using a Piper diagram several trends were identified:

- Trend 1 – There is a clear shift in off-site groundwater signatures, indicating mining impact on boreholes situated in close proximity to mining infrastructure and waste facilities. These samples have more sulphate and chloride signature, similar to that of the onsite groundwater samples.
- Trend 2 – The off-site groundwater samples have a bicarbonate rich, magnesium signature reflecting that of recent recharge.
- Trend 3 – The process water has a sodium-potassium rich signature and displays a greater chloride and sulphate signature than the stream water and groundwater samples.
- Trend 4 – The localised surface water samples have also been impacted by mining operation. The first samples reflect calcium and magnesium rich signature while later samples have been affected by chloride and sulphate concentrations.

Although groundwater water and process water have been affected by mining, these changes in water signatures are minimal.

Figure 26 to **Figure 28** below presents the following:

- Groundwater samples are presented as circles, with a banded circle as the first sample and a filled circle the last sample. A cross represents the downstream groundwater signature.
- Surface water samples are squares following the same principal for first and last samples as for groundwater samples.
- The process water samples are presented as triangles, with an upright triangle being the first sample and an upside-down triangle the last sample.

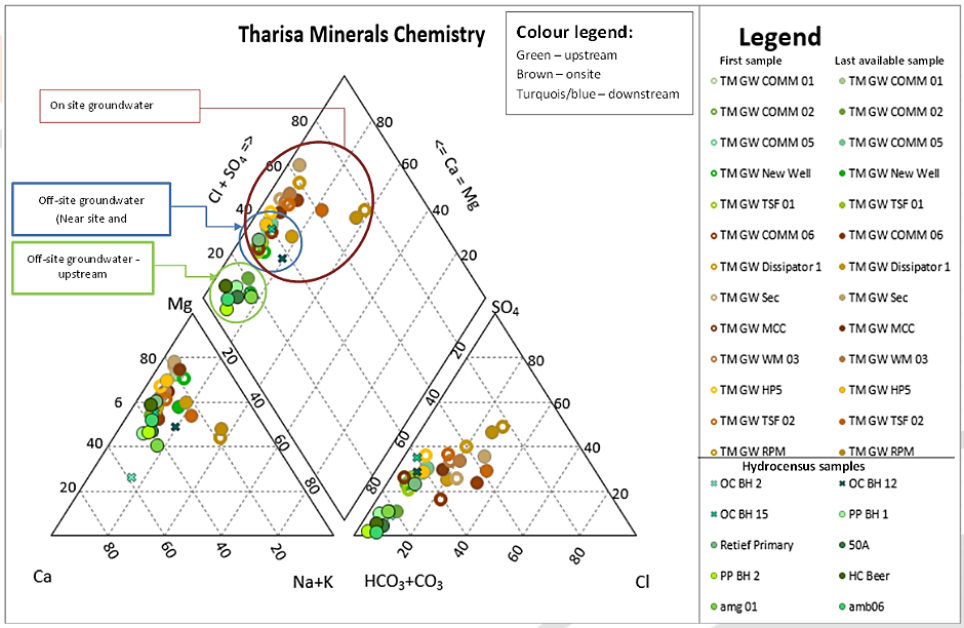


Figure 26: Change in Groundwater Hydrogeolocial Signature

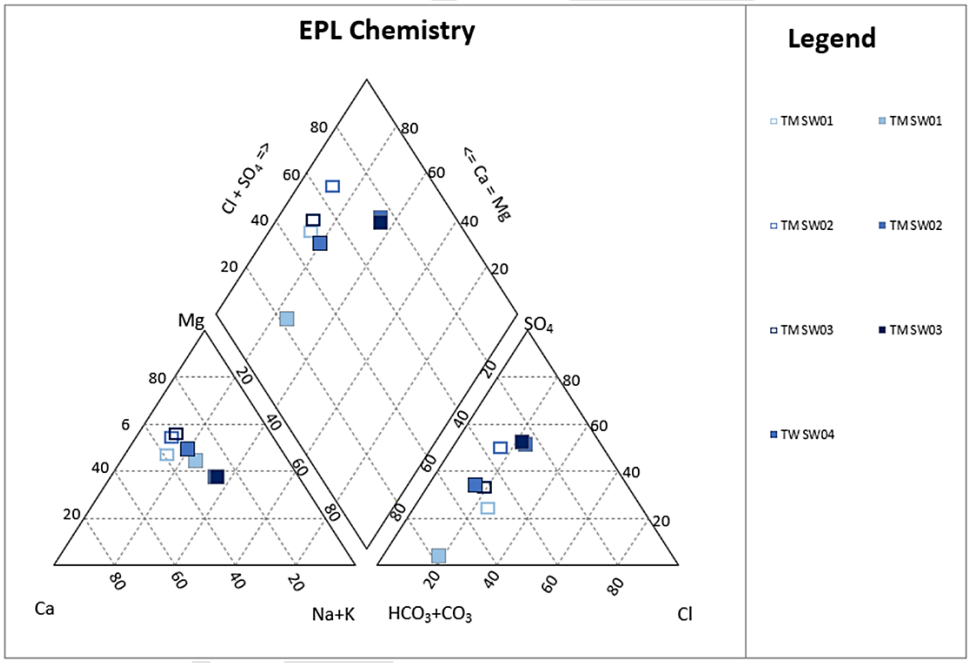


Figure 27: Change in Surface Water Hydrogeological Signature

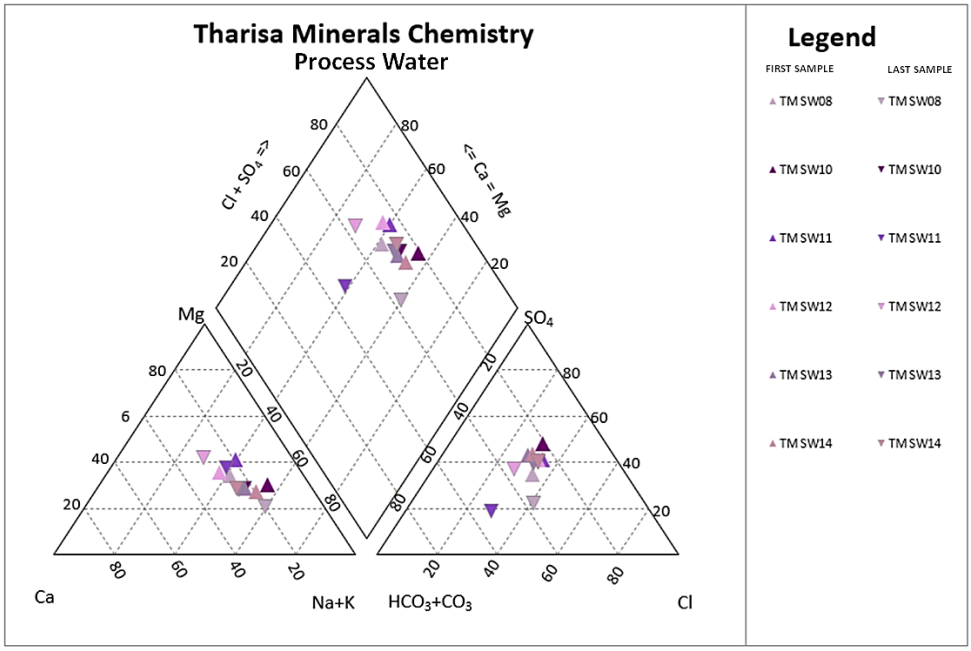


Figure 28: Change in Process Water Hydrochemical Signature

Isotope studies were also conducted historically (Artesium Consulting Services, 2022a). From the studies it is inferred that there is interaction between the pit water, borehole water and the surface water (Sterkstroom).

LONGTERM HYDROCHEMICAL MONITORING DATA

Detailed analysis of the long-term water quality monitoring data spanning 10 years and ± 1 300 samples (2013 to 2023) showed that nitrate is the only parameter of concern. Nitrite as well as nitrate exceeds the SANS 241 Drinking Water Standard for both the P50 and P95 values for the process water[57] (Table 21). Nitrate also exceeds the SANS Drinking Quality standards in all the groundwater samples and the downstream surface water samples. It is noted that the impacts downstream of the existing WRD is localised as the P50 value does not exceed the SANS guideline. It is expected that nitrate breaks down along the flow path with a half-life of ± 100 - 150 days on this site.

In addition, Table 21 also shows exceedances for manganese in the off-site groundwater and upstream surface water samples indicating geological origin.

[57] Note that process water is not expected to conform to drinking water quality standards.

Table 21: Geochemical Leach Test Results and Long-Term Water Quality Monitoring Data – Source

	Variable interval	2020 Tailings LCT Test (1 sample)	Vulcan Tailings LCT Tests (2 samples)	WRD LCT Tests (14 samples)	Variable interval	Process Water (416 samples)	Groundwater (Off-site -256 samples)	Groundwater (On Site - 350 samples)	GW_Down-stream TSF (184 samples)	GW_Down-stream WRD (72 samples)	Sterkstroom (Upstream - 127 samples)	Sterkstroom (Downstream - 88 samples)	SANS 241 Limit	LCT0	Randwater - Rustenburg Municipality
pH	Min	9.04	7.7	9.29	P50	8.18	7.76	7.90	8.02	7.46	7.54	7.92	5 ≤ 9.7		7.86
	Max		9.2	9.65	P95	8.73	8.61	8.67	8.67	8.65	8.21	8.42			
TDS	Min	48	52.00	59.00	P50	807.6	357.0	699.0	692.0	430.8	65.7	99.9	≤1200	1000	301.91
	Max		412.00	66.00	P95	1092.1	495.2	1014.1	865.3	722.6	116.7	312.5			
Ca	Min	7.16			P50	55.1	38.6	54.6	61.3	45.8	9.0	9.8			25.04
	Max				P95	83.5	72.9	81.4	81.4	72.8	16.6	28.8			
Mg	Min	2.21			P50	50.5	47.3	96.4	106.4	55.3	7.1	9.7			14.17
	Max				P95	81.6	69.6	163.7	129.8	95.7	13.0	31.2			
Na	Min	7.1			P50	118.0	12.7	19.0	21.6	14.4	3.9	5.7	≤200		30.14
	Max				P95	198.9	20.7	117.9	62.0	18.6	7.5	26.3			
F	Min	<0.1	0.2	0.2	P50	0.212	0.239	0.253	0.288	0.199	0.176	0.182	≤1.5	1.5	0.48
	Max		0.2	0.2	P95	0.450	0.466	0.496	0.496	0.466	0.466	0.466			
Ni	Min	0.006	<0.01	0.005	P50	0.001	0.001	0.001	0.001	0.001	0.001	<0.001	≤0.07	0.07	0.004
	Max		<0.025	0.007	P95	0.003	0.024	0.034	0.019	0.066	0.005	<0.005			
Cl	Min	1.27	<2	<2	P50	87.5	13.5	46.5	37.3	36.9	7.2	7.4	≤250	300	55.62
	Max		4	<2	P95	150.7	21.8	147.4	79.8	68.1	14.8	19.7			
SO_4	Min	8	<2	3.33	P50	165.6	40.4	107.4	106.3	68.4	4.9	11.3	≤500	250	43.75
	Max		5	4.36	P95	271.4	72.3	204.2	159.3	106.6	17.0	54.8			
Al	Min (SPLP)	1.31	0.17		P50	0.002	0.003	0.002	0.003	0.002	0.001	0.001	≤0.2		0.05
	Max (SPLP)		0.51		P95	0.070	0.028	0.006	0.029	0.005	0.083	0.140			
As	Min	0.003	<0.001	0.003	P50	<0.001	<0.001	<0.001	<0.001	<0.007	<0.001	<0.001	≤0.01	0.01	0.005
	Max		<0.01	0.005	P95	<0.007	<0.01	<0.01	<0.01	<0.01	<0.019	<0.019			
Cr	Min	**0.4**	<0.01	0.02	P50	0.001	0.001	0.003	0.004	0.001	<0.001	<0.001	≤0.05	0.1	0.003
	Max		<0.025	0.04	P95	0.006	0.007	0.031	0.036	0.007	<0.007	<0.007			
Fe	Min	**1.1**			P50	0.001	0.003	<0.001	<0.004	<0.001	0.033	0.009	≤2		0.05
	Max				P95	0.004	0.009	<0.009	<0.009	<0.009	0.475	0.140			
Mn	Min	0.015	<0.025	0.015	P50	0.001	0.001	0.001	0.001	0.001	0.001	0.001	≤0.1	0.5	0.0097
	Max			0.043	P95	0.079	**0.269**	0.004	0.004	0.001	**0.156**	0.063			
N_Ammonia	Min				P50	0.354	0.042	0.037	0.034	0.039	0.072	0.049	≤1.5		0.16
	Max				P95	1.336	0.578	0.124	0.120	0.112	0.251	0.124			
NO_2-N	Min				P50	**2.287**	0.084	0.086	0.100	0.071	0.075	0.088	≤0.9		0.13
	Max				P95	**15.730**	0.240	0.447	0.602	0.122	0.158	0.227			
NO_3-N	Min	0.45	<0.1	0.21	P50	**47.39**	3.16	**22.85**	**18.85**	7.24	0.42	0.92	≤11	11	0.63
	Max		0.3	0.28	P95	**82.49**	**14.50**	**61.87**	**34.76**	**56.57**	0.91	**28.88**			
B	Min	0.05	<0.025	<0.025	P50	0.001	ND	ND	ND	ND	<0.001	<0.001	≤2.4	0.5	0.02
	Max		<0.025	<0.025	P95	0.011	ND	ND	ND	ND	<0.042	<0.042			
Ba	Min	0.15	<0.025	<0.025	P50	0.039	ND	ND	ND	ND	0.029	0.023	≤1.3	0.7	0.05
	Max		<0.025	<0.025	P95	0.064	ND	ND	ND	ND	0.049	0.036			
*Cd	Min	<0.0001	<0.001	<0.001	P50	0.001	<0.001	0.001	<0.001	<0.001	0.001	0.001	≤0.003	0.003	0.001
	Max		<0.001	<0.001	P95	0.002	<0.005	0.005	<0.005	<0.005	0.005	0.005			
Co	Min	0.001	<0.025	<0.025	P50	0.001	ND	ND	ND	ND	<0.001	<0.001		0.5	
	Max		<0.025	<0.025	P95	0.001	ND	ND	ND	ND	<0.007	<0.007			
Cu	Min	0.007	<0.01	<0.01	P50	0.001	0.001	0.001	0.002	0.001	0.001	0.001	≤2	2	0.008
	Max		<0.01	<0.01	P95	0.002	0.016	0.022	0.011	0.031	0.005	0.005			
*Hg	Min	<0.0001	<0.001	<0.001	P50	<0.001	<0.004	<0.001	<0.014	<0.004	<0.001	<0.001	≤0.006	0.006	0.001
	Max		0.003	<0.001	P95	<0.007	<0.015	<0.015	<0.015	<0.007	<0.014	<0.014			
K	Min	2.3			P50	12.26	0.50	0.73	0.33	0.78	1.44	1.55			6.25
	Max				P95	22.00	1.41	5.55	1.74	1.44	2.87	3.70			
Li	Min	0.001			P50	0.001	ND	ND	ND	ND	<0.001	<0.001			

	Variable interval	2020 Tailings LCT Test (1 sample)	Vulcan Tailings LCT Tests (2 samples)	WRD LCT Tests (14 samples)	Variable interval	Process Water (416 samples)	Groundwater (Off-site -256 samples)	Groundwater (On Site - 350 samples)	GW_Down-stream TSF (184 samples)	GW_Down-stream WRD (72 samples)	Sterkstroom (Upstream - 127 samples)	Sterkstroom (Downstream - 88 samples)	SANS 241 Limit	LCT0	Randwater - Rustenburg Municipality
	Max				P95	0.005	ND	ND	ND	ND	<0.001	<0.001			
Mo	Min	0.0006	<0.025	<0.025	P50	0.024	ND	ND	ND	ND	<0.001	<0.001	≤0.07	0.07	
	Max		<0.025	<0.025	P95	0.065	ND	ND	ND	ND	<0.012	<0.012			
Pb	Min	<0.001	<0.001	<0.001	P50	0.001	0.004	0.001	0.004	0.001	<0.001	<0.001	≤0.01	0.01	0.006
	Max		<0.001	<0.001	P95	0.004	0.009	0.010	0.010	0.009	<0.009	<0.009			
**Se	Min	0.0006	<0.001	<0.001	P50	<0.001	<0.005	<0.001	<0.008	<0.005	<0.001	<0.001	≤0.04	0.01	0.006
	Max		0.001	0.002	P95	<0.007	<0.025	<0.025	<0.025	<0.007	<0.008	<0.008			
V	Min	0.008	<0.025	<0.025	P50	0.003	ND	ND	ND	ND	0.001	0.001	≤0.2	0.2	
	Max		<0.025	<0.025	P95	0.014	ND	ND	ND	ND	0.002	0.002			
Zn	Min	0.002	<0.025	<0.025	P50	0.001	0.002	0.002	0.003	0.001	0.002	0.002	≤3	5	0.03
	Max		<0.025	<0.025	P95	0.027	0.057	0.035	0.040	0.005	0.008	0.009			
	*Detection limit analysed is above the SANS Drinking water guideline **Detection limit analysed is set above the LCT0 limit, but below the SANS Drinking water quality limit ND - No Data														

SIGNIFICANT PARAMETERS OF EXCEEDANCE IN THE SOURCES AND PATHWAY

Significant parameters of exceedance were identified by considering the P50 and P95 of the data in addition to other statistical parameters such as percentage exceedances (>5%) and the mean. These results were compared to both the SANS Drinking Water quality standards and the LCT0 limits to inform the significance of the exceedances. From Table 21 and **Table 22**, it is evident that nitrate is the main parameter of concern exceeding the SANS Drinking water quality limit in the P95 (top 5% values) for groundwater, downstream surface water and process water[58].

Process water and on-site groundwater has the highest concentrations nitrate with > 91% and > 49% SANS 241 Drinking Water Standard exceedances recorded (**Table 22**), respectively, and the P50 values exceeding by 4 times and 2 times, respectively (Table 21). The main sources of elevated nitrate concentrations from the waste storage facilities would be blasting materials used during mining. The downstream TSF samples exceeded the SANS Drinking water quality limit in the P50 (18.85 mg/l) and the P95 (34.76). The nitrate concentrations downstream of the WRD is on average below the SANS Drinking water quality limits (P50 = 7.24 mg/l). The P95 (56.57 mg/l), however, indicated that high concentrations nitrate is released in pulses. Considering the off-site groundwater[59] monitoring localities, no significant nitrate exceedance was observed. Off-site nitrate concentrations exceed the SANS Drinking Water quality limits by 3.5 mg/L (P50 = 14.5 mg/l).

The downstream surface water results indicated > 12% exceedance in samples analysed with the P95 (28.88 mg/L) and Maximum (48.84 mg/l) concentration exceeding the SANS 241 Drinking Water Standard, with the P50 at 0.92 mg/l, indicating that the impact is rather due to short pulse events (Figure 33) and again diluted after rainfall events.

A notable observation is that neither manganese, chrome nor iron (exceeded in tailings leachate tests) were found to significantly exceed the SANS 241 Drinking Water Standards in the long-term monitoring data. It was also noted that TDS exceeded the LCT0 limit onsite groundwater and TDS and sulphate also exceeded the LCT0 limit for process water. *It is important to note that these parameters did not exceed the limits during the geochemical testing.*

Table 22: Significant Parameters of Exceedance for The Hydrochemical Source and Pathway

	Source		Source/pathway	Pathway	
	Process water		On-site groundwater	Off-site groundwater	
	NO3-N mg/l	NO2-N mg/l	NO3-N mg/l	Mn mg/l	NO3-N mg/l
Sample count	414	287	304	111	202
Total Sample Count	416	416	350	112	253
SANS 241 Limit	11	0.9	11	0.1	11
Exceedance Count	379	175	149	7	26
Exceedance %	91.55%	60.98%	49%	6.31%	12.9%
Mean	46.41	4.16	25.14	0.02	5.504
P5	3.63	0.06	3.0	0.001	0.290
P50	47.39	2.29	22.8	0.001	3.2
P95	82.49	15.73	61.9	0.13	14.5

[58] Note that process water is not expected to conform to the SANS limit although this gives an indication of the significance of the concentrations.

[59] Off-site groundwater was mainly informed by upstream samples as only 3 downstream samples are available.

Table 23: Significant Parameters of Exceedance for The Hydrochemical Source and Pathway (Continues)

	Pathway		
	Surface water Upstream	Surface water On-site (mid-stream)	Surface water Downstream
	Mn mg/l	NO3-N mg/l	NO3-N mg/l
Sample count	126	94	88
Total Sample Count	127	96	88
SANS 241 Limit	0.1	11	11
Exceedance Count	15	7	11
Exceedance %	11.90%	7.45%	12.50%
Mean	0.04	3.65	4.29
P5	0.001	0.27	0.28
P50	0.001	0.96	0.92
P95	0.16	14.82	28.88

10.5.4.3 POTENTIAL RECEPTORS ANALYSIS

Considering the topographical and groundwater level data review and analysis, the potential mass migration plume from the TSF 3 WRD Extension 1 (depending on the construction schedule and timelines) would move in a north-east and south-eastern direction. **Only one directly affected potential receptor was identified, namely the 1) Sterkstroom River to the East of TSF 3 and WRD Extension 1** (**Figure 29**).

Several I&APs and hydrocensus boreholes situated within 2 km from the proposed development footprint (TSF 3 WRD Extension 1) and within the MRA include:

- Isolated Residence West of existing WRD and within 200 m from the TSF 3 WRD Extension 1;
- The graveyard, Piet Retief Primary School, and demolished isolated residences are situated within 1 km from the proposed TSF 3 WRD Extension 1 (indicated in orange on **Figure 29**);
- Hydrocensus boreholes within the MR boundary and situated upstream, West of the proposed TSF 3 WRD Extension 1 include boreholes 50a, PP BH 1 and PP BH 2;
- The du Preez's Residence West of the proposed facility;
- The Lapologang Community (pink on **Figure 29**); and
- The Marikana Engineering Community Project west of the proposed facility.

It is not expected that the development of the TSF 3 WRD Extension 1 will impact on these I&APs nor the hydrocensus boreholes as these are not located on the development footprint, but rather upstream and outside the anticipated potential mass migration zone. It is however advised that isolated residences that may potentially be affected (if any), be relocated prior to the start of construction. These must be identified through a detailed assessment and mass transport modelling.

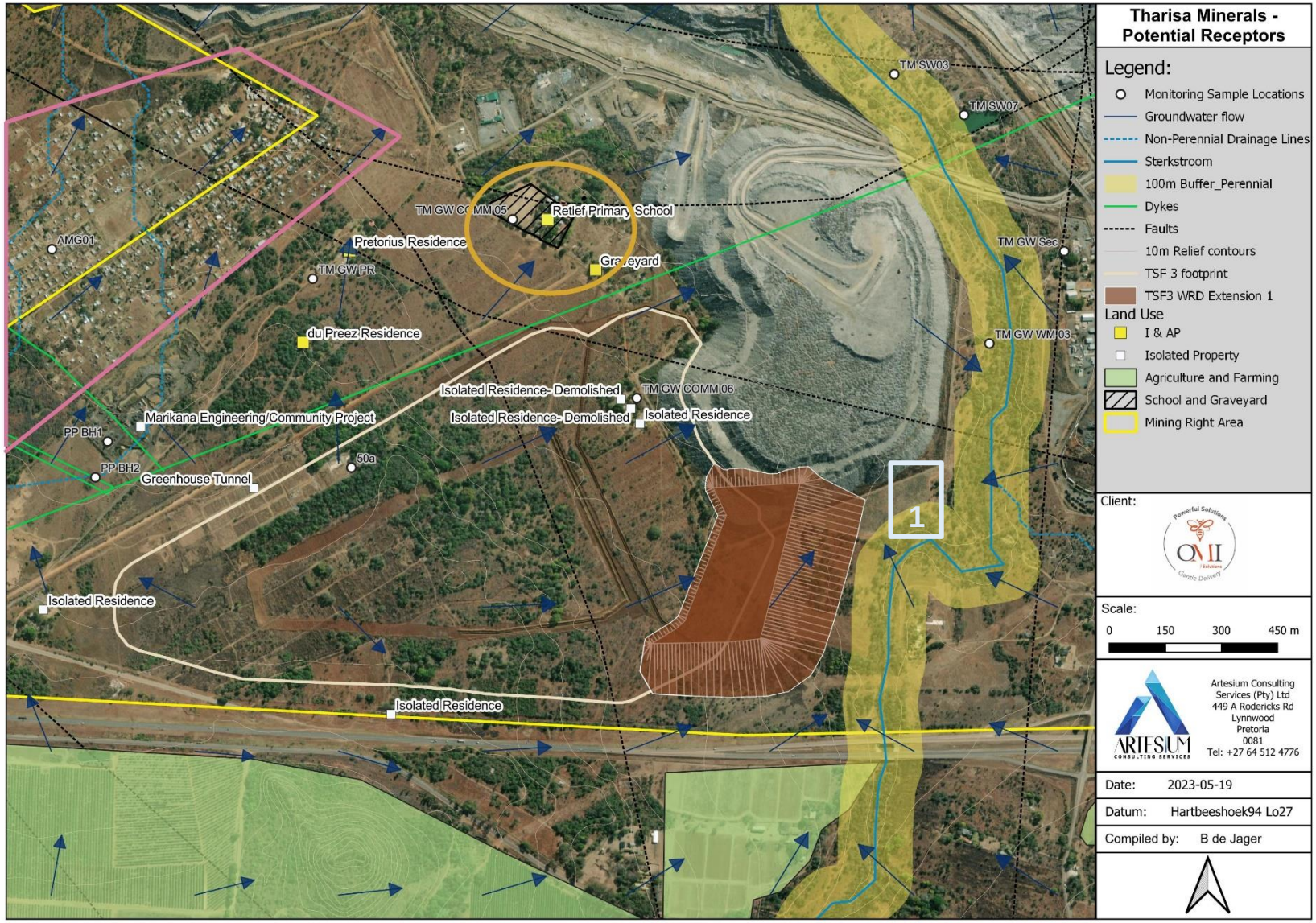


Figure 29: Spatial Locations of Potential Receptors and Groundwater Flow Directions

10.6 SURFACE WATER

10.6.1 WATER MANAGEMENT AREA

Tharisa is located near Marikana in the Quaternary sub-catchment A21K. The mine falls within the Lower Crocodile Secondary and Crocodile River catchment and within Limpopo Water Management Area which was formerly the Crocodile West Marico Water Management Area (WMA3) (**Figure 30**). The Crocodile River is a major tributary of the Limpopo River (Drainage Region A) which discharges into the Indian Ocean (Mozambique). The Pienaars, Apies, Moretele, Jukskie, Hennops, Magalies and Elands rivers are all major tributaries of the Crocodile River which make up the A20 tertiary hydrological catchment with its 39 quaternary catchments (GCS, 2022).

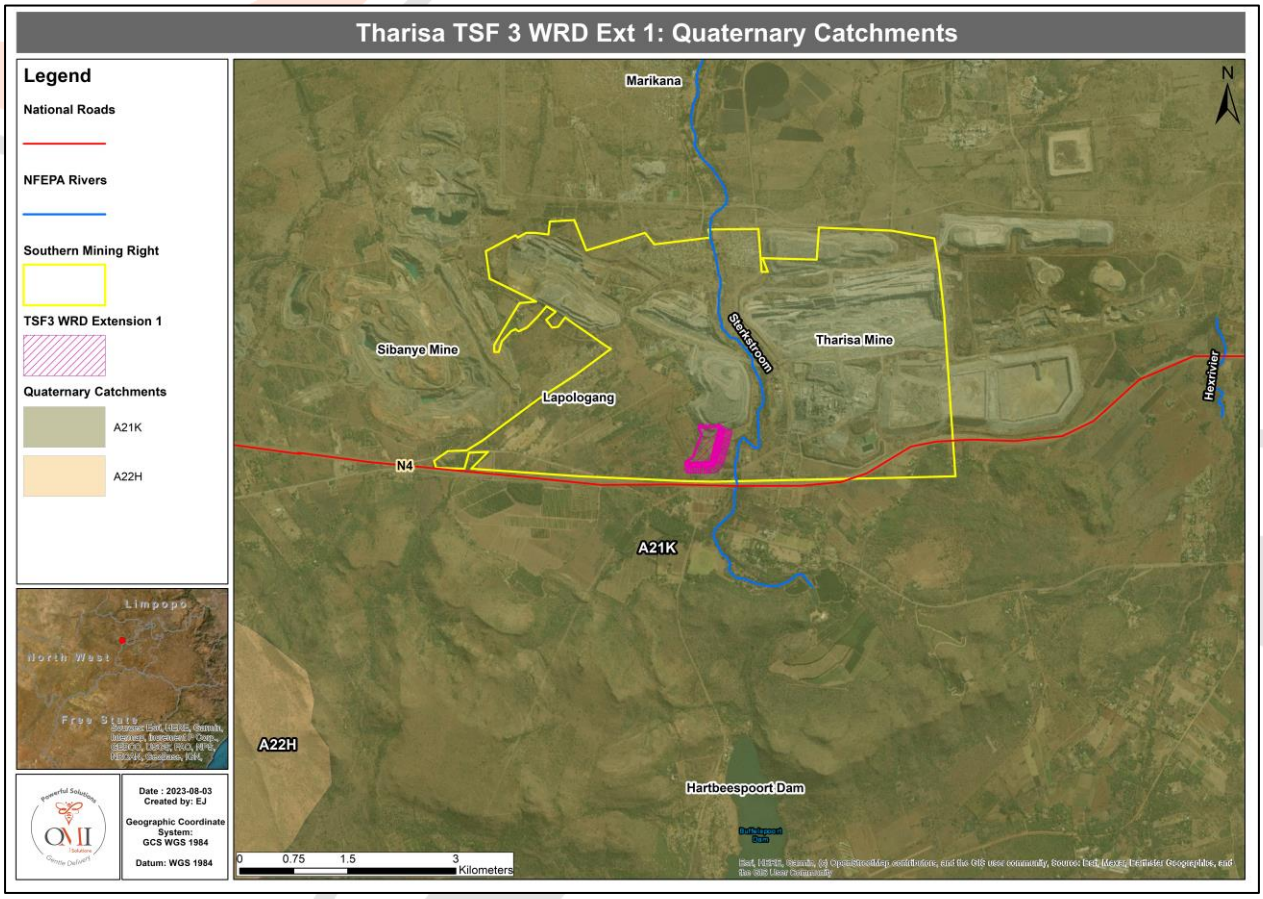


Figure 30: Tharisa Mine Water Management Area and Quaternary Catchments

10.6.2 WATERCOUSES

10.6.2.1 SURFACE WATER HYDROLOGY

The following watercourse is located within the vicinity of the proposed TSF 3 WRD Extension 1 Project:

- The Sterkstroom River which is a perennial watercourse which flows from the Buffelspoort Dam, south of the N4, in a northerly direction through the centre of the project area.

10.6.2.2 HYDROGEOMORPHIC (HGM) UNITS

No wetland was identified within the area. The Sterkstroom River represent a perennial floodplain river channel with riparian woodland. The riparian map and regulated areas are presented in **Figure 32**.

The project area is drained by surface run-off (i.e., sheetwash) with surface water flowing into non-perennial streams that eventually drain into the major river systems of the area, in this case the perennial Sterkstroom River (**Figure 31(b)**) (AGES, 2023b).

The perennial Sterkstroom River can be described as a floodplain river or a lowland river. The perennial Sterkstroom River floodplain is not classified as a floodplain wetland, but a river with some wetland characteristics in the channel and its banks (AGES, 2023b).

The vegetation associated with the floodplain is mostly microphyllous woodland and hygrophilous grasses in the project area. Species such as *Searsia lancea*, *Combretum erythrophyllum*, *Vachellia karroo*, *Ziziphus mucronata* and *Searsia pyroides* mostly grow in the riparian floodplain area (Photograph a), together with grass species such as Sporobolus africanus and Eragrostis rotifer. Small depressions have formed on the floodplains where water “takes a short-cut” over the floodplain during flood events.

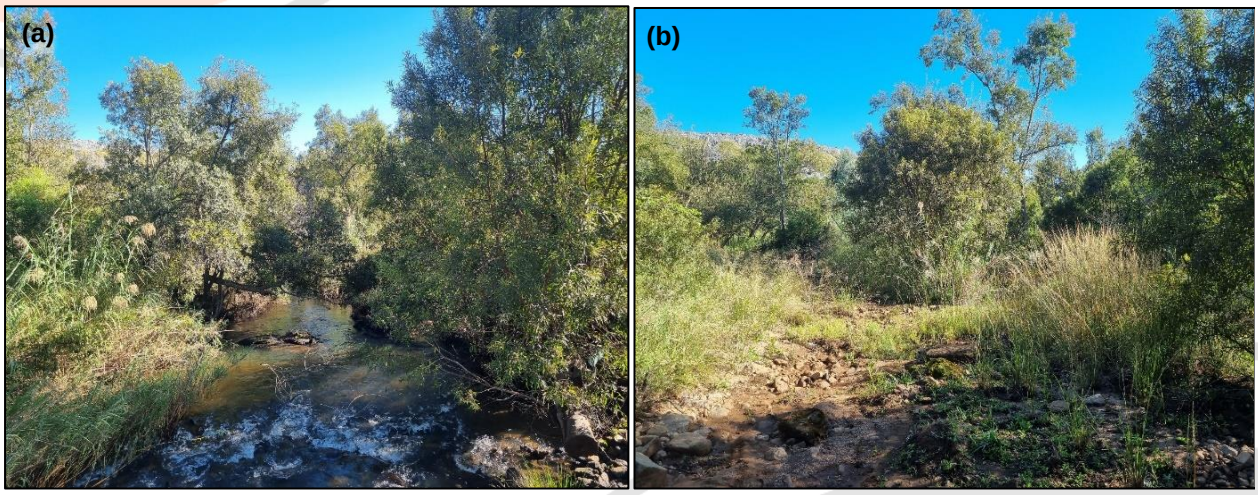


Figure 31: (a) Perennial Sterkstroom River in the project area (b) Riparian woodland along the Sterkstroom River floodplain in the project area

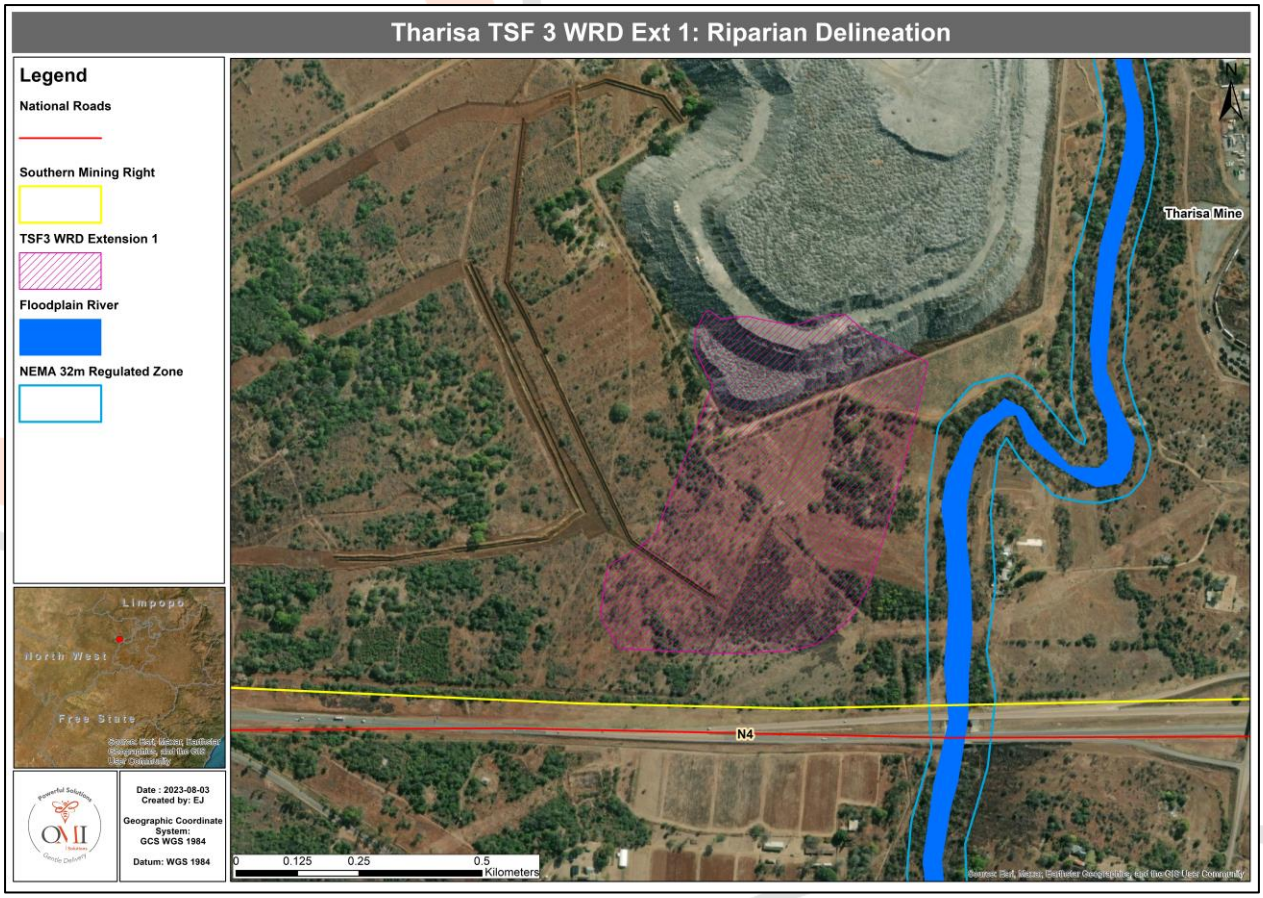


Figure 32: Riparian Delineation Map of the Proposed TSF 3 WRD Extension 1 Site

10.6.3 SURFACE WATER QUALITY

According to Artesium Consulting Services (2023), From the long-term surface water quality monitoring, hydrochemical data indicates that the nitrate concentrations of two samples, TW SW02 and TW SW03, have increased by 25 – 35 mg/l since November 2020. It is evident that the nitrate concentrations plotted in line with the 2013 P50 and P95 baseline values, and below the SANS 241 (2015) until 2020, whereafter nitrate sharply increased, but only for short periods, indicating short pulse events of high nitrate concentrations (**Figure 33**).

All three remaining samples, TW SW01, TW SW16 and TW SW17, are consistently below the SANS 241 Drinking Water Quality Limits. During the 2021 hydrocensus, one downstream sample was analysed, TW SW04, with the results showing nitrate and nitrite concentrations below the SANS 241 Drinking water limit, indicating localised impacts on site.

TDS and pH values are both below the 241 SANS water standard limit for all surface samples (**Figure 34** and Figure 35), but both these parameter concentrations have also increased since November 2020. **Figure 33** to **Figure 35** graphically presents the surface water monitoring data for concentrations nitrate, nitrite, TDS and pH.

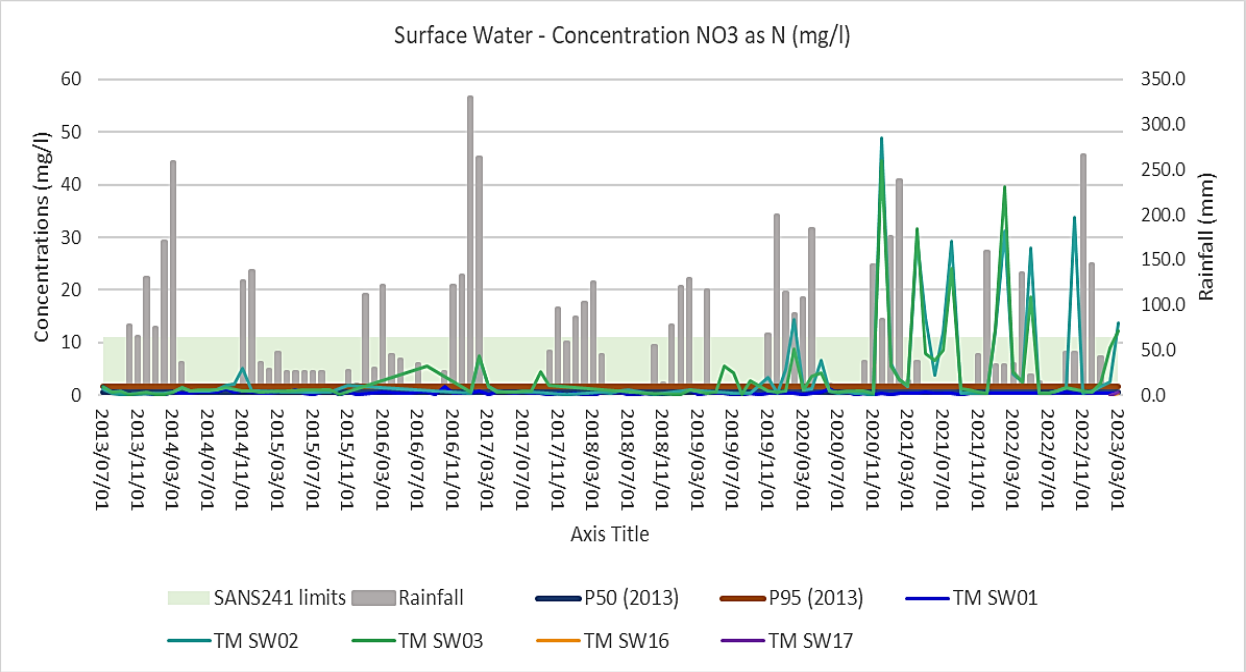


Figure 33: Surface Water Nitrate Concentrations with Time

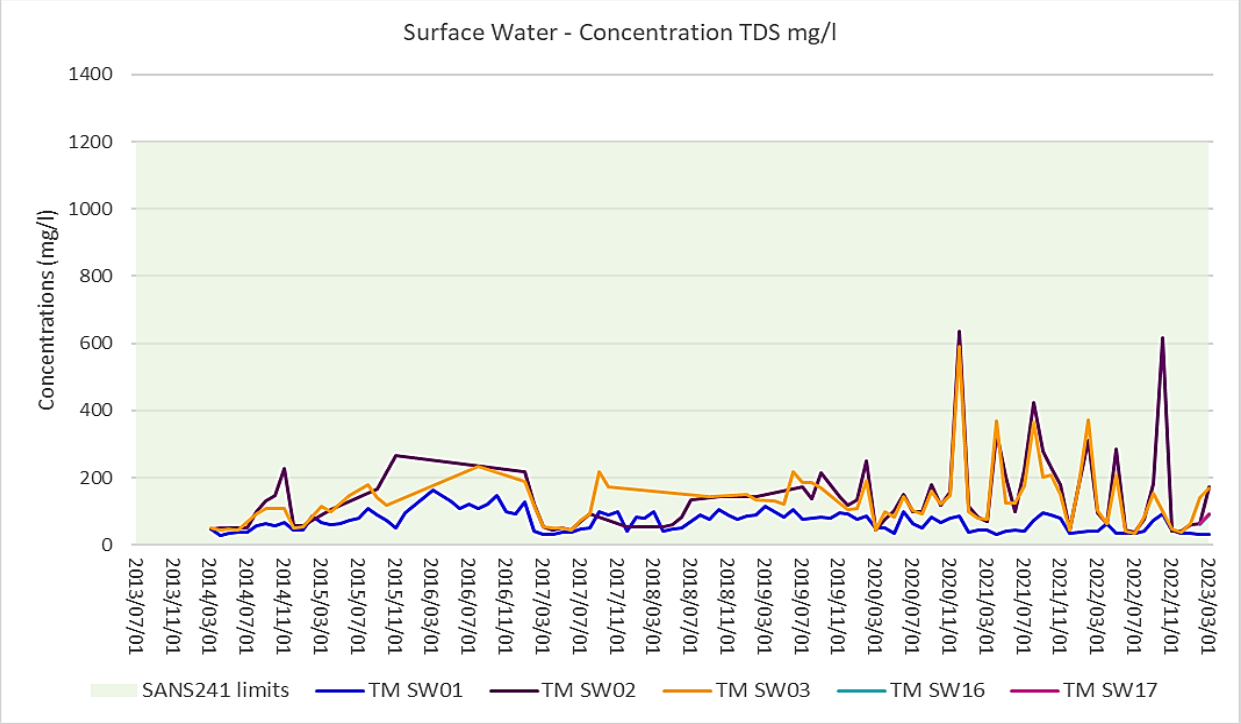


Figure 34: Surface Water TDS Concentrations with Time

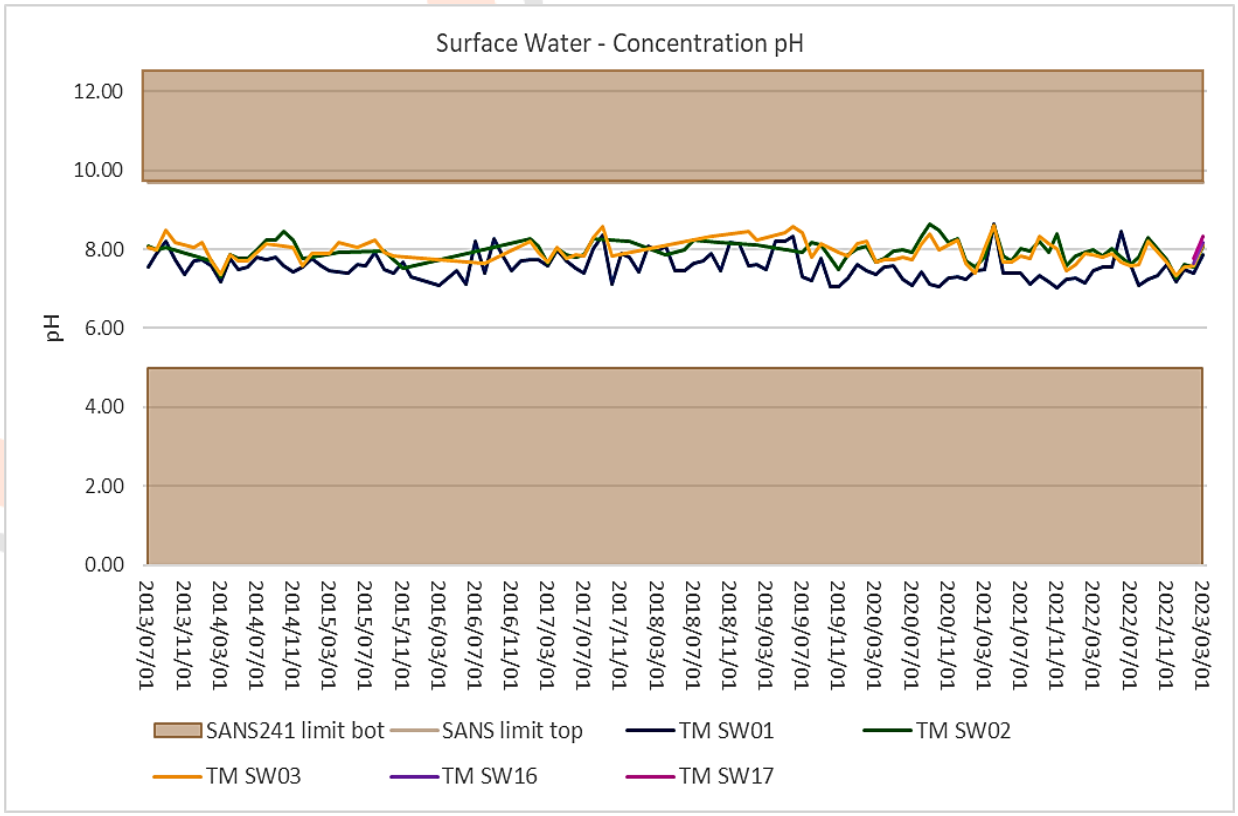


Figure 35: Surface water pH Range with Time

Figure 36 and Figure 37 show the Nitrate and nitrite spatial plots. It is evident from the maps that exceedances are localised and confined to the mining lease area within 500 m from known waste facilities. Additional on site and downstream monitoring localities are proposed to strengthen these findings.

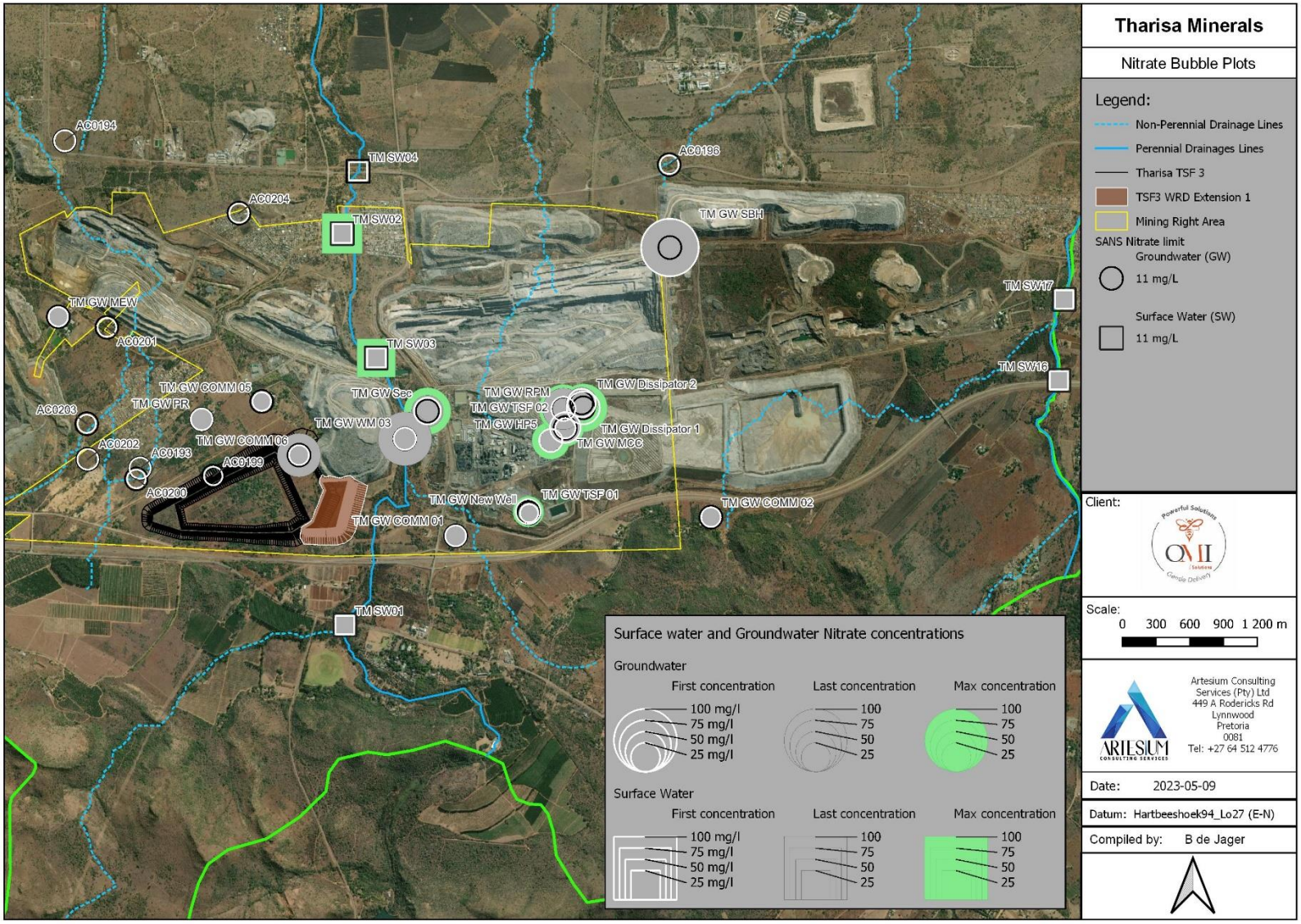


Figure 36: Spatial Distribution of Nitrate Concentrations Observed at Surface and Groundwater Monitoring Localities

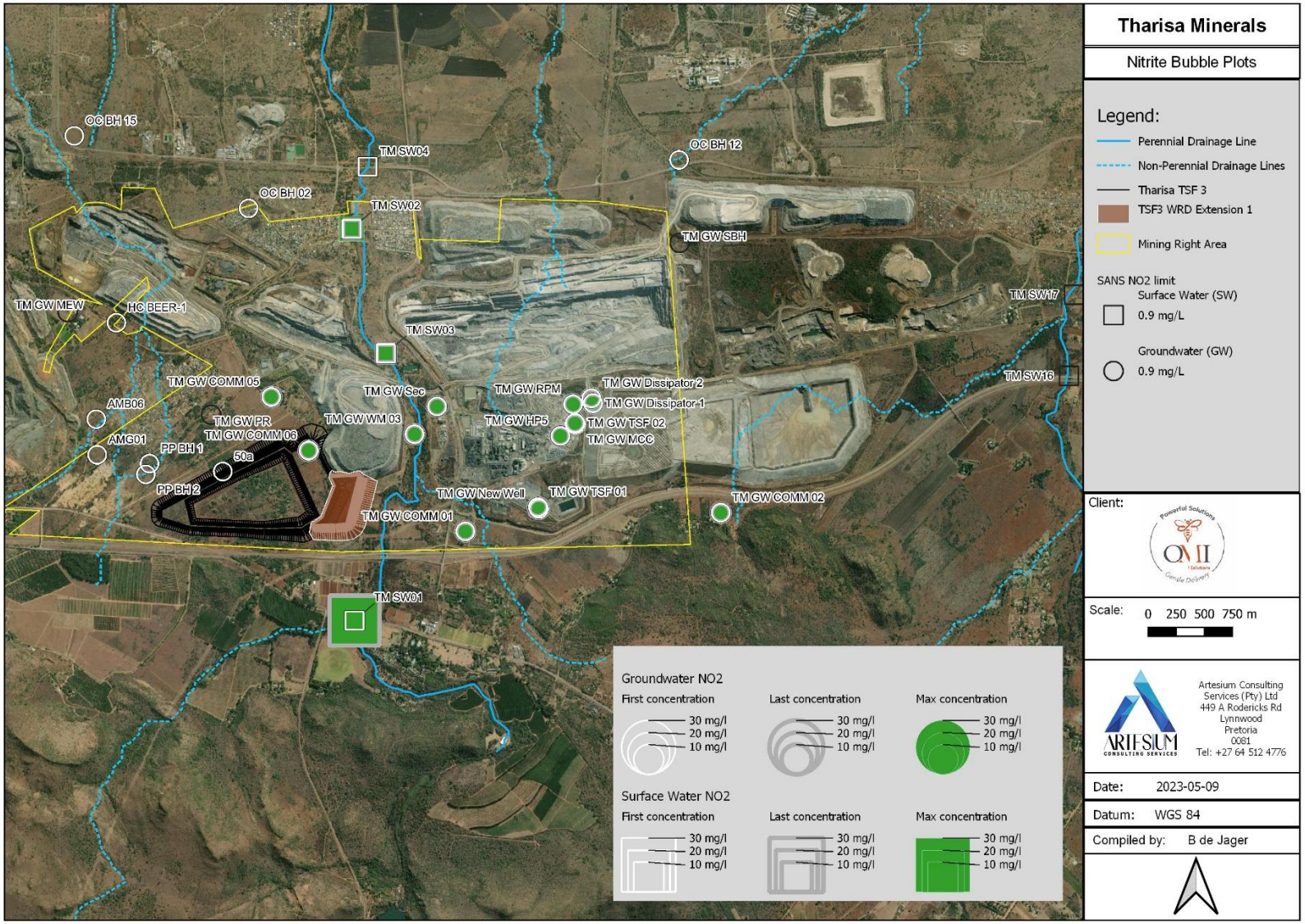


Figure 37: Spatial Distribution of Nitrite Concentrations Observed at Surface and Groundwater Monitoring Localities

10.6.4 RIVERINE INTEGRITY

Evidence was observed on site of transformation of the floristic characteristics of the site at least to some extent. Impacting activities which may have altered the expected floristic composition include alien infestation, mining activities and road crossings. One riparian / water course areas were assessed and classified in terms of its integrity (AGES, 2023b).

Table 24: Present Ecological State and Ecological Importance & Sensitivity of The Riparian Systems on the Proposed TSF 3 WRD Extension 1 Site

Catchment	Hydro-geomorphic Unit	Ecological Importance and Sensitivity (EIS)	Present Ecological Status (PES)
A21K	Perennial Sterkstroom River	Moderate	Class C: Moderately Modified

Anthropogenic disturbance of soil and primary vegetation have altered the natural hydrological functioning of the drainage systems associated with the proposed TSF 3 WRD Extension 1 project area.

The reference state of the Sterkstroom River was probably Class B that changed to a Class C. The drainage system as an entity has a Class C PES (Moderately Modified). The riparian woodland plays an important role as a corridor for fauna in the area and has been impacted by upstream agricultural activities and road crossings. The state of the individual hydrologic component functions is as follows:

- Hydrologic: Class D – Largely Modified
- Water quality: Class C: Moderately Modified
- Hydraulic / Geomorphic: Class C: Moderately Modified
- Biota: Class C: Moderately Modified

Considering the importance of the fauna corridor as well as the red data species associated with the wetlands, the area has a Moderate EIS. This HGM unit is therefore considered to be ecologically sensitive and important. The biodiversity of this riparian zone may be sensitive to flow and habitat modification, while the channel plays a significant role in moderating the quantity and quality of water entering downstream areas.

10.7 TERRESTRIAL BIODIVERSITY

A Terrestrial Biodiversity including Plant and Animal Species Assessment was conducted for the project. According to the DFFE Environmental Screening Tool the site comprises very high terrestrial biodiversity sensitivity, medium animal species sensitivity and low plant species sensitivity. A pre-screening site visit was conducted by the Biodiversity Specialist (AGES, 2023c) on the 14 April 2023 to determine if the assessment was accurate and if the studies recommended should be conducted. After the site visit the following was concluded:

- The site has a Medium Sensitivity from a terrestrial biodiversity perspective due to the presence of a small section (roughly 2-3 hectares) of indigenous woodland with protected tree species.
- The site has a Medium Sensitivity from an Animal Species Theme Perspective due to the presence of natural fauna habitats.
- The site has a Medium Sensitivity from a Plant Species Theme Perspective due to the presence of indigenous woodland.

10.7.1 TERRESTRIAL FLORA

10.7.1.1 REGIONAL VEGETATION

The proposed Tharisa TSF 3 WRD Extension 1 project is situated within the Savanna biome which is the largest biome in Southern Africa. The Savanna Biome is characterised by a grassy ground layer and a distinct upper layer of woody plants (trees and shrubs).

The most recent classification of the area by Mucina and Rutherford (2006) shows that the proposed TSF 3 WRD Extension 1 site is classified as Marikana Thornveld (**Figure 38**) The Marikana Thornveld vegetation type is considered Endangered. While the national conservation target for this vegetation type is 19%, less than 1% is statutorily conserved. This vegetation type has been transformed (48%), mainly by cultivation and urban or built-up areas. Most agricultural development of this area is in the western regions towards Rustenburg, while in the east industrial development is a greater threat. Alien invasive plants are localised in high densities, especially along drainage lines, in this vegetation type.

The Marikana Thornveld vegetation type is characterised by open *Vachellia karroo* woodland, in valleys and slightly undulating plains and some lowland hills. Shrubs are denser along drainage lines, on termitaria and rocky outcrops or in other habitats protected from fire.

10.7.1.2 CONSERVATION IMPORTANCE

The proposed TSF 3 WRD Extension 1 project lies within Critical Biodiversity Area 2 (CBA 2) and Ecological Support Area 2 (ESA 2) areas, according to the North West Biodiversity Conservation Plan (**Figure 39**).

Although the actual WRD footprint is in CBA 2 and ESA 2, these areas represent zero sensitivity (due to mining infrastructure), low sensitivity and Medium-Low sensitivity areas characterised only by a few pockets of woodland, old fields and degraded grassland. These areas do not represent land that will contribute towards ecosystem functioning and should subsequently be classified as “Other Natural Areas” or “No Natural Habitat Remaining”.

10.7.1.3 PROTECTED AREAS NETWORK AND NATIONAL PROTECTED AREAS EXPANSION STRATEGY (NPAES)

Officially protected areas, either provincially or nationally that occur close to a project site could have consequences as far as impacts on these areas are concerned. For the proposed TSF 3 WRD Extension 1 site and associated infrastructure however, the Magaliesberg Protected Environment and Kgaswane Nature Reserve is located about 7.5 km to the south and south-west of the project area (**Figure 40**). Furthermore, the project area is in the Magaliesberg Biosphere Reserve transition zone, although mining is a confirmed land-use for the transition zone.

The NPAES are areas designated for future incorporation into existing protected areas (both National and informal protected areas). These areas are large, mostly intact areas required to meet biodiversity targets, and suitable for protection. They may not necessarily be proclaimed as protected areas in the future and are a broad scale planning tool allowing for better development and conservation planning. No NPAES occur within the project area, with the closest located roughly 10 km north-east of the area, representing North West / Gauteng Bushveld (**Figure 40**).

10.7.1.4 IMPORTANT BIRD AREAS (IBA)

The Magaliesberg IBA is located within the project area, although the actual Magaliesberg habitat is not represented on site (**Figure 41**).

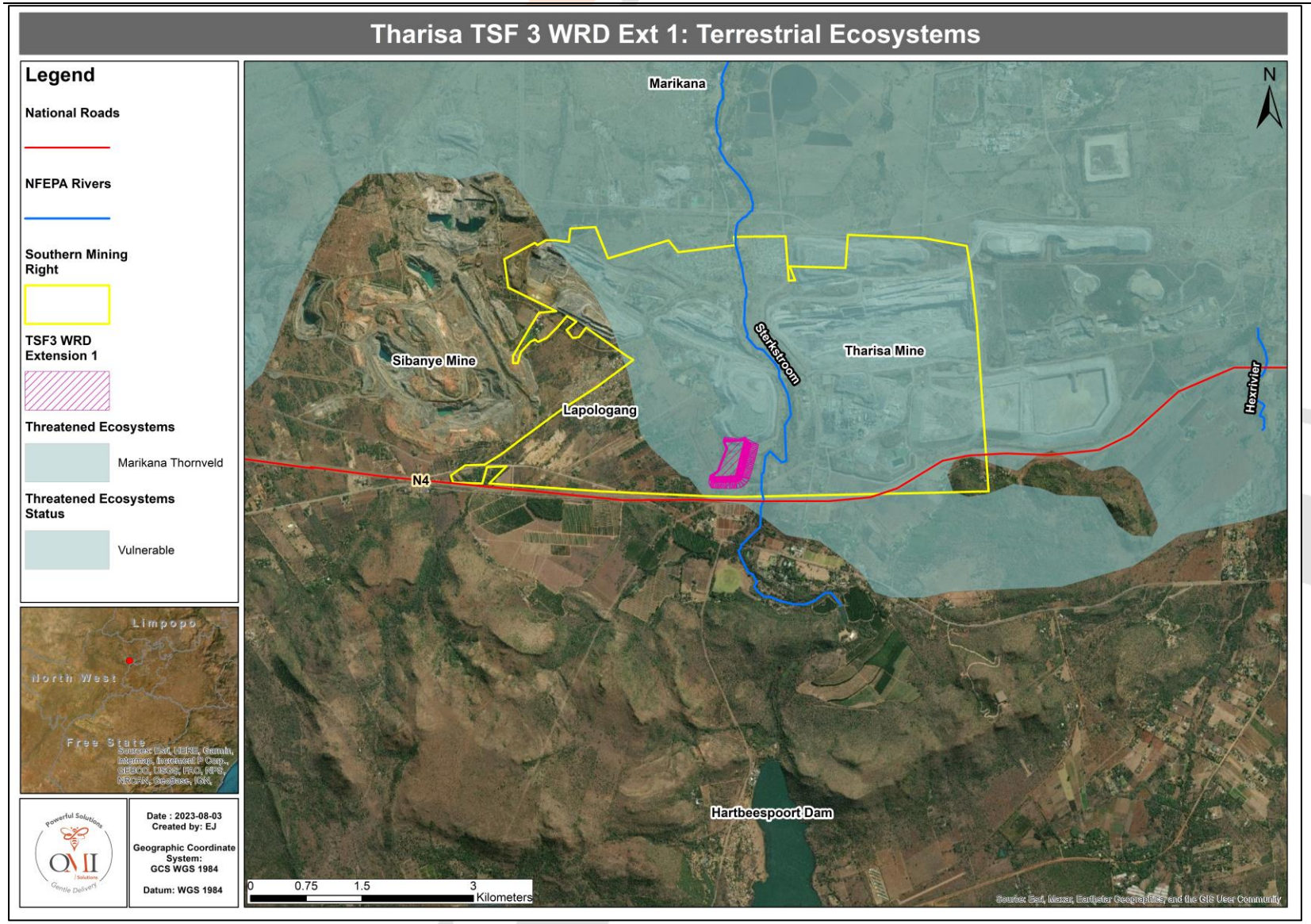


Figure 38: Ecosystem and Ecosystem Threat Status relevant to the TSF 3 WRD Extension 1 Project

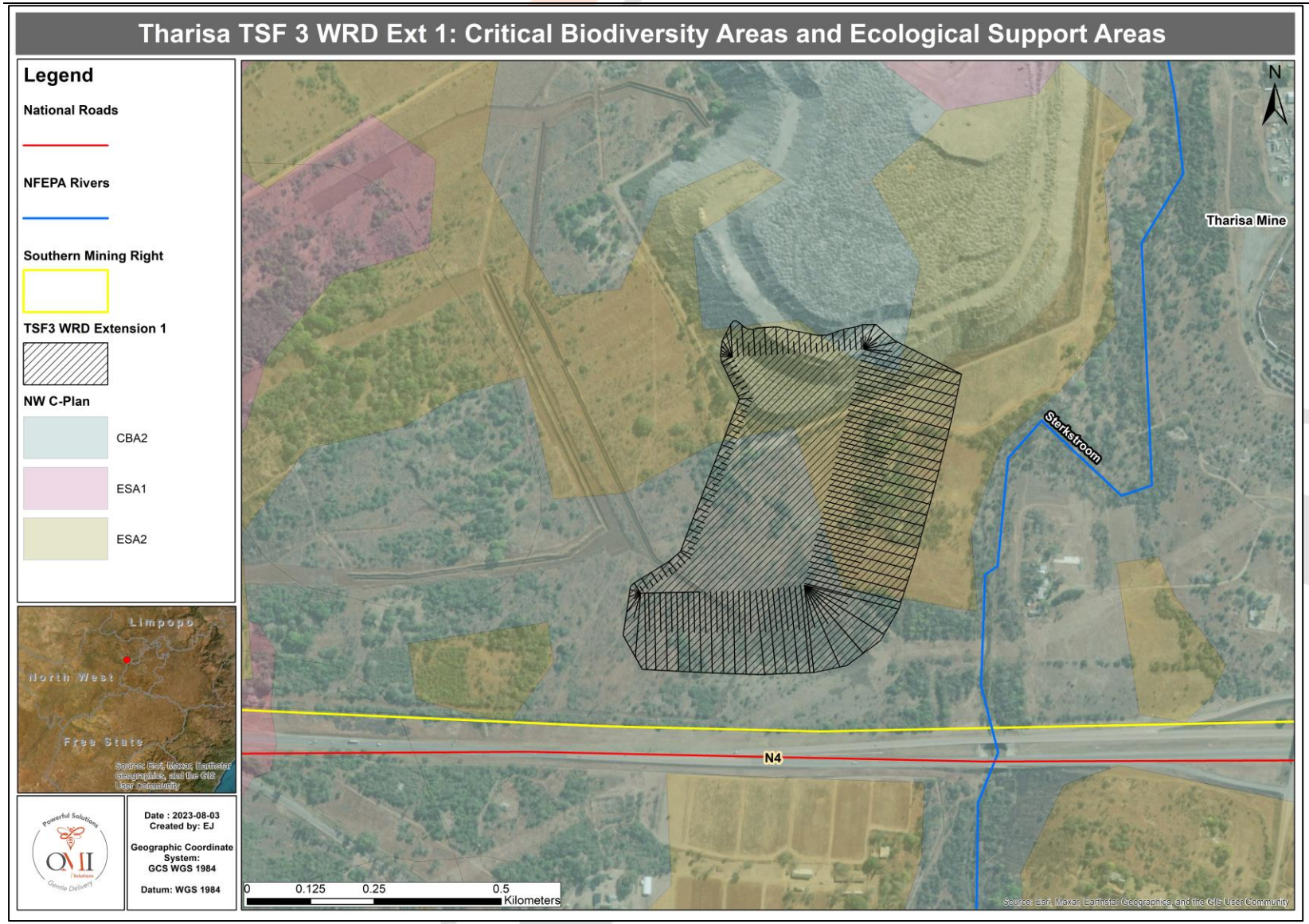


Figure 39: North West C-Plan Map for the Project Site

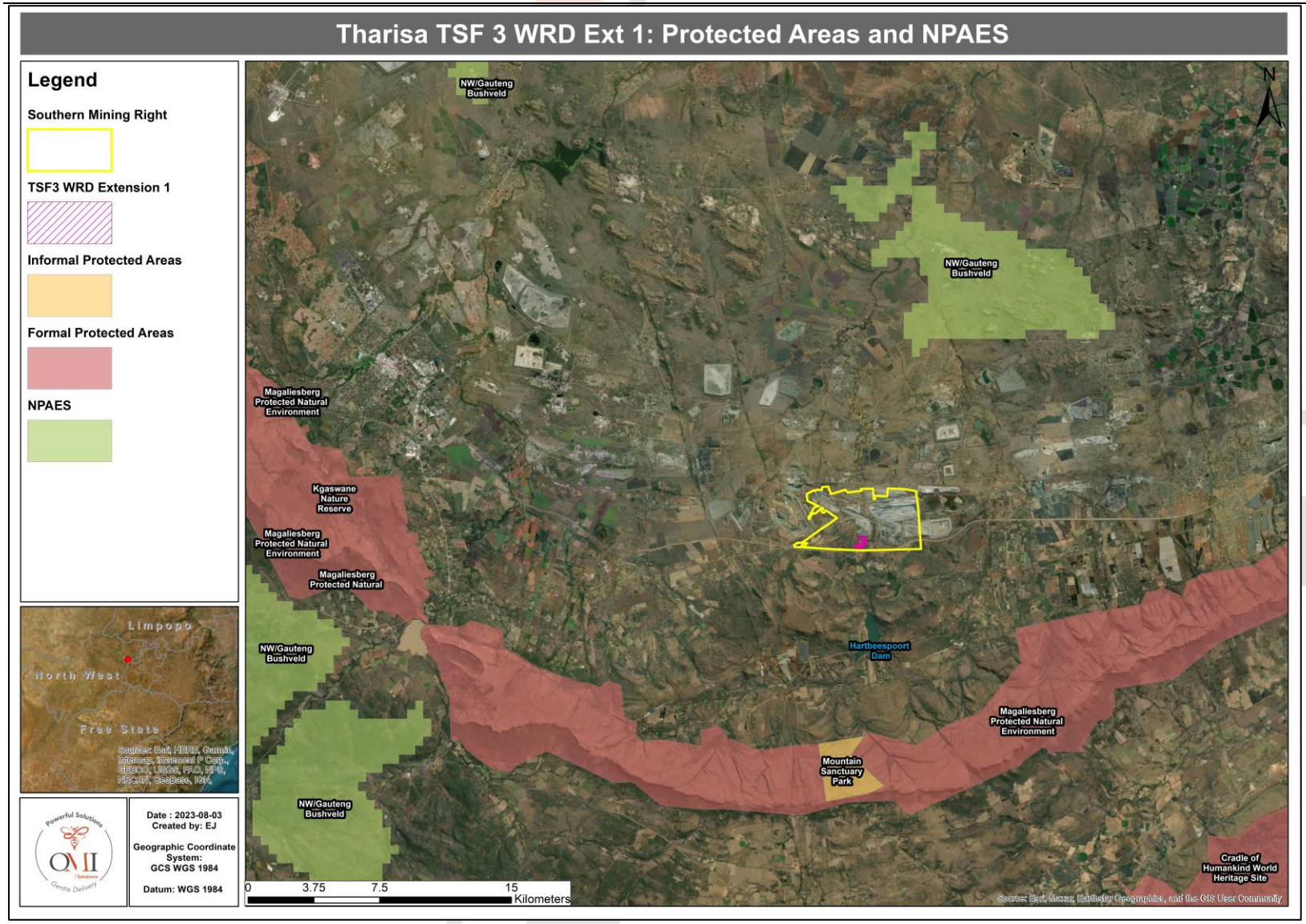


Figure 40: Location of the Project Area in relation to listed Protected Areas and NPAES.

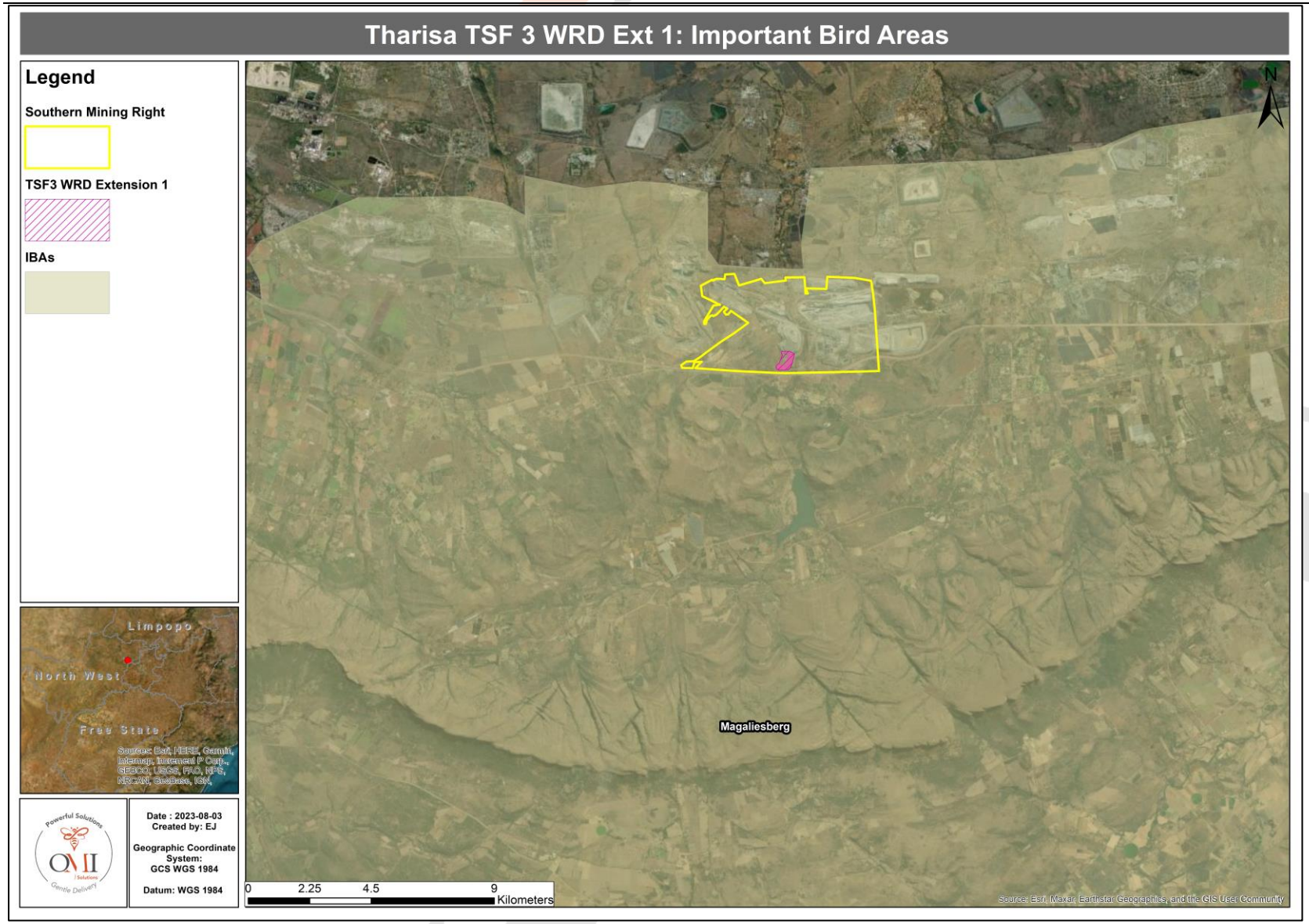


Figure 41: IBAs near the Project Area

10.7.1.5 VEGETATION UNITS FOUND ON SITE

The proposed TSF 3 WRD Extension 1 site occurs on slightly undulating plains with a section of a WRD forming the northern section of the site. The farms surrounding the project area is primarily used for mining. Marikana is well known as a productive agricultural area, although the area is best known for the mining activities. The state of the vegetation of the proposed project area varies from being slightly degraded to completely degraded. The farm is currently zoned for mining.

The vegetation communities identified in the area are classified as physiographic physiognomic units, where physiognomic refers to the outer appearance of the vegetation, and physiographic refers to the position of the plant communities in the landscape.

The vegetation units identified on site is as follows:

- Mixed Senegalia caffra – *Combretum molle* woodland.
- Secondary old fields
    - Degraded *Vachellia karroo* woodland.
    - Degraded grasslands.
- Degraded woodland / old farmstead / gardens.

The vegetation units for the project area are presented in **Figure 42**, with the descriptions provided in **Table 26**.

10.7.1.6 SPECIES OF CONSERVATION CONCERN

The following red data species are listed for the specific Quarter Degree Grid Square (QDS) (**Table 25**).

Table 25: Red data species Potentially Occurring in the Project Area according to the Plants of Southern Africa (POSA) Database

Family	Common Name	Species	Threat status
Myrothamnaceae	*Resurrection Plant*	*Myrothamnus flabellifolius*	Data Deficient

None of this species was documented during the surveys considering that the habitat is completely different from habitat within which this species will usually occur. Additionally, the DFFE Environmental Screening Tool did not highlight any listed species.

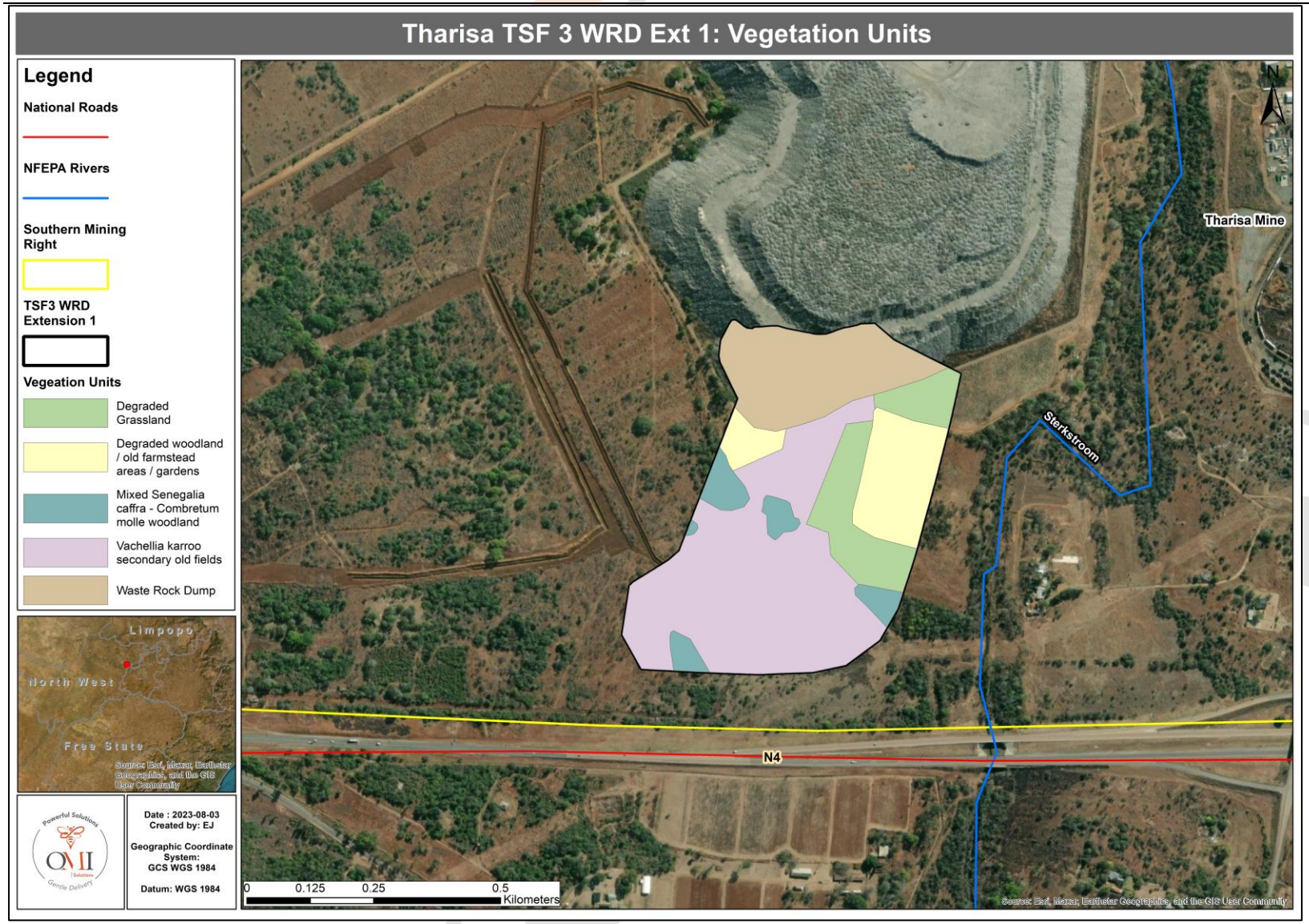
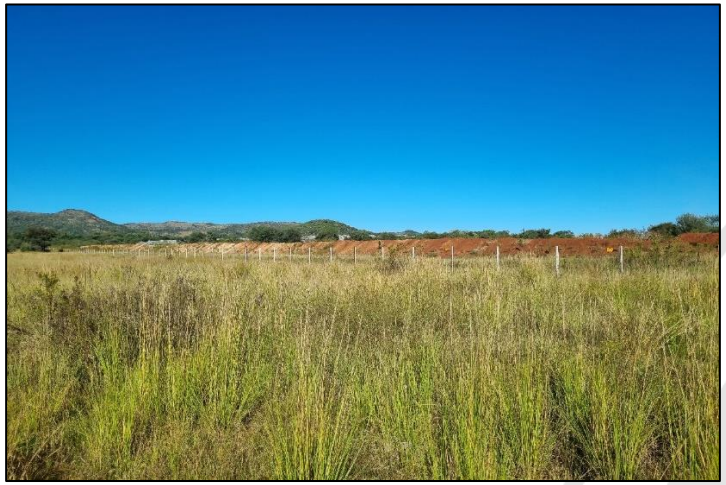


Figure 42: Vegetation Unit Map of the proposed TSF 3 WRD Extension 1 Site

Table 26: Vegetation Units Botanical Analyses and Characteristics

Vegetation Unit	Botanical Analysis and Characteristics	Recommendations
Mixed *Senegalia caffra – Combretum molle* woodland  Photograph 1. Mixed *Senegalia caffra – Combretum* molle woodland in the project area	• State of the vegetation: Slightly degraded • Need for rehabilitation: Low. • Conservation priority: Medium • Soils & Geology: Shallow rocky to gravelly soils of the Mispah / Glenrosa soil forms derived from norite. • Density of woody layer: Trees: 10-20% (avg. height: 3-6m); Shrubs: 10% (avg. height: 1-2m) • Density of herbaceous layer: Grasses: 40-50% (avg. height: 0.5m); Forbs: <1% (avg. height: 0.3m) • Sensitivity: Medium • Dominant plant species: *Combretum molle, Senegalia caffra, Dombeya rotundifolia, Grewia monticolia, Grewia bicolor and Dichrostachys cinerea* • Red data species: None observed. • Protected tree species (DFFE): *Sclerocarya birrea*	• The vegetation unit is classified as having a Medium Sensitivity due to representing woodland areas with a widespread distribution. • Any removal of the protected trees (*Sclerocarya birrea*) documented in isolated areas) listed in the National Forest Act would need a licence being obtained from DFFE.
Secondary Old fields	***Vachellia karroo* woodland** • State of the vegetation: Open microphyllous woodland in a state of succession • Conservation Priority: Medium-Low. • Characteristic: Open savanna woodland on red apedal soils • Dominant Plant Species: *Vachellia tortilis, Dichrostachys cinerea, Ziziphus mucronata* • Density of wood layer: Trees: 2-5% (avg. height: 3-6m); Shrubs:5-10% (avg. height: 1-2m)	• The vegetation unit is classified as having a Low (Degraded Grassland) and Medium-low (Woodland) Sensitivity due to being in a state of succession. • The development of the WRD can be supported in the area with mitigation measures implemented where necessary, especially with regards to the proximity to the Sterkstroom River.

Vegetation Unit	Botanical Analysis and Characteristics	Recommendations
 Photograph 2: *Vachellia karroo* secondary old fields in the project area  Photograph 3: Degraded grassland in the project area (secondary old fields).	• Density of herbaceous layer: Grasses: 50-60% (avg. height: 0.8m); Forbs: <1 (avg. height: 0.5m) • Sensitivity: Medium-Low • Red data species: None observed. • Protected tree species (DAFF): None observed. **Degraded grassland** • State of the vegetation: Grassland with scattered microphyllous trees • Conservation Priority: Low. • Characteristic: Grassland with scattered trees on vertic, black clay soils • Dominant Plant Species: *Aristida congesta, Hyparrhenia hirta, Cynodon dactylon.* • Density of wood layer: Trees: <1% (avg. height: 3-6m); Shrubs:1-2% (avg. height: 1-2m) • Density of herbaceous layer: Grasses: 70-80% (avg. height: 0.8m); Forbs: <1 (avg. height: 0.5m) • Sensitivity: Low • Red data species: None observed. • Protected tree species (DAFF): None observed	

Vegetation Unit	Botanical Analysis and Characteristics	Recommendations
Degraded woodland / old farmstead / gardens  Photograph 4. Degraded woodland surrounding the old farmstead.	• State of the vegetation: Degraded woodland / exotic bushclumps / gardens • Need for rehabilitation: High • Conservation priority: Low • Soils & Geology: Red-yellow apedal loam soils derived from norite • Density of woody layer" Trees: 10-20% (avg. height: 3-6m); Shrubs: 2-5% (avg. height: 1-2m) • Density of herbaceous layer: Grasses: 40-50% (avg. height: 0.8-1.2m); Forbs: <1% (avg. height: 0.8m) • Sensitivity: Low • Dominant species: *Celtis africana, Ziziphus mucronata, Dichrostachys cinerea, Dodonaea angustifolia, Vachellia tortilis and Searsia lancea, exotic weeds, Cynodon dactylon, Pennisetum clandestinum* • Red data species: None observed • Protected species: None observed	• The vegetation unit is classified as having a low sensitivity due to the state of degradation. • Unlimited development can be supported in the area. Care should however be taken not to impact on the adjacent riparian woodland.

10.7.1.7 ALIEN INVASIVE SPECIES

The Alien and Invasive Species Regulations (GNR 599 of 2014) are stipulated as part of the National Environmental Management: Biodiversity Act (10/2004). The regulation listed a total of 559 alien species as invasive and further 560 species are listed as prohibited and may not be introduced into South Africa. Below is a brief explanation of the four categories of Invasive Alien Plants as per the regulation.

- Category 1a: Invasive species requiring compulsory control. Remove and destroy. Any specimens of Category 1a listed species need, by law, to be eradicated from the environment. No permits will be issued.
- Category 1b: Invasive species requiring compulsory control as part of an invasive species control programme. Remove and destroy. These plants are deemed to have such a high invasive potential that infestations can qualify to be placed under a government sponsored invasive species management programme. No permits will be issued.
- Category 2: Invasive species regulated by area. A demarcation permit is required to import, possess, grow, breed, move, sell, buy or accept as a gift any plants listed as Category 2 plants. No permits will be issued for Category 2 plants to exist in riparian zones.
- Category 3: Invasive species regulated by activity. An individual plant permit is required to undertake any of the following restricted activities (import, possess, grow, breed, move, sell, buy or accept as a gift) involving a Category 3 species. No permits will be issued for Category 3 plants to exist in riparian zones.

The following alien invasives and exotic plant species were recorded on the site and surroundings during the surveys as stipulated in the Alien and Invasive Species Regulations (GNR 599 of 2014) (**Table 27**).

According to the amended regulations (No. R280) of March 2001 of the Conservation of Agricultural Resources Act 1983 (Act no. 43 of 1983), it is the legal duty of the land user/landowner to control invasive alien plants occurring on the land under their control.

Table 27: List of Alien Invasive Species Found on Site

Species	Category
Agave sisalana	2
Argemone ochroleuca	1b
Cereus jamacaru	1b
Conyza albida / Conyza bonariensis	1b
Datura stramonium	1b
Eucalyptus camaldulensis	1b
Ipomoea purpurea	1b
Jacaranda mimosifolia	2
Laggera decurrens	1b
Lantana camara	1b
Melia azedarach	1b
Morus alba	2
Nicotiana glauca	1b
Opuntia ficus-indica	1b
Ricinus communis	2

Species	Category
Solanum mauritianum	1b
Tamarisk chinensis	1b
Tecoma stans	1b
Tithonia rotundifolia	1b
Verbena brasiliensis	1b
Xanthium strumarium	1b

Please note that Tharisa has embarked on an annual project for the eradication of Alien Invasive Plants in the surrounding areas. The 2023FY project is focused on the Sterkstroom riverbanks, where alien invasive plants are identified and removed using physical and chemical methods. The project kicked off on 2 August 2023 and will continue until 31 March 2024.

10.7.1.8 MEDICINAL PLANTS

Medicinal plants are an important aspect of the daily lives of many people and an important part of the Southern African cultural heritage. The impact of the proposed TSF 3 WRD Extension 1 on populations of medicinal plants will be very low, although certain plants play an important role in the local culture. The following medicinal plant species occur in the project area (Van Wyk et al., 1997) as indicated in **Table 28**:

Table 28: Medicinal Plant Species and their Habitats in the Project Area

Species	Indigenous / exotic	Status	Habitat of species
Vachellia karroo	Indigenous	Widespread	Riparian woodland / floodplains / old fields on fertile soils
Vachellia tortilis	Indigenous	Widespread	Woodlands on loamy to clayey soils including floodplains / old fields on fertile soils
Datura stramonium	Exotic	Widespread	Old fields / disturbed land
Dichrostachys cinerea	Indigenous	Widespread	Degraded woodland / natural woodland areas on sandy soils
Dombeya rotundifolia	Indigenous	Widespread	Riparian woodland / mountainous areas
Ehretia rigida	Indigenous	Localised	Termitaria / riparian woodland
Grewia bicolor	Indigenous	Widespread	All habitats of area
Gomphocarpus fruticosa	Indigenous	Localised	Along floodplains of rivers / in seasonal zones of rivers
Lippia javanica	Indigenous	Widespread	Old fields / disturbed land
Ricinus communis	Exotic	Widespread	Varied habitats / disturbed land along river courses
Sclerocarya birrea	Indigenous	Widespread	Sandy plains
Vernonia oligocephala	Indigenous	Widespread	Throughout many vegetation units of Savanna Biome
Ziziphus mucronata	Indigenous	Widespread	Riparian woodland / floodplains / old fields on fertile soils

The following recommendations for the site can be made regarding medicinal plants of importance:

- Develop a comprehensive medicinal plant monitoring and evaluation system that uses indicators describing driving forces, states and impacts of key variables. This needs to be implemented at

various levels along the supply and demand chain and will facilitate the early identification of non-sustainable harvesting levels, improved policy, and regulations and law enforcement.

- Promote the substitution of rare and endangered plants with more common alternatives.
- Provide background research for the establishment of an alternative health farm. Specific emphasis should be placed on the traditional use of medicinal plants by various cultural groups.
- Persons collecting plants and animals should have the necessary permits from the relevant provincial department as well as have the permission for such activities from the Management Authority. This should also apply to traditional healers and scientists and general information sessions should be held to educate people of such requirements.

10.7.2 TERRESTRIAL FAUNA

10.7.2.1 FAUNAL HABITATS IN THE PROJECT AREA

The regional fauna has been studied extensively and is known to exhibit many unique features. The area has been settled for many centuries, and the fauna is usually considered impoverished due to the degradation caused by mining activities, built-up land and other man-induced impacts. There are two main faunal habitat types present on the site that might be impacted on by the proposed TSF 3 WRD Extension 1 namely:

- Mixed woodland.
- Degraded grassland.

10.7.2.2 MAMMALS

Species observed on site include Single-striped Mouse, Scrub Hare, Common Mole-rat, Multimammate Mouse and Slender Mongoose. Mine shafts in the vicinity may provide suitable habitat for a few bat species.

Larger mammals that occurred historically at the site have been displaced over many decades as a result of the mining and agricultural activities in the larger areas. This loss of large species means that the mammal diversity on these sites is far from its original natural state not only in terms of species richness but also with regards to functional roles in the ecosystem (AGES, 2023c).

Mammals are sensitive to disturbances and habitat destruction and degradation and as such the anticipated species diversity of the study area would be low. Mining and settlement areas have negated the possibility of encountering any medium to large mammals. The presence of feral dogs and cats as well as poaching activities, poses a threat to the presence of mammals on site. The mammals are mostly represented by generalised species such as rodents, scrub hares and smaller antelope (steenbok, common duiker) that will move through the area while foraging. The proximity of the informal settlements does however place constant pressure on these mammal populations and many of these populations will eventually disappear from the area completely (AGES, 2023c). The natural habitats associated with the area will still support populations of herbivores such as duiker and steenbok. Most of the habitat types are degraded and fragmented, although the habitat that will still be utilised by small mammals, such as rodents, is still intact. Smaller mammal species such as honey badgers and serval can become habituated to anthropogenic influences, while other species will rather move away from the construction activities and will seldom use the area. Many of the bat species of conservation concern in the project area are cave-dependant for roosting or alternatively could inhabit the mine shafts on site. Any individuals that utilise the proposed site would therefore either be foraging or migrating and would not be affected by the localised loss of habitat due to the development of the WRD. The dominant species composition therefore comprises of widespread taxa with unspecialised life history traits (AGES, 2023c).

Most mammal species are highly mobile and will move away during construction. The impact will also be low if one compares the footprint of the development and the overall range of individual species. It is

therefore considered highly unlikely that any mammal species that still occur in the area will be affected negatively by the development of the mining infrastructure, although mitigation measures should be enforced. The connectivity[60] of the project site to the remainder of the larger area is poor due to other developments, roads, agriculture and mining activities. The most important corridors that need to be preserved for free-roaming mammal species in the larger area include the Sterkstroom River. The use of trapping techniques was not deemed necessary due to the degraded state of the natural environment (AGES, 2023c).

10.7.2.3 AVIFUANA (BIRDS)

Two major bird habitat systems were identified within the borders of the project site, including the woodland and degraded grassland.

Most bird species identified within the study area are common species known to nest within or utilise the degraded grassland and woodland habitat in the region and may be either permanently or occasionally present within the study area. According to Birdlife South Africa, the study area falls inside the Magaliesberg Important Bird Area (IBA), although in terms of habitat the site is not typical of the Magaliesberg habitat type for avifauna (AGES, 2023c).

Microphyllous woodland usually supports much higher bird numbers compared to the broadleaved woodlands. The ground cover between the trees consists of mainly short grasses interspersed with shrubs (Barnes, 1998). The plains area where the proposed TSF 3 WRD Extension 1 is planned, represents microphyllous woodland and supports many smaller bird species such as Ashy Tit, Pied Babbler, Kalahari Robin, Burntnecked Eremomela, Desert Barred Warbler, Marico Flycatcher, PriritBatis, Crimsonbreasted Shrike, Longtailed Shrike, Threestreaked Tchagra, Great Sparrow, Whitebrowed Sparrowweaver, Scalyfeathered Finch, Violeteared Waxbill and Blackcheeked Waxbill.

In general terms the open grassland patches in between the microphyllous woodland could attract the Secretarybird, White-bellied Korhaans, and White Stork and Abdim's Stork. However, the proximity to various mining areas and informal settlements means that disturbance levels in these areas are likely to be high due to humans, and hunting by dogs, and therefore the potential to find these species in the area are considered very low. The low reporting for these species is evidence of the impact that the surrounding communities are having on the birds that would, under optimum conditions, inhabit these open areas. The grassland patches are also a favourite foraging area for non-Red Data game birds such as Swainson's Spurfowl and Helmeted Guineafowl. This in turn could attract larger raptors because of both the presence and accessibility of prey. Many habitat generalist species utilise this habitat type predominantly for foraging and hunting purposes. The disturbances of the topsoil layers also very often allow for greater foraging for insectivorous species. The farmland habitat type, however, is not a habitat type that is relied upon by any avifaunal species for survival (AGES, 2023c).

The conservation status of many of the bird species that are dependent on riverine areas reflects the critical status of wetlands or rivers nationally, with many having already been destroyed. The perennial Sterkstroom River is located about 200 meters to the east of the project area and might support avifauna typically found in these habitats.

10.7.2.4 HERPETOFAUNA (REPTILES AND AMPHIBIANS)

There is a potential presence of some toads and sand frogs in the perennial river east of the site, as they only need temporary pools for reproduction and the riverine area may provide suitable habitat. Amphibian species potentially occurring in the area include Common River Frog, Natal Sand Frog, Gutteral Toad,

[60] Connectivity (habitat connectivity) - Allowing for the conservation or maintenance of continuous or connected habitats, to preserve movements and exchanges associated with the habitat.

Raucous Toad and Bubbling Kassina. These species are non-threatened and widespread species, and as such the development will not have any impact on amphibian conservation within the region.

Reptile species such as the Southern Rock Python, the Black Mamba, Puff Adder, Snouted Cobra, Boomslang, Vine Snake, Spotted Bush Snake and several members of the green snakes (*Philothamnus* spp.) is expected to occur in the larger area, although the potential to find these species in the project area is low due to the anthropogenic influences. The general habitat type for reptiles consists of open to very dense bushveld, with limited available habitat for diurnally active and sit-and-wait predators, such as terrestrial skinks and other reptiles. Arboreal species (e.g. Flapnecked Chameleon, agama species, Boomslang) are the more prominent components of the local herpetofauna in the woodland areas outside the fenced mining area.

10.7.2.5 RED DATA SPECIES

According to the existing databases and the field survey the following number of fauna species included in the International Union for Conservation of Nature (IUCN) red data lists can potentially be found in the project area (**Table 29**):

Table 29: Red Data List of Potential Fauna for the Project Area

English Name	Conservation Status	Probability of occurrence
MAMMALS		
Brown Hyena	Near Threatened	Low
Serval	Near Threatened	Low
Tsessebe	Vulnerable	Zero – restricted to game reserves
Sable antelope	Vulnerable	Zero – restricted to game reserves
Leopard	Vulnerable	Low
BIRDS		
Korhaan, Southern Black	Vulnerable	Low
Kingfisher, Half-collared	Near Threatened	Low
Eagle, Tawny	Endangered	Medium
Eagle, Verreauxs'	Vulnerable	Low
Stork, Abdim's	Near Threatened	Low
Stork, Black	Vulnerable	Low
Roller, European	Near Threatened	Medium
Korhaan, White-bellied	Vulnerable	Low
Falcon, Lanner	Vulnerable	Low
Vulture, White-backed	Endangered	Low
Vulture, Cape	Endangered	Low
Duck, Maccoa	Near Threatened	Low
Eagle, Martial	Endangered	Low
Secretarybird	Vulnerable	Low
Owl, African Grass	Vulnerable	Low
HERPETOFAUNA		
Crocodile	Vulnerable	Low

10.7.2.6 DFFE ENVIRONMENTAL SCREENING TOOL LISTED SPECIES

Table 30 indicates the listed species for the project area according to the Environmental Screening Tool:

Table 30: Listed Mammal Species for the Project Area According to the Environmental Screening Tool, Status and Habitat

Species	Status	Habitat
Crocidura maquassiensis	Vulnerable	Riparian woodland and open water (reedbeds) – Sterkstroom River only habitat in the area
Dasymus robertsi (African Marsh Rat)	Vulnerable	Riparian woodland and open water (reedbeds) – Sterkstroom River only habitat in the area

Crocidura maquassiensis

This is a rare species endemic to South Africa, Swaziland and Zimbabwe, existing in moist grassland habitats in the Savannah and Grassland biomes. Little is known about the habitats and ecology of this species. Specimens have been found on rocky or montane grassland, such as recently in the Soutpansberg Mountains (Taylor et al., 2015). The main threats to shrews are the loss or degradation of moist, productive areas such as wetlands and rank grasslands within suitable habitat.

Probability of occurrence on site: LOW due to no suitable habitat occurring in the project area.

Probability of impact during vegetation clearance: LOW, due to no suitable habitat observed on site. No population of the species was documented.

Dasymus robertsi

The African marsh rat have been recorded from a wide variety of habitats, including forest and savannah, swampland and grasslands, but they rely on intact wetlands in these areas. They have not been recorded from agricultural landscapes or dam areas and considering this aspect the probability of finding this species on the proposed TSF 3 WRD Extension 1 footprint areas is considered very low, although it might occur in the reedbeds of the Sterkstroom River system.

Probability of occurrence on site: LOW due to no suitable habitat occurring in the project area.

Probability of impact during vegetation clearance: LOW, due to no suitable habitat observed on site. No population of the species was documented.

10.7.3 ECOLOGICAL SENSITIVITY

Following the ecological surveys, the classification of the study area into different sensitivity classes and development zones was based on information collected at various levels on different environmental characteristics. Factors which determined sensitivity classes were as follows:

- Presence, density and potential impact of development on rare, endemic and protected plant species.
- Conservation status of vegetation units.
- Soil types, soil depth and soil clay content.
- Previous land-use.
- State of the vegetation in general as indicated by indicator species.

Below included is the sensitivity map for the proposed TSF 3 WRD Extension 1 development, (**Figure 43**). Only criteria applicable to the specific vegetation units were used to determine the sensitivity of the specific unit. Specific mitigation should be implemented in the natural woodland areas with protected trees (licence application).

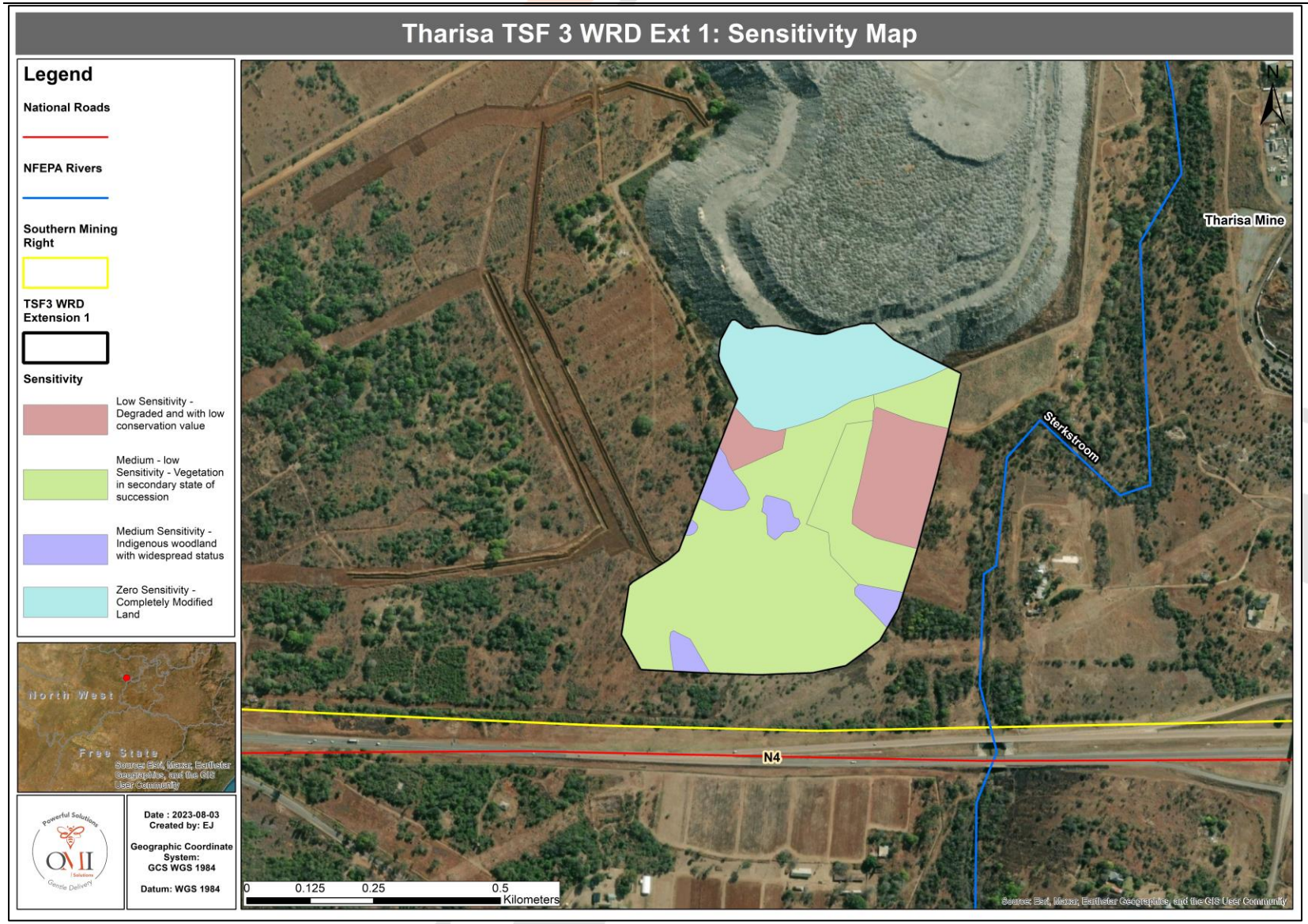


Figure 43: Ecological Sensitivity Map of the Project Area

10.8 VISUAL LANDSCAPE

10.8.1 LANDSCAPE CHARACTER

The landscape character of the study is therefore dominated by mining infrastructure as indicated in **Figure 44**. Mining activities occur to the North, and immediate west and East of Tharisa Mine. Amongst the mining activities North of the mine is open land mostly owned by mining companies and the community of Marikana. North of the project site, in the MR area, is the Mmaditlhokwa community, and East of the MR area is the Bokamoso community.

The development of the TSF 3 WRD Extension 1, which is immediately adjacent to an approved TSF (TSF 3) and the existing West WRD 1, will not cause a major change to the existing character of the landscape.

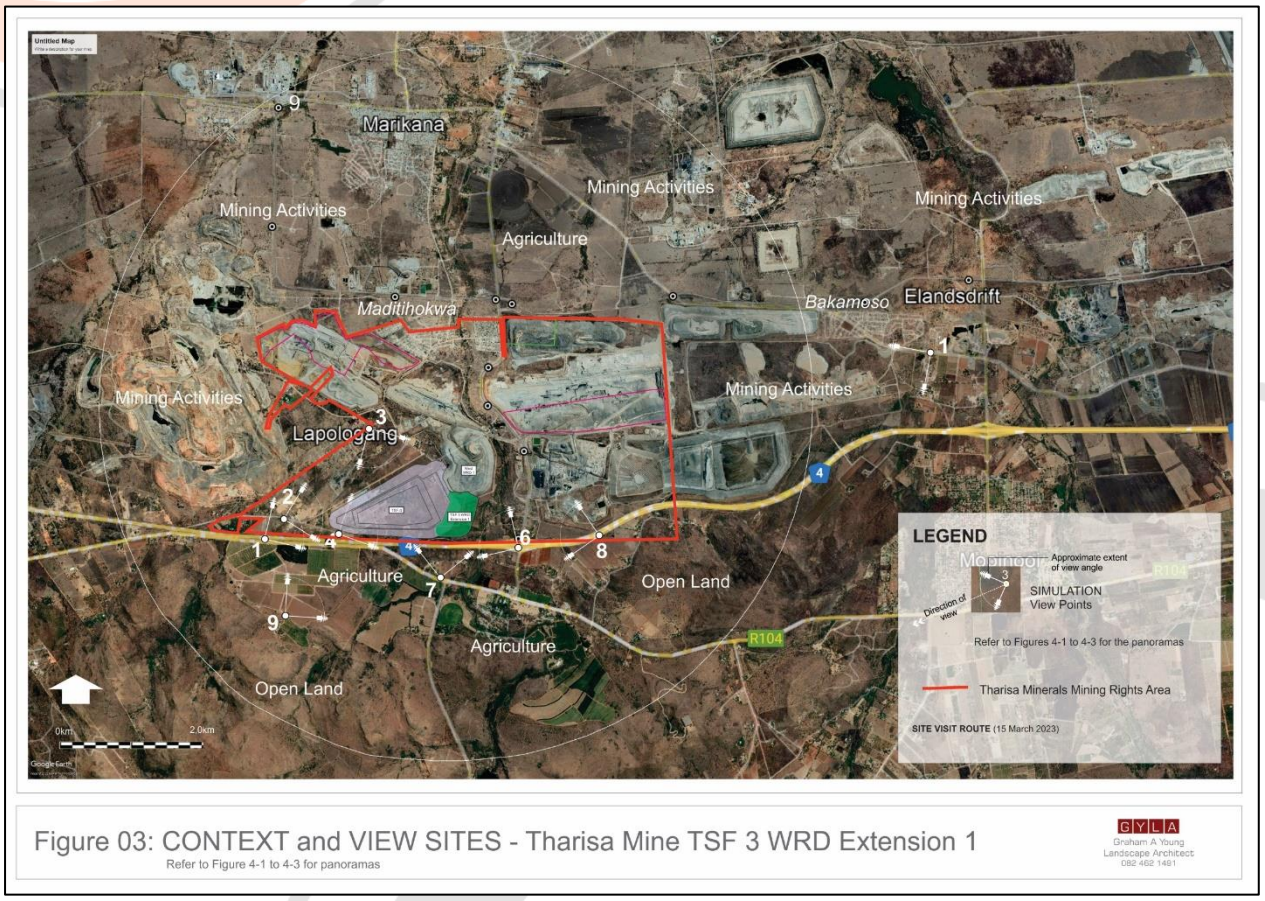


Figure 44: Tharisa TSF3 WRD Extension 1 Surrounding Land Use and View Sites

10.8.2 VISUAL RESOURCE AND SENSE OF PLACE

Whilst areas immediately south of the project site are associated with the natural hills which have visual appeal and exhibit positive character, any long view towards the proposed TSF 3 WRD Extension 1 (i.e. beyond the immediate surrounds of a residential/tourist property) from within these areas would be dominated by mining activities. **Table 31** summarises the value of the visual resource of the project area within the context of the sub-region.

Table 31: Value of the Visual Resource for the Project Area

High	Moderate	Low
None	General for the areas South of the N4 associated with the foothills of the Magaliesberg	General for the MR area and the study area surrounding the mine on its North, West and East
This landscape type is considered to have a *high* value because it is a: A distinct landscape that exhibits an extremely positive character with valued features that combine to give the experience of unity, richness, and harmony. It is a landscape that may be of particular importance to conserve, and which has a strong sense of place. Sensitivity: It is sensitive to change in general and will be detrimentally affected if the change is inappropriately dealt with.	This landscape type is considered to have a *moderate* value because it is a: A common landscape that exhibits some positive character, but which has evidence of alteration/ degradation/ erosion of features resulting in areas of more mixed character. Sensitivity: It is potentially sensitive to change in general and change may be detrimental if inappropriately dealt with	This landscape type is considered to have a *low* value because it is a: Minimal landscape, negative with few, if any, valued features. Sensitivity: It is not sensitive to change in general and scope for positive enhancement frequently occurs

Overall, the proposed TSF 3 WRD Extension 1 occurs in a landscape rated primarily low in visual resource value.

The combination of the mining, agricultural, open land and communities, create the sense of place for the study area. Mining activities dominate the sub-region resulting in a landscape that exhibits little positive character, and which has been deformed from its original natural features. The resultant sense of place is weak and of mixed character.

10.8.3 SENSITIVE VIEWERS AND LOCATIONS

Figure 45 identifies receptor locations potentially vulnerable to changes in the landscape caused by the physical presence of the proposed TSF 3 WRD Extension 1. The primary areas of concern are:

- Residential properties (farm and homesteads) South of the project site
- Residential communities in the MR area and West of the project site, and
- Travellers along the N4 National Road (not likely to be sensitive due to the context of the sub-region).

These sensitive viewing locations are indicated in **Figure 45**. In the worst-case scenario, people living and visiting properties immediately adjacent the existing mine will experience changes to views, notably due to the growing scale and extent of the TSF 3 WRD Extension 1.

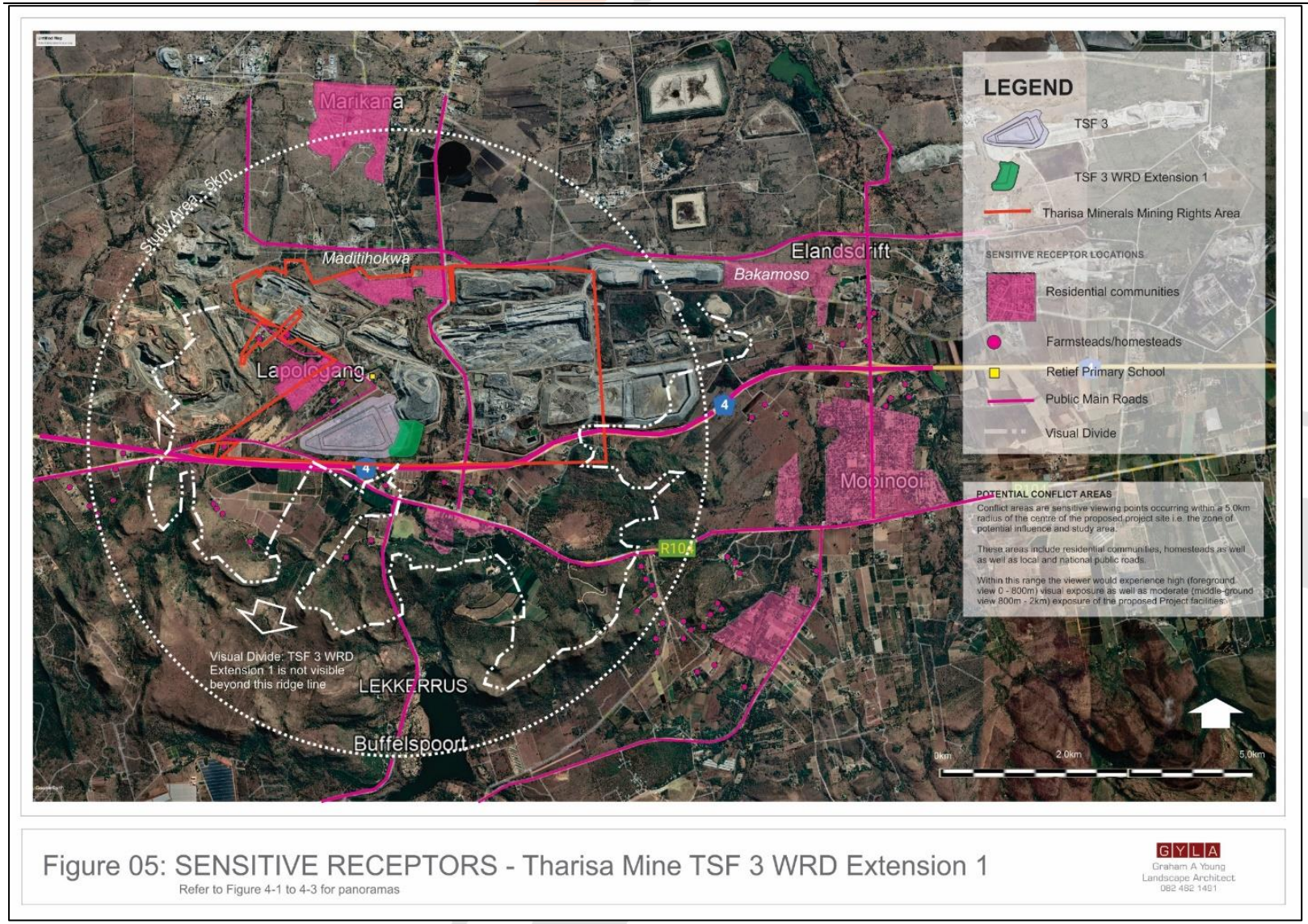


Figure 05: SENSITIVE RECEPTORS - Tharisa Mine TSF 3 WRD Extension 1

Refer to Figure 4-1 to 4-3 for panoramas

GYLA
Graham A Young
Landscape Architect
082 492 1491

Figure 45: Tharisa Mine TSF 3 WRD Extension 1 Visual Sensitive Receptors

10.8.4 VISIBILITY, VISUAL EXPOSURE AND VISUAL INTRUSION

10.8.4.1 VISIBILITY

The proposed TSF 3 WRD Extension 1 is potentially visible to people living South of the site, within a 5 km radius of it and along the N4 and local roads. However, due to the high Visual Absorption Capacity (VAC) of the existing and future mining activities, views to the proposed TSF 3 WRD Extension 1 will be experienced along with other mining activities of equal scale and bulk (specifically the TSF 3 and the West WRD 1) i.e. visibility will not increase *per se*, rather the height and bulk of what is seen would increase slightly.

10.8.4.2 VISUAL EXPOSURE

Due to visual exposure, residential properties South of the proposed TSF 3 WRD Extension 1 would experience a growing WRD. However, this exposure would be no greater than what would occur from the TSF 3 and existing West WRD 1, immediately West and north of the site.

10.8.4.3 VISUAL INTRUSION

Visual intrusion deals with contextualism, i.e. how well does a project activity fit with or disrupt/ enhance the ecological and cultural aesthetic of the landscape as a whole?

The proposed TSF 3 WRD Extension 1 project will appear in foreground and middle-ground of views from areas to the West, South and East of the project site and be moderately intrusive. Visual intrusion is however diminished considerably, specifically as it must be assessed against the approved TSF 3, which has a similar height and bulk as the proposed TSF 3 WRD Extension 1.

Table 32: Visual Intrusion

HIGH INTRUSION	MODERATE INTRUSION	LOW INTRUSION For all sensitive viewing areas within the study area
The Project would: • Have a substantial negative effect on the visual quality (sense of place) of the landscape relative to the baseline landscape. • Contrast dramatically with the patterns or elements that define the structure of the landscape.	The Project would: • Have a moderate negative effect on the visual quality and sense of place of the landscape. • Contrast with the current patterns or elements that define the structure of the landscape.	The Project would: • Have a minimal to insignificant effect on the visual quality and sense of place of the landscape. • Contrasts minimally with the patterns or cultural elements that define the structure of the landscape.
RESULT: An intensive change over a localized area resulting in major changes in key views.	*RESULT:* Moderate change in landscape characteristics over localized area resulting in a moderate change to key views.	*RESULT:* Minimal to insignificant change resulting in a minor change to key views sensitive viewing areas.

10.9 AIR QUALITY BASELINE

10.9.1 AIR QUALITY SENSITIVE RECEPTORS

The closest residential developments to Tharisa Mine and the proposed TSF 3 WRD Extension 1 consist of the Mmaditlhokwa and Lapologang communities, with the town of Marikana approximately 1.5 km to the North of the MR boundary. Individual farmsteads also surround the project area (**Figure 46** as identified from Google Earth). The location of selected sensitive receptors (individual homesteads) that have the potential to be impacted by the project have been provided in **Table 33**.

Table 33: Nearest Air Quality Sensitive Receptors (AQSR) in the Vicinity of the Mine

Receptor	Easting	Northing
AQSR1	25°43'56.58" S	27°27'31.47" E
AQSR2	25°44'01.67" S	27°27'29.85" E
AQSR3 (Wolvaardt Residence)	25°43'59.08" S	27°27'45.26" E
AQSR4 (van der Hoven Residence)	25°44'01.20" S	27°27'44.10" E
AQSR5 (Retief Primary School)	25°44'20.70" S	27°28'36.02" E
AQSR6 (Pretorius Residence)	25°44'23.72" S	27°28'17.35" E
AQSR7 (du Preez Residence)	25°44'31.14" S	27°28'13.41" E
AQSR14	25°44'55.45" S	27°27'10.91" E
AQSR15	25°45'00.53" S	27°27'11.63" E
AQSR16	25°44'59.07" S	27°27'03.69" E
AQSR17	25°44'59.51" S	27°26'58.78" E
AQSR18	25°44'55.71" S	27°26'56.19" E
AQSR19	25°45'11.56" S	27°26'58.59" E
AQSR20	25°45'03.36" S	27°26'43.85" E
AQSR21	25°45'02.97" S	27°26'33.10" E
AQSR22	25°44'48.19" S	27°26'22.77" E
AQSR23	25°45'04.49" S	27°26'22.60" E
AQSR24	25°45'00.28" S	27°26'13.00" E
AQSR25	25°45'07.92" S	27°26'07.43" E
AQSR26	25°45'16.99" S	27°26'14.70" E
AQSR27	25°45'23.14" S	27°26'06.55" E
AQSR28	25°45'20.38" S	27°28'27.15" E
AQSR29	25°45'17.14" S	27°28'45.59" E
AQSR30	25°45'13.71" S	27°29'00.99" E
AQSR31	25°44'57.59" S	27°29'13.07" E
AQSR32	25°45'13.65" S	27°29'18.04" E
AQSR33	25°44'57.76" S	27°29'26.85" E
AQSR34 (Potgieter Residence)	25°45'01.54" S	27°29'35.04" E
AQSR35	25°45'19.31" S	27°29'33.01" E
AQSR36	25°45'17.58" S	27°29'43.51" E
AQSR37	25°45'12.25" S	27°29'56.34" E
AQSR38	25°45'23.00" S	27°30'08.07" E
AQSR39	25°45'12.37" S	27°30'23.43" E
AQSR40	25°44'58.18" S	27°30'28.74" E
AQSR41	25°44'51.59" S	27°30'38.53" E
AQSR42	25°44'57.06" S	27°30'47.42" E
AQSR43	25°44'55.34" S	27°30'55.36" E
AQSR44	25°45'21.11" S	27°31'05.52" E
AQSR45	25°43'08.70" S	27°29'01.42" E

Receptor	Easting	Northing
AQSR46	25°42'18.33" S	27°29'07.99" E
AQSR47	25°42'38.48" S	27°29'56.16" E
AQSR48 (Lonmin Training Centre)	25°42'31.63" S	27°31'20.42" E

10.9.2 EXISTING SOURCES OF EMISSIONS NEAR THE PROJECT SITE

Mining and processing activities, farming and residential land-uses occur in the region. These land-uses contribute to baseline pollutant concentrations via vehicle tailpipe emissions, household fuel combustion, biomass burning and various fugitive dust sources. Long-range transport of particulates, emitted from remote tall stacks and from large-scale biomass burning in countries to the north of South Africa, has been found to contribute to background fine particulate concentrations within the South African boundary (Andreae, et al., 1998; Garstang et al.,1996; Piketh et al.,1996). The following existing sources of emissions occur near the project site:

- Mining and Industrial Operations;
- Agricultural operations;
- Unpaved roads;
- Vehicles tailpipe emissions;
- Household fuel burning; and
- Crop burning and wildfires.

Figure 46: Air Quality Sensitive Receptors in the Vicinity of the Tharisa Mine

10.9.3 LOCAL AIR QUALITY

It is expected that various local and far-a-field sources are expected to contribute to ambient concentrations in the region. Local sources include wind erosion from exposed areas, fugitive dust from agricultural activities and mining activities, vehicles on roadways and veld burning.

Particulates represent the main pollutant of concern in the assessment of mining operations. The particulates in the atmosphere may contribute to visibility reduction, pose a threat to human health, or simply be a nuisance due to their soiling potential.

Tharisa Mine has a dustfall monitoring network in place and does passive sampling of NO_2 and SO_2. Monthly dust fallout monitoring is carried out at 14 locations around the mine. The monitoring locations can be seen in **Table 33** and **Figure 47**. Data analysed for the ambient air quality is limited to the period January to March 2021 (passive sampling) and January 2021 to April 2023 (dustfall). Both NO_2 and SO_2 are screened against the National Ambient Air Quality Standards (NAAQS) while dustfall is screened against the National Dust Control Regulations (NDCR).

It should be noted that the ambient measurements account for all emission contributions in the region, not just the mine.

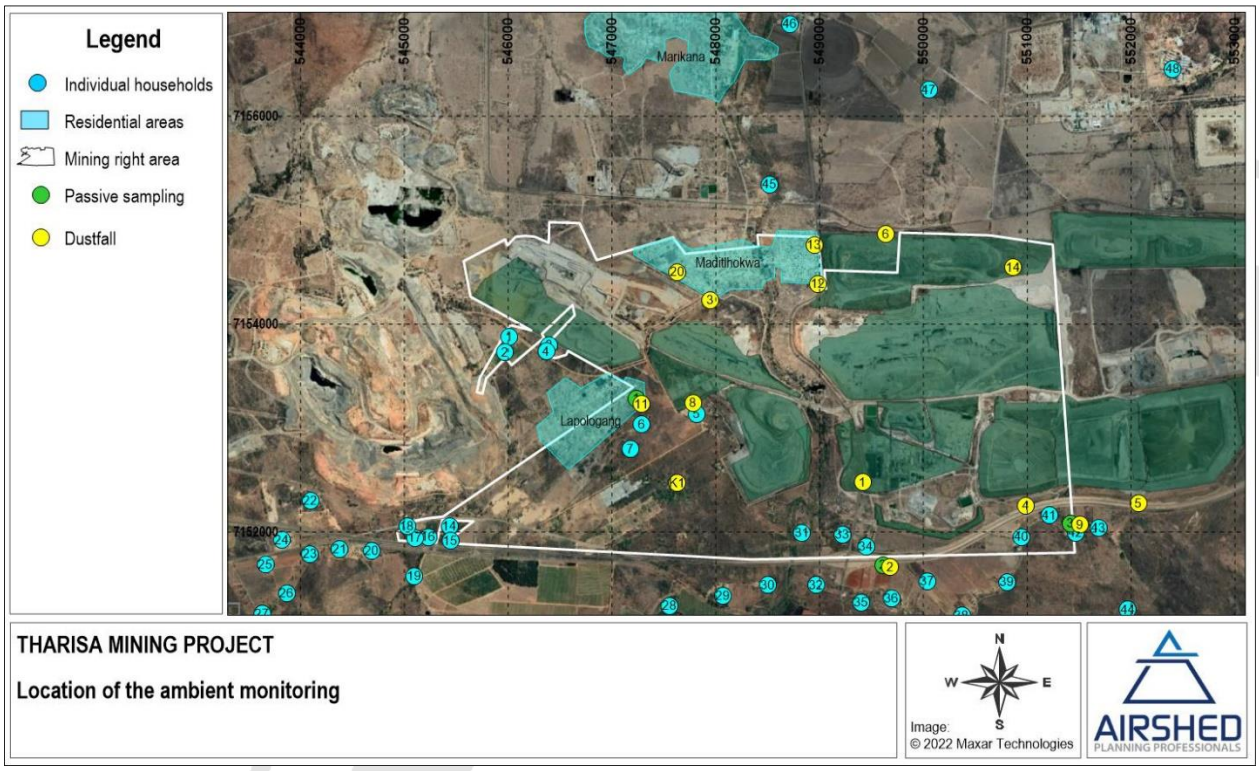


Figure 47: Tharisa Mine Ambient Monitoring Locations (Airshed, 2023a)

10.9.3.1 AMBIENT NO_2 AND SO_2 CONCENTRATIONS

The current monitoring network comprises of three radiello® passive monitors for NO_2 and SO_2. The results of the NO_2 and SO_2 monitoring for the periods January to March 2021 are represented in **Table 34**.

While you may not validly compare the NO_2 and SO_2 results obtained to the annual standard unless you continuously sampled for a year and obtained an average, the radiello® passives technique provides an indication of possible high incidences of NO_2 and SO_2 levels at Tharisa Mine. Results obtained for NO_2 and SO_2 for the months in review were well below the NAAQS.

Table 34: Summary of NO_2 and SO_2 concentrations for 2021

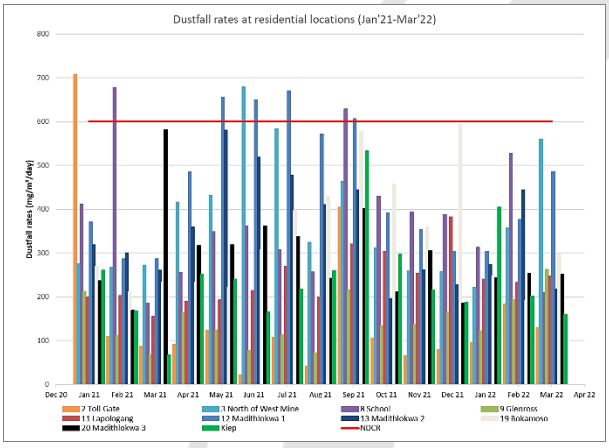
Ambient Air Quality Parameter	Station	Jan 2021 (µg/m³)	Jan 2021 (µg/m³)	Jan 2021 (µg/m³)	NAAQS Annual (µg/m³)
NO_2 Concentrations	Lapologang	5	3.7	7.1	40
	Swanepoel	2.3	5.4	10.6	40
	Glenross farmhouse	4.6	2.2	0.7	40
SO_2 Concentrations	Lapologang	0.3	1.1	1.1	50
	Swanepoel	1.4	0.3	3.9	505
	Glenross farmhouse	0.7	0.9	1.6	50

10.9.3.2 DUSTFALL MONITORING NETWORK

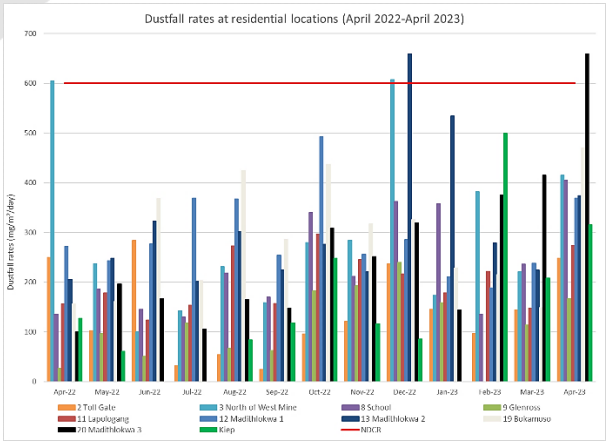
The latest results were taken from the available dustfall monitoring reports which included 15 single dust buckets at and around Tharisa Mine (**Figure 47**). Aquatico currently performs the dustfall sampling.

From the results of the monitoring period January 2021 – March 2022 (se **Figure 48 A**), it was found that dustfall at Sites 2 (toll gate),3 (North of West Open Pit), 8 (school) and 12 (Mmaditlhokwa 1) exceeded the NDCR for residential areas (exceed 600 mg/m²/day). The NDCR allow for a permitted frequency of exceeding the dustfall rate of two exceedances within a calendar year (not sequential months). Mmaditlhokwa 1 exceeded the NDCR four times during the 2021 year (with three sequential months during May, June and July) and is therefore not compliant. For the monitoring period April 2022-April 2023 (**Figure 48 B**) the NDCR for residential areas is exceeded at Site 3 (North of West Open Pit), 13 (Mmaditlhokwa 2) and 20 (Mmaditlhokwa 3) but were within the permitted frequency of exceedances within a year. All sequential non-compliances exceedances were communicated to relevant departments as incidents and all applicable documentation in this regard were provided to the authorities.

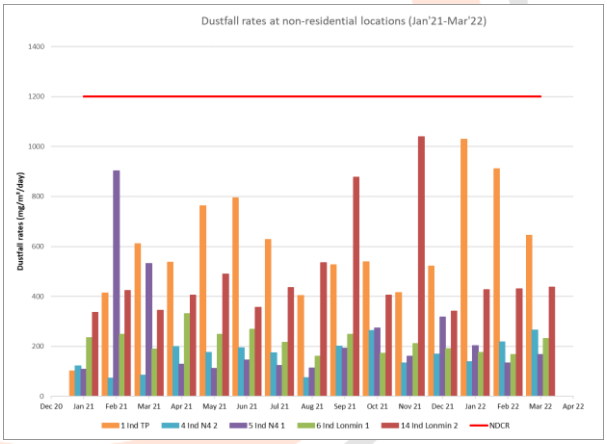
The results for the monitoring campaigns at non-residential locations are shown in **Figure 48 C** (January 2021-March 2022) and **Figure 48 D** (April 2022-April 2023). The NDCR for non-industrial areas (exceed 1200 mg/m²/day) was not exceeded in either of the two campaigns.



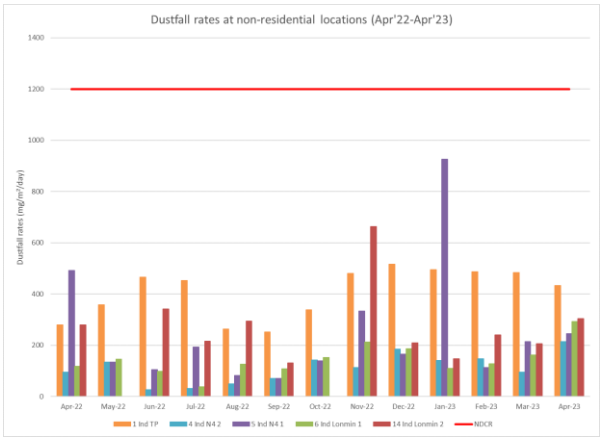
A: Results of the dustfall monitoring campaign – residential locations (January 2021-March 2022)



B: Results of the dustfall monitoring campaign – residential locations (April 2022-April 2023)



C: Results of the dustfall monitoring campaign – non-residential locations (January 2021-March 2022)



D: Results of the dustfall monitoring campaign – non-residential locations (April 2022-April 2023)

Figure 48: Results of the Dustfall Monitoring Campaign for Non-residential and Residential Locations (January 2021-April 2023)

10.9.4 CURRENT MINING AND PROCESS EMISSIONS

Activities during the operational phases of the proposed TSF 3 WRD Extension 1 likely to result in pollutants to air are shown in **Table 35**.

Table 35: Potential Sources of Air Emissions and Impacts Associated with Current Tharisa Mine Activities

Activity	Associated pollutants	
Open pit mining – East Pit; West Pit & Far West Pit	Blasting – intermittent source of emissions	PM; SO_2; NOx; CO; CO_2
	Drilling	PM; SO_2; NOx; CO; CO_2
	Excavation of ore and waste rock	Mostly PM, gaseous emissions from mining equipment (PM; SO_2; NOx; CO; CO_2)
	Loading of ore and waste rock onto trucks	Mostly PM, gaseous emissions from haul truck exhaust (PM; SO_2; NOx; CO; CO_2)
Haulage of ore and waste rock	Ore from pits to Run of Mine (ROM) stockpiles and from ROM stockpiles to crusher plants (Voyager and Genesis)	PM from road surfaces and windblown dust from trucks, gaseous emissions from truck exhaust (PM, SO_2; NOx; CO; CO_2)
	Waste rock from pits to WRDs[(a)]	
Off-loading of ore and waste rock	Ore at ROM stockpiles and at crusher plants (Voyager and Genesis)	Mostly PM, gaseous emissions from haul truck exhaust (PM, SO_2; NOx; CO; CO_2)
	Waste rock at WRDs[(a)]	
Wind erosion	From exposed WRD[(b)]- ROM & TSF surfaces	Mostly PM, gaseous emissions from mining equipment (PM; SO_2; NOx; CO; CO_2)
Processing Plants - Voyager and Genesis	Crushing, screening, milling	Mostly PM, gaseous emissions from machinery (PM, SO_2; NOx; CO; CO_2)
	Dense Media Separation (DMS) at the chrome plant	PM; SO_2; NOx; CO; CO_2

Notes: (a) Far East WRD1; Far West WRD2; West WRD 1; West WRD 2; TSF

(b) Far East WRD1; Far West WRD2; West WRD 1; West WRD 2; TSF; East WRD1; Topsoil Berm

Pollutants with the potential to result in human health impacts which are assessed in this study include PM2.5 and PM10. Dustfall is assessed for its nuisance potential. Results are primarily provided in the form of isopleths to present areas of exceedance of assessment criteria.

PM10

The simulated highest daily and annual average PM10 concentrations for the current operations are provided in **Figure 49** and **Figure 50** (current – mitigated).

Simulated PM10 daily ground level concentrations (GLCs), with current mitigation measures in place, are in non-compliance with the NAAQS over a portion of the Mmaditlhokwa community and to the north-east of the mining rights boundary, but at no other AQSRs (**Figure 49**). The simulated number of exceedances of the daily PM10 NAAQS at Mmaditlhokwa Community are 41 with a single exceedance at AQSR33 and AQSR34 (Potgieter Residence). Over an annual average the ground level concentrations (GLCs) are within the NAAQS at all AQSRs, except at Mmaditlhokwa Community with an annual average of 40.5 µg/m³ just over the NAAQS (and **Figure 50**).

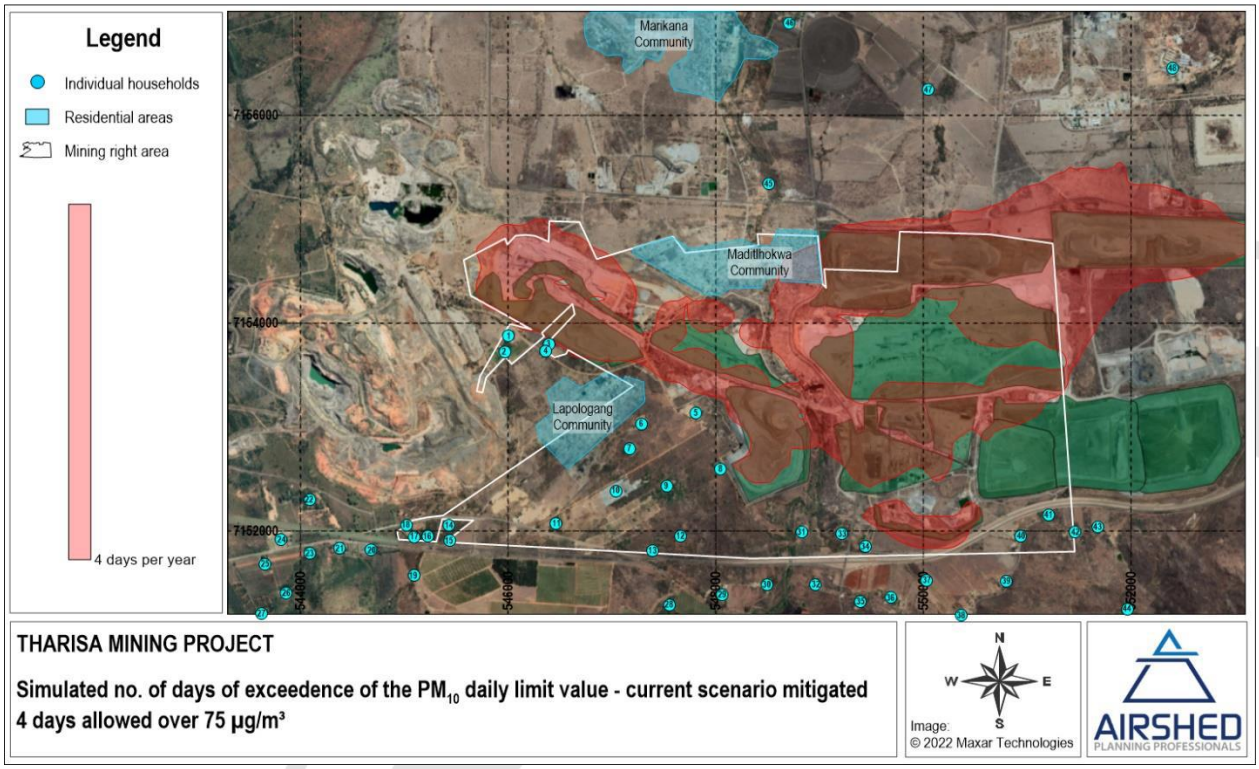


Figure 49: Current Scenario – Area of Non-Compliance of Daily PM10 NAAQS (mitigated)

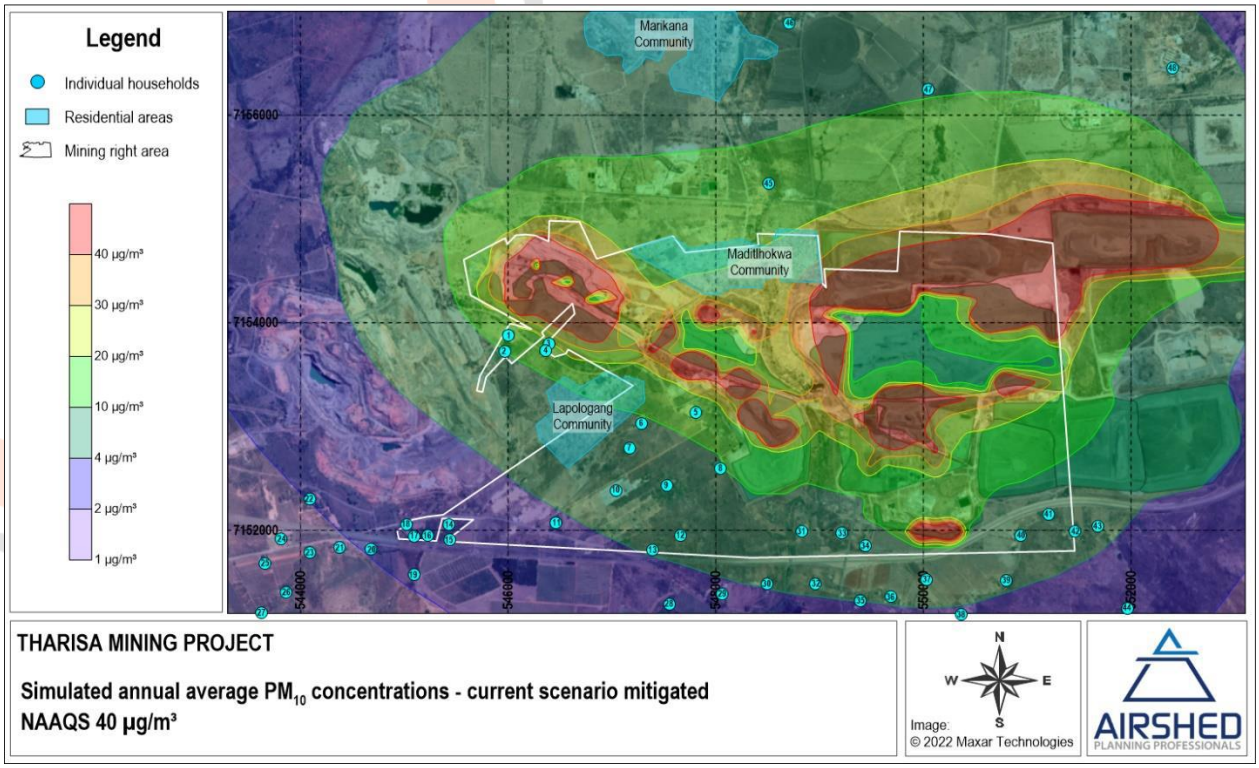


Figure 50: Current Scenario – Area of Non-Compliance of Annual PM10 NAAQS (mitigated)

PM2.5

The simulated highest daily and annual average PM2.5 concentrations for the current operations are provided in **Figure 51** and **Figure 52** (current – mitigated), with the GLCs at each of the AQSRs provided in Table 12 for the current operations of the Air Quality Impact Assessment.

Simulated PM2.5 daily GLCs, with current mitigation measures in place, are in non-compliance with the NAAQS for an area to the North East of the mining rights boundary (mostly over the far east WRD), but not at any AQSRs (**Figure 51**). Over an annual average the GLCs are within the NAAQS at all AQSRs (**Figure 52**).

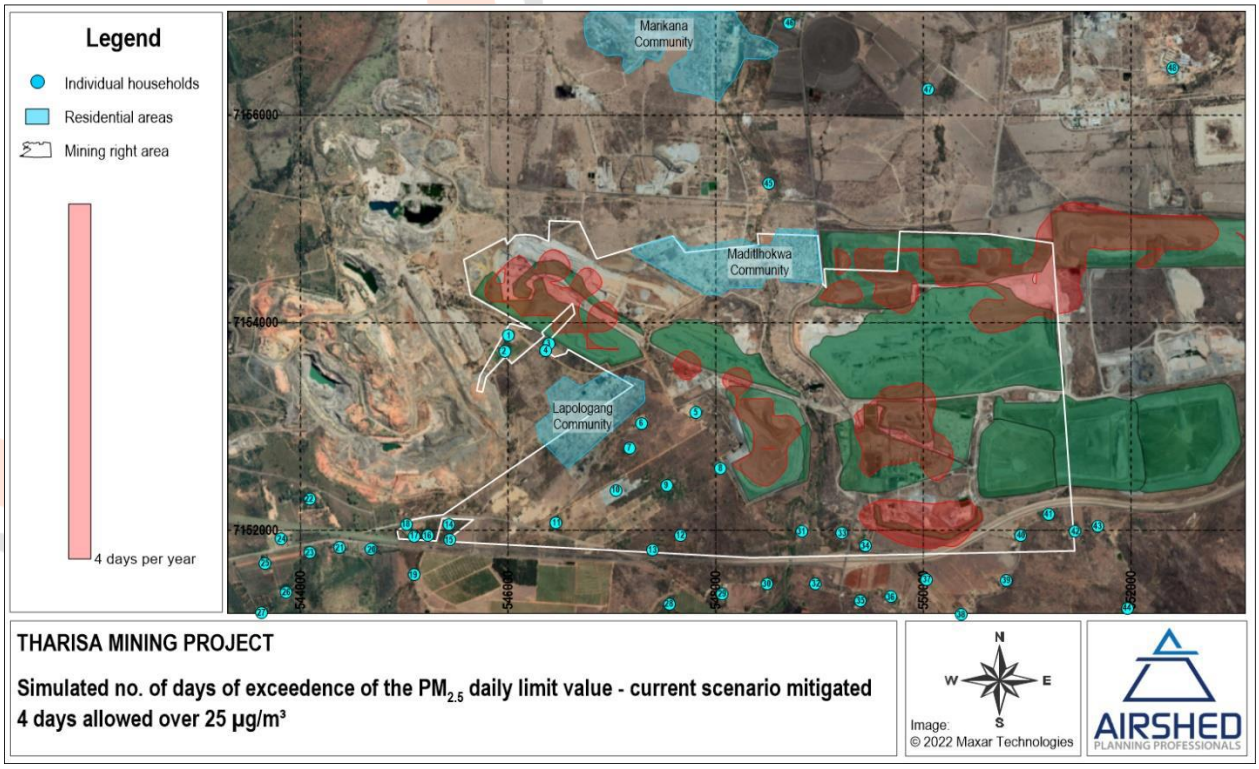


Figure 51: Current scenario – Area of Non-Compliance of Daily PM2.5 NAAQS (mitigated)

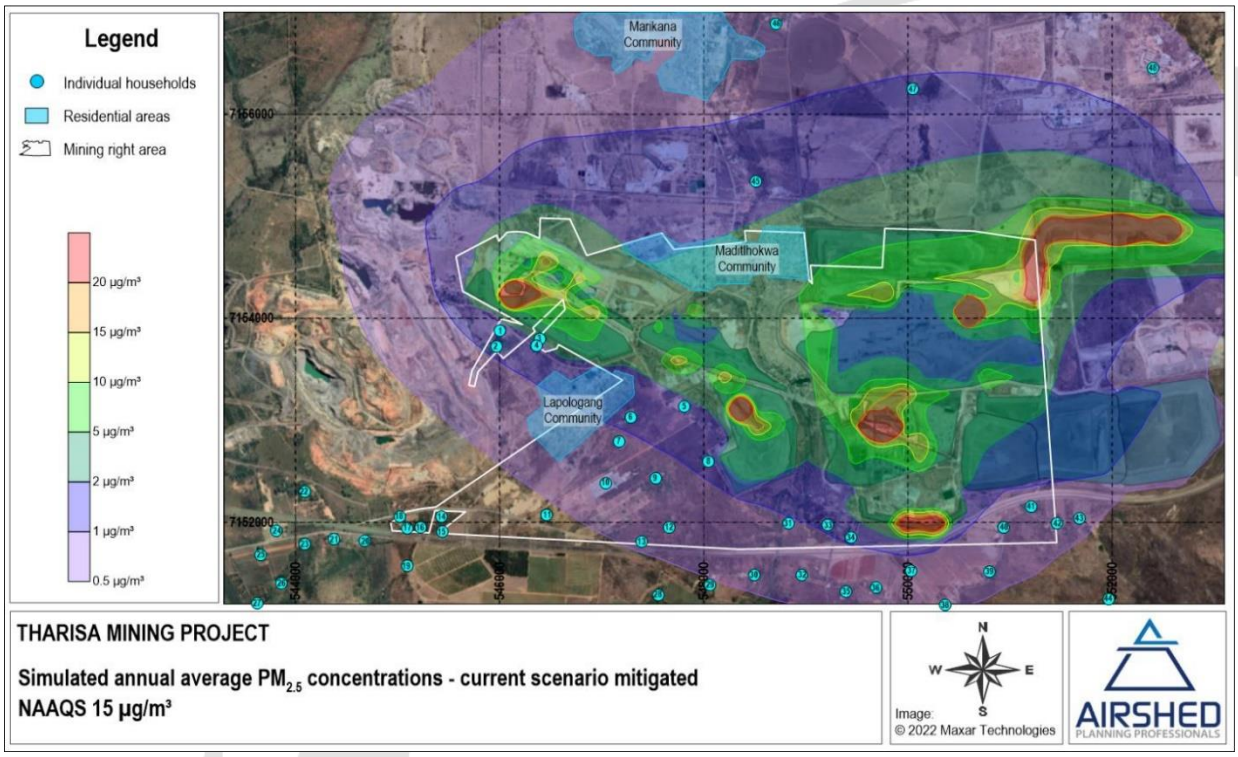


Figure 52: Current scenario – Area of Non-Compliance of Annual PM2.5 NAAQS (mitigated

Dust Fallout

The simulated maximum daily dustfall rates for the current operations is provided in **Figure 53**. Simulated maximum daily dustfall rates for current mitigated operations are within the NDCR non-residential limit (1 200 mg/m²/day) and the residential limit (600 mg/m²/day) at all the AQSRs (**Figure 53**).

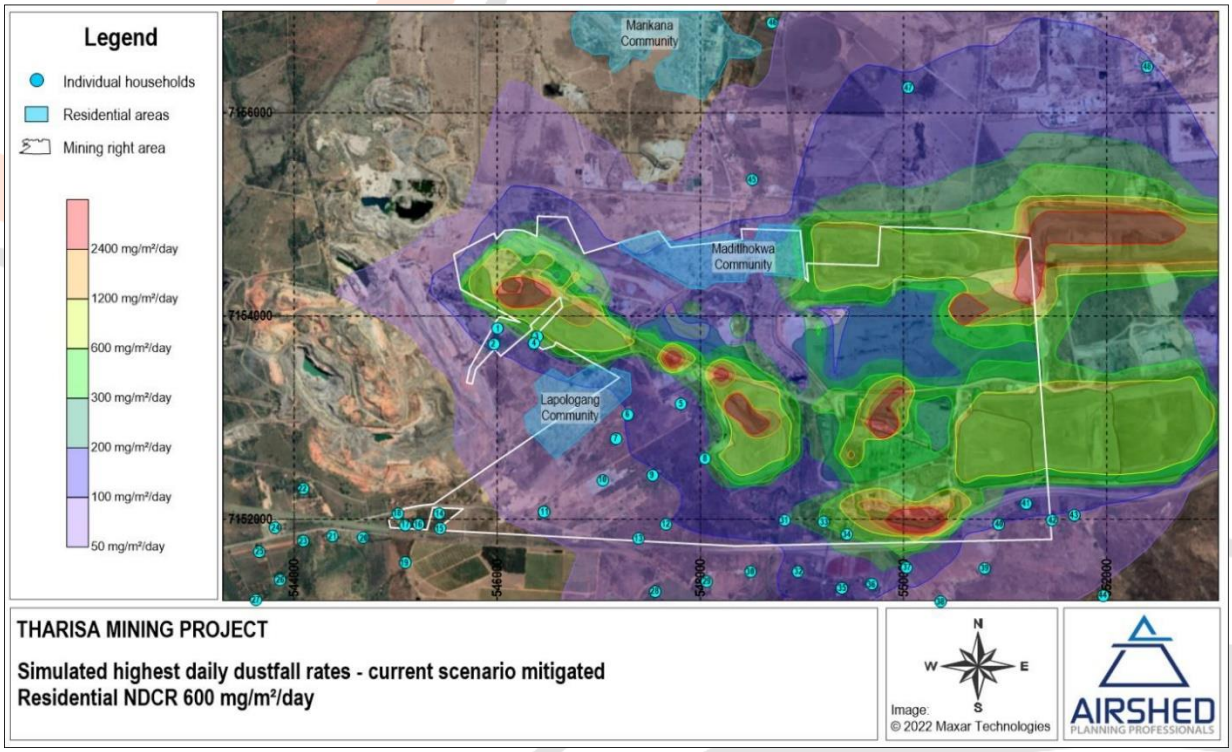


Figure 53: Current Scenario – Area of Non-Compliance with Monthly Dustfall NDCR (mitigated

Metals

ICP (Inductively Coupled Plasma) Spectroscopy[61] for 42 elements was conducted on the three composite samples from the waste rock, the tailings, and the road surfaces. Only toxic metals that had a content above the detection limit were included in the assessment. The highest metal content from the three samples were applied to the PM10 simulated dust concentrations and screened against the most stringent RfC to determine the potential for health impacts. The metals with RfCs guideline values include aluminium (Al), barium (Ba), chromium (VI)(particulates), copper (Cu), iron (Fe), manganese (Mn), and nickel (Ni). Only barium (Ba) and nickel (as soluble salts) have sub-chronic RfCs and these were applied to the daily (24-hour) modelled PM10 concentrations for all three scenarios. Al, Ba, CrVI, Mn and Ni all have chronic inhalation RfCs which were applied to the annual average PM10 concentrations for all three scenarios. The hazard quotient (HQ) was below 1 for all the metals evaluated, implying that adverse non-cancer effects are unlikely to occur due to exposure from these elements.

The Excess Lifetime Cancer Risk are listed in **Table 36**. The CrVI content in the simulated PM10 concentrations have a potential Moderate risk, with a Low risk associated with iron and a Very Low risk to nickel.

[61] ICP Spectroscopy is an analytical technique used to measure and identify elements within a sample matrix based on the ionization of the elements withing the sample.

Table 36: Excess Lifetime Cancer Risk Calculated at All Identified AQSR From the Simulated PM10 Annual Average Concentrations Due to Current Operations (Mitigated) and Future Project Operations (Unmitigated and Mitigated)

Metals	Current Operations (mitigated)
Chromium (CrVI)[(a)]	5.1 in 10 000
Iron (Fe)	2.9 in 1 000 000
Nickel (Ni)	3.3 in 10 million

Risk Ration by colour	*Very Low*	*Low*	*Moderate*	*High*	*Very High*

Notes: (a) Assumed all chromium is hexavalent chrome which is an overly conservative assumption.

10.10 NOISE BASELINE

10.10.1 NOISE SENSITIVE RECEPTORS

Noise sensitive receptors generally include places of residence and areas where members of the public may be affected by noise generated by mining, processing and transport activities. The impact of an intruding industrial/mining noise on the environment rarely extends over more than 5 km from the source. The closest residential developments to the proposed TSF 3 WRD Extension 1 consist of the Mmaditlhokwa and Lapologang communities. Individual farmsteads also surround the project area (**Figure 54** as identified from Google Earth). The location of selected sensitive receptors (individual homesteads) that have the potential to be impacted by the project have been provided in **Table 37.**

Table 37: The Location of Individual Noise Sensitive Receptors (NSR) Within the Project Area

Receptor	Easting	Northing
NSR1	25°43'56.58" S	27°27'31.47" E
NSR2	25°44'01.67" S	27°27'29.85" E
NSR R3 (Wolvaardt Residence)	25°43'59.08" S	27°27'45.26" E
NSR 4 (van der Hoven Residence)	25°44'01.20" S	27°27'44.10" E
NSR5 (Retief Primary School)	25°44'20.70" S	27°28'36.02" E
NSR6 (Pretorius Residence)	25°44'23.72" S	27°28'17.35" E
NSR7 (du Preez Residence)	25°44'31.14" S	27°28'13.41" E
NSR14	25°44'55.45" S	27°27'10.91" E
NSR15	25°45'00.53" S	27°27'11.63" E
NSR16	25°44'59.07" S	27°27'03.69" E
AQSR17	25°44'59.51" S	27°26'58.78" E
NSR18	25°44'55.71" S	27°26'56.19" E
NSR19	25°45'11.56" S	27°26'58.59" E
NSR20	25°45'03.36" S	27°26'43.85" E
NSR21	25°45'02.97" S	27°26'33.10" E
NSR22	25°44'48.19" S	27°26'22.77" E
NSR23	25°45'04.49" S	27°26'22.60" E
NSR24	25°45'00.28" S	27°26'13.00" E
NSR25	25°45'07.92" S	27°26'07.43" E
NSR26	25°45'16.99" S	27°26'14.70" E
NSR27	25°45'23.14" S	27°26'06.55" E
NSR28	25°45'20.38" S	27°28'27.15" E
NSR29	25°45'17.14" S	27°28'45.59" E
NSR30	25°45'13.71" S	27°29'00.99" E
NSR31	25°44'57.59" S	27°29'13.07" E

Receptor	Easting	Northing
NSR32	25°45'13.65" S	27°29'18.04" E
NSR33	25°44'57.76" S	27°29'26.85" E
NSR34 (Potgieter Residence)	25°45'01.54" S	27°29'35.04" E
NSR35	25°45'19.31" S	27°29'33.01" E
NSR36	25°45'17.58" S	27°29'43.51" E
NSR37	25°45'12.25" S	27°29'56.34" E
NSR38	25°45'23.00" S	27°30'08.07" E
NSR39	25°45'12.37" S	27°30'23.43" E
NSR40	25°44'58.18" S	27°30'28.74" E
NSR41	25°44'51.59" S	27°30'38.53" E
NSR42	25°44'57.06" S	27°30'47.42" E
NSR43	25°44'55.34" S	27°30'55.36" E
NSR44	25°45'21.11" S	27°31'05.52" E
NSR45	25°43'08.70" S	27°29'01.42" E
NSR46	25°42'18.33" S	27°29'07.99" E
NSR47	25°42'38.48" S	27°29'56.16" E
NSR48 (Lonmin Training Centre)	25°42'31.63" S	27°31'20.42" E

Figure 54: Sensitive Receptors within the Project Area

10.10.2 BASELINE NOISE LEVELS

10.10.2.1 BACKGROUND REFERENCE CONDITIONS

Acusolv have been undertaking noise measurements for the Tharisa Mine since 2012. The general ambient noise profile of the area, as concluded by Acusolv (van Zyl, 2021), is summarised below.

Tharisa Mine is located in a district where the character of ambient noise is already affected by industrialisation and economic activity, which over time, has resulted in an increase in road traffic noise and noise generated by intensive mining activities. Road traffic noise emanates from the N4 and secondary roads, such as the D1325 between Buffelspoort and Marikana. The N4 has a wide noise footprint. It has a significant impact on people living within a zone of approximately 1.2 km either side of the road and is clearly audible in most of the project area. In addition, mining noise affects communities in the immediate surroundings of mines.

Against this background, the area surrounding Tharisa Mine in its current state cannot be considered a typical rural environment anymore. None of the district descriptions in SANS 10103 meaningfully applies to typical mining areas. Moreover, background noise levels (i.e., excluding noise from Tharisa) in the assessment area are not homogeneous but vary over a considerable range. Depending on the locations and distances of houses or communities relative to the N4 and relative to other roads and other mines in the area, background noise levels measured in surveys conducted by Acusolv have been found to vary between broadly 50 to 60 decibels A (dBA) (daytime) and 40 to 55 dBA night-time, respectively.

Residences within a zone of 250 m from the N4, for example, are subject to night-time road traffic noise levels of between 45 and 55 dBA, depending on topography and distance from the N4. This has been confirmed by noise surveys conducted in earlier studies (van Zyl, 2021) (Thlago Environmental Health and Safety Solutions, 2022). The location of the noise sampling sites is provided in **Figure 55**.

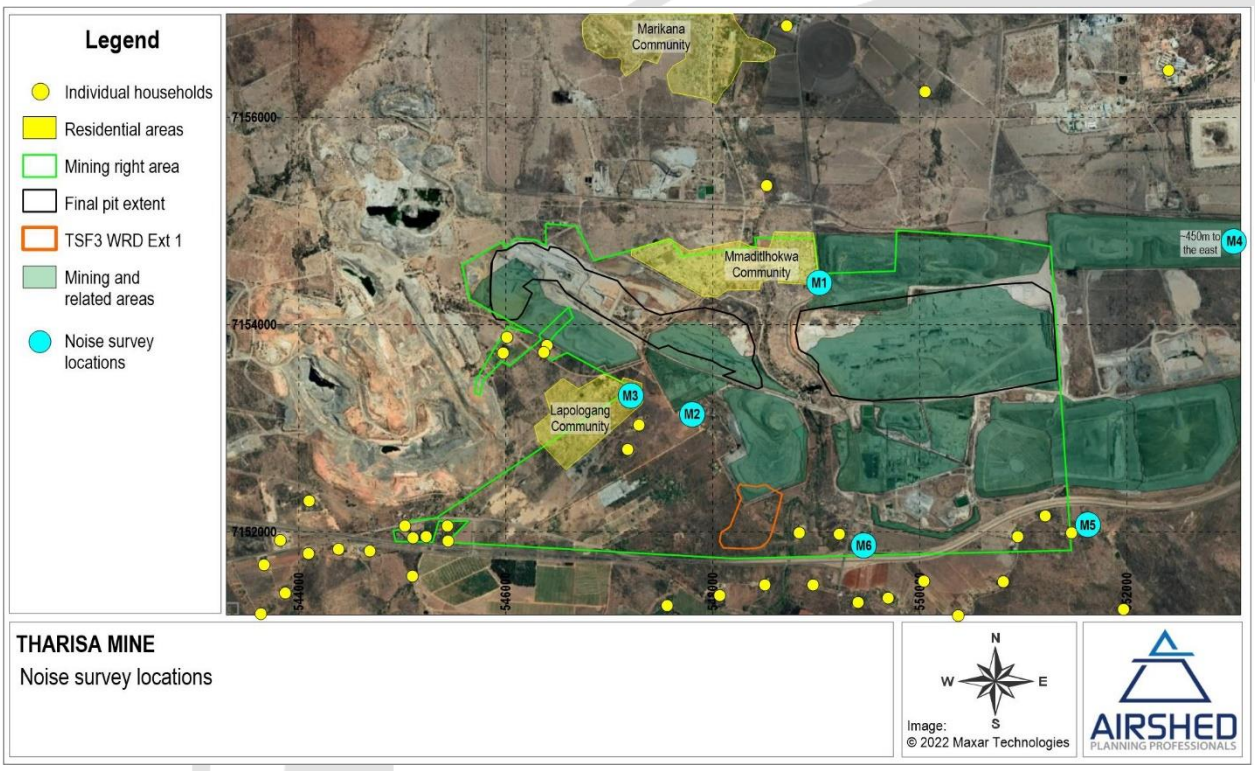


Figure 55: Location of The Noise Sampling Sites for Surveys Conducted by Acusolv for The Annual Tharisa Mine Noise Surveys (Van Zyl, 2021)

Although no formal baseline surveys had been carried out prior to the initial start-up of Tharisa Mine, various efforts have been made in previous surveys conducted by Acusolv to acquire data representative of prevailing background conditions (in the absence of Tharisa Mine). These estimated nominal background daytime and night-time noise levels under normal conditions (outside lockdown restrictions), are summarised in **Table 38** and **Figure 56**.

Table 38: Estimated Background Levels[62] in the Areas Surrounding Tharisa Mine (Based on Information Obtained from the 2021 Noise Survey (Van Zyl, 2021))

Sampling Location	Description	Main Sources of Background Noise	Background Noise Levels (dBA)	
			Day-Time	Night-Time
M1	Madithlokwa Village opposite East Pit mining operations	• D1325 Road Noise • Community activities • Distant mining activities in the area	60	50
M2	School and surroundings	• Community activities • Mining activities in the district	50	45
M3	Lapologang south of Tharisa Far West mining operations	• Community activities • Mining activities in the district	50	45
M4	Bokamoso Village in the vicinity of the dump operations north-east of Tharisa East Mine	• Road traffic noise from tarred public road • Community activities	55	45
M5	Residence Potgieter D south of the N4 opposite Tharisa TSF	• N4 highway traffic • Distant mining activities in the district	60	50
M6	Residence Potgieter H between Tharisa Mine and the N4	• N4 highway traffic • Distant mining activities in the district	60	50

[62] Daytime and night-time background noise ratings in the absence of Tharisa noise. Derived from measurements and observations made in previous surveys. Rounded to the nearest 5 dB interval as per SANS 10103 practice.

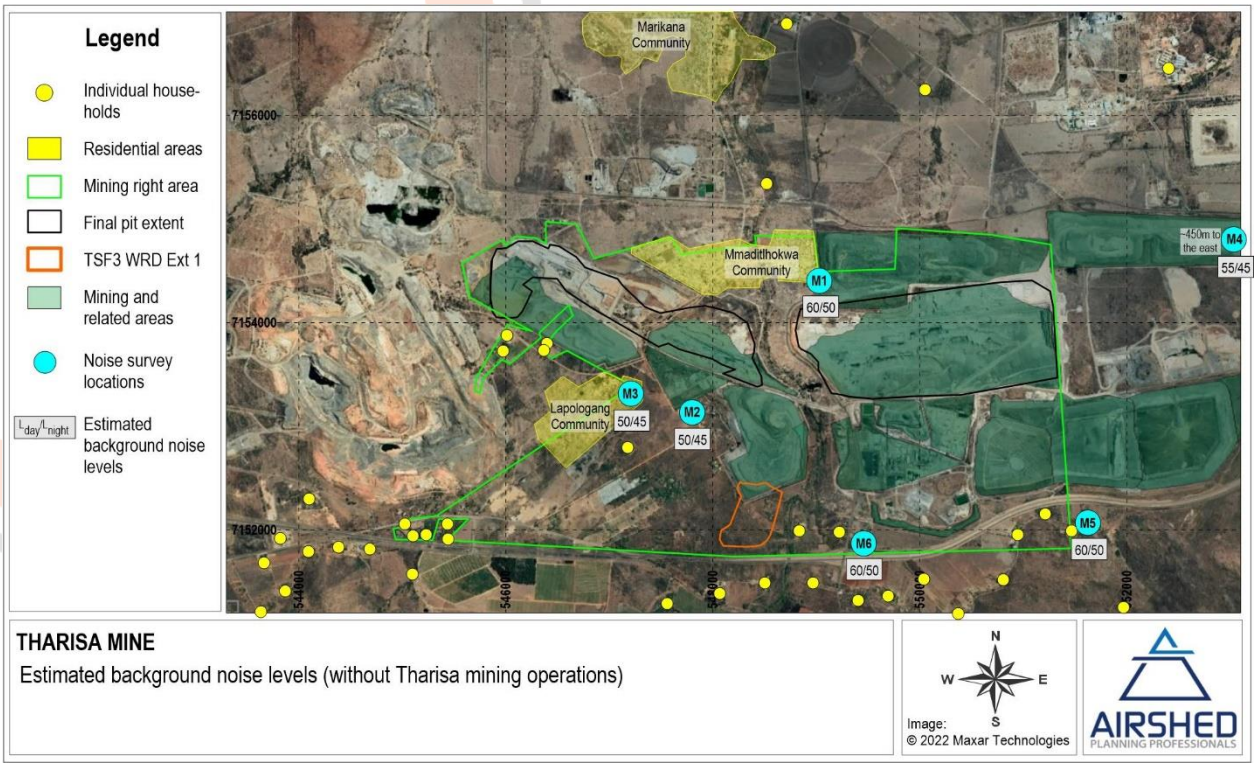


Figure 56: Estimated Background Levels in The Areas Surrounding Tharisa Mine (Based on Information Obtained from the 2021 Noise Survey (Van Zyl, 2021))

10.10.2.2 MEASURED NOISE LEVELS FOR THE 2021 SURVEY

Acusolv undertook a noise survey for the Tharisa Mine in 2021 (van Zyl, 2021). A summary of the measured baseline noise levels for this period is provided in **Table 39** and **Figure 57**.

Table 39: Measured Baseline Noise Levels For 2021 In the Areas Surrounding Tharisa Mine (Based on Information Obtained from the 2021 Noise Survey (Van Zyl, 2021))

Sampling Location	Description	Measured noise levels obtained from the 2021 annual survey (dBA)	
		Day-Time	Night-Time
M1	Madithlokwa Village opposite East Pit mining operations	60	56
M2	School and surroundings	56	50
M3	Lapologang south of Tharisa Far West mining operations	58	50
M4	Bokamoso Village in the vicinity of the dump operations north-east of Tharisa East Mine	53	52
M5	Residence Potgieter D south of the N4 opposite Tharisa TSF	54	48
M6	Residence Potgieter H between Tharisa Mine and the N4	57	59

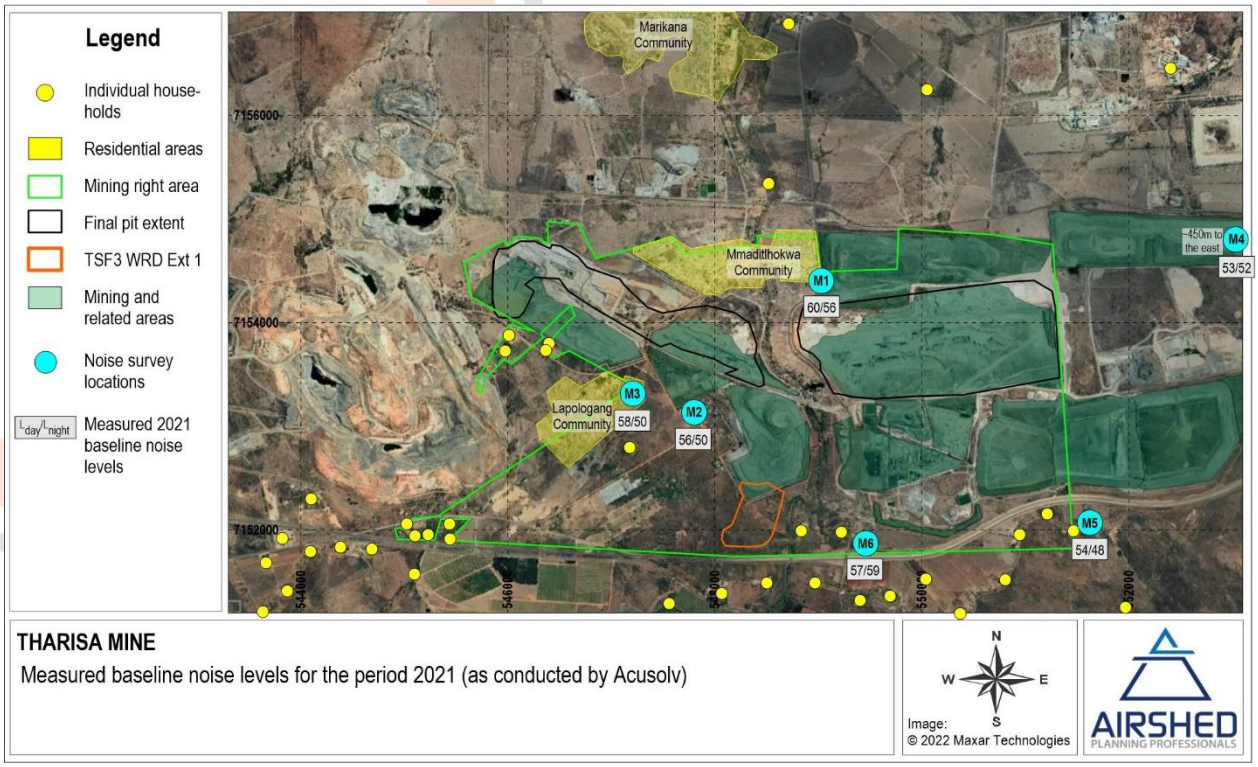


Figure 57: Measured Baseline Noise Levels For 2021 In the Areas Surrounding Tharisa Mine (Based on Information Obtained from the 2021 Noise Survey (Van Zyl, 2021))

Considering the estimated background noise levels as provided in **Section 10.10.2.1**, the noise levels measured at M3 (day-time), M4 (night-time) and M6 (night-time) are equivalent to or exceed the 1992 Noise Control Regulations (The Republic of South Africa, 1992) “disturbing noise” definition (greater than 7dBA from ambient sound levels). Complaints are thus to be expected from close sensitive receptors to the Tharisa mining area.

10.10.2.3 MEASURED NOISE LEVELS FOR THE 2022 SURVEY

Noise measurements were undertaken by Thlago Environmental Health and Safety Solutions (Thlago) on 24 and 25 May 2022 (Thlago Environmental Health and Safety Solutions, 2022) at five selected sampling locations. A summary of the measured baseline noise levels for this period is provided in **Table 40** and **Figure 58**.

Table 40: Measured Baseline Noise Levels For 2022 In the Areas Surrounding Tharisa Mine (Based on Information Obtained from the 2021 Noise Survey (van Zyl, 2021))

Sampling Location	Description	Measured noise levels obtained from the 2022 survey (dBA)	
		Day-Time	Night-Time
R1	Potgieter residence	58.9	55.3
R2	Pretorius residence	59.7	54.7
R3	van der Hoven residence	60.0	55.7
R4	Kgoitsi house (residence)	58.3	55.6
R5	Church	58.1	56.5

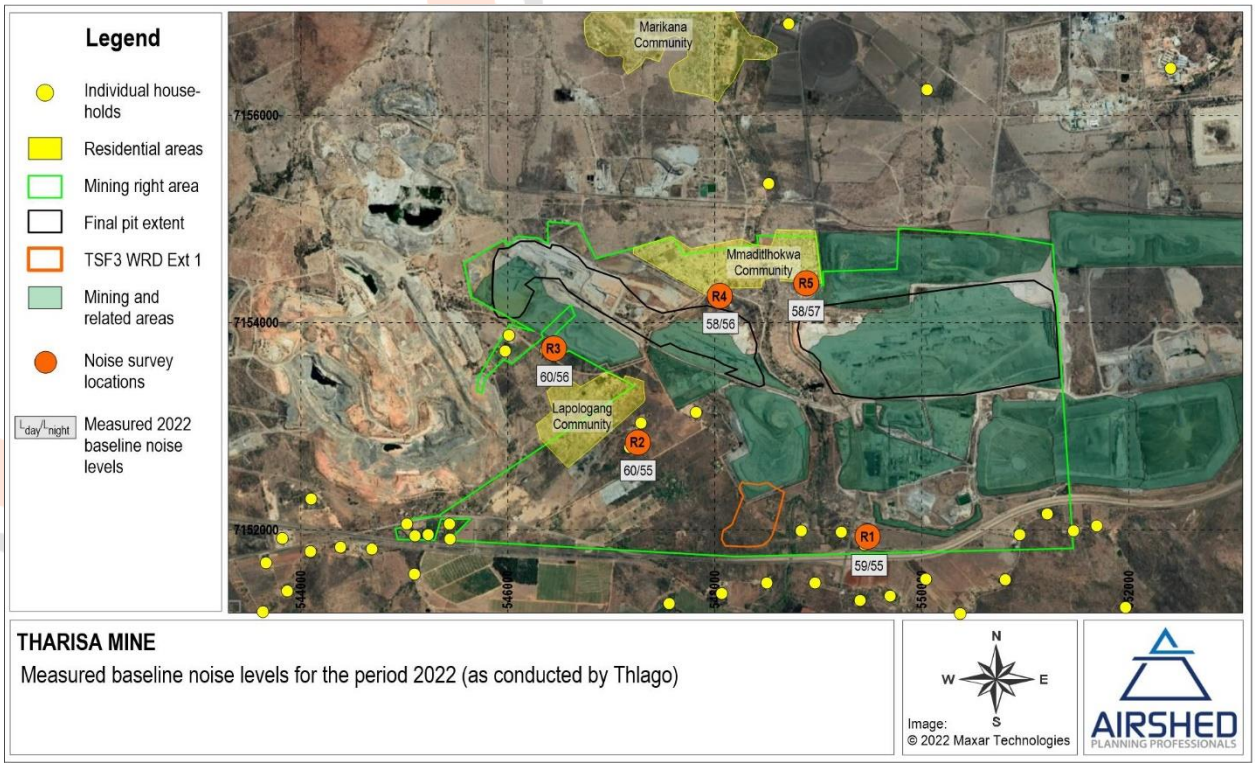


Figure 58: Measured Baseline Noise Levels For 2022 In the Areas Surrounding Tharisa Mine (Based on Information Obtained from the 2022 Noise Survey (Thlago Environmental Health and Safety Solutions, 2022))

Considering the estimated background noise levels as provided in **Table 38**, the noise levels measured at R2 (day-time), R3 (day-time) and R5 (night-time) are equivalent or exceed the 1992 Noise Control Regulations “disturbing noise” definition (greater than 7dBA from ambient sound levels).

Tharisa is currently conducting noise surveys on a monthly basis following concerns from the nearby communities of Mmaditlhokwa and Lapologang.

10.11 SOCIO-ECONOMIC ENVIRONMENT

10.11.1 REGIONAL CONTEXT

The proposed TSF 3 WRD Extension 1 site is located in the Rustenburg Local Municipality (LM), a Category B municipality in the North West Province. It is one of five LMs together with Moses Kotane LM, Kgetlengrivier LM, Madibeng LM, and Moretele LM that forms part of the Bojanala Platinum DM.

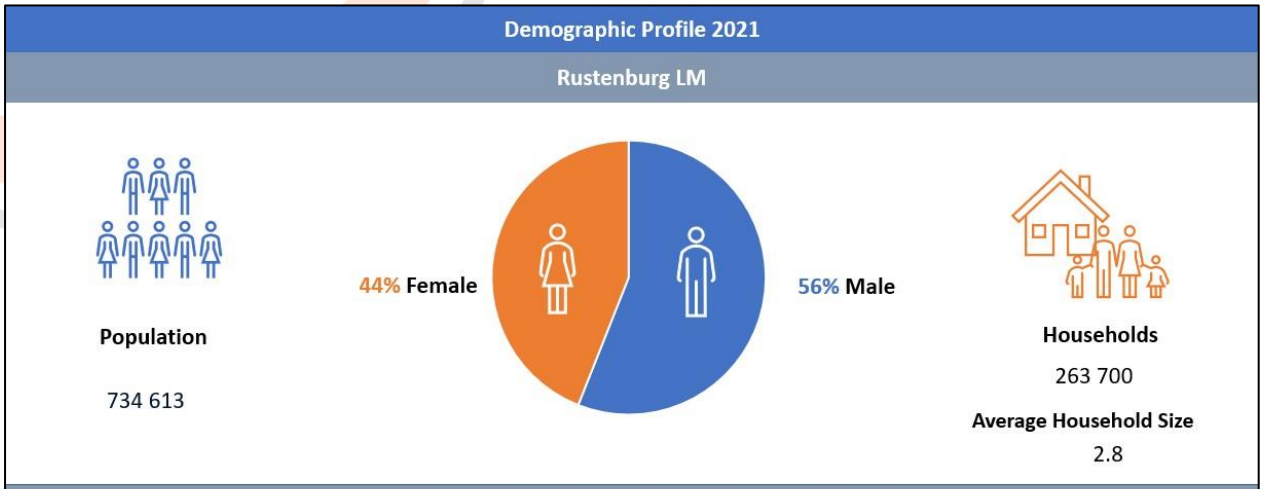
Historically, Rustenburg has been inhabited by various indigenous groups, including the Bafokeng, Bakgatla, and Batlhaping communities. These communities have deep-rooted cultural traditions and have played a significant role in shaping the local heritage and identity.

The sense of place in Rustenburg is influenced by its natural surroundings, with the municipality being located close to the picturesque Magaliesberg mountain range. The primary study area encompasses of very few protected areas that function as nature reserves, providing opportunities for various outdoor activities such as hiking, fishing, water sports, game viewing, camping, and birdwatching. Among these attractions, the notable Magaliesberg Nature Reserve stands out as a key tourist destination, and two chalets are conveniently located near the project site. Additionally, there are two primary schools located in the primary zone of influence which surround the proposed TSF 3 WRD Extension 1 site. The proposed TSF 3 WRD Extension 1 is approximately 2 km from the nearest school, which could be a concern for the

proposed TSF 3 WRD Extension 1 as its construction and any resulting disturbances could potentially affect how the school operates.

10.11.2 DEMOHRAPHICS, HEALTH AND CRIME PROFILES

In Rustenburg LM, the majority of residents can be categorised as African, with smaller populations of Indian, coloured, and white individuals. In terms of population distribution, males constitute a larger proportion than females. **Figure 59** provides a visual representation of this demographic composition, with males accounting for 56% of the total population.



District, Provincial and National demographic profiles

Location	Population	Household Total	Average Household Size
Bojanala Platinum DM	1 942 979	639 88	3.0
North West	4 112 960	1 241 382	3.3
South Africa	59 852 195	16 684 205	3.6

Figure 59: Population Demographics

In 2021, Rustenburg LM had a population of around 734 613 individuals residing in 263 700 households. This population represents approximately 37.8% of the total population of Bojanala Platinum DM and approximately 17.9% of the total population of the North West province. Furthermore, the average household size in Rustenburg LM is 2.8 people per household, which is lower than the district average of 3.0, the provincial average of 3.3, and the national average of 3.6.

Crime is an important indicator of a community's socioeconomic status. Serious crimes comprise of contact crimes, sexual offences, robberies with aggravating circumstances, crimes involving property, and crimes discovered as a result of police action. From 2018 to 2021, the municipality witnessed a significant average annual decline of 31.3% in serious crimes. However, it is noteworthy that in the year 2022, there was a notable increase of 18.3% in reported crimes. The exact reasons for this increase in crime during the specified period are uncertain. However, it is worth considering that the introduction of a new development project could potentially contribute to an increase in crime rates. The construction and operation of a project often attract a transient population, which can introduce new dynamics and challenges related to crime.

10.11.3 INCOME AND EDUCATION LEVELS

In 2020, approximately 15.0% of households in Rustenburg LM were estimated to have an annual income of R30,000 or less. This represents a slight decrease compared to the 2010 figure of 26.4% (Rustenburg Local Municipality, 2022). According to the Rustenburg LM's Integrated Development Plan (IDP), a majority of the population in the municipality falls within the low-income bracket, with average household incomes ranging between R192,000 and R360,000 per annum.

Table 41: Primary Study Area Household Income (2011) (Stats SA, 2012)

Annual Household Income	Percentage of LM Population
No Income	16.8%
Under R4 800	2.7%
R4 801 – R9 600	4.1%
R9 601 – R19 600	11.2%
R19 601 – R38 200	17.2%
R38 201 – R76 400	23.1%
R76 401 - R153 800	12.1%
R153 801 - R307 600	7.1%
R307 601 – R614 400	4.0%
R614 401 – R1 228 800	1.2%
R1 228 801 – R2 457 600	0.3%
R2 457 601 +	0,2%

However, when considering the per capita income of R78,100, Rustenburg LM has the highest per capita income in the district, surpassing both the North West (R52,600) and Bojanala Platinum DM (R59,900) averages. In fact, Rustenburg LM's per capita income (R78,100) is also higher than the national average for South Africa, which stands at R58,700.

Low average income levels are often associated with challenges in accessing quality education. **Figure 60** provides an overview of the educational attainment levels of residents in Rustenburg LM. approximately 8.8% of the adult population in Rustenburg LM have not received any formal education, while around 30.4% have completed at least their matriculation. Less than 3% of the adult population in Rustenburg LM hold higher education degrees, such as bachelor's degrees, Honours degrees, as well as Master's and Doctorate degrees.

It is important to note that the analysis presented above focuses on the significant education levels within Rustenburg LM. However, it is worth acknowledging that there are other levels of education in the area, including Grade 1-4 education.

The below analysis shows that the residents within Rustenburg LM are reasonably skilled, implying that the area has a sufficient labour force to support the necessary skills for the development of the TSF 3 WRD Extension 1.

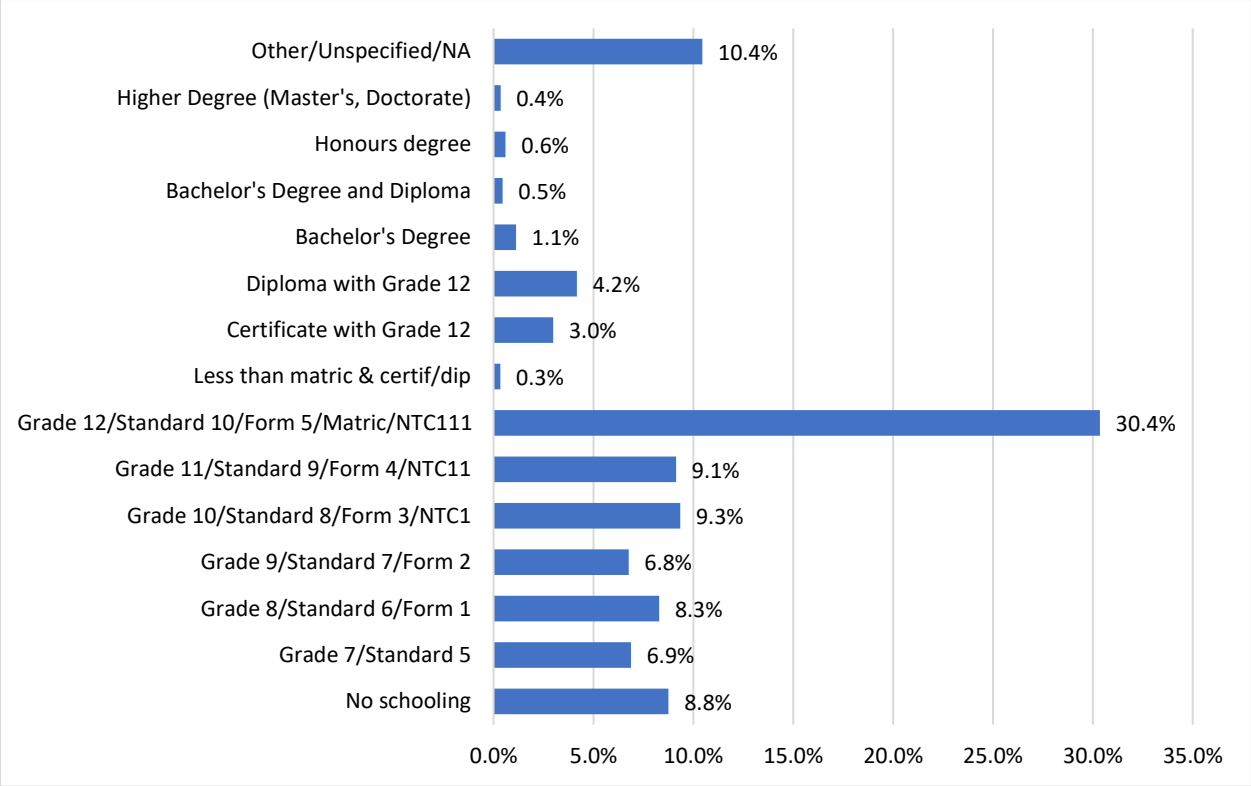


Figure 60: Education Levels in Rustenburg LM

10.11.4 LABOUR FORCE AND EMPLOYMENT STRUCTURE

In 2021, the employed population in Rustenburg LM accounted for approximately 51% of Bojanala Platinum DM's total employed population. The working-age population (WAP) constituted 74% of Rustenburg LMs' total population, which translates to about 259 890 people. **Figure 61** depicts the labour force profile in Rustenburg LM, showing that only 67% of the WAP is economically active while 33% of the WAP is not economically active.

Among the employed population in Rustenburg LM, around 14% (approximately 35,947 individuals) work in the informal sector, while about 86% (approximately 223,943 individuals) work in the formal sector. The formal sector comprises 14% skilled workers, 65% semi-skilled workers, and 21% low-skilled workers. This distribution can be attributed to the lack of individuals with higher education in the LM and the prevalence of job opportunities in the mining industry, which predominantly require semi-skilled labour.

Around 29% of the employed population in Rustenburg LM is engaged in the tertiary sector, while approximately 63% work in the primary sector. The mining and quarrying sector holds significant importance for Rustenburg LM, as it employed about 63% of all workers in 2021 (Quantec, 2022).

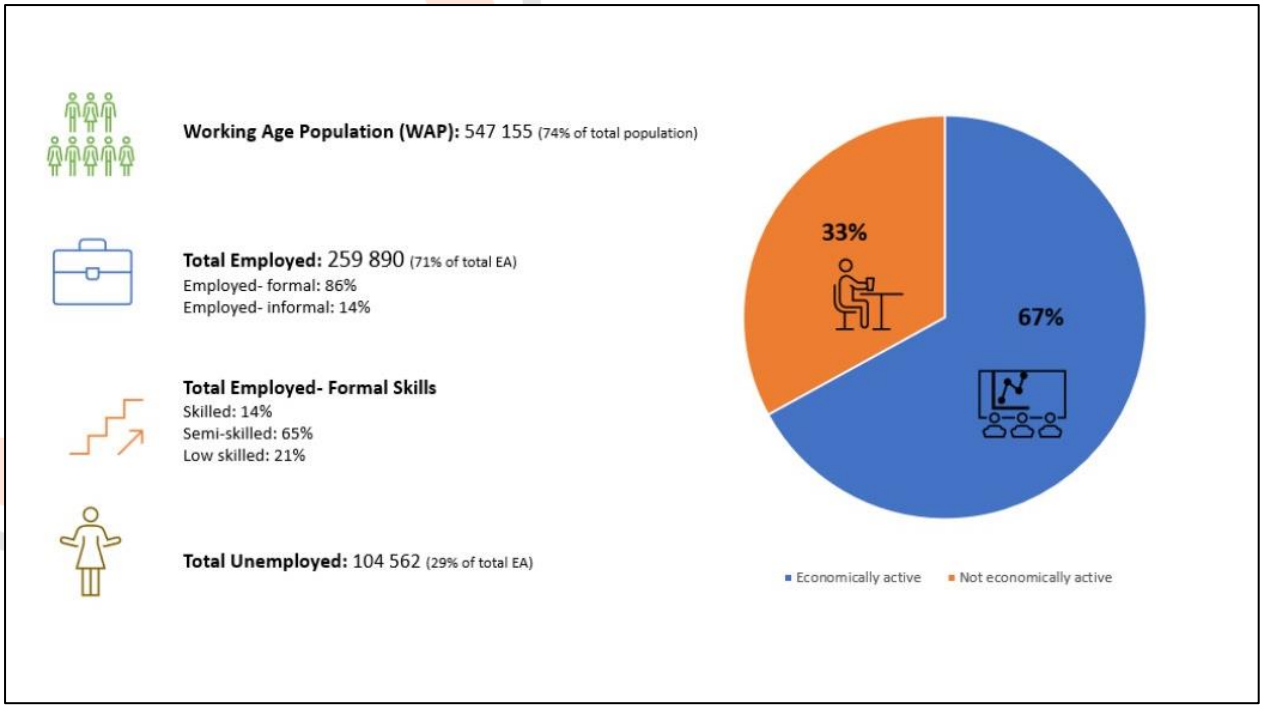


Figure 61: Rustenburg LM Labour Force Profile

10.11.5 ECONOMIC PROFILE

Table 42 shows that the Gross Value Added (GVA) of the Rustenburg LM was valued at R122 502 million in 2021. This constituted approximately 34% (a third) of the total GVA for the Bojanala Platinum DM in that year, making Rustenburg LM the largest contributor to the DM. The economic profile of Rustenburg LM is dominated by the primary sector, with the highest contributing sector being the mining and quarrying sector. The dominance of this sector is evident in **Table 43** below.

Table 42: Local Municipality Contributions to Bojanala Platinum DM and North West Province (2021) (Urban-Econ calculations based on Quantec, 2022)

Area/economy 2021	GVA	GVA Contribution	
	R (millions)	North West Province	Bojanala Platinum DM
North West Province	357657,711	100%	
Bojanala Platinum DM	216422,853	61%	100%
Kgetlengrivier LM	3191,249	1%	1%
Madibeng LM	60404,877	17%	28%
Moretele LM	6776,325	2%	3%
Moses Kotane LM	23548,034	7%	11%
Rustenburg LM	122502,368	34%	57%

As can be seen in **Table 43**, the biggest contributor to Rustenburg LM's GVA is the mining and quarrying sector (62.7%). This is followed by the finance, insurance, real estate and business services, which contribute approximately 8.7% of the LM's GVA. The proposed TSF 3 WRD Extension 1 is expected to contribute to the LMs' mining and quarrying GVA, however, because it is a Waste Dump, it is unlikely that this would have a significant impact on the GVA of the LM.

Table 43: Sector Contributions to the Rustenburg LM Economy (Urban-Econ calculations based on Quantec, 2022)

Rustenburg LM Economic Sectors	GVA (R millions)	Contribution
Agriculture, forestry and fishing	745.4	0.6%
Mining and quarrying	76 752.3	62.7%
Manufacturing	5533.0	4.5%
Electricity, gas and water	2 083.7	1.7%
Construction	1 684.1	1.4%
Wholesale and retail trade, catering and accommodation	8 598.1	7.0%
Transport, storage and communication	3 123.6	2.5%
Finance, insurance, real estate and business services	10 635.3	8.7%
General government	6 120.0	5.0%
Community, social and personal services	7 226.9	5.9%
Total	**122 502.4**	**100.0%**

10.11.6 ACCESS TO BASIC SERVICES

As shown in **Figure 62**, almost half of the households in the Rustenburg LM have piped water within their yards and about 29.3% of households have piped water inside their dwellings. Approximately 8.7% of the households in Rustenburg LM access water through a community stand, while the rest of the households get their water through water tankers, boreholes, and even other sources such as rainwater tanks, rivers/streams, and water vendors.

In terms of access to energy, approximately 89.4% of Rustenburg LMs' households have access to electricity, which is provided by Eskom, while about 6.2% use candles for energy. Approximately 4.1% of the households use paraffin for energy while a minor share of the households uses other sources such as gas. Regarding sanitation, only roughly 57% of Rustenburg LMs' households have access to flushing toilets with sewage systems, while none of the households uses pit toilets. The majority (67.8%) of the Rustenburg LM households have their refuse removed weekly. The above suggests that besides the provision of electricity, the LM is likely to be underdeveloped and that the standards of living are fairly low. The proposed TSF 3 WRD Extension 1 is unlikely to improve the LMs' access to basic services, however, it may indirectly impact the standards of living of the local community.

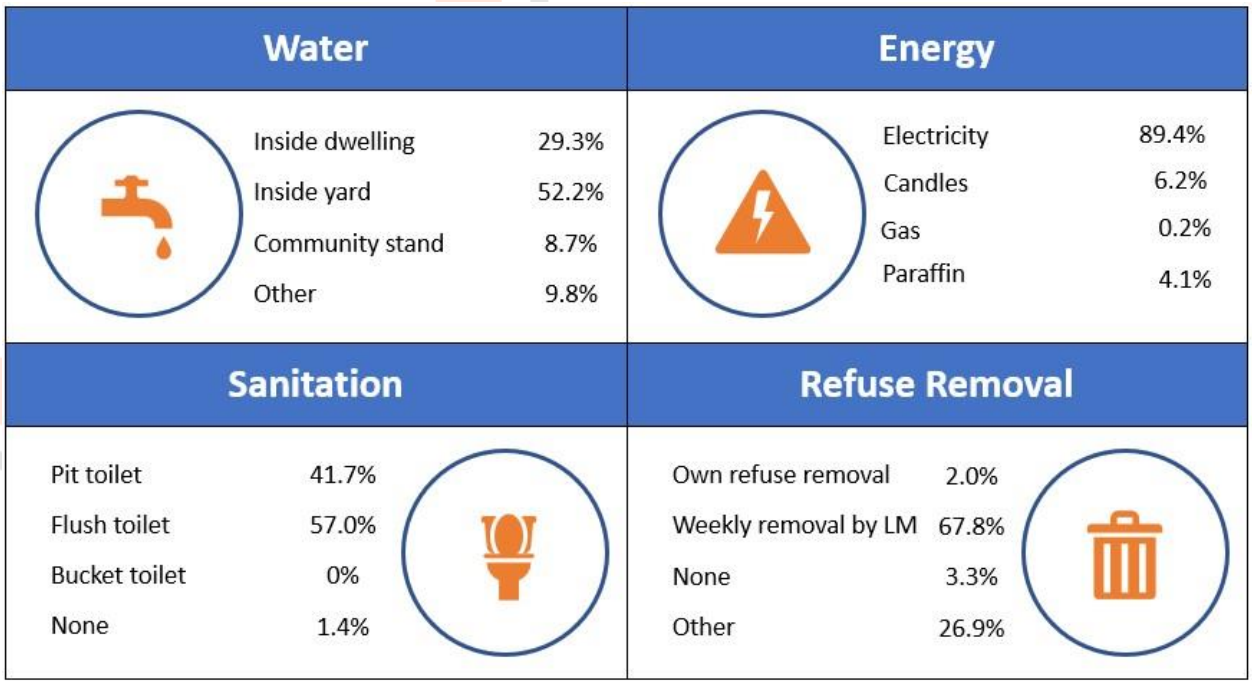


Figure 62: Access to Basic Services

10.12 HERITAGE RESOURCES

10.12.1 ARCHAEOLOGY AND CULTURAL LANDSCAPE

10.12.1.1 DESKTOP APPRAISAL

In terms of heritage resources, the general landscape around the project area is primarily well known for its Iron Age Farmer and Colonial / Historical Period archaeology related to farming, rural expansion and warfare as well as Industrialization of the past century. A Heritage Impact Assessment (HIA) conducted by Pistorius (2007)[63] for the proposed Tharisa Mine development documented the following heritage resources:

- Stone walled settlements which date from the Late Iron Age.
- Historical structures such as farm houses with outbuildings, agricultural infrastructure and the van Rensburg School (now called the Retief Primary School).
- At least six graveyards.
- Objects with heritage significance such as outdated and discarded agricultural implements.

One of the graveyards documented by Pistorius is indicated to occur in the Tharisa Mine TSF 3 WRD Extension 1 Project.

[63] Pistorius, J.C.C. 2007. A Phase I Heritage Impact Assessment (HIA) on K/Kraal 342 and Elandsdrift 467 near Marikana for the proposed new Tharisa Minerals Mine, North West Province. Unpublished report prepared for Tharisa Mine.

Figure 63: View of A Cemetery and Building Remains Noted by Pistorius (2007) Outside the Project Area in The Larger Landscape

An analysis of historical aerial imagery and archive maps of the project area reveals the following:

- Farm 342, originally known as “K/Kraal” is indicated on the South African War Map (1899-1902) of the Rustenburg area dating to 1900 as well as Jeppe’s Map of the Transvaal (1899).
- Historical farming and agriculture fields as well as dwellings and man-made structures are legible on aerial imagery dating to 1932, 1949 and 1970 in areas subject to this assessment.
- Large portions of the project area seem to have been used as agricultural lands as indicated on topographic maps dating to 1969, 1985 and 1996.
- A number of buildings, presumably farmsteads and so-called “huts” are indicated on topographic maps of the project area dating to 1969, 1985 and 1996.
- Two farmsteads in the project area were demolished in the past decade as is evident from Google Earth imagery.

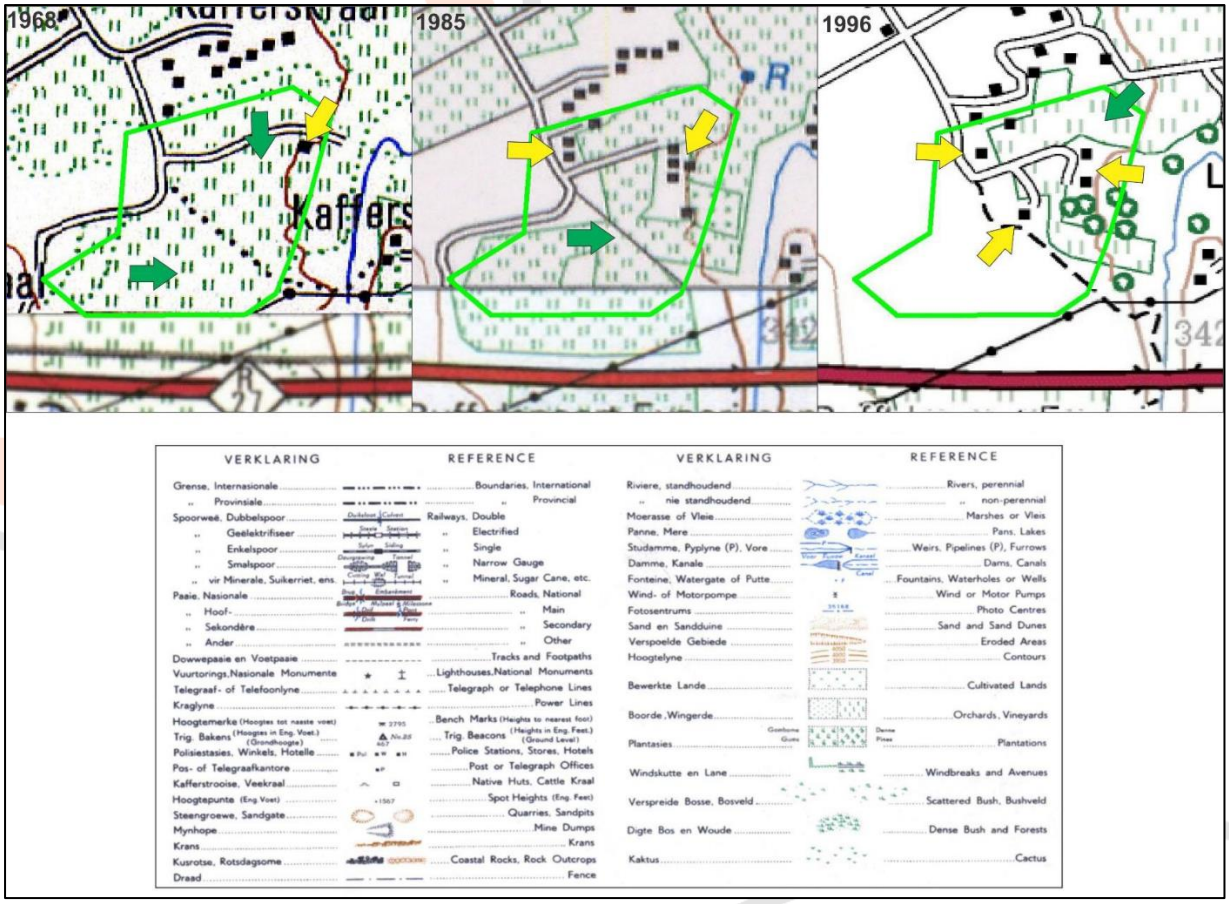


Figure 64: Historical Topographic Maps of The Project Area (Green Outline). Farmsteads and So-Called "Huts" Are Indicated by The Yellow Arrows and Cultivated Land Are Indicated with The Green Arrows

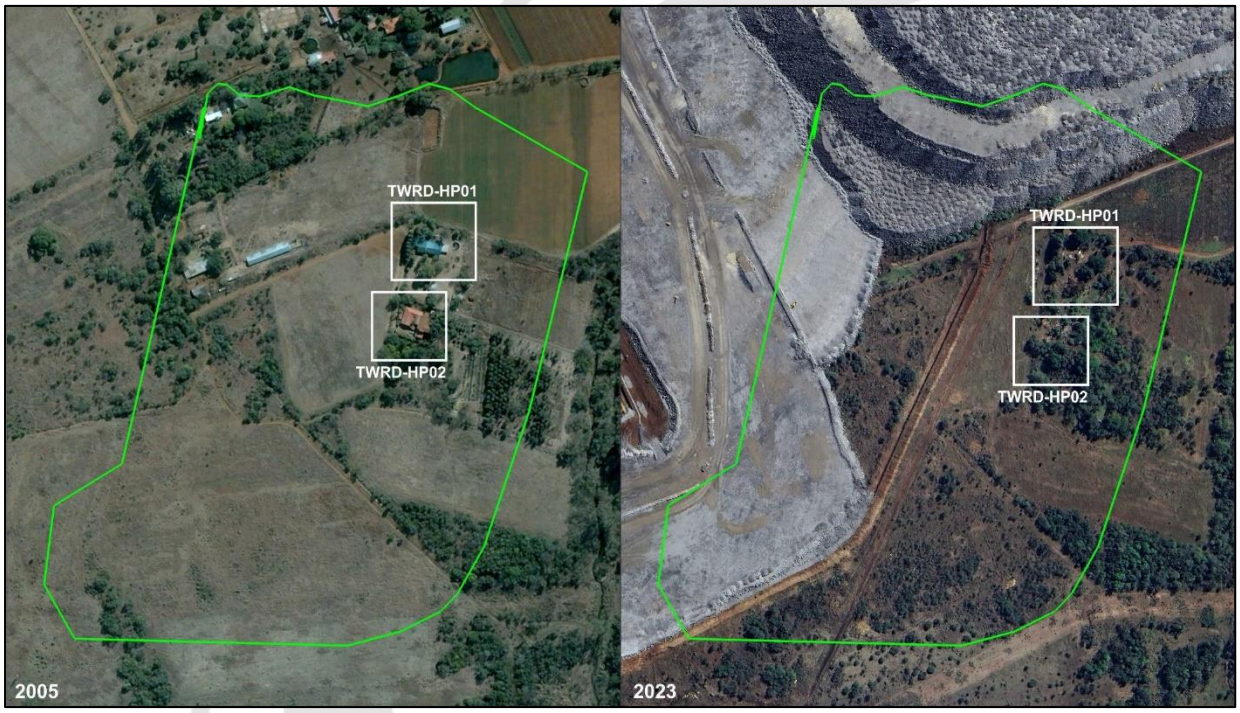


Figure 65: Google Earth imagery indicating transformation of the project area by mining in the last decade. Note the disappearance of the farmstead buildings at TWRD-HP01 and TWRD-HP02.

10.12.1.2 SITE SURVEY FINDINGS

An analysis of historical aerial imagery and archive maps of areas subject to this assessment suggests a landscape which has been subjected to historical farming activities possibly sterilising the area of heritage remains. This inference was confirmed during an archaeological site assessment but *in situ* heritage remains were encountered. The following observations were made during the site survey.

Farm	Site	Description	Coordinates	Field Rating
342	TWRD-HP01	Built Environment Remains	S25.746796° E27.483875°	2a. Low Significance
	TWRD-HP02	Built Environment Remains	S25.747504° E27.483681°	

The ruined remains of two Historical Period farmsteads consisting out of a number of concrete and brick foundation structures, building rubble and material culture such as glass, metal, plastic were noted in the project area. An absolute temporal context for the farmsteads could not be ascertained but they seem to appear on archive aerial photographs (1932, 1949 and 1970 as well as 2005) and historical topographical maps (1968, 1985 and 1996). The sites are older than 60 years - and generally protected under the National Heritage Resource Act (NHRA 1999) but building structures and features are either lost or poorly preserved and no notable heritage or historical association could be established. The site occurs within the proposed TSF 3 WRD Extension 1 and impact is likely where potential direct impacts to the site should be monitored.

Figure 66: View Building Rubble and General Surroundings at Site TWRD-HP01

Figure 67: View of An Old Access Road and Foundation Structures at Site TWRD-HP02.

Pistorius documented a small “unmarked” cemetery in the project area (coded “GY05”) in an HIA for the Tharisa Mine conducted in 2007. No photographs are provided, and he described the cemetery as follows:

"Graveyard 05 contains the remains of four members of the van Rensburg family. One grave is fitted with a simple headstone made from bricks while two other graves are fitted with small slate headstones. These head stones contain no inscriptions. All four graves are covered with stones."

Farm	Site	Description	Coordinates	Field Rating
342	TWRD-BP01	Burial Site Site GY05 – Pistorius 2007	S25.747182° E27.481989°	4b. High significance (to be confirmed)

This burial site could not be located during the site survey subject to the current assessment. Upon enquiry, the Tharisa Environmental Officer indicated that all graves within mining areas had previously been relocated. However, confirmation of the relocation of the cemetery will be required in order to ensure that human remains are not damaged or lost. Should it be established that the burials were not relocated, potential direct impacts to the site should be mitigated and monitored.

Figure 68: View of site where Pistorius Documented a Cemetery in 2007 (TWRD-BP01).

A partially intact concrete building foundation structure was noted in the project area. An absolute age for the structure could not be ascertained but the buildings do not appear on historical topographical maps and aerial photographs and the site is probably of more recent age. The structure remains are therefore not of heritage significance.

Farm	Site	Description	Coordinates	Field Rating
342	TWRD-FT01	Built Environment Remains	S25.747449° E27.481805°	No significance

Figure 69: View of a Building Floor And Foundation Structure In The Project Area at TWRD-FT01.

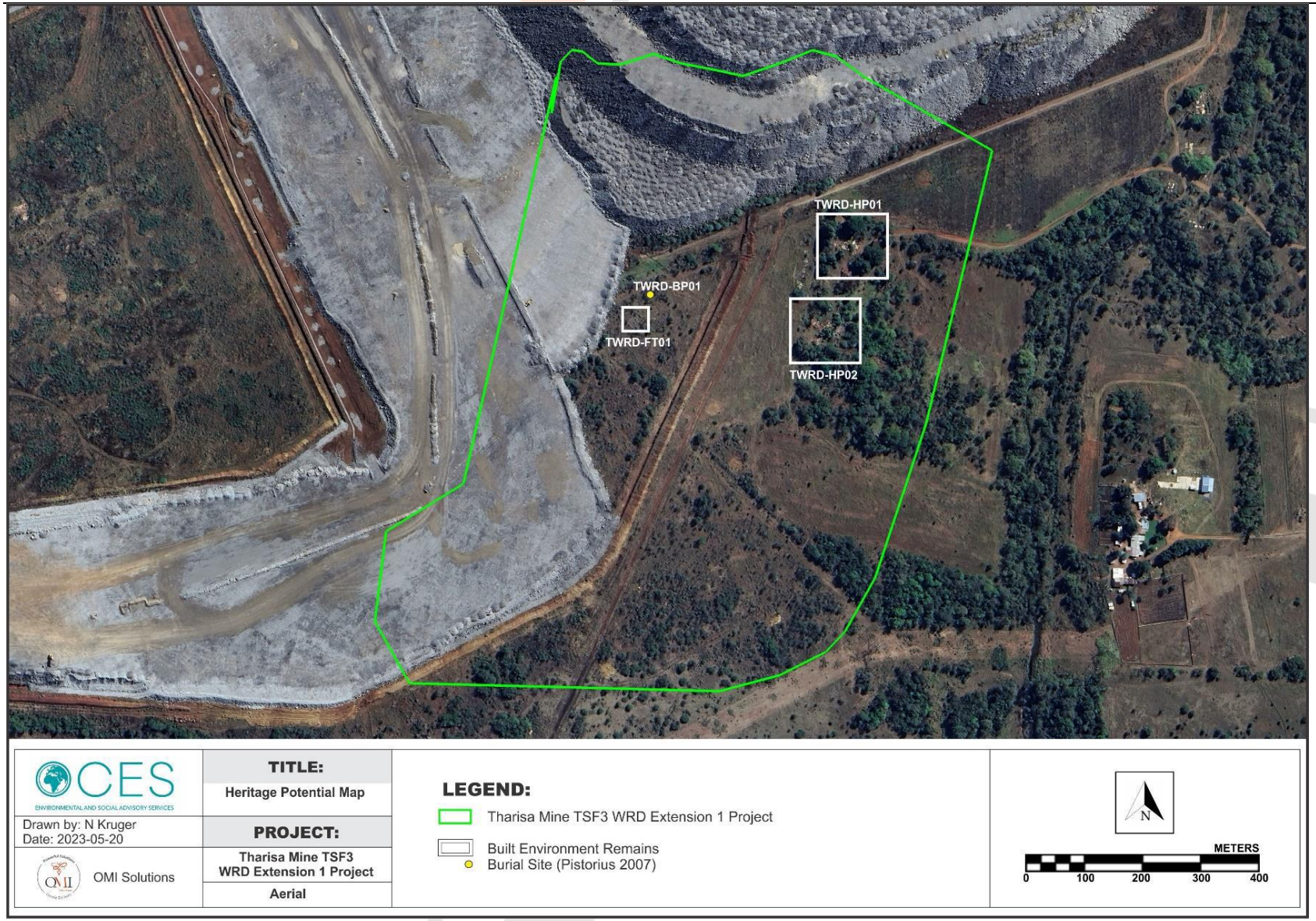


Figure 70: An Aerial Image of Indicating the Locations of Heritage Sites And Features Discussed In The Text

11 DESCRIPTION OF THE CURRENT LAND USE[64]

The project area is situated on slightly undulating plains and located to the west of the perennial Sterkstroom River. Small sections of original vegetation remain intact on the site, although most of the site represent old, cultivated land. A section of the site has already been modified by a WRD to the North. The major land uses of the project area as classified by the Environmental Potential Atlas of South Africa (2000) are mining and vacant / unspecified land (AGES, 2023c).

Additionally, the land use surrounding the Tharisa MR area is dominated by mining activities as indicated in **Figure 71**. Mining activities occur to the North, and immediate West and East of Tharisa Mine. Amongst the mining activities North of the mine is open land mostly owned by mining companies and the community of Marikana (GLYA, 2023). Immediately West of the project site, in the MR area, is the Lapologang community.

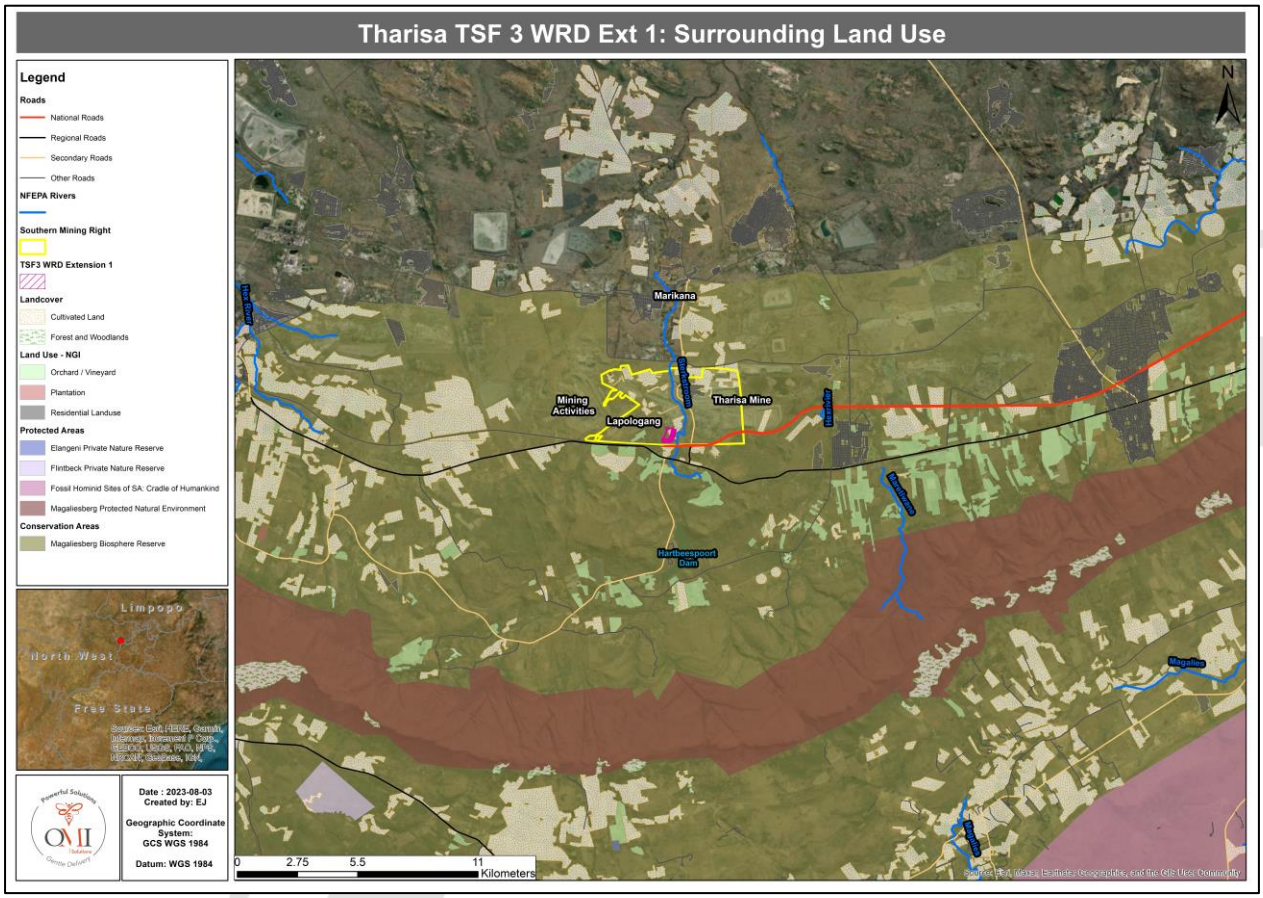


Figure 71: Land Uses Surrounding the Project Area

[64] Required as per the EIA regulations Appendix 2 (g) a full description of the process followed to reach the proposed preferred activity, site, and location of the development footprint within the site, including (iv) the environmental attributes associated with the alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects.

12 DESCRIPTION OF SPECIFIC ENVIRONMENTAL FEATURES AND INFRASTRUCTURE ON THE SITE[65]

In terms of the DFFE[66] guidelines for Integrated Environmental Management (IEM), "sensitive landscapes" is a broad term applying to:

- Nature conservation or ecologically sensitive areas – indigenous plant communities (particularly rare communities or forests), wetlands, rivers, river banks, lakes, islands, lagoons, estuaries, reefs, inter-tidal zones, beaches and habitats of rare animal species;
- Unstable physical environments, such as unstable soil and geo-technically unstable areas;
- Important nature reserves – river systems, groundwater systems, high potential agricultural land;
- Sites of special scientific interest;
- Sites of social significance or interest – including sites of archaeological, historic, cultural spiritual or religious importance and burial sites; and
- Green belts or public open space in municipal areas.

Sensitive landscapes in the project area (in terms of the above definition) are discussed in detail in **Section 10**. These include but are not limited to:

- The project area is located adjacent to the listed National Freshwater Ecosystem Priority Areas (NFEPA) rivers being the Sterkstroom River.
- The vegetation on the TSF 3 WRD Extension 1 site consists of woodland of the Marikana Thornveld, which is considered Endangered. A few individuals of the protected tree *Sclerocarya birrea* (marula) occurred in isolated sections of the proposed TSF 3 WRD Extension 1 site and thus require an NFA permit should they be removed.
- The proposed TSF 3 WRD Extension 1 is in CBA 2 and ESA 2 areas. Although the actual WRD footprint is in CBA 2 and ESA 2, **these areas represent zero sensitivity** (due to the existing mining infrastructure i.e. WRDs), Low sensitivity and Medium-Low sensitivity areas characterised only by a few pockets of woodland, old fields and degraded grassland. These areas do not represent land that will contribute towards ecosystem functioning and should subsequently be classified as "Other Natural Areas" or "No Natural Habitat Remaining".
- The Magaliesberg Protected Environment and Kgaswane Nature Reserve is located about 7.5 kilometers to the south and south-west of the project area. Furthermore, the project area is in the Magaliesberg Biosphere Reserve transition zone, although mining is a confirmed land-use for the transition zone. No NPAES occur within the project area, with the closest located roughly 10 km north-east of the area, representing North West / Gauteng Bushveld.
- The Magaliesberg IBA is located within the project area, although the actual Magaliesberg habitat is not represented on site.

The map below (**Figure 72**) show overlays of the land use, heritage and ecological findings as well as the protected areas in proximity to the TSF 3 WRD Extension 1 site. **It shall be re-iterated that the EXT will occur within the approved MR area wherein the ecological sensitivity has been rated as Medium-Low sensitivity.**

[65] Required as per the EIA regulations Appendix 2 (g): a full description of the process followed to reach the proposed preferred activity, site, and location of the development footprint within the site, including (iv) the environmental attributes associated with the alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;

[66] At the time the Department of Environmental Affairs and Tourism (DEAT).

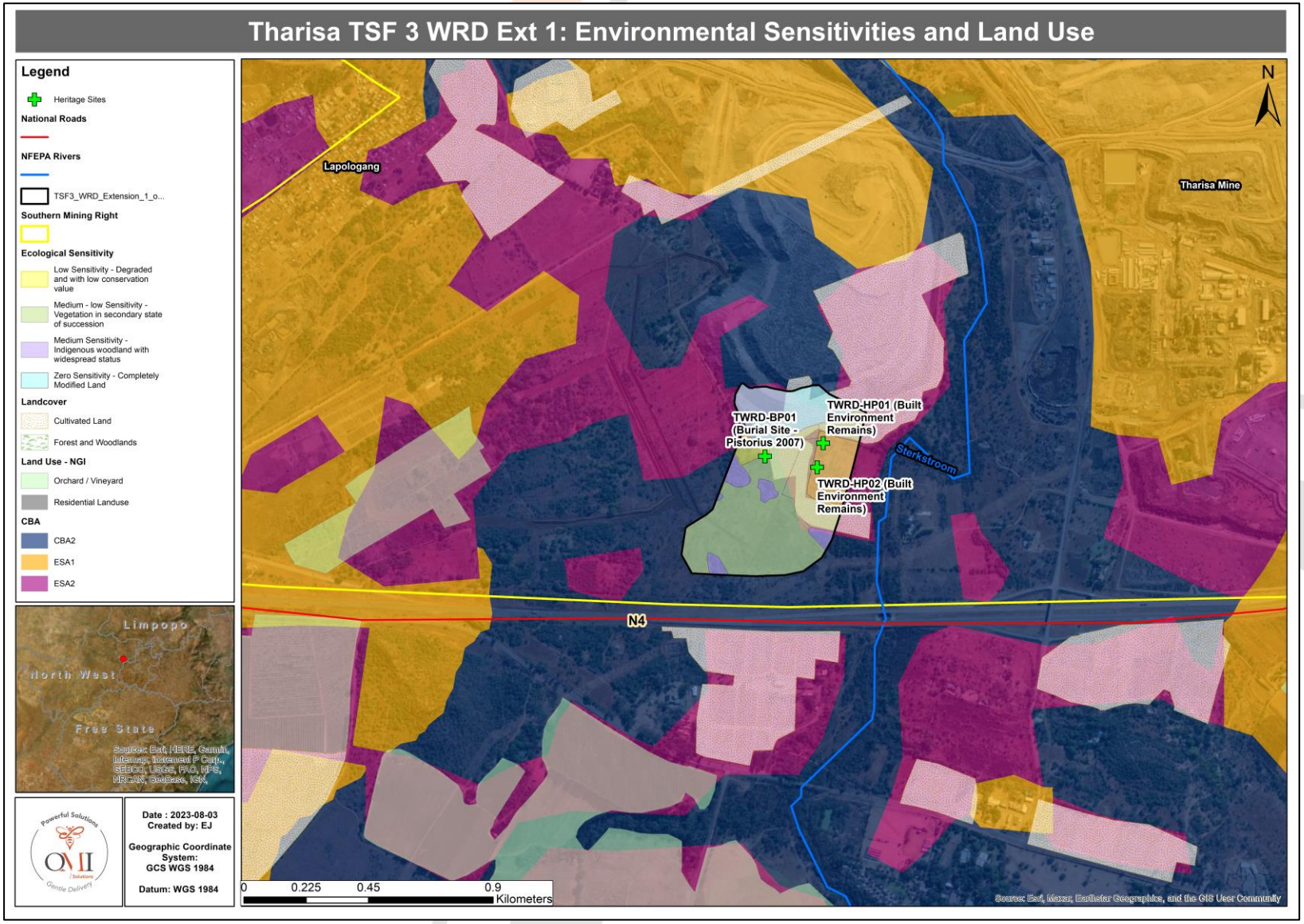


Figure 72: Overlay of Protected Areas, Land Use and Land Cover, Heritage and Ecological Sensitivities of the Project Site

13 PRELIMINARY IMPACTS IDENTIFIED[67]

The prelimnary impact assessment, without mitigation (WOM), details are listed below in **Table 44**.

Table 44: Preliminary Impacts Identified During the Scoping Assessment[68]

Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Probability		Duration		Scale		Magnitude/ Severity		Significance	
				Magnitude	Score	Magnitude	Score	Magnitude	Score	Magnitude	Score	Score	Magnitude
Agro-Ecosystem													
Planning Phase													
Soils and land capability	Delay of mining onset	WOM	Negative	Probable	2	Long Term	4	Local	1	High	8	26	Low
Construction Phase													
Soils and land capability	Soil destruction and sterilisation	WOM	Negative	Definite	5	Permanent	5	Site	2	High	8	75	High
Soils and land capability	Soil compaction	WOM	Negative	Definite	5	Permanent	5	Local	1	High	8	70	High
Soils and land capability	Soil erosion and sedimentation	WOM	Negative	Definite	5	Permanent	5	Site	2	High	8	75	High
Soils and land capability	Spillages of harmful substances	WOM	Negative	Highly Probable	4	Long Term	4	Regional	3	Medium	6	52	Moderate
Soils and land capability	Loss of land capability	WOM	Negative	Definite	5	Permanent	5	Site	2	High	8	75	High
Operational Phase													
Soils and land capability	Soil destruction and sterilisation	WOM	Negative	Definite	5	Permanent	5	Site	2	High	8	75	High
Soils and land capability	Soil compaction	WOM	Negative	Definite	5	Permanent	5	Site	2	High	8	75	High
Soils and land capability	Increased soil erosion and sedimentation of watercourses	WOM	Negative	Definite	5	Permanent	5	Regional	3	High	8	80	High
Soils and land capability	Spillages of harmful substances resulting in soil pollution	WOM	Negative	Highly Probable	4	Long Term	4	Regional	3	Medium	6	52	Moderate
Soils and land capability	Loss of land capability	WOM	Negative	Definite	5	Permanent	5	Site	2	High	8	75	High
Closure and Decommissioning Phase													
Soils and land capability	Improvement of eroded soils and compaction	WOM	Positive	Highly Probable	4	Long Term	4	Local	1	Low	2	28	Low
Soils and land capability	Increased soil erosion and sedimentation	WOM	Negative	Highly Probable	4	Long Term	4	Regional	3	Medium	6	52	Moderate
Soils and land capability	Soil compaction	WOM	Negative	Definite	5	Permanent	5	Local	1	Medium	6	60	Moderate
Soils and land capability	Spillages of harmful substances resulting in soil pollution	WOM	Negative	Highly Probable	4	Medium Term	3	Regional	3	Medium	6	48	Moderate
Closure and Post closure													
Soils and land capability	Improvement of land capability	WOM	Positive	Highly Probable	4	Long Term	4	Local	1	Low	2	28	Low
Soils and land capability	Soil erosion and sedimentation	WOM	Negative	Highly Probable	4	Medium Term	3	Site	2	Medium	6	44	Moderate
Terrestrial Biodiversity													
Planning Phase													
Fauna & Flora	Delay of mining onset	WOM	Negative	Definite	5	Short Term	1	Local	1	High	8	50	Moderate
Fauna & Flora	Delay of WRD construction	WOM	Negative	Definite	5	Short Term	1	Local	1	Low	2	20	Negligible

[67] Required as per the EIA regulations Appendix 2 (g) a full description of the process followed to reach the proposed preferred activity, site and location of the development footprint within the site, including (v) the impacts and risks which have informed the identification of each alternative, including the nature, significance, consequence, extent, duration and probability of such identified impacts, including the degree to which these impacts (aa) can be reversed; (bb) may cause irreplaceable loss of resources; and (cc) can be avoided, managed or mitigated

[68] Appendix 2 of the EIA Regulations of 2014 (as amended) and the template as provided by the DMRE requires that the impacts and risk of each alternative including the nature, significance, consequence, extent, duration and probability of such identified impacts, including the degree to which these can be reversed; may cause irreplaceable loss of resources; and can be avoided, managed or mitigated, be included to the Scoping Report. TAKE NOTE – the preliminary impacts, mitigation measures and associated reporting are subject to being updated during the EIA phase subsequent to further and more detailed specialist studies being conducted as may be required or as new information becomes available (these being for scoping purposes at present). The impacts below were stated without mitigation measures being taken into account. The potential for residual risk with mitigation will only be established during the EIA Phase once all the specialist studies have been completed. The reason for including an impact statement is to identify which aspects need to be investigated further in the EIA Phase by means of specialist studies and to identify mitigation measures in order to reduce the significance of the impact identified during the Scoping Phase.

Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Probability		Duration		Scale		Magnitude/ Severity		Significance	
				Magnitude	Score	Magnitude	Score	Magnitude	Score	Magnitude	Score	Score	Magnitude
Construction Phase													
Fauna & Flora	Habitat destruction / fragmentation of fauna habitats	WOM	Negative	Definite	5	Permanent	5	Site	2	High	8	75	High
Fauna & Flora	Soil erosion and sedimentation	WOM	Negative	Definite	5	Permanent	5	Site	2	High	8	75	High
Flora	Spreading and establishment of alien invasive species	WOM	Negative	Highly Probable	4	Permanent	5	Site	2	High	8	60	Moderate
Flora & Fauna	Habitat degradation due to dust	WOM	Negative	Definite	5	Long term	4	Regional	3	High	8	75	High
Fauna & Flora	Spillages of harmful substances	WOM	Negative	Highly Probable	4	Long term	4	Regional	3	Medium	6	52	Moderate
Fauna	Road mortalities of fauna / impact of human activities on site	WOM	Negative	Highly Probable	4	Long term	4	Regional	3	Medium	6	52	Moderate
Operational Phase													
Fauna & Flora	Habitat destruction / fragmentation of fauna habitats	WOM	Negative	Definite	5	Permanent	5	Regional	3	High	8	80	High
Flora	Soil erosion and sedimentation	WOM	Negative	Definite	5	Permanent	5	Regional	3	High	8	80	High
Flora	Spreading and establishment of alien invasive species	WOM	Negative	Highly Probable	4	Permanent	5	Site	2	Medium	6	52	Moderate
Flora & Fauna	Habitat degradation due to dust	WOM	Negative	Definite	5	Long term	4	Regional	3	High	8	75	High
Flora	Spillages of harmful substances	WOM	Negative	Highly Probable	4	Long term	4	Regional	3	Medium	6	52	Moderate
Fauna	Road mortalities of fauna / impact of human activities on site	WOM	Negative	Highly Probable	4	Long term	4	Regional	3	Medium	6	52	Moderate
Closure and Decommissioning Phase													
Fauna & Flora	Improvement of habitat through revegetation / succession over time	WOM	Positive	Highly Probable	4	Long term	4	Local	1	Low	2	28	Low
Flora	Soil erosion and sedimentation	WOM	Negative	Highly Probable	4	Long term	4	Site	2	Medium	6	48	Moderate
Flora	Spreading and establishment of alien invasive species	WOM	Negative	Highly Probable	4	Long term	4	Site	2	Medium	6	48	Moderate
Fauna & Flora	Habitat degradation due to dust	WOM	Negative	Highly Probable	4	Long term	4	Site	2	High	8	56	Moderate
Fauna & Flora	Spillages of harmful substances	WOM	Negative	Highly Probable	4	Medium term	3	Regional	3	Medium	6	48	Moderate
Fauna	Road mortalities of fauna / impact of human activities on site	WOM	Negative	Highly Probable	4	Long term	4	Regional	3	Medium	6	52	Moderate
Post-Closure & Rehabilitation Phase													
Fauna & Flora	Improvement of habitat through revegetation / succession over time	WOM	Positive	Highly Probable	4	Long term	4	Local	1	Low	2	28	Low
Flora	Soil erosion and sedimentation	WOM	Negative	Highly Probable	4	Medium term	3	Site	2	Medium	6	44	Moderate
Flora	Spreading and establishment of alien invasive species	WOM	Negative	Highly Probable	4	Medium term	3	Site	2	Medium	6	44	Moderate
Wetland & Riparian													
Planning Phase													
Rivers / watercourses	Delay of mining onset	WOM	Negative	Definite	5	Short term	1	Local	1	High	8	50	Moderate
Construction Phase													
Rivers / watercourses	Riverine destruction / fragmentation of riparian habitats	WOM	Negative	Highly probable	4	Long term	4	Local	1	Medium	6	44	Moderate
Rivers / watercourses	Soil erosion and sedimentation	WOM	Negative	Definite	5	Permanent	5	Site	2	High	8	75	High
Rivers / watercourses	Potential establishment and spread of declared weeds and alien invader plants in rivers / watercourses	WOM	Negative	Highly probable	4	Permanent	5	Site	2	High	8	60	Moderate
Water quality in permanent watercourses	Spillages of harmful substances	WOM	Negative	Highly probable	4	Medium term	3	Regional	3	Medium	6	48	Moderate
Operational Phase													
Wetlands / watercourses	Soil erosion and sedimentation in wetland / watercourses	WOM	Negative	Definite	5	Permanent	5	Regional	3	High	8	80	High

Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Probability		Duration		Scale		Magnitude/ Severity		Significance	
				Magnitude	Score	Magnitude	Score	Magnitude	Score	Magnitude	Score	Score	Magnitude
Wetlands / watercourses	Spreading and establishment of alien invasive species in rivers	WOM	Negative	Highly Probable	4	Permanent	5	Site	2	Medium	6	52	Moderate
Wetlands / watercourses	Spillages of harmful substances leading to water pollution in rivers	WOM	Negative	Highly Probable	4	Long term	4	Regional	3	Medium	6	52	Moderate
Decommissioning Phase													
Wetlands / watercourses	Improvement of riparian habitat through revegetation / succession over time	WOM	Positive	Highly probable	4	Long term	4	Local	1	Low	2	28	Low
Wetlands / watercourses	Soil erosion and sedimentation in rivers	WOM	Negative	Highly probable	4	Long term	4	Regional	3	Medium	6	52	Moderate
Wetlands / watercourses	Spreading and establishment of alien invasive species in rivers	WOM	Negative	Highly probable	4	Long term	4	Regional	3	Medium	6	52	Moderate
Wetlands / watercourses	Spillages of harmful substances	WOM	Negative	Highly probable	4	Medium term	3	Regional	3	Medium	6	48	Moderate
Closure and Post-Closure Phase													
Wetlands / watercourses	Improvement of wetland habitat at crossings through revegetation / succession over time	WOM	Positive	Highly probable	4	Long term	4	Local	1	Low	2	28	Low
Wetlands / watercourses	Soil erosion and sedimentation	WOM	Negative	Highly probable	4	Medium term	3	Site	2	Medium	6	44	Moderate
Wetlands / watercourses	Spreading and establishment of alien invasive species	WOM	Negative	Highly probable	4	Medium term	3	Site	2	Medium	6	44	Moderate
Hydrogeological													
Construction Phase													
Hydrogeological	Contamination to groundwater systems and surface runoff	WOM	Negative	Highly Probable	4	Medium term	3	Site	2	Medium	6	44	Moderate
Hydrogeological	Contamination to groundwater systems through baseflow and surface runoff	WOM	Negative	Highly Probable	4	Medium term	3	Site	2	Medium	6	44	Moderate
Operational Phase													
Hydrogeological	Contamination to baseflow and groundwater systems	WOM	Negative	Highly Probable	4	Long term	4	Site	2	Medium	6	48	Moderate
Hydrogeological	Contamination to groundwater and surface water systems	WOM	Negative	Highly Probable	4	Long term	4	Regional	3	Medium	6	52	Moderate
Hydrogeological	Contamination to groundwater and surface water (Sterkstroom) systems	WOM	Negative	Highly Probable	4	Long term	4	Regional	3	Medium	6	52	Moderate
Closure and Post closure													
Hydrogeological	Contamination to groundwater and surface water (Sterkstroom) systems	WOM	Negative	Highly Probable	4	Long term	4	Regional	3	Medium	6	52	Moderate
Heritage													
Construction Phase													
Burial Sites / Graves (TWRD-BP01) if site was not previously relocated	Damage/destruction of sites, potential loss of human burial sites	WOM	Negative	Definite	5	Permanent	5	Local	1	High	8	70	High
Built Environment Heritage Features (TWRD-HP01, TWRD-HP02)	Damage/destruction of sites	WOM	Negative	Highly Probable	4	Short term	1	Local	1	Low	2	16	Negligible
Operational Phase													
Burial Sites / Graves (TWRD-BP01) if site was not previously relocated	Damage/destruction of sites, potential loss of human burial sites	WOM	Negative	Improbable	1	Long term	4	Site	2	Low	2	8	Negligible
Built Environment Heritage Features (TWRD-HP01, TWRD-HP02)	Damage/destruction of sites	WOM	Negative	Probable	2	Long term	4	Site	2	Low	2	16	Negligible
Closure and Post closure													
Burial Sites / Graves (TWRD-BP01) if site was not previously relocated	Damage/destruction of sites, potential loss of human burial sites	WOM	Negative	Improbable	1	Long term	4	Site	2	Medium	6	12	Negligible
Built Environment Heritage Features (TWRD-HP01, TWRD-HP02)	Damage/destruction of sites	WOM	Negative	Probable	2	Long term	4	Regional	3	Low	2	18	Negligible
Air Quality													
Construction Phase													

Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Probability		Duration		Scale		Magnitude/ Severity		Significance	
				Magnitude	Score	Magnitude	Score	Magnitude	Score	Magnitude	Score	Score	Magnitude
Air Quality	Vehicle entrainment of dust, wind erosion	WOM	Negative	Definite	5	Short Term	1	Local	1	Medium	6	40	Low
Operational Phase													
Air Quality	Dust emissions from material off-loading onto the WRD, disturbances by strong wind currents and dust from the movement of haul trucks	WOM	Negative	Definite	5	Long Term	4	Local	1	Medium	6	55	Moderate
Closure and Post closure													
Air Quality	Vehicle entrainment of dust, windblown dust from WRD. Post-closure should not result in significant air quality impacts provided the WRD has been fully vegetated and rehabilitated	WOM	Negative	Definite	5	Short Term	1	Local	1	Medium	6	40	Low
Noise													
Construction Phase													
Noise	Nuisance and health risks caused by an increase in the ambient noise level as a result of noise impacts associated with the construction of the TSF 3 WRD Extension 1	WOM	Negative	Probable	2	Medium term	3	Site	2	Medium	6	22	Low
Operational Phase													
Noise	Nuisance and health risks caused by an increase in the ambient noise level as a result of noise impacts associated with the operation of the TSF 3 WRD Extension 1	WOM	Negative	Highly Probable	4	Long term	4	Site	2	Medium	6	48	Moderate
Closure and Post closure													
Noise	Nuisance and health risks caused by an increase in the ambient noise level as a result of noise impacts associated with the closure and rehabilitation of the TSF 3 WRD Extension 1	WOM	Negative	Probable	2	Medium term	3	Site	2	Medium	6	22	Low
Visual													
Construction Phase													
Physical (visual) presence	Change to the visual environment observed by sensitive receptors. No sense of place impact	WOM	Negative	Probable	2	Medium term	3	Regional	3	Low	2	16	Negligible
Operational Phase													
Physical (visual) presence	Change to the visual environment observed by sensitive receptors. No sense of place impact	WOM	Negative	Probable	2	Long term	4	Regional	3	Medium	6	26	Low
Closure and Post closure													
Physical (visual) presence	Improvement of the visual quality (over operational baseline) of the project area visible from nearby residential receptors as well as public roads	WOM	Negative	Probable	2	Medium term	3	Regional	3	Low	2	16	Negligible
Socio- Economic													
Construction Phase													
Economic	Temporary increase in production and GDP in the local economy	WOM	Positive	Definite	5	Medium term	3	Regional	3	Low	2	40	Low
Socio-economic	Creation of temporary employment opportunities on-site- although mosntly current workforce to be used	WOM	Positive	Definite	5	Medium term	3	Regional	3	Low	2	40	Low
Social	Deterioration of quality of life due to dust, noise, visual, water supply, water pollution and other environmental impacts	WOM	Negative	Highly Probable	4	Medium term	3	Site	2	Low	2	28	Low

Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Probability		Duration		Scale		Magnitude/ Severity		Significance	
				Magnitude	Score	Magnitude	Score	Magnitude	Score	Magnitude	Score	Score	Magnitude
Social	Temporary increase in crime associated with the influx of people	WOM	Negative	Highly Probable	4	Medium term	3	Site	2	Medium	6	44	Moderate
Social	Degradation of the natural environment resulting in impacts on ecosystem services	WOM	Negative	Definite	5	Medium term	3	Site	2	Low	2	35	Low
Operational Phase													
Economic	Long-term increase in production and GDP in the local economy	WOM	Positive	Definite	5	Long term	4	Regional	3	Low	2	45	Moderate
Socio-economic	Creation of permanent employment opportunities in the local and regional economy	WOM	Positive	Definite	5	Long term	4	Regional	3	Low	2	45	Moderate
Social	Deterioration of quality of life due to dust, noise, visual, water supply, water pollution and other environmental impacts	WOM	Negative	Highly Probable	4	Long term	4	Local	1	Low	2	28	Low
Social	Degradation of the natural environment resulting in impacts on ecosystem services	WOM	Negative	Definite	5	Long term	4	Site	2	Low	2	40	Low
No-Go Alternative													
Socio-economic	No increase in production, GDP and employment in the local economy	WOM	Negative	Probable	2	Permanent	5	Regional	3	Low	2	20	Negligible

14 METHODOLOGY USED IN INDENTIFYING AND RANKING ENVIRONMENTAL IMPACTS[69]

14.1 IMPACT ASSESSMENT

The EIA 2014 Regulations (as amended) promulgated in terms of Sections 24 (5), 24(m) and 44 of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (as amended) (NEMA), require that all identified potential impacts associated with the project be assessed in terms of their overall potential significance on the natural, social and economic environments. The criteria identified in the EIA Regulations (2014) (as amended) include the following:

- Nature of the impact;
- Extent of the impact;
- Duration of the impact
- Probability of the impact occurring;
- Degree to which impact can be reversed;
- Degree to which impact may cause irreplaceable loss of resources;
- Degree to which the impact can be mitigated; and
- Cumulative impacts.

The significance of the aspects/impacts of the process will be rated by using a matrix derived from Plomp (2004) and adapted to some extent to fit this process. These matrices use the consequence and the likelihood of the different aspects and associated impacts to determine the significance of the impacts.

Table 45: Definitions of Factors Used to Determine Impact Significance

Aspect	Description	Weight
Probability: This describes the likelihood of the impact actually occurring.		
Improbable:	The possibility of the impact occurring is very low, due to the circumstances, design or experience.	1
Probable:	There is a probability that the impact will occur to the extent that provision must be made therefore.	2
Highly Probable:	It is most likely that the impact will occur at some stage of the development.	4
Definite:	The impact will take place regardless of any prevention plans, and there can only be relied on mitigatory actions or contingency plans to contain the effect.	5
Duration: The lifetime of the impact		

[69] Required as per the EIA regulations Appendix 2 (g) a full description of the process followed to reach the proposed preferred activity, site, and location of the development footprint within the site, including (vi) the methodology used in identifying and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks associated with the alternatives

Aspect	Description	Weight
Short term:	The impact will either disappear with mitigation or will be mitigated through natural processes in a time span shorter than any of the phases.	1
Medium term:	The impact will last up to the end of the phases, where after it will be negated.	3
Long term:	The impact will last for the entire operational phase of the project but will be mitigated by direct human action or by natural processes thereafter.	4
Permanent:	Impact that will be non-transitory. Mitigation either by man or natural processes will not occur in such a way or in such a time span that the impact can be considered transient.	5
Scale: The physical and spatial size of the impact		
Local:	The impacted area extends only as far as the activity, e.g. footprint	1
Site:	The impact could affect the whole, or a measurable portion of the above-mentioned properties.	2
Regional:	The impact could affect the area including the neighbouring residential areas.	3
Magnitude/Severity:. Does the impact destroy the environment or alter its function.		
Low:	The impact alters the affected environment in such a way that natural processes are not affected.	2
Medium:	The affected environment is altered, but functions and processes continue in a modified way.	6
High:	Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.	8
Significance: This is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. ***Calculated as = Sum (Duration, Scale, Magnitude) x Probability***		
Negligible:	The impact is non-existent or unsubstantial and is of no or little importance to any stakeholder and can be ignored.	<20
Low:	The impact is limited in extent, has low to medium intensity; whatever its probability of occurrence is, the impact will not have a material effect on the decision and is likely to require management intervention with increased costs.	<40
Moderate:	The impact is of importance to one or more stakeholders, and its intensity will be medium or high; therefore, the impact may materially affect the decision, and management intervention will be required.	<60
High:	The impact could render development options controversial or the project unacceptable if it cannot be reduced to acceptable levels; and/or the cost of management intervention will be a significant factor in mitigation.	>60

14.2 IMPACT MITIGATION HIERARCHY

The Impact Mitigation Hierarchy is a tool which is used reiteratively throughout a project lifecycle to avoid impacts and, if unavoidable, minimise and mitigate such impacts whilst maximising positive effects, with the purpose of maintaining the interdependent sustainability requirements for biophysical system integrity and basic human well-being, avoiding inappropriate trade-offs that result in the loss of essential ecosystem functioning. The first tier considers how to avoid the impact entirely and is considered early in the project lifecycle to allow for alternatives to be considered. The impacts which cannot be avoided should be minimised, reduced or rectified in a manner which will achieve sustainability objectives and targets. If impacts cannot be avoided, minimised, reduced (over time), or rectified, consideration can be given to the implementation of offsets, depending on the significance of such impacts. Offsets are therefore only to be used in exceptional circumstances to compensate for residual impacts caused by development projects, whether these are unavoidable societal impacts, harm to ecosystem functioning or the loss of biodiversity.

However, the consideration of offsets is only appropriate if an impact mitigation hierarchy approach has been followed in the assessment and management of impacts. The need for offsets must also be evaluated against the achievement of sustainability objectives, indicators and targets. A proposed offset should be stated explicitly, and reasoned motivations should be provided in support of the application of offsets to inform decision-making (DEA, 2014). At this stage in the project all impacts have been reduced/minimised and or avoided all together. Therefore no offsets or other actions are required outside of the management measures proposed in **Table 46**.

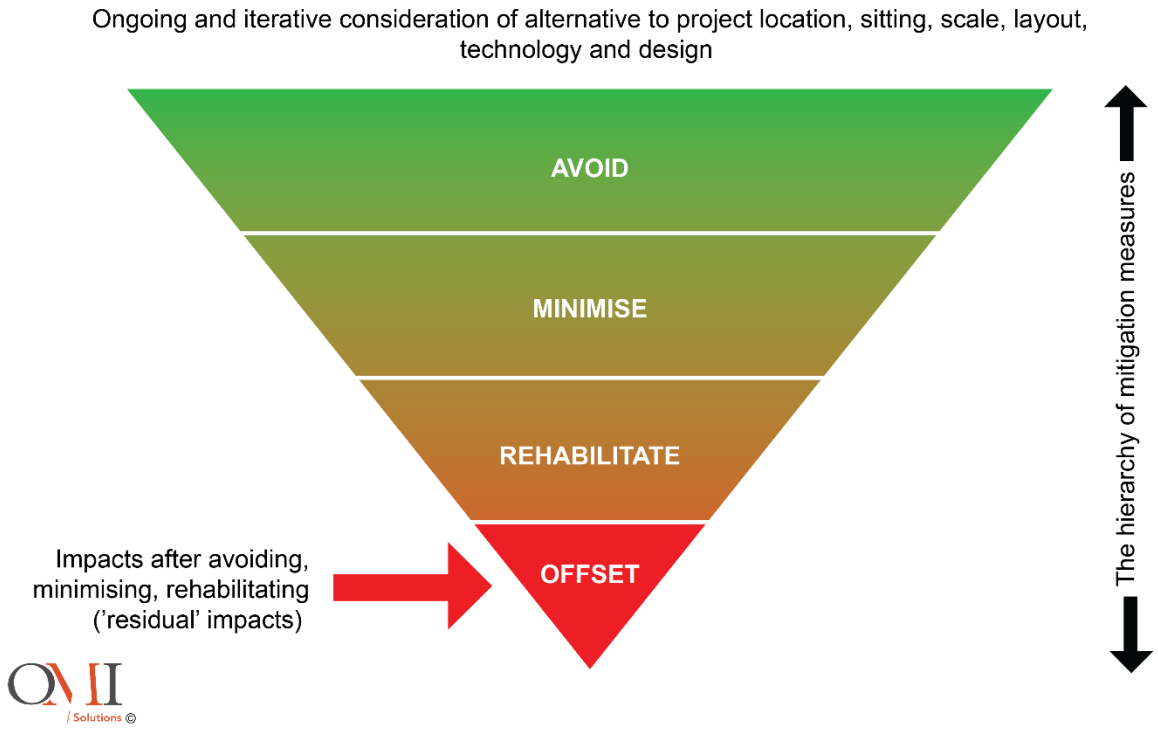


Figure 73: Levels of the Impact Mitigation Hierarchy

15 THE POSITIVE AND NEGATIVE IMPACTS AND RISKS THAT THE PROJECT WILL HAVE ON THE ENVIRONMENT AND THE COMMUNITY THAT MAY BE AFFECTED THAT INFORMED THE IDENTIFICATION OF EACH ALTERNATIVE[70]

Refer to the Alternatives Assessment discussion in **Section 8** for the advantages and disadvantages of the site layout alternative options considered. An assessment of preliminary impacts identified for the proposed mining development was undertaken in **Table 44**.

[70] Required as per the EIA regulations Appendix 2 (g) a full description of the process followed to reach the proposed preferred activity, site and location of the development footprint within the site, including (vii) positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community that may be affected focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;

16 THE POSSIBLE MITIGATION MEASURES THAT COULD BE APPLIED AND THE LEVEL OF RISK[71]

Table 46: Preliminary Mitigation Measures[72]

Activity	Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Significance	Management Objective	Management Measures	Mitigation Effect
					Magnitude			
Agro-Ecosystem								
Planning Phase								
Siting of WRD on sensitive soils and close to watercourses	Soils and land capability	Delay of mining onset	WOM	Negative	Low	• Obtaining of IWUL for WRD close to water course • Strategic siting of mine infrastructure	• Apply and obtain IWUL from DWS after liaison with relevant officials and site visit to the area. • Siting of WRD on least sensitive areas	Can be avoided, managed or mitigated
Construction Phase								
Topsoil & subsoil stripping	Soils and land capability	Soil destruction and sterilisation	WOM	Negative	High	• Prevent edge effects. • Keep WRD footprint restricted to layout plans	• Conservation of topsoil should be ategorized on site and done as follows: o The topsoil needs to be stockpiled separately from the waste rock to preserve soil organisms and propagules; o Topsoil should only be harvested, handled and spread during the autumn and winter (March to August). Handling wet topsoil dramatically reduces soil beneficial properties and further damages soil structure due to increased compaction; o Topsoil stockpiles should not exceed a height of 2 meters where possible. The topsoil outer layer should also be protected from wind erosion using wind nets and soil binders. If topsoil needs to be stockpiled for longer than 12 months, seeding will improve long term stability and help to keep the soil in an active state; o Topsoil stockpile heights more than 5 meters and duration of storage until the end of the mining operations will likely destroy the bulk of propagates and most of the soil microbes. This can be countered by ensuring proper rehabilitation of the stockpile itself and additional augmentation of the rehabilitated areas where the stored topsoil will finally be placed. To reduce the risk of degrading the topsoil when placed in a single large topsoil stockpile and to prevent cross zoning of soils	Can be reversed

[71] Required as per the EIA regulations Appendix 2 (g) a full description of the process followed to reach the proposed preferred activity, site and location of the development footprint within the site, including (viii) the possible mitigation measures that could be applied and level of residual risk

[72] Note that the above mitigation measures are subject to being updated during the EIA phase subsequent to further and more detailed work being conducted as may be required or as new information becomes available (these being for scoping purposes at present). Monitoring is listed as part of the mitigation measures; however it must be noted that monitoring in itself is not a mitigation measure. Monitoring is important to quantify and verify impacts against pre-development baseline and must be used to pro-actively determine when mitigations should be required.

Activity	Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Significance	Management Objective	Management Measures	Mitigation Effect
					Magnitude			
							from different vegetation types, it is recommended that topsoil originating from different areas should be stored separately during the operational phase. Dust suppression would likely be a priority. It is recommended that topsoil from stockpiles more than 5 meters be used first for concurrent rehabilitation; ○ Double handling of topsoil must be avoided as far as possible. Double handling will severely damage the underground structures such as roots and bulbs that contribute significantly to effective rehabilitation; ○ Stockpile topsoil separately from subsoil; Stockpile in an area that is protected from storm water runoff and wind; Maintain topsoil stockpiles in a weed free condition; and Topsoil should not be compacted in any way, nor should any object be placed or stockpiled upon it.	
Heavy machinery and vehicle movement to and on WRD and topsoil facilities	Soils and land capability	Soil compaction	WOM	Negative	High	• Prevent edge effects • Keep WRD footprint restricted to layout plans • To limit soil loss and compaction	• Soil should be handled when dry during removal and placement to reduce the risk of compaction. • Vegetation (grass and small shrubs) should not be cleared from the site prior to mining activities or construction (except if vegetation requires relocation as determined through an ecology assessment) • During construction, sensitive soils with high risk of compaction (e.g., clayey soils) must be avoided by construction vehicles and equipment, wherever possible, to reduce potential impacts. Only necessary damage must be caused and, for example, unnecessary driving around in the veld or bulldozing natural habitat must not take place • Rip and/or scarify all compacted areas. Do not rip and/or scarify areas under wet conditions, as the soil will not loosen. Compacted soil can also be decompacted by “Rotary Decompactors” to effectively aerate soils for vegetation establishment	Can be reversed
Topsoil & subsoil stripping, exposure of soils to wind and rain during construction causing erosion and sedimentation of watercourses	Soils and land capability	Soil erosion and sedimentation	WOM	Negative	High	• To prevent the loss of soil through the expansion of the WRD • To prevent the loss of topsoil capability during stockpiling • To prevent the contamination of soils due to	• Cover disturbed soils as completely as possible, using vegetation or other materials • Minimize the amount of land disturbance and develop and implement stringent erosion and dust control practices • Sediment trapping, erosion and storm water control should be addressed by a hydrological engineer in a detailed storm water management plan	Can be avoided, managed or mitigated

Activity	Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Significance	Management Objective	Management Measures	Mitigation Effect
					Magnitude			
						spillages of reagents • To prevent soil erosion	• All aspects related to dust and air quality should be addressed by an air quality specialist in a specialist report • Protect sloping areas and drainage channel banks that are susceptible to erosion and ensure that there is no undue soil erosion resultant from activities within and adjacent to the construction camp and Work Areas • Repair all erosion damage as soon as possible to allow for sufficient rehabilitation growth • Gravel roads must be well drained to limit soil erosion	
Heavy machinery and vehicle movement on site	Soils and land capability	Spillages of harmful substances	WOM	Negative	Moderate	• To prevent contamination of soil due to the spillages of hydrocarbons and reagents used in the process and during transportation of these substances • To reduce the risk of contamination of soils due to increased fuel deliveries	• Ensure that mining related waste or spillage and effluent do not affect the sensitive habitat boundaries and associated buffer zones • This risk of spillages of reagents and hydrocarbons on the soil during transportation can be reduced with proper maintenance of vehicles. This would include a rigorous and proactive maintenance program • This risk can be further reduced through an adequate program of training of drivers and crews. This would include defensive driver training, basic vehicle maintenance, and emergency control of spills. For the vehicle crews to be adequately able to control any spills at an early stage, the vehicles must be properly equipped with spill containment equipment (booms, sandbags, spades, absorbent pads, etc.). Responsibility for training lies with the transport contractor. Adequate training, maintenance, and equipment of transport crews should be included as a requirement for transport contracts • Hydrocarbons should be stored in a concrete lined and bermed facility that has been designed to contain 110% of the volume of the tanks in the event of a spill. This eliminates the potential impacts to soils from spills of hydrocarbons • All employees will be trained in cleaning up of a spillage. The necessary spill kits containing the correct equipment to clean up spills will be made available at strategic points in the plant area	Can be avoided, managed or mitigated
Topsoil & subsoil stripping, clearing of vegetation for establishment of WRD	Soils and land capability	Loss of land capability	WOM	Negative	High	• Prevent edge effects • Keep WRD footprint restricted to layout plans	• No specific mitigation can be applied during the construction phase itself to prevent loss of land capability considering that the land use will change to industrial. This, however, does not prevent the mine from ensuring that disturbance and clearing should be confined to the footprint areas of the WRD and not over the larger area. This can be done in the following ways:	Can be reversed

Activity	Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Significance	Management Objective	Management Measures	Mitigation Effect
					Magnitude			
							○ Clearly demarcate the entire WRD footprint prior to initial site clearance and prevent construction personnel from leaving the demarcated area. This could be done through the fencing off the entire footprint and instituting strict access control to the areas that are to remain undisturbed as soon as possible after initial site clearance. ○ All activities associated with the WRD should be restricted to specific recommended areas and strict buffer zones should be applied around the sensitive areas. The Environment Control Officer (ECO) should demarcate and control these areas. Unnecessary bulldozing through the veld should be avoided	
Operational Phase								
Topsoil & subsoil stripping, WRD laydown area	Soils and land capability	Soil destruction and sterilisation	WOM	Negative	High	Refer to Construction Phase objectives	• The most desired approach during all the mining phases is to continually rehabilitate the soils to the best possible state – considering the current technology and knowledge available as well as the financial means to conduct such rehabilitation. The rehabilitation of soils to pre-mining conditions is basically impossible though • Refer to mitigation measures for similar impacts during the construction phase	N/A
Heavy machinery and vehicle movement to and on WRD and topsoil facilities	Soils and land capability	Soil compaction	WOM	Negative	High	Refer to Construction Phase objectives	• During operation, sensitive soils with high risk of compaction (e.g., clayey soils) must be avoided by vehicles and equipment, wherever possible, to reduce potential impacts. Only necessary damage must be caused and, for example, unnecessary driving around in the veld or bulldozing natural habitat must not take place. Vehicles should also stick to existing haul roads when dumping of waste rock and topsoil are done • Rip and/or scarify all compacted areas on a continuous basis. Do not rip and/or scarify areas under wet conditions, as the soil will not loosen. Compacted soil can also be decompacted by “Rotary Decompactors” to effectively aerate soils for vegetation establishment • Refer to mitigation measures that are for similar for impacts during the construction phase	Can be reversed
Increased hardened surfaces around infrastructure, laydown areas of waste rock	Soils and land capability	Increased soil erosion and sedimentation of watercourses	WOM	Negative	High	Refer to Construction Phase objectives	• Rehabilitation: revegetate or stabilize all disturbed areas as soon as possible • The vegetative (grass) cover on the soil stockpiles (berms) must be continually monitored to maintain a high basal cover. Such maintenance will limit soil erosion by both the mediums of water (runoff) and wind (dust) • Refer to mitigation measures for similar impacts during the construction phase	Can be avoided, managed or mitigated

Activity	Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Significance	Management Objective	Management Measures	Mitigation Effect
					Magnitude			
Heavy machinery and vehicle movement on site.	Soils and land capability	Spillages of harmful substances resulting in soil pollution	WOM	Negative	Moderate	Refer to Construction Phase objectives	• Vehicle maintenance only done in designated areas – spill trays, sumps to be used and managed according to the correct procedures • Vehicles and machines must be maintained properly to ensure that oil spillages are kept to a minimum • Fuel and oil storage facilities should be bunded with adequate storm water management measures • Operational and Maintenance plan and schedule for management of sewage facilities should be compiled. An emergency plan should be compiled to deal with system failures and should include a down-stream notification procedure • Routine checks should be done on all mechanical instruments for problems such as leaks, overheating, vibration, noise or any other abnormalities. All equipment should be free of obstruction, be properly aligned and be moving at normal speed. Mechanical maintenance must be according to the manufacturer's instructions • Refer to mitigation measures for similar impacts during the construction phase	Can be avoided, managed or mitigated
Establishment of WRD	Soils and land capability	Loss of land capability	WOM	Negative	High	Refer to Construction Phase objectives	Refer to mitigation measures for similar impacts during the construction phase	Can be reversed
Closure and Decommissioning Phase								
Rehabilitation of mining site	Soils and land capability	Improvement of eroded soils and compaction	WOM	Positive	Low	• To ensure that the mining areas rehabilitated according to prescriptions • To shape and prepare the rehabilitation areas to blend in with the surrounding environment • To rehabilitate all disturbed areas to a suitable post closure land use • To manage the social impact of closure on personnel who became redundant due to closure • To keep all the post closure monitoring in place and to ensure that the necessary	• Plant vegetation species for rehabilitation that will effectively bind the loose material, and which can absorb run-off from the mining areas • Monitor the establishment of the vegetation cover on the rehabilitated WRD to the point where it is self-sustaining • Protect rehabilitated areas until the area is self-sustaining • Diversion trenches and storm water measures must be maintained • Water management facilities will stay operational and maintained and monitored until such a stage is reached where it is no longer necessary • All the monitoring and reporting on the management and rehabilitation issues to the authorities will continue till closure of the mine is approved • Refer to mitigation measures for the construction and operational phases needed during the decommissioning & closure phase that are similar	N/A

Activity	Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Significance	Management Objective	Management Measures	Mitigation Effect
					Magnitude			
						reporting is done to the authorities and interested and affected parties		
Cessation of mining / Rehabilitation of WRD	Soils and land capability	Increased soil erosion and sedimentation	WOM	Negative	Moderate	Refer to Construction Phase objectives	Refer to mitigation measures for the construction and operational phases needed during the decommissioning & closure phase for similar impacts	Can be avoided, managed or mitigated
Rehabilitation of WRD, heavy machinery and vehicle movement on site	Soils and land capability	Soil compaction	WOM	Negative	Moderate	Refer to Construction Phase objectives	• During closure, sensitive soils with high risk of compaction (e.g., clayey soils) must be avoided by vehicles wherever possible, to reduce potential impacts. Only necessary damage must be caused and, for example, unnecessary driving around in the veld or bulldozing natural habitat must not take place • Rip and/or scarify all compacted areas on a continuous basis. Do not rip and/or scarify areas under wet conditions, as the soil will not loosen. Compacted soil can also be decompacted by "Rotary Decompactors" to effectively aerate soils for vegetation establishment. Other soil rehabilitation measures are discussed in section 11 of the Agro-Ecosystem Report (AGES, 2023a) • Soil should be sampled and analysed prior to replacement during rehabilitation. If necessary, and under advisement from a suitably qualified restoration ecologist, supplemental fertilization may be necessary • Refer to mitigation measures for the construction and operational phases needed during the decommissioning & closure phase for similar impacts	Can be reversed
Rehabilitation of WRD, heavy machinery and vehicle movement on site	Soils and land capability	Spillages of harmful substances resulting in soil pollution	WOM	Negative	Moderate	Refer to Construction Phase objectives	Refer to mitigation measures for the construction and operational phases needed during the decommissioning & closure phase for similar impacts	Can be avoided, managed or mitigated
Closure and Post closure								
Rehabilitation / Natural processes	Soils and land capability	Improvement of land capability	WOM	Positive	Low	Refer to Construction Phase objectives	• Once mining activities have ceased, the WRD should be rehabilitated, and vegetation will colonize the dump after dump have been covered with topsoil and reseeded. The rehabilitation of the soils and revegetation is discussed in section 11 of the Agro-Ecosystem Report (AGES, 2023a) • Refer to mitigation measures for the other mining phases needed during the closure phase that are relevant	N/A
Exposed surfaces / unrehabilitated areas on site post closure / poor monitoring during LoM	Soils and land capability	Soil erosion and sedimentation	WOM	Negative	Moderate	Refer to Construction Phase objectives	Rehabilitation	Can be avoided, managed or mitigated
Terrestrial Biodiversity								
Planning Phase								
Obtaining of IWUL establishment of WRD and location of WRD with zone of regulation of watercourses	Fauna & Flora	Delay of mining onset	WOM	Negative	Moderate		Apply and obtain IWUL from DWS after liaison with relevant officials and site visit to the area	Can be avoided, managed or mitigated

Activity	Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Significance	Management Objective	Management Measures	Mitigation Effect
					Magnitude			
Obtaining permits for the eradication of protected trees / flora	Fauna & Flora	Delay of WRD construction	WOM	Negative	Negligible		Apply and obtain permits from DFFE after liaison with relevant officials and follow-up site visit to the area	Can be avoided, managed or mitigated
Construction Phase								
Clearing of vegetation for WRD construction, access roads etc. causing direct habitat destruction / fragmentation	Fauna & Flora	Habitat destruction / fragmentation of fauna habitats	WOM	Negative	High	<u>Habitat Destruction</u>: • Prevent edge effects • Keep WRD footprint restricted to layout plans • To limit the habitat loss due to the increase of the mining footprint <u>Habitat Fragmentation:</u> • To limit the impact on wildlife habitat • To limit the loss in carrying capacity • To prevent negative impact on fauna populations through infrastructure development	<u>Habitat Destruction:</u> • The removal of the isolated indigenous trees and shrubs should only occur on the construction footprint area of the development and not over the larger area. Where possible, vegetation should be retained in between infrastructural elements associated with the project • Conduct flora species search and rescue efforts before ground clearing begins to reduce negative impacts on species of concern • Remove and relocate any plants of botanical or ecological significance as indicated by the ecologist or Mine Environmental Control Officer (ECO) • No activity must take place within the 1:100 year floodline or the delineated riparian habitat, whichever is the greatest, or within 500 m radius from the boundary of any wetland unless authorised by a water use license • No activities that negatively affect catchment yield, hydrology and hydraulics must be practiced unless authorised • All construction activities should be conducted in such a way that minimal damage is caused to the water course's riparian zone. Only necessary damage must be caused and, for example, unnecessary driving around in the veld or bulldozing natural habitat must not take place. Where impacts are unavoidable a water use licence application should be submitted to the Department of Water & Sanitation • Construction should preferably take place in winter to reduce disturbance to breeding fauna and flowering flora • Clearly demarcate the entire development footprint prior to initial site clearance and prevent construction personnel from leaving the demarcated area • Monitoring should be implemented during the construction activities to ensure that minimal impact is caused to the watercourses of the area • Vegetation to be removed as it becomes necessary – do not clear the entire footprint simultaneously unless required • The Mine ECO should advise the construction team in all relevant matters to ensure minimum destruction and damage to the environment. The	May cause irreplaceable loss of resources

Activity	Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Significance	Management Objective	Management Measures	Mitigation Effect
					Magnitude			
							Mine ECO should enforce any measures that he/she deem necessary. Regular environmental training should be provided to construction workers to ensure the protection of the habitat, fauna and flora and their sensitivity to conservation • Where trenches pose a risk to animal safety, they should be cordoned off to prevent animals falling in and getting trapped and/or injured. This could be prevented by the constant excavating and backfilling of trenches during construction • Poisons for the control of problem animals should be avoided since the wrong use thereof can have disastrous consequences for the raptors occurring in the area. Poisons for the control of rats, mice or other vermin should only be used after approval from an ecologist <u>Habitat Fragmentation:</u> • Use existing facilities (e.g., access roads, graded areas) to the extent possible to minimise the amount of new disturbance • Ensure protection of important resources by establishing protective buffers to exclude unintentional disturbance. All efforts must be made to ensure as little disturbance as possible to the sensitive habitats such as ravines and moist grassland pockets during construction • During construction, sensitive habitats must be avoided by construction vehicles and equipment, wherever possible, to reduce potential impacts. Only necessary damage must be caused and, for example, unnecessary driving around in the veld or bulldozing natural habitat must not take place • Construction activities must remain within defined construction areas and the road servitudes. No construction / disturbance must occur outside these areas	
Topsoil & subsoil stripping, exposure of soils and rock to wind and rain during construction causing erosion and sedimentation	Fauna & Flora	Soil erosion and sedimentation	WOM	Negative	High	• To prevent the loss of soil through the development of the WRD • To prevent the loss of topsoil capability during stockpiling • To prevent the contamination of soils due to spillages of reagents	• Sediment trapping, erosion and storm water control should be addressed by a hydrological engineer in a detailed storm water management plan • Steps must be taken to ensure that stormwater does not result in bank instability and excessive levels of silt entering the water course(s) • Stormwater must be diverted from construction works, access roads, linear infrastructure and must be managed in such a manner as to disperse runoff and to prevent the concentration of stormwater flow	May cause irreplaceable loss of resources

Activity	Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Significance	Management Objective	Management Measures	Mitigation Effect
					Magnitude			
						• To prevent soil erosion	• The velocity of stormwater discharges must be attenuated, and the banks of the watercourses protected • Cover disturbed soils as completely as possible, using vegetation or other materials • Minimise the amount of land disturbance and develop and implement stringent erosion and dust control practices • Protect sloping areas and drainage channel banks that are susceptible to erosion and ensure that there is no undue soil erosion resultant from activities within and adjacent to the construction camp and Work Areas. • Repair all erosion damage as soon as possible to allow for sufficient rehabilitation growth. • Structures must be non-erosive, structurally stable and must not induce any flooding or safety hazard • Structures must be inspected regularly for accumulation of debris, blockage, erosion of abutments and overflow areas – debris must be removed and damages must be repaired and reinforced immediately • Necessary erosion prevention mechanisms must be employed to ensure the sustainability of all structures and activities and to prevent in-stream sedimentation • Stockpiling of removed soil and sand must be stored outside of the 1:100 floodline and/or delineated riparian habitat and/or the regulated area of a water course, whichever is the greater, to prevent being washed into the channel and must be covered to prevent wind and rain erosion • Slope/bank stabilisation measures must be implemented with a 1:3 ratio or flatter and vegetated with indigenous vegetation immediately after the shaping • As much indigenous vegetation growth as possible should be promoted within the proposed TSF 3 WRD Extension 1 area to protect soil and to reduce the percentage of the surface area which is paved, hardened and/or compacted	
Vegetation clearing / vehicle movement	Flora	Spreading and establishment of alien invasive species	WOM	Negative	Moderate	To implement an alien invasive eradication programme to manage and control alien species on the mine	• Control involves killing the alien invasive plants present, killing the seedlings which emerge, and establishing and managing an alternative plant cover to limit re-growth and re-invasion. The control of these species should even begin prior to the construction phase considering that small populations of the Alien Invasive Species (AIS) occur around the site • Institute strict control over materials brought onto site, which should be inspected for seeds of	May cause irreplaceable loss of resources

Activity	Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Significance	Management Objective	Management Measures	Mitigation Effect
					Magnitude			
							noxious plants and steps taken to eradicate these before transport to the site. Routinely fumigate or spray all materials with appropriate low-residual herbicides prior to transport to site or in a quarantine area on site. The contractor is responsible for the control of weeds and invader plants within the construction site for the duration of the construction phase • Rehabilitate disturbed areas as quickly as possible to reduce the area where invasive species would be at a strong advantage and most easily able to establish • Institute a monitoring programme to detect alien invasive species early, before they become established and, in the case of weeds, before the release of seeds • Institute an eradication/control programme for early intervention if invasive species are detected, so that their spread to surrounding natural ecosystems can be prevented • A detailed plan should be developed for control of noxious weeds and invasive plants that could colonise the area because of new surface disturbance activities at the site. The plan should address monitoring, weed identification, the way weeds spread, and methods for treating infestations	
Vegetation clearing / vehicle movement	Flora & Fauna	Habitat degradation due to dust	WOM	Negative	High	• To reduce dust emission levels to acceptable norms in terms of aesthetics, health and annoyance • To implement a dust monitoring programme which will enable the mine to determine the impacts associated with its activities • To manage the operations in such a way as to ensure that the impact on the air quality is prevented and reduced	• Daily dampening of disturbed areas or other dust suppression methods such as dust-aside or more environmentally friendly methods • Re-vegetation of impacted areas is to be conducted on an on-going basis • Place dust generating activities where maximum protection can be obtained from natural features • Locating dust generating activities where prevailing winds will blow dust away from surrounding landowners • Minimise the need to transport and handle materials by placing adequate storage facilities close to processing areas • Minimise the re-handling of material which obviously has cost benefits as well • Exposed material should be protected from the wind by keeping it within voids or protecting it with topographical features where possible • Reduce the drop heights wherever practicable • Protect activities from wind by erecting a screen or using a natural barrier • All roads on site should be dampened or treated with a binding agent	May cause irreplaceable loss of resources

Activity	Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Significance	Management Objective	Management Measures	Mitigation Effect
					Magnitude			
							• The general vehicle speed should be restricted as there is a direct relationship between the speed and vehicle entrained emissions. Speed limit on site should be 40km/h and on provincial roads as per the speed limit indicated • Monitoring, modelling and emission measurements should be regarded as complementary components in any integrated approach to exposure assessment or determining compliance against air quality criteria	
Heavy machinery and vehicle movement on site	Fauna & Flora	Spillages of harmful substances	WOM	Negative	Moderate	• To prevent contamination of flora due to the spillages of hydrocarbons and reagents used in the process and during transportation of these substances • To reduce the risk of contamination of soils due to increased fuel deliveries	• Ensure that mining related waste or spillage and effluent do not affect the sensitive habitat boundaries and associated buffer zones • This risk of spillages of reagents and hydrocarbons on the soil during transportation can be reduced with proper maintenance of vehicles. This would include a rigorous and proactive maintenance program • This risk can be further reduced through an adequate program of training of drivers and crews. This would include defensive driver training, basic vehicle maintenance, and emergency control of spills. For the vehicle crews to be able to control any spills at an early stage, the vehicles must be properly equipped with spill containment equipment (booms, sandbags, spades, absorbent pads, etc.). Responsibility for training lies with the transport contractor. Adequate training, maintenance, and equipment of transport crews should be included as a requirement for transport contracts • All employees will be trained in cleaning up of a spillage. The necessary spill kits containing the correct equipment to clean up spills will be made available at strategic points • Pollution of and disposal/spillage of any material into the water course must be prevented, reduced, or otherwise remediated through proper operation, maintenance and effective protective measures. • Vehicles and other machinery must be serviced well outside the 1:100 year floodline or delineated riparian habitat, whichever is the greatest • Oils and other potential pollutants must be disposed of at an appropriate licenced site, with the necessary agreement from the management of such a site • Vehicles must be checked for oil leaks and all maintenance must take place at a designated site further than 32 meters from the boundary of the water course(s)	May cause irreplaceable loss of resources

Activity	Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Significance	Management Objective	Management Measures	Mitigation Effect
					Magnitude			
							• Any hazardous substances must be handled according to the relevant legislation relating to transport, storage and use of the substance and all storage facilities must be equipped with large, clearly readable material safety data sheets (MSDS) • All reagent storage tanks and reaction units must be supplied with a bunded area built to contain sufficient capacity of the facility and provided with sumps and pumps to return the spilled material back into the system. The system must be maintained in a state of good repair and standby pumps must be provided • Silt, litter and hydrocarbon (oil) traps must be installed to minimise the risk of pollutants entering the natural drainage system of the area. A register must be in place to indicate that oils are recovered/recycled or alternatively disposed at a licenced facility	
Heavy machinery and vehicle movement on site; construction of infrastructure, roads etc. on site	Fauna	Road mortalities of fauna / impact of human activities on site	WOM	Negative	Moderate	Prevent fauna mortalities because of vehicle movement	• More fauna are normally killed the faster vehicles travel. A speed limit should be enforced as determined by the mine environmental manager. It can be considered to install speed bumps in sections where the speed limit tends to be disobeyed. (Speed limits will also lessen the probability of road accidents and their negative consequences) • Travelling at night should be avoided or limited as much as possible. No travelling at night should be allowed without approval by the mine manager • Lights should be positioned 5m from the roads or paved areas	May cause irreplaceable loss of resources
Operational Phase								
Laydown areas of WRD and topsoil stockpile	Fauna & Flora	Habitat destruction / fragmentation of fauna habitats	WOM	Negative	High	Refer to Construction Phase objectives	<u>Habitat Destruction:</u> • Concurrent rehabilitation should occur during the operational phase on all exposed areas created by construction as well as roads, stockpiles and the WRD. Only indigenous species should be used for rehabilitation. The following programmes should be implemented as part of the operational phase of the mine: • Concurrent rehabilitation programme • Alien invasive eradication programme • Fire management programme • Educational and training programme on conservation and ecological systems • Refer to mitigation measures for the construction phase needed during the operational phase for similar impact	May cause irreplaceable loss of resources

Activity	Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Significance	Management Objective	Management Measures	Mitigation Effect
					Magnitude			
							<u>Habitat Fragmentation:</u> • Refer to mitigation measures for the construction phase needed during the operational phase for similar impacts	
Increased hardened surfaces around infrastructure and exposed areas around laydown area of WRD and topsoil stockpile	Flora	Soil erosion and sedimentation	WOM	Negative	High	Refer to Construction Phase objectives	• Rehabilitation: revegetate or ategoriz all disturbed areas as soon as possible. Indigenous trees can be planted in the buffer zone of the proposed TSF 3 WRD Extension 1 to enhance the aesthetic value of the site and ategoriz soil conditions • The vegetative (grass) cover on the soil stockpiles (berms) must be continually monitored to maintain a high basal cover. Such maintenance will limit soil erosion by both the mediums of water (runoff) and wind (dust) • Conservation of topsoil should be ategorized on site and done as follows: o Topsoil should be handled twice only – once to strip and stockpile, and secondly to replace, level, shape and scarify ○ Topsoil stockpiles should not exceed a height of 2 meters where possible. The topsoil outer layer should also be protected from wind erosion using wind nets and soil binders. If topsoil needs to be stockpiled for longer than 12 months, seeding will improve long term stability and help to keep the soil in an active state ○ Topsoil stockpile heights more than 5 meters and duration of storage until the end of the mining operations will likely destroy the bulk of propagates and most of the soil microbes. This can be countered by ensuring proper rehabilitation of the stockpile itself and additional augmentation of the rehabilitated areas where the stored topsoil will finally be placed. To reduce the risk of degrading the topsoil when placed in a single large topsoil stockpile and to prevent cross zoning of soils from different vegetation types, it is recommended that topsoil originating from different areas should be stored separately during the operational phase. Dust suppression would be a priority. It is recommended that topsoil from stockpiles more than 5 meters be used first for concurrent rehabilitation ○ Stockpile topsoil separately from subsoil ○ Stockpile in an area that is protected from storm water runoff and wind	May cause irreplaceable loss of resources

Activity	Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Significance	Management Objective	Management Measures	Mitigation Effect
					Magnitude			
							○ Maintain topsoil stockpiles in a weed free condition ○ Topsoil should not be compacted in any way, nor should any object be placed or stockpiled upon it ○ Stockpile topsoil for the minimum time possible i.e., strip just before the relevant activity commences and replace as soon as it is completed • Refer to mitigation measures for the construction phase needed during the operational phase for similar impacts	
Heavy machinery and vehicle movement on site	Flora	Spreading and establishment of alien invasive species	WOM	Negative	Moderate	Refer to Construction Phase objectives	Refer to mitigation measures for the construction phase needed during the operational phase for similar impacts	May cause irreplaceable loss of resources
Heavy machinery and vehicle movement on site	Flora & Fauna	Habitat degradation due to dust	WOM	Negative	High	Refer to Construction Phase objectives	• Dampening of disturbed areas as required. • Re-vegetation of disturbed areas is to be conducted on an ongoing basis • Dust fallout monitoring to be conducted according to the requirements of the National Dust Control Regulations • Place dust generating activities where maximum protection can be obtained from natural features • Locating dust generating activities where prevailing winds will blow dust away from surrounding landowners • Minimise the need to transport and handle materials by placing adequate storage facilities close to processing areas • Exposed material should be protected from the wind by keeping it within voids or protecting it with topographical features where possible • Reduce the drop heights wherever practicable. • Protect activities from wind by erecting a screen or using a natural barrier • Fine spray or fog suppression can also be used in loading bays • All roads on site should be dampened or treated with a binding agent • The general vehicle speed should be restricted as there is a direct relationship between the speed and vehicle entrained emissions • Monitoring, modelling and emission measurements should be regarded as complementary components in any integrated approach to exposure assessment or determining compliance against air quality criteria. • Refer to mitigation measures for the construction phase needed during the operational phase for similar impacts	May cause irreplaceable loss of resources

Activity	Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Significance	Management Objective	Management Measures	Mitigation Effect
					Magnitude			
Heavy machinery and vehicle movement on site	Flora	Spillages of harmful substances	WOM	Negative	Moderate	Refer to Construction Phase objectives	• Vehicle maintenance only done in designated areas – spill trays, sumps to be used and managed according to the correct procedures • Vehicles and machines must be maintained properly to ensure that oil spillages are kept to a minimum • Fuel and oil storage facilities should be bunded with adequate storm water management measures • Operational and Maintenance plan and schedule for management of sewage facilities should be compiled. An emergency plan should be compiled to deal with system failures and should include a down-stream notification procedure • Routine checks should be done on all mechanical instruments for problems such as leaks, overheating, vibration, noise or any other abnormalities. All equipment should be free of obstruction, be properly aligned and be moving at normal speed. Mechanical maintenance must be according to the manufacturer's instructions • Refer to mitigation measures for the construction phase needed during the operational phase for similar impacts	May cause irreplaceable loss of resources
Heavy machinery and vehicle movement on site; workers accommodated on site causing poaching, wood collection, fires etc.	Fauna	Road mortalities of fauna / impact of human activities on site	WOM	Negative	Moderate	Refer to Construction Phase objectives	Refer to mitigation measures for the construction phase needed during the operational phase for similar impacts	May cause irreplaceable loss of resources
Closure and Decommissioning Phase								
Rehabilitation of mining site	Fauna & Flora	Improvement of habitat through revegetation / succession over time	WOM	Positive	Low	• To ensure that the disturbed areas are rehabilitated according to prescriptions • To shape and prepare the rehabilitated WRD to blend in with the surrounding environment • To rehabilitate all disturbed areas to a suitable post closure land use • To manage the social impact of closure on personnel who became redundant due to closure • To keep all the post closure	• Plant vegetation species for rehabilitation that will effectively bind the loose material, and which can absorb run-off from the mining areas • Final profile lines of the rehabilitated WRD must fit in with the character of the topography in the area. • Rehabilitate all disturbed areas • Diversion trenches and storm water measures must be maintained • Water management facilities will stay operational and maintained and monitored until such a stage is reached where it is no longer necessary • The WRD will be shaped to make it safe • All the monitoring and reporting on the management and rehabilitation issues to the authorities will continue till closure of the mine is approved	N/A

Activity	Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Significance	Management Objective	Management Measures	Mitigation Effect
					Magnitude			
						monitoring in place and to ensure that the necessary reporting is done to the authorities and interested and affected parties		
Demolition of mining infrastructure / cessation of mining / rehabilitation of mining site	Flora	Soil erosion and sedimentation	WOM	Negative	Moderate	Refer to Construction Phase objectives	Refer to mitigation measures for the construction and operational phases needed during the decommissioning phase for similar impacts	May cause irreplaceable loss of resources
Demolition of mining infrastructure / cessation of mining / rehabilitation of mining site	Flora	Spreading and establishment of alien invasive species	WOM	Negative	Moderate	Refer to Construction Phase objectives	Refer to mitigation measures for the construction phase needed during the decommissioning phase for similar impacts	May cause irreplaceable loss of resources
Demolition of mining infrastructure / cessation of mining / rehabilitation of mining site / vehicle movement on site	Fauna & Flora	Habitat degradation due to dust	WOM	Negative	Moderate	Refer to Construction Phase objectives	Refer to mitigation measures for the construction and operational phases needed during the decommissioning phase for similar impacts	May cause irreplaceable loss of resources
Heavy machinery and vehicle movement on site	Fauna & Flora	Spillages of harmful substances	WOM	Negative	Moderate	Refer to Construction Phase objectives	Refer to mitigation measures for the construction and operational phases needed during the decommissioning phase for similar impacts	May cause irreplaceable loss of resources
Heavy machinery and vehicle movement on site	Fauna	Road mortalities of fauna / impact of human activities on site	WOM	Negative	Moderate	Refer to Construction Phase objectives	Refer to mitigation measures for the construction phase needed during the decommissioning phase for similar impacts	May cause irreplaceable loss of resources
Post-Closure & Rehabilitation Phase								
Rehabilitation / Natural successional processes	Fauna & Flora	Improvement of habitat through revegetation / succession over time	WOM	Positive	Low	• To ensure that the disturbed areas are rehabilitated according to prescriptions • To shape and prepare the rehabilitated WRD to blend in with the surrounding environment • To rehabilitate all disturbed areas to a suitable post closure land use • To manage the social impact of closure on personnel who became redundant due to closure • To keep all the post closure monitoring in place and to ensure that the necessary reporting is done to the authorities and interested and affected parties	• Plant vegetation species for rehabilitation that will effectively bind the loose material, and which can absorb run-off from the mining areas • Rehabilitate all the disturbed areas and footprints. • Monitor the establishment of the vegetation cover on the rehabilitated site to the point where it is self-sustaining • Protect rehabilitated areas until the area is self-sustaining • Diversion trenches and storm water measures must be maintained • Water management facilities will stay operational and maintained and monitored until such a stage is reached where it is no longer necessary • The WRD must be shaped to make it safe • All the monitoring and reporting on the management and rehabilitation issues to the authorities will continue till closure of the mine is approved	N/A

Activity	Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Significance	Management Objective	Management Measures	Mitigation Effect
					Magnitude			
Exposed surfaces / unrehabilitated areas on site post closure / poor monitoring during LoM	Flora	Soil erosion and sedimentation	WOM	Negative	Moderate	Refer to Construction Phase objectives	• Diversion trenches and storm water measures must be maintained • Water management facilities will stay operational and maintained and monitored until such a stage is reached where it is no longer necessary • Refer to mitigation measures for the construction and operational phases needed during the rehabilitation phase for similar impacts	May cause irreplaceable loss of resources
Exposed surfaces / poor monitoring of revegetation on site	Flora	Spreading and establishment of alien invasive species	WOM	Negative	Moderate	Refer to Construction Phase objectives	Monitor and manage invader species and alien species on the rehabilitated land until the natural vegetation can outperform the invaders or aliens	May cause irreplaceable loss of resources
Wetland & Riparian								
Planning Phase								
Obtaining of IWUL for crossings, establishment of WRD and location of WRD within zone of regulation of watercourses / riparian zones	Rivers / watercourses	Delay of mining onset	WOM	Negative	Moderate	Apply and obtain IWUL from DWS after liaison with relevant officials and site visit to the area	Apply and obtain IWUL from DWS after liaison with relevant officials and site visit to the area	Can be avoided, managed or mitigated
Construction Phase								
Clearing of vegetation for WRD and close to riparian zones and watercourses as well as road crossings	Rivers / watercourses	Riverine destruction / fragmentation of riparian habitats	WOM	Negative	Moderate	• Prevent edge effects. • Keep WRD footprint restricted to layout plans. • To limit the habitat loss due to the increase of the mining footprint	• No activity must take place within the 1:100-year flood line or the delineated riparian habitat, whichever is the greatest, or within 100 m radius from the boundary of any riparian zone unless authorised in the IWUL • Existing vegetation composition must be maintained or improved by maintaining the natural variability in flow fluctuations • No activities that negatively affect catchment yield, hydrology and hydraulics must be practiced unless authorised • All construction and maintenance activities should be conducted in such a way that minimal damage is caused to the watercourses riparian zone. Only necessary damage must be caused and, for example, unnecessary driving around in the veld or bulldozing natural habitat must not take place. Where impacts are unavoidable a water use license application should be submitted to Department of Water & Sanitation • Work in rivers, streams and riparian zones should preferably be done during the low flow season • The construction camp must be located outside the extent of the watercourse(s) and must be recovered and removed within one (1) month after construction has been completed • During the construction phase vehicles must not be allowed to indiscriminately drive through any riverine areas • Remove and relocate any plants of botanical or ecological significance as indicated by the ecologist or Environmental Control Officer (ECO)	May cause irreplaceable loss of resources

Activity	Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Significance	Management Objective	Management Measures	Mitigation Effect
					Magnitude			
							• Vegetation to be removed as it becomes necessary. • Construction should preferably take place in winter to reduce disturbance to breeding fauna and flowering flora • Clearly demarcate the entire development footprint prior to initial site clearance and prevent construction personnel from leaving the demarcated area • Monitoring should be implemented during the construction activities to ensure that minimal impact is caused to the rivers of the area • The ECO should advise the construction team in all relevant matters to ensure minimum destruction and damage to the riparian zone environment. The ECO should enforce any measures that he/she deems necessary. Regular environmental training should be provided to construction workers to ensure the protection of the habitat, fauna and flora and their sensitivity to conservation • Indigenous riparian vegetation, including dead trees, outside the limits of disturbance indicated in the site plans must not be removed from the area	
Topsoil & subsoil stripping, exposure of soils and rock to wind and rain during construction causing erosion and sedimentation in rivers	Rivers / watercourses	Soil erosion and sedimentation	WOM	Negative	High	To prevent bank erosion of rivers and sedimentation of streams / rivers in the area	• Sediment trapping, erosion and storm water control should be addressed by a hydrological engineer in a detailed storm water management plan • The overall macro-channel structures and mosaic of cobbles and gravels must be maintained by ensuring a balance (equilibrium) between sediment deposition and sediment conveyance. A natural flooding and sedimentation regime must thus be ensured as far as reasonably possible • Steps must be taken to ensure that stormwater does not result in bank instability and excessive levels of silt entering the watercourse(s)/rivers • Stormwater must be diverted from construction works, access roads, linear infrastructure and must be managed in such a manner as to disperse runoff and to prevent the concentration of stormwater flow • The velocity of stormwater discharges must be attenuated, and the banks of the watercourses protected • Cover disturbed soils as completely as possible, using vegetation or other materials • Minimize the amount of land disturbance and develop and implement stringent erosion and dust control practices • Protect sloping areas and drainage channel banks that are susceptible to erosion and ensure that	May cause irreplaceable loss of resources

Activity	Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Significance	Management Objective	Management Measures	Mitigation Effect
					Magnitude			
							there is no undue soil erosion resultant from activities within and adjacent to the construction camp and Work Areas • Repair all erosion damage as soon as possible to allow for sufficient rehabilitation growth • Structures must be non-erosive, structurally stable and must not induce any flooding or safety hazard • Structures must be inspected regularly for accumulation of debris, blockage, erosion of abutments and overflow areas – debris must be removed and damage must be repaired and reinforced immediately • Existing flood terraces and deposition of sediments on these terraces to ensure optimum growth, spread and recruitment of these species must be maintained • Necessary erosion prevention mechanisms must be employed to ensure the sustainability of all structures and activities and to prevent in-stream sedimentation • Stockpiling of removed soil and sand must be stored outside of the 1:100 flood line and/or delineated riparian habitat and/or the regulated area of a riparian zone, whichever is the greater, to prevent being washed into the river and must be covered to prevent wind and rain erosion • Slope/bank stabilization measures must be implemented with a 1:3 ratio or flatter and vegetated with indigenous vegetation immediately after the shaping • As much indigenous vegetation growth as possible should be promoted within the proposed TSF 3 WRD Extension 1 area to protect soil and to reduce the percentage of the surface area, which is paved, hardened and/or compacted • All material works (such as tar, sand and gravel) that are left unused or spilled adjacent to the roadway should be immediately removed during the construction of crossings	
Vegetation clearing, topsoil & subsoil stripping, vehicle movement on site	Rivers / watercourses	Potential establishment and spread of declared weeds and alien invader plants in rivers / watercourses	WOM	Negative	Moderate	To implement an alien invasive eradication programme to manage and control alien species on the mine	• Alien and invader vegetation must not be allowed to further colonize the area, and all new alien vegetation recruitment must be sustainably eradicated or controlled. Control involves killing the alien invasive plants present, killing the seedlings which emerge, and establishing and managing an alternative plant cover to limit re-growth and re-invasion. The control of these species should even begin prior to the construction phase considering that small populations of the AIS occur around the site	May cause irreplaceable loss of resources

Activity	Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Significance	Management Objective	Management Measures	Mitigation Effect
					Magnitude			
							• Institute strict control over materials brought onto site, which should be inspected for seeds of noxious plants and steps taken to eradicate these before transport to the site. Routinely fumigate or spray all materials with appropriate low-residual herbicides prior to transport to site or in a quarantine area on site. The contractor is responsible for the control of weeds and invader plants within the construction site for the duration of the construction phase • Rehabilitate disturbed areas as quickly as possible to reduce the area where invasive species would be at a strong advantage and most easily able to establish • Institute a monitoring programme to detect alien invasive species early, before they become established and, in the case of weeds, before the release of seeds • Institute an eradication/control programme for early intervention if invasive species are detected, so that their spread to surrounding natural ecosystems can be prevented • A detailed plan should be developed for control of noxious weeds and invasive plants that could colonize the area because of new surface disturbance activities at the site. The plan should address monitoring, weed identification, the way weeds spread, and methods for treating infestations	
Heavy machinery and vehicle movement on site	Water quality in permanent watercourses	Spillages of harmful substances	WOM	Negative	Moderate	• To prevent contamination of rivers / watercourses due to the spillage of hydrocarbons and reagents used in the process and during transportation of these substances. • To reduce the risk of contamination of soils due to increased fuel deliveries	• Pollution of and disposal/spillage of any material into the watercourse must be prevented, reduced, or otherwise remediated through proper operation, maintenance and effective protective measures • Vehicles and other machinery must be serviced well outside the 1:100 year flood line or delineated riparian habitat, whichever is the greatest • Oil and other potential pollutants must be disposed of at an appropriately licenced site, with the necessary agreement from the management of such a site • Vehicles must be checked for oil leaks and all maintenance must take place at a designated site further than 32 meters from the boundary of the riparian zone associated with each watercourse • All employees must be trained in cleaning up of a spillage. The necessary spill kits containing the correct equipment to clean up spills will be made available at strategic points • Any hazardous substances must be handled according to the relevant legislation relating to transport, storage and use of the substance and all	May cause irreplaceable loss of resources

Activity	Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Significance	Management Objective	Management Measures	Mitigation Effect
					Magnitude			
							storage facilities must be equipped with large, clearly readable material safety data sheets (MSDS) • All hazardous substances must be stored within a bunded area built to contain sufficient capacity of the facility and provided with sumps and pumps to return the spilled material back into the system. The system must be maintained in a state of good repair and standby pumps must be provided • Silt, litter and hydrocarbon (oil) traps must be installed to minimise the risk of pollutants entering the natural drainage system of the area. A register must be in place to indicate that oils are recovered/recycled or alternatively disposed of in a licenced facility • Activities (including spill clean-up) must start up-stream and proceed into a down-stream direction, so that the recovery processes can start immediately, without further disturbance from upstream works • Operational and Maintenance plan and schedule for management of sewage facilities should be compiled. An emergency plan should be compiled to deal with system failures and should include a down-stream notification procedure	
Operational Phase								
Increased hardened surfaces around infrastructure and exposed areas around laydown areas of WRD and stockpiles, road crossings	Wetlands / watercourses	Soil erosion and sedimentation in wetland / watercourses	WOM	Negative	High	Refer to Construction Phase objectives	• Clean stormwater and run-off must be gently directed towards dense grassland stands from where it migrates to watercourse(s) • Concurrent rehabilitation should occur during the operational phase on all exposed areas created by construction as well as roads, stockpiles and the WRD, especially at crossings. Only indigenous species should be used for rehabilitation. The following programmes should be implemented as part of the operational phase of the mine: o Concurrent rehabilitation programme o Alien invasive programme o Fire management programme o Educational and training programme on the conservation of wetland / riparian systems • As much indigenous vegetation growth as possible should be promoted within the proposed TSF 3 WRD Extension 1 area to protect soil and to reduce the percentage of the surface area which is paved, hardened and/or compacted • Run-off from paved, hardened and compacted surfaces should be slowed down by the strategic placement of berms • Rehabilitation: revegetate or stabilize all disturbed areas as soon as possible. Indigenous trees can be	May cause irreplaceable loss of resources

Activity	Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Significance	Management Objective	Management Measures	Mitigation Effect
					Magnitude			
							planted in the buffer zone of the proposed TSF 3 WRD Extension 1 to enhance the aesthetic value of the site and ategoriz soil conditions • The vegetative (grass) cover on the soil stockpiles (berms) must be continually monitored to maintain a high basal cover. Such maintenance will limit soil erosion by both the mediums of water (runoff) and wind (dust) • Conservation of topsoil should be prioritized on site and done as follows: o Topsoil should be handled twice only – once to strip and stockpile, and secondly to replace, level, shape and scarify o Stockpile topsoil separately from subsoil o Stockpile in an area that is protected from storm water runoff and wind o Maintain topsoil stockpiles in a weed free condition o Topsoil should not be compacted in any way, nor should any object be placed or stockpiled upon it o Stockpile topsoil for the minimum time possible i.e., strip just before the relevant activity commences and replace as soon as it is completed • Soils that have become compacted through the activities must be loosened to an appropriate depth to allow seed germination • Refer to mitigation measures for the construction phase needed during the operational phase for similar impacts	
Heavy machinery and vehicle movement on site	Wetlands / watercourses	Spreading and establishment of alien invasive species in rivers	WOM	Negative	Moderate	Refer to Construction Phase objectives	• Encroachment of additional exotic species and terrestrial species in riparian zones must be discouraged • Refer to mitigation measures for the construction phase needed during the operational phase for similar impacts	May cause irreplaceable loss of resources
Heavy machinery and vehicle movement on site	Wetlands / watercourses	Spillages of harmful substances leading to water pollution in rivers	WOM	Negative	Moderate	Refer to Construction Phase objectives	• Vehicle maintenance must only be done in designated areas – spill trays, sumps to be used and managed according to the correct procedures • Vehicles and machines must be maintained properly to ensure that oil spillages are kept to a minimum • Fuel and oil storage facilities should be bunded with adequate storm water management measures. • Routine checks should be done on all mechanical instruments for problems such as leaks, overheating, vibration, noise or any other abnormalities. All equipment should be free of obstruction, be properly aligned and be moving at	May cause irreplaceable loss of resources

Activity	Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Significance	Management Objective	Management Measures	Mitigation Effect
					Magnitude			
							normal speed. Mechanical maintenance must be done according to the manufacturer's instructions • Refer to mitigation measures for the construction phase needed during the operational phase for similar impacts	
Decommissioning Phase								
Rehabilitation of mining site	Wetlands / watercourses	Improvement of riparian habitat through revegetation / succession over time	WOM	Positive	Low	Refer to Construction Phase objectives	• The Licensee must embark on a systematic long-term rehabilitation programme to restore the watercourse(s) to environmentally acceptable and sustainable conditions after completion of the activities, which must include, but not be limited to the rehabilitation of disturbed and degraded riparian areas to restore and upgrade the riparian habitat integrity to sustain a bio-diverse riparian ecosystem • All disturbed areas must be re-vegetated with an indigenous seed mix in consultation with an indigenous plant expert, ensuring that during rehabilitation only indigenous shrubs, trees and grasses are used in restoring the biodiversity • Plant vegetation species for rehabilitation that will effectively bind the loose material, and which can absorb run-off from the WRD • Rehabilitate all the land where disturbance has taken place • Monitor the establishment of the vegetation cover on the rehabilitated site to the point where it is self-sustaining • Protect rehabilitation areas until the area is self-sustaining • Diversion trenches and storm water measures must be maintained • Water management facilities must stay operational and maintained and monitored until such a stage is reached where it is no longer necessary • The WRD must be shaped to make it safe • All the monitoring and reporting on the management and rehabilitation issues to the authorities must continue till closure of the mine is approved • Rehabilitated areas must always have a vegetation basal cover of at least 15%	Can be avoided, managed or mitigated
Cessation of mining / rehabilitation of disturbed areas	Wetlands / watercourses	Soil erosion and sedimentation in rivers	WOM	Negative	Moderate	Refer to Construction Phase objectives	Refer to mitigation measures for the construction phase needed during the decommissioning phase for similar impacts	May cause irreplaceable loss of resources
Cessation of mining / rehabilitation of disturbed areas	Wetlands / watercourses	Spreading and establishment of alien invasive species in rivers	WOM	Negative	Moderate	Refer to Construction Phase objectives	• Institute strict control over materials brought onto site, which should be inspected for seeds of noxious plants and steps taken to eradicate these before transport to the site. Routinely fumigate or spray all materials with appropriate low-residual herbicides prior to transport to site or in a	May cause irreplaceable loss of resources

Activity	Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Significance	Management Objective	Management Measures	Mitigation Effect
					Magnitude			
							quarantine area on site. The contractor is responsible for the control of weeds and invader plants within the construction site for the duration of the construction phase • Rehabilitate disturbed areas as quickly as possible to reduce the area where invasive species would be at a strong advantage and most easily able to establish • Institute a monitoring programme to detect alien invasive species early, before they become established and, in the case of weeds, before the release of seeds • Institute an eradication/control programme for early intervention if invasive species are detected, so that their spread to surrounding natural ecosystems can be prevented	
Heavy machinery and vehicle movement on site	Wetlands / watercourses	Spillages of harmful substances	WOM	Negative	Moderate	Refer to Construction Phase objectives	Refer to mitigation measures for the construction phase needed during the decommissioning phase for similar impacts	May cause irreplaceable loss of resources
Closure and Post-Closure Phase								
Rehabilitation / Natural successional processes	Wetlands / watercourses	Improvement of wetland habitat at crossings through revegetation / succession over time	WOM	Positive	Low	• To ensure that the mining areas are rehabilitated according to prescriptions. • To shape and prepare the rehabilitation areas to blend in with the surrounding environment. • To rehabilitate all disturbed areas to a suitable post closure land use. • To manage the social impact of closure on personnel who became redundant due to closure. • To keep all the post closure monitoring in place and to ensure that the necessary reporting is done to the authorities and interested and affected parties	Refer to mitigation measures for the decommissioning phase needed during the closure and post-closure phases for similar impacts	Can be avoided, managed or mitigated

Activity	Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Significance	Management Objective	Management Measures	Mitigation Effect
					Magnitude			
Exposed surfaces / unrehabilitated areas on site post closure / poor monitoring during LoM	Wetlands / watercourses	Soil erosion and sedimentation	WOM	Negative	Moderate	Refer to Construction Phase objectives	• Rehabilitated structures must be inspected regularly for the accumulation of debris, blockages, instabilities and erosion with concomitant remedial and maintenance actions • A comprehensive and appropriate rehabilitation and management programme to restore the watercourse(s) to environmentally acceptable and sustainable conditions after decommissioning must be developed and submitted to the Provincial Head for written approval within one (1) month prior to a watercourse being directly affected • A Riparian Management and Rehabilitation Plan for the activities must be compiled by a professional, independent, qualified and registered riparian specialist when riparian zones are to be affected and submitted to the Provincial Head for written approval within one (1) month prior to a riparian zone being affected	May cause irreplaceable loss of resources
Exposed surfaces / poor monitoring of revegetation on site	Wetlands / watercourses	Spreading and establishment of alien invasive species	WOM	Negative	Moderate	Refer to Construction Phase objectives	• An active campaign for controlling invasive species must be implemented within disturbed zones to ensure that it does not become a conduit for the propagation and spread of invasive exotic plants. • Monitor and manage invader species and alien species on the rehabilitated land until the natural vegetation can outperform the invaders or aliens	May cause irreplaceable loss of resources
Hydrogeological								
Construction Phase								
Contamination to ground- and surface water systems from oil, grease and diesel spillages from construction vehicles.	Hydrogeological	Contamination to groundwater systems and surface runoff	WOM	Negative	Moderate	To lower the impact from moderate to negligible impact.	• Road compaction • Vehicles must be checked for oil leaks and all maintenance must take place at a designated site with spillage sumps • Spill-sorb or a similar product to be kept on site and used to clean up hydrocarbon spills in the event that they should occur • All employees must be trained in cleaning up of a spillage • Polluted soil and used spill materials must be disposed of at a licenced facility	Can be avoided, managed or mitigated
Storage of chemicals and building materials during construction of waste facility.	Hydrogeological	Contamination to groundwater systems through baseflow and surface runoff	WOM	Negative	Moderate	To lower the impact from moderate to negligible impact.	• Implement best ategori principals for storing hazardous substances and keep spill kits near working areas • All hazardous substances must be stored within a bunded area	Can be avoided, managed or mitigated
Operational Phase								
Surface water runoff from facility to Sterkstroom River during large rainfall events	Hydrogeological	Contamination to baseflow and groundwater systems	WOM	Negative	Moderate	To lower the impact from moderate to low impact.	Divert the stormwater runoff towards existing dirty water structures on site by means of a breakwater wall and drain, to divert and collect stormwater runoff from the WRD and divert towards mining water dams	Can be avoided, managed or mitigated

Activity	Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Significance	Management Objective	Management Measures	Mitigation Effect
					Magnitude			
Cumulative impact of nitrate mass migration from existing facilities (TSF 3 and West WRD1) towards the Sterkstroom River, and along preferential groundwater pathways towards boreholes north and northwest.	Hydrogeological	Contamination to groundwater and surface water systems	WOM	Negative	Moderate	To lower the impact from moderate to low impact.	• Water quality monitoring and seepage capturing from toe trenches and boreholes • Planting of phytoremediation (e.g., *Sersia Lancea*) downstream of facilities • Ensure proper environmental management principles are followed and no additional water supply boreholes are added within the plume area. West and East open pits dewatering cone acts as a sink and ensures mass migration towards open pits. Natural decay of nitrates due to de-nitrification (conservative half-life calculated during previous assessments) will also limit impacts	Can be avoided, managed or mitigated
Nitrate mass migration from planned new facility (TSF 3 WRD Extension 1) downstream along preferential groundwater pathways: • Sterkstroom west of proposed facility	Hydrogeological	Contamination to groundwater and surface water (Sterkstroom) systems	WOM	Negative	Moderate	To lower the impact from moderate to low impact.	• Water quality monitoring and seepage capturing from toe trenches and boreholes • Planting of phytoremediation (e.g., *Sersia Lancea*) downstream of facilities • Ensure proper environmental management principles are followed and no additional water supply boreholes are added within the plume area. West and East open pits dewatering cone acts as a sink and ensures mass migration towards open pits. Natural decay of nitrates due to de-nitrification (conservative half-life calculated during previous assessments) will also limit impacts	Can be avoided, managed or mitigated
Closure and Post closure								
Nitrate mass transport and seepage from the proposed TSF 3 WRD Extension 1 downstream along preferential groundwater pathways.	Hydrogeological	Contamination to groundwater and surface water (Sterkstroom) systems	WOM	Negative	Moderate	To lower the impact from moderate to low impact.	• Rehabilitation of facilities (capping and vegetation) to limit rainfall recharge • Water quality monitoring. Natural decay of nitrates due to de-nitrification (conservative half-life calculated during previous assessments) will also limit impacts	Can be avoided, managed or mitigated
Heritage								
Construction Phase								
Surface alteration activities associated with the project development.	Burial Sites / Graves (TWRD-BP01) if site was not previously relocated.	Damage/destruction of sites, potential loss of human burial sites	WOM	Negative	High	Maintain and monitor impact on burial sites.	**CONFIRM SITE STATUS:** • Confirm relocated status of the burials during the preconstruction phase by means of the perusal of the necessary accompanying documents and heritage permits **IF SITE HAS NOT BEEN RELOCATED AND IT IS TO BE RETAINED:** • Avoidance: Redesign project infrastructure to avoid impact, implement a development no-go buffer of 50m (if site is retained) • Site monitoring: Weekly monitoring during initial site clearing and earth moving activities by an ECO familiar with the sensitivity of receptors, or the Heritage Consultant. Monthly monitoring of the burial sites is recommended during subsequent stages of development. A Site Management Plan	May cause irreplaceable loss of resources

Activity	Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Significance	Management Objective	Management Measures	Mitigation Effect
					Magnitude			
							(SMP) and a 50m conservation buffer should be implemented **IF SITE HAS NOT BEEN RELOCATED AND IMPACT IS TO OCCUR:** • Site Impact Mitigation: Grave Relocation, permitting, social consultation (if impact is to occur)	
Surface alteration activities associated with the project development.	Built Environment Heritage Features (TWRD-HP01, TWRD-HP02)	Damage/destruction of sites	WOM	Negative	Negligible	Monitor potential destruction of previously undocumented heritage resources / burial sites.	General Site Monitoring in order to detect the presence of and limit impact on previously undocumented heritage receptors during construction / site clearing / earth moving	Can be avoided, managed or mitigated
Operational Phase								
All activities associated with operations and mining.	Burial Sites / Graves (TWRD-BP01) if site was not previously relocated.	Damage/destruction of sites, potential loss of human burial sites	WOM	Negative	Negligible	Maintain and monitor impact on burial sites.	**IF SITE HAS NOT BEEN RELOCATED AND IT IS TO BE RETAINED:** • Avoidance: Redesign project infrastructure to avoid impact, implement a development no-go buffer of 50m (if site is retained) • Site monitoring: Weekly monitoring during initial site clearing and earth moving activities by an ECO familiar with the sensitivity of receptors, or the Heritage Consultant. Monthly monitoring of the burial sites is recommended during subsequent stages of development. A Site Management Plan (SMP) and a 50m conservation buffer should be implemented	Can be avoided, managed or mitigated
All activities associated with operations and mining.	Built Environment Heritage Features (TWRD-HP01, TWRD-HP02)	Damage/destruction of sites	WOM	Negative	Negligible	Monitor potential destruction of previously undocumented heritage resources / burial sites.	General Site Monitoring in order to detect the presence of and limit impact on previously undocumented heritage receptors during construction / site clearing / earth moving	May cause irreplaceable loss of resources
Closure and Post closure								
All activities associated with closure and post closure of the mine.	Burial Sites / Graves (TWRD-BP01) if site was not previously relocated.	Damage/destruction of sites, potential loss of human burial sites	WOM	Negative	Negligible	Maintain and monitor impact on burial sites.	**IF SITE HAS NOT BEEN RELOCATED AND IT IS TO BE RETAINED:** • Avoidance: Redesign project infrastructure to avoid impact, implement a development no-go buffer of 50m (if site is retained) • Site monitoring: Weekly monitoring during initial site clearing and earth moving activities by an ECO familiar with the sensitivity of receptors, or the Heritage Consultant. Monthly monitoring of the burial sites is recommended during subsequent stages of development. A Site Management Plan (SMP) and a 50m conservation buffer should be implemented	Can be avoided, managed or mitigated
All activities associated with closure and post closure of the mine.	Built Environment Heritage Features (TWRD-HP01, TWRD-HP02)	Damage/destruction of sites	WOM	Negative	Negligible	Monitor potential destruction of previously undocumented heritage resources / burial sites.	General Site Monitoring in order to detect the presence of and limit impact on previously undocumented heritage receptors during construction / site clearing / earth moving	Can be avoided, managed or mitigated
Air Quality								

Activity	Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Significance	Management Objective	Management Measures	Mitigation Effect
					Magnitude			
Construction Phase								
• Grading of new roads to the new WRD; • Vehicle (trucks) on newly graded unpaved roads; and • Land clearing for new WRD section	Air Quality	Vehicle entrainment of dust, wind erosion	WOM	Negative	Low	N/A	Tharisa Mine has a dustfall monitoring network in place and does passive sampling of NO_2 and SO_2. The significance rating is based on the expectation that the TSF 3 WRDE 1 will not result in an increase in air pollution, but rather a change in the area of impact due to its location and therefore no additional management objectives are proposed at this stage	N/A
Operational Phase								
All mining activities related to the storage of waste rock on the proposed TSF 3 WRD Extension 1	Air Quality	Dust emissions from material off-loading onto the WRD, disturbances by strong wind currents and dust from the movement of haul trucks	WOM	Negative	Moderate	N/A	Tharisa Mine has a dustfall monitoring network in place and does passive sampling of NO_2 and SO_2. The significance rating is based on the expectation that the TSF 3 WRD Extension 1 will not result in an increase in air pollution, but rather a change in the area of impact due to its location and therefore no additional management objectives are proposed at this stage	N/A
Closure and Post closure								
• Topsoil recovered from stockpiles for rehabilitation and re-vegetation of surroundings; and • Vehicle activity on unpaved road surfaces during rehabilitation	Air Quality	Vehicle entrainment of dust, windblown dust from WRD. Post-closure should not result in significant air quality impacts provided the WRD has been fully vegetated and rehabilitated	WOM	Negative	Low	N/A	Tharisa Mine has a dustfall monitoring network in place and does passive sampling of NO_2 and SO_2. The significance rating is based on the expectation that the TSF 3 WRD Extension 1 will not result in an increase in air pollution, but rather a change in the area of impact due to its location and therefore no additional management objectives are proposed at this stage	N/A
Noise								
Construction Phase								
Land clearing in the footprint of the TSF 3 WRD Extension 1	Noise	Nuisance and health risks caused by an increase in the ambient noise level as a result of noise impacts associated with the construction of the TSF 3 WRD Extension 1	WOM	Negative	Low	Reduce noise impacts	• Routine monitoring of ambient noise and to comply with the relevant estimated background noise levels as provided in Section 3.3.1 of the Air Quality Report (Airshed Planning Professionals , 2023b) • Construction staff need to be trained on noise control plan during health & safety briefings • 'Low noise' equipment, or methods of work is to be selected • Avoid clustering of mobile plant near receptors and enforce rest periods for unavoidable maximum noise events • Investigate use of alternatives to audible reversing alarms (such as broadband noise emitting models) or configure to maximise forward movements of mobile plant • Regular inspection and maintenance of all equipment is to be established • Avoid unnecessary equipment idling • Where possible, limit activities to day-time working hours (6am – 6pm) • Establish community engagement and ensure all affected persons have been consulted with prior to the commencement of and during activities	Can be avoided, managed or mitigated
Operational Phase								

Activity	Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Significance	Management Objective	Management Measures	Mitigation Effect
					Magnitude			
All activities associated with operations on the TSF 3 WRD Extension 1	Noise	Nuisance and health risks caused by an increase in the ambient noise level as a result of noise impacts associated with the operation of the TSF 3 WRD Extension 1	WOM	Negative	Moderate	Reduce noise impacts	• Train operational staff on noise control plan during health & safety briefings; • Regular inspection and maintenance of all equipment • A noise complaints register must be kept • If complaints are received, noise sampling should be undertaken at the NSRs, and source of noise should be investigated	Can be avoided, managed or mitigated
Closure and Post closure								
All activities associated with closure and rehabilitation of the TSF 3 WRD Extension 1	Noise	Nuisance and health risks caused by an increase in the ambient noise level as a result of noise impacts associated with the closure and rehabilitation of the TSF 3 WRD Extension 1	WOM	Negative	Low	Reduce noise impacts	• Routine monitoring of ambient noise and to comply with the relevant estimated background noise levels as provided in Section 3.3.1 of the Air Quality Report (Airshed Planning Professionals , 2023b) • Closure staff need to be trained on noise control plan during health & safety briefings • 'Low noise' equipment, or methods of work is to be selected • Avoid clustering of mobile plant near receptors and enforce rest periods for unavoidable maximum noise events • Investigate use of alternatives to audible reversing alarms (such as broadband noise emitting models) or configure to maximise forward movements of mobile plant • Regular inspection and maintenance of all equipment is to be established • Avoid unnecessary equipment idling • Where possible, limit activities to day-time working hours (6am – 6pm) • Establish community engagement and ensure all affected persons have been consulted with prior to the commencement of and during activities	Can be avoided, managed or mitigated
Visual								
Construction Phase								
Vegetation clearance and construction of the toe drainage, access roads and stormwater diversions	Physical (visual) presence	Change to the visual environment observed by sensitive receptors. No sense of place impact	WOM	Negative	Negligible	Reduce visual impacts	Apply effective dust suppression techniques and limited work to occur during night-time	Can be reversed
Operational Phase								
Trucks moving overburden to the WRD dumps, graders maintaining the haul roads and water tankers wetting the roads. Growth of the WRD as mining progresses	Physical (visual) presence	Change to the visual environment observed by sensitive receptors. No sense of place impact	WOM	Negative	Low	Reduce visual impacts	Apply effective dust suppression techniques and limited work to occur at night. Grading of the WRD to avoid harsh excavated lines and mimic nearby hills and rehabilitation of the WRD. Maximum slopes of 1:3. Mitigation will slightly reduce the impact, but the significance will remain the same	Can be reversed
Closure and Post closure								
Final shaping and rehabilitation of the WRD dump	Physical (visual) presence	Improvement of the visual quality (over operational baseline) of the project area visible from nearby residential receptors as well as public roads	WOM	Negative	Negligible	Reduce visual impacts	Effective management of rehabilitated areas such that the grassed (hydroseeded) areas are established and permanently sustainable and final shaping to avoid harsh slopes. Mitigation will slightly reduce the impact, but the significance will remain the same	Can be reversed

Activity	Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Significance	Management Objective	Management Measures	Mitigation Effect
					Magnitude			
Socio- Economic								
Construction Phase								
Improved household income resulting in increased business sales in the local economy	Economic	Temporary increase in production and GDP in the local economy	WOM	Positive	Low	The proposed mitigation measures will possibly increase the positive impact on the local economy	To optimise the stimulation of the local economy through direct, indirect, and induced effects, the following should be applied where possible: • Procure construction materials, goods, and products from local and domestic suppliers if feasible • Employ local contractors where possible	Can be avoided, managed or mitigated
Employment of local community members	Socio-economic	Creation of temporary employment opportunities on-site	WOM	Positive	Low	The proposed mitigation measures will possibly increase the positive impact on the local employment rates	The following is recommended to increase the employment opportunities created in the local communities, where feasible: • Employ labour-intensive methods in construction, where feasible • Employ local residents and communities, where possible • Utilise local suppliers, where possible	Can be avoided, managed or mitigated
Construction activities resulting in dust, noise, visual, water supply, water pollution and other environmental impacts	Social	Deterioration of quality of life due to dust, noise, visual, water supply, water pollution and other environmental impacts	WOM	Negative	Low	Reduced probability of deterioration of quality of life	Recommendations and mitigation measures provided in the Air Quality, Noise, Visual, Hydrogeological and Wetland Impact Assessments must be adhered to	Can be avoided, managed or mitigated
Influx of people seeking employment	Social	Temporary increase in crime associated with the influx of people	WOM	Negative	Moderate	Decrease level of crime associated with new developments'	The following mitigations are advised to be instituted to minimise and possibly eliminate the impact altogether: • Ensure proper fencing and monitoring of the fencing is in place • Maximise job creation and allocation to locals as far as practically possible. Recruitment of workers should be planned in advance and should not take place On-site. This will reduce the probability of work seekers loitering in the area surrounding the project site • Hire additional security personnel during the construction period	May cause irreplaceable loss of resources
Increased pollution levels and the removal of natural habitats through vegetation clearance	Social	Degradation of the natural environment resulting in impacts on ecosystem services	WOM	Negative	Low	Reduce negative environmental impacts	Recommendations as per Environmental Assessment	May cause irreplaceable loss of resources
Operational Phase								
Improved household income resulting in increased business sales in the local economy	Economic	Long-term increase in production and GDP in the local economy	WOM	Positive	Moderate	Stimulate growth of local economy	Where feasible, procure goods and services required for the operation of the WRD from the local economy	Can be avoided, managed or mitigated
Employment of local community members	Socio-economic	Creation of permanent employment opportunities in the local and regional economy	WOM	Positive	Moderate	Stimulate the growth of the local economy	Where feasible, aim to fill all new positions with labour from the local community	Can be avoided, managed or mitigated
Operational activities resulting in dust, noise, visual, water supply and water pollution and other environmental impacts	Social	Deterioration of quality of life due to dust, noise, visual, water supply, water pollution and other environmental impacts	WOM	Negative	Low	• Reduced probability of deterioration of quality of life. • Increase probability of similar developments that	Reduce negative impacts by following recommendations and mitigation measures provided in the Air Quality, Noise, Visual, Hydrogeological and Wetland Impact Assessments. Increase positive impacts by partnering with communities, setting an example of how developments can benefit communities to help attract similar developments in the area	Can be avoided, managed or mitigated

Activity	Aspect Affected	Potential Impact	Without Mitigation (WOM)	Nature (Negative or Positive Impact)	Significance	Management Objective	Management Measures	Mitigation Effect
					Magnitude			
						will increase opportunities in the area		
Increased pollution levels and the removal of natural habitats through vegetation clearance	Social	Degradation of the natural environment resulting in impacts on ecosystem services	WOM	Negative	Low	Reduce negative environmental impacts	Recommendations as per Environmental Impact Assessment	May cause irreplaceable loss of resources
No-Go Alternative								
Project does not go ahead, and the area stays as is	Socio-economic	No increase in production, GDP and employment in the local economy	WOM	Negative	Negligible	N/A	No mitigation measures are required	N/A

17 THE OUTCOME OF THE SITE SELECTION MATRIX: FINAL SITE LAYOUT PLAN[73]

No site location alternatives were investigated as the WRD expansion ties in with the existing mining activities. The alternative extension of the WRD would have been placed over a larger footprint and would have required the diversion of the Sterkstroom. Therefore, after detailed evaluation the Preferred Alternative, WRD outside of the floodline of the Sterkstroom was proposed and will be further evaluated throughout this EIA process.

No fatal flaws were identified during the specialist scoping assessments.

Refer to the Alternatives Assessment discussion in **Section 8.** In line with the DMRE requirements, the proposed site layout plan is provided in **Figure 3** and **ANNEXURE D**.

18 MOTIVATION WHERE NO ALTERNATIVE SITES WERE CONSIDERED[74]

The proposed TSF 3 WRD Extension 1 is situated on various portions of the Farm K/Kraal 342 JQ owned by Tharisa and therefore no site location alternatives were investigated as the WRD expansion ties in with the existing mining activities. Refer to the Alternatives Assessment discussion in **Section 8** of this report.

19 STATEMENT MOTIVATING THE PREFERRED SITE[75]

The proposed TSF 3 WRD Extension 1 is situated on various portions of the Farm K/Kraal 342JQ. As part of Tharisa's on-going mine planning, the need for an additional mine residue stockpile for waste rock, which will be consist of a WRD extension to West WRD 1 at TSF 3 has been identified. No site location alternatives were therefore investigated as the proposed TSF 3 WRD Extension 1 is an extension of an existing WRD to allow for sufficient capacity for additional waste rock, thus tying in with the existing mining activities.

Some layout options have been evaluated during the initial phases of the project for the expansion of the waste rock dump. These options are shown in **Figure 4**. The alternative extension of the WRD would have been placed over a larger footprint and would have required the diversion of the Sterkstroom. Therefore, after detailed evaluation the Preferred alternative WRD outside of the floodline of the Sterkstroom was proposed and will be further evaluated throughout this EIA process. The proposed TSF 3 WRD Extension 1 will assist in providing time to Tharisa to better model and apply for the necessary dumps going forward.

[73] Required as per the EIA regulations Appendix 2 (g) a full description of the process followed to reach the proposed preferred activity, site and location of the development footprint within the site, including (ix) the outcome of the site selection matrix

[74] Required as per the EIA regulations Appendix 2 (g) a full description of the process followed to reach the proposed preferred activity, site and location of the development footprint within the site, including (x) if no alternatives, including alternative locations for the activity were investigated, the motivation for not considering such

[75] Required as per the EIA regulations Appendix 2 (g) a full description of the process followed to reach the proposed preferred activity, site and location of the development footprint within the site, including (xi) a concluding statement indicating the preferred alternatives, including preferred location of the activity

20 PLAN OF STUDY FOR THE EIA PROCESS

20.1 ALTERNATIVES TO BE CONSIDERED INCLUDING GO/NO-GO OPTION[76]

The DFFE guidelines for an IEM procedure requires that an environmental investigation considers feasible alternatives for any proposed development. Furthermore, the EIA Regulations (2014) (as amended) require that a number of alternatives for accomplishing the same objectives shall be considered.

Various alternatives have been assessed for the project at scoping level, and workshopped during specialist, applicant, and engineering team interactions. The alternatives were also influenced by the existing baseline environmental data and specialist inputs, and by discussions with authorities and with I&APs.

Alternatives relevant to this development can be categorised into the following:

- Location alternatives;
- Layout alternatives;
- Technological alternatives; and
- The “no-go” alternative.

Please refer to the Alternatives Assessment discussion in **Section 8** of this report.

20.2 DESCRIPTION OF THE ASPECTS TO BE ASSESSED AS PART OF THE ENVIRONMENTAL IMPACT ASSESS PROCESS[77]

Key aspects identified by the EAP and specialists to be assessed as part of the EIA include inter alia:

- Biodiversity (flora and fauna) aspects;
- Agro-Ecosystem aspects;
- Surface water aspects;
- Groundwater aspects including impacts on groundwater quality and quantity;
- Heritage aspects;
- Air quality aspects (dust and emissions);
- Noise aspects;
- Visual aesthetics;
- Socio-economic aspects (job creation, social investment, health, safety, skills training, sense of place, etc.);
- Rehabilitation and associated Financial Provision; and
- Stormwater management.

[76] Required as per the EIA regulations Appendix 2 (h) a plan of study for undertaking the environmental impact assessment process to be undertaken, including-(i) a description of the alternatives to be considered and assessed within the preferred site, including the option of not proceeding with the activity

[77] Required as per the EIA regulations Appendix 2 (h) a plan of study for undertaking the environmental impact assessment process to be undertaken, including (ii) a description of the aspects to be assessed as part of the environmental impact assessment process;

20.3 DESCRIPTION OF ASPECTS TO BE ASSESSED BY SPECIALISTS[78]

Regulation 16(1)(v) of the EIA Regulations, 2014 (as amended) provides that an applicant for EA is required to submit a report generated by the Screening Tool as part of its application (https://screening.environment.gov.za). The following specialist studies are required by the DFFE Environmental Screening Tool Report (**ANNEXURE E**) for the TSF 3 WRD Extension 1 Project:

- Visual Impact Assessment;
- Archaeological and Cultural Heritage Impact Assessment;
- Terrestrial Biodiversity Impact Assessment;
- Aquatic Biodiversity Impact Assessment;
- Socio-Economic Assessment;
- Plant Species Assessment; and
- Animal Species Assessment.

The EAP however also identified additional specialist assessments to be undertaken for the project as follows:

- Agro-Ecosystem Impact Assessment;
- Air Quality Impact Assessment;
- Hydrogeology Impact Assessment; and
- Noise Impact Assessment.

As part of the EA Process, a number of investigations were undertaken by suitably qualified specialists in order to gather baseline information pertaining to the current state of the environment as well as to identify the environmental impacts that may be associated with the TSF 3 WRD Extension 1 activities.

Of the specialist studies listed as required by the DFFE Screening Tool Report, the following specialist studies have been excluded with a motivation for the exclusion provided below:

- Palaeontology Impact Assessment

  The TSF 3 WRD Extension 1 site falls within an insignificant sensitivity area on the South African Heritage Resources Agency (SAHRIS) PalaeoSensitivity Map and there no palaeontological studies are required.

The EIA process will be used to determine the best practical environmental option for the proposed TSF 3 WRD Extension 1 and will assist the mine in identifying appropriate mitigation measures. The main objective of the mitigation measures will be to reduce the operational and long-term effects of the proposed TSF 3 WRD Extension 1 on the environment.

The following specialist studies will be undertaken to fulfil the following Scope of Work:

20.3.1 AIR QUALITY IMPACT ASSESSMENT

Compilation of a source emissions inventory for the proposed TSF 3 WRD Extension 1 including:

- Identification and quantification of all emissions associated with the proposed expansion operations.
- Pollutants quantified will be limited to particulate matter (Total Suspended Particulate (TSP), Thoracic particulate matter (PM10) and Respirable particulate matter (PM2.5)).

[78] Required as per the EIA regulations Appendix 2 (h) a plan of study for undertaking the environmental impact assessment process to be undertaken, including (iii) aspects to be assessed by specialists;

- Use will be made of engineering design parameters, design emission standards, emissions factors published by the United States Environmental Protection Agency (US EPA) and Australian National Pollutant Inventory (NPI).

Atmospheric dispersion simulations of all PM10, PM2.5 and dust fallout, and gaseous pollutants for the operations reflecting the highest hourly, daily and annual average concentrations due to routine emissions from the current mining operations and the expansion operations will be done, to determine potential air quality impacts. An internationally approved dispersion model such as the US EPA AERMOD will be used.

Dispersion modelling will be done for the following scenarios:

- Incremental impacts from the WRD expansion project alone.
- Cumulative impacts from the current mining operations (to be taken from the Tharisa WRD expansion Air Quality Impact Assessment (AQIA)) and the additional expansion operations.

An impact assessment will be done by comparing ambient pollutant concentration levels to the relevant air quality standards and limits, screening the simulated results against the relevant environmental standards, and identifying and quantifying potential air quality impacts from the project on Air Quality Sensitive Receptors (AQSRs). A quantitative cumulative air quality assessment will be done. Suitable air quality management and mitigation measures based on the findings of the impact assessment to limit air quality impacts to identified AQSRs will be identified and recommended. Additional recommendations for the mine's air quality monitoring programme will be provided and a specialist air quality impact assessment report in the prescribed specialist report format will be compiled.

20.3.2 NOISE IMPACT ASSESSMENT

A noise assessment will be done where noise emissions from the project's operational phases will be estimated using the 'Concawe method'. Data representative of conditions in the study area and obtained from the baseline noise measurements will be applied in the calculations. Noise impacts will be calculated both in terms of total ambient noise levels as a result of the project as well as the effective change in ambient noise levels. Impacts will be calculated and assessed according to guidelines provided by the National Noise Control Regulations and International Finance Corporation (IFC). The findings of the above components will offer informed recommendations for noise management measures, including mitigation and monitoring (if necessary). The identification of noise management and mitigation measures based on the findings of the noise impact assessment and a specialist noise report will be compiled. The following actions will be undertaken for the Noise Impact Assessment:

- The establishment of a comprehensive noise source inventory for proposed activities.
- Noise propagation simulations to determine environmental noise levels as a result of the project activities.
- The screening of simulated noise levels against environmental noise criteria.
- Determination of environmental risk according to stipulated Impact Assessment methodology.
- The identification and recommendation of suitable noise management, mitigation and monitoring measures.
- Compilation of a comprehensive environmental noise impact assessment report.

20.3.3 HYDROGEOLOGICAL IMPACT ASSESSMENT

The existing 3D numerical groundwater flow and mass transport model to estimate the potential environmental impact from the proposed TSF 3 WRD Extension 1 will be updated. The following actions will be undertaken:

- Developing a hydrogeological Conceptual model.

- Updating of the 3D numerical groundwater flow model utilising Feflow code.
- Model calibration using the latest water level, abstraction and hydrochemical data.
- Model simulations will be used to qualify the impact of management decisions on:
  - Groundwater flow directions and velocities;
  - Mass transport from the mine residue facility; and
  - Mitigation measures required for capture of leakage.
- Groundwater Impact Assessment (GIA) Matrix.
- GIS spatial analysis and map compilation.
- Compilation of EIA Level Report.

20.3.4 TERRESTRIAL BIODIVERSITY (INCLUDING PLANT AND ANIMAL SPECIES) IMPACT ASSESSMENT

The objectives of the terrestrial biodiversity impact assessment are as follows:

- The primary aim of this project is to investigate options for enhancing and / or maintaining biodiversity to mitigate the impact of the development and related infrastructure with the overall objective of preventing further loss of biodiversity. The product would be a tool for promoting and lobbying for the recognition of the importance of species habitat and habitat conservation. Options available to maintain the current level of floral diversity include:
  - Protection of native vegetation restored elsewhere in return for unavoidable clearing.
  - Minimisation of habitat fragmentation.
  - Minimisation of any threats to the native flora and fauna and their habitats during the construction and operational phases of the developments.
  - Rehabilitation to establish plant communities / landscaping that will provide future habitat values.
- To produce a clear and agreed species and habitat priorities for conservation actions. This includes the following:
  - Determine the ecological impacts and actions the development will have on the biodiversity of a species and habitat level.
  - Conduct a risk analysis of the impacts identified to determine the significance of the impacts on the fauna and flora of the study area.
  - Protection and enhancement of vegetation / habitats of high conservation value.
  - The retention of a substantial amount of native vegetation / habitat of adequate size and configuration to promote the conservation of the existing flora communities.
  - The retention and / or creation of vegetation links, wildlife corridors and vegetation buffers wherever possible, subject to the appropriate bush fire risk management.
  - The protection of water quality in the locality so as not to threaten native aquatic flora that rely on the watercourse for survival.
- Provide recommendations on the ecological mitigation measures to be implemented by the developer and the way forward.

The following actions will be undertaken during the EIA phase:

- Determine the ecological impact the development will have on the fauna and flora of the site and conduct an impact rating assessment.
- Indicate mitigation measures and management measures to be implemented to prevent any negative impacts on the fauna and flora of the area.
- Identify and describe ecologically sensitive areas. Create a sensitivity map to indicate specific sensitive areas based on various environmental parameters such as natural vegetation in a good condition, rockiness, slopes, flood lines etc.
- Identify problem areas in need of special treatment or management, e.g., bush encroachment, erosion, degraded areas, reclamation areas.
- Make recommendations, impact ratings and risk assessments for each specific impact.
- Compile a report with the findings and maps.

20.3.5 AGRO-ECOSYSTEM IMPACT ASSESSMENT

The following actions will be undertaken during the EIA phase:

- From the soil survey results link the optimal land use and other potential uses and options to the agricultural potential of the soils by classifying the soils into different Agricultural Potential classes according to the requirements set by the NEMA regulations (GN 320) and the Department of Agriculture, South Africa. From these results soils maps and an agricultural potential map will be compiled.
- Discussion of the agricultural potential and land capability in terms of the soils, water availability, grazing capacity, surrounding developments and status of land.
- Identify potential impacts of the development on the soils and provide mitigation measures to manage these impacts.
- Make recommendations, impact ratings and risk assessments for each specific impact.
- Compile a report with the findings and maps.

20.3.6 WETLAND AND RIPARIAN IMPACT ASSESSMENT

The following actions will be undertaken during the EIA phase:

- Classify riparian zones/wetlands according to their hydro-geomorphic characteristics.
- Determine the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) of all wetlands and riparian areas on site.
- Determine the impacts and risks associated with the proposed TSF 3 WRD Extension 1 on the wetlands and/or riparian zones (risk assessment matrices).
- Make recommendations, impact ratings and risk assessments for each specific impact.
- Compile a report with the findings and maps.

20.3.7 SOCIOECONOMIC IMPACT ASSESSMENT

The purpose of the EIA phase is to go into deeper detail regarding the socio-economic impacts the proposed TSF 3 WRD Extension 1 will have on the community. The following actions will be undertaken during the EIA phase:

- Updating the baseline information

The purpose of this step is to update the information in the baseline profile to ensure it is up to date and reflective of the reality on the ground. This is done in consultation with the Applicant and inputs received from other specialists after the scoping phase process.

- Project data collection and economic impact modelling:
    - The purpose of this step is to collect data related to the project and specifically its economic and job creation parameters. An economic modelling exercise can also be undertaken to determine the potential economic benefit of the project throughout the local and national economies using the economic model developed based on the Social Accounting Matrix (SAM). For this purpose, through a discussion with the Applicant, information on the expenditure during various project stages will be collected, which would include, inter alia:
        - Construction costs (CAPEX) and operational expenditure.
        - Intermediate inputs required and percentage of imports of the total project spending.
        - Distribution of procurement of intermediate inputs among local areas, provinces, and South Africa.
        - Skills requirements.
        - Number of people to be employed during construction and operation.
    - Following the data gathering process, potential economic impacts derived from these potential costs and benefits of the project will be identified. These will then be quantified in monetary terms to be used in further modelling exercises. Using quantified potential cost and benefits of the project, a modelling exercise determining the indirect and induced effects of the activities, either positive or negative, will be undertaken. Modelling of impacts will be done using economic models developed based on the provincial and national Social Accounting Matrices (SAMs). Impacts determined through the modelling exercise will include production, value-added, employment, household income, and government revenue. Differentiation will be made between impacts that are expected to take place within the local municipality, province, and rest of the country.
- Impact assessment:
    - The purpose of this step is to analyse the social and economic implications of the proposed TSF 3 WRD Extension 1 on the affected community and local economy on macro, regional, and micro (site)-levels. For each phase of the project's life-cycle, the following groups of impacts will be examined:
        - Impacts directly associated with the construction and operation, where applicable.
        - Secondary impacts that involve the changes in the community structure and economic activities in the environment directly or indirectly affected by the development, as applicable to the site.
        - Cumulative impacts that consider other projects or developments.

      The type of impacts that will be covered under the above-mentioned groups will include:

        - Natural capital
        - Human capital
        - Physical capital
        - Financial capital
        - Institutional and political capital

The impact assessment undertaken will assist in providing high-level impacts for the proposed site, illustrating the highest benefit and minimise potential negative effects.

- Impact evaluation, mitigations and closure risk assessment:

All socio-economic impacts identified will be assessed and ategorized in line with the rating provided by the environmental specialist. A mitigation plan will be formulated whereby recommendations to reduce or

eliminate the potential negative effects on the affected parties and enhance positive impacts will be provided.

20.3.8 HERITAGE IMPACT ASSESSMENT

The following actions will be undertaken during the EIA phase:

- Provide an inventory of archaeological artefacts, structures (including graves) and settlements which may be expected in the project area following the detailed site survey.
- Provide a cultural context and provenience for archaeological artefacts, structures (including graves), in the project area and in the surrounding landscape following a detailed desktop background study and review of existing heritage information.
- Assess the nature and degree of significance of such resources within the areas and establish possible heritage conservation buffers.
- Establish heritage informants/constraints through establishing thresholds of impact significance.
- Assess any current and future developmental impacts on the archaeological and historical remains and apply these in a standard impact assessment matrix.
- Propose heritage management measures for heritage mitigation, management and permitting for future development activities in the project areas, where applicable.
- Drawing on findings from the heritage assessments, guide the development planning in terms of infrastructure layout and potential heritage impacts and recommend further heritage assessment requirements for the project based on the heritage landscape and its estimated sensitivity.
- Compile a Heritage Impact Assessment (HIA) Report. All information accumulated in the desktop, aerial and site surveys will be compiled into an HIA Report for project, which will rate possible impacts emanating from the proposed TSF 3 WRD Extension 1 and provide heritage management measures in order to minimise the damage or destruction of heritage resources. The HIA Report will include survey methodologies, survey results, archaeological and historical contexts and general comments and suggestions. Ultimately, it will establish the significance (none, low, medium, high) of heritage resources (if present in the survey areas) and findings on the possible impact of the development on these resources will be made. The HIA Report will provide the foundation for the further management and conservation of any heritage resources by means of recommendations as to heritage site management procedures.
- Liaise and consult with the South African Heritage Resources Authorities (SAHRA) with regards to the site investigations (NIDs and all SAHRIS submissions), recommendations pertaining to possible management and mitigation measures as well as the final decision (ROD) for the project heritage landscapes. The HIA Report will be submitted to SAHRA via the SAHRIS platform. Further procedures such as exemption, mitigation or conservation management will follow on review comments from the Agency.

20.3.9 VISUAL IMPACT ASSESSMENT

potential visual impacts arising from the project based on the general requirements of a Level 3 assessment. The visual impact assessment report aims to identify the landscape characteristics of the project area (landscape context) and visually sensitive areas or receptors. It also identifies the significance of visual impacts and potential mitigation measures.

The following actions will be taken:

- Identification of issues raised in scoping phase.

- Description of the receiving environment (landscape context) and the proposed TSF 3 WRD Extension 1.
- Establishment of view catchment area, view corridors, viewpoints and receptors.
- Indication of potential visual impacts using established criteria.
- Inclusion of potential lighting impacts at night.
- Description of alternatives, mitigation measures and monitoring programmes.

20.4 PROPOSED METHOD OF ASSESSING THE ENVIRONMENTAL ASPECTS INCLUDING THE PROPOSED METHOD OF ASSESSING ALTERNATIVES[79]

Assessment of environmental aspects and alternatives will be based on the Department of Environmental Affairs Guideline Document: EIA Regulations, 2014 (as amended). The significance of the aspects/impacts of the proposed activities will be rated by using a matrix derived from Plomp (2004) and adapted to some extent to fit this process. These matrixes use the consequence and the likelihood of the different aspects and associated impacts to determine the significance of the impacts. Refer to **Section 14** above for more details.

20.5 PROPOSED METHOD OF ASSESSING DURATION SIGNIFICANCE[80]

The significance of the impacts will be determined through a synthesis of the criteria described in **Section 14**.

20.6 STAGES AT WHICH THE COMPETENT AUTHORITY WILL BE CONSULTED[81]

The Department was consulted prior to submission of the Environmental Authorisation Application and was/will also be consulted upon submission of the following reports:

- Draft SR;
- Final SR;
- Draft EIA&EMPr (submission still to take place); and
- Final EIA&EMPr (submission still to take place).

The following illustration **(Figure 74)** shows the Scoping and EIA process as per the NEMA EIA Regulations, 2014 (as amended). The stages at which the Competent Authority (CA), the DMRE in this instance, will be consulted are indicated on the illustration.

[79] Required as per the EIA regulations Appendix 2 (h) a plan of study for undertaking the environmental impact assessment process to be undertaken, including (iv) a description of the proposed method of assessing the environmental aspects, including aspects to be assessed by specialists

[80] Required as per the EIA regulations Appendix 2 (h) a plan of study for undertaking the environmental impact assessment process to be undertaken, including (v) a description of the proposed method of assessing duration and significance

[81] Required as per the EIA regulations Appendix 2 (h) a plan of study for undertaking the environmental impact assessment process to be undertaken, including (vi) an indication of the stages at which the competent authority will be consulted

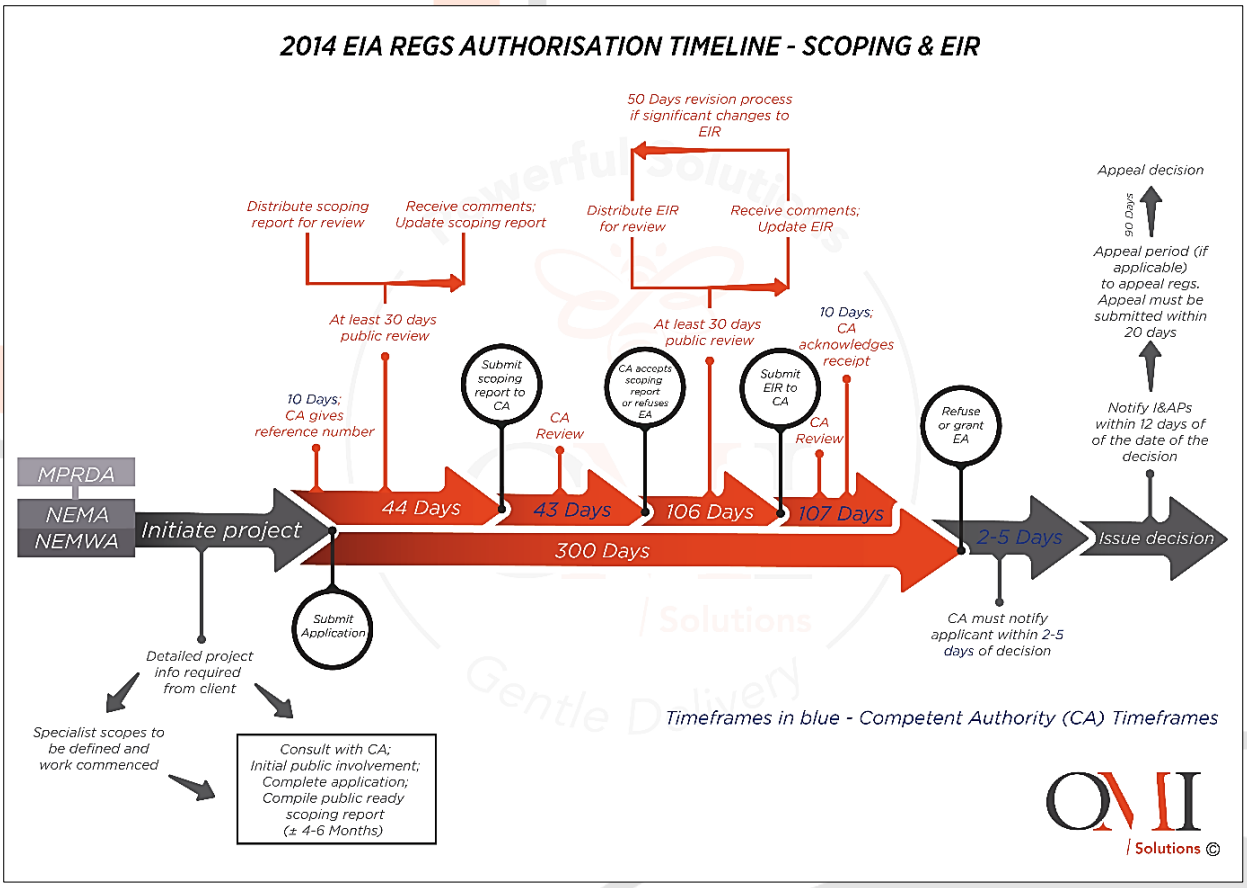


Figure 74: Scoping and EIA process showing the Competent Authority Liaison Stages

20.7 PARTICULARS OF THE PUBLIC PARTICIPATION PROCESS WITH REGARD TO THE IMPACT ASSESSMENT PROCESS THAT WILL BE CONDUCTED[82]

The stakeholder engagement forms an integral part of the EIA process and is conducted during the planning and design stages of the project as well as the scoping and EIA phases. The aim of public participation and consultation is to achieve the following:

- Provide for public input and facilitate negotiated outcomes;
- Create trust and partnerships;
- Minimize negative impacts and enhance positive impacts;
- Provide up-front indication of issues that may prevent project continuation or can cause costly delays at a later stage; and
- Enhanced and shared benefits.

In accordance with the Chapter 6 of the EIA Regulations, 2014 (as amended), potential I&APs either have been or will be notified of the proposed TSF 3 WRD Extension 1. Please refer to **Section 9** and **ANNEXURE F**.

[82] Required as per the EIA regulations Appendix 2 (h) a plan of study for undertaking the environmental impact assessment process to be undertaken, including (vii) particulars of the public participation process that will be conducted during the environmental impact assessment process

20.7.1 DETAILS OF THE ENGAGEMENT TO BE FOLLOWED PROCESS WITH REGARD TO THE IMPACT ASSESSMENT PROCESS THAT WILL BE CONDUCTED[83]

The I&AP database will be updated during the entire EA process, as and when additional I&APs register for the project. Comments raised during the process will continually feed into a CRR to be made available with the Draft EIA&EMPr.

In addition, an open day and focus group meeting(s) will be held during the review period of the draft EIA&EMPr. The aim of these meetings will be to:

- Discuss and explain the project and contents of the draft reports; and
- obtain comments and issues with regards to the contents of the draft reports.

20.7.2 DESCRIPTION OF THE INFORMATION TO BE PROVIDED TO INTERESTED AND AFFECTED PARTIES AND THE ENGAGEMENT PROCESS

The following information will be provided to the Interested and affected parties:

- The site plan.
- List of activities to be authorised.
- Alternatives assessed.
- Scoping level specialist studies
- Scale and extent of activities to be authorised.
- Typical impacts of activities to be authorised (e.g. Surface disturbance, dust, noise, drainage, fly rock etc.).
- The duration of the activity.
- Sufficient detail of the intended operation to enable I&APs to assess what impact the activities will have on them or on the use of their land.

In addition, the following reports have been/will be provided to I&APs:

- Draft SR
- Draft EIA&EMPr
- Scoping and EIA level specialist reports

During the scoping phase a public open day was held where the following information was made available:

- Site Plans;
- Alternatives;
- A description of activities and operations to be undertaken;
- Baseline information;
- Specialist studies to be undertaken; and
- Proposed impact assessment methods.

[83] Required as per the EIA regulations Appendix 2 (h) a plan of study for undertaking the environmental impact assessment process to be undertaken, including (vii) particulars of the public participation process that will be conducted during the environmental impact assessment process;

During the EIA Phase, the following information will be disclosed in the Draft EIA&EMPr:

- Impact assessment undertaken and results thereof;
- Outcome of the specialist's studies;
- Management measures;
- Monitoring plans; and
- Closure objectives.

20.8 DESCRIPTION OF THE TASKS THAT WILL BE UNDERTAKEN DURING THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS[84]

The following tasks will be undertaken during the EIA Phase:

- **Appointment of Specialists:** The identified specialists were appointed to undertake the specialist studies as identified in this SR for the EIA.
- **Completion of the PPP:** The comments received from I&APs will be included and assessed in the EIA&EMPr.
- **Draft EIA&EMPr:** The results of the specialist studies will be synthesised by the project team to provide a draft EIA&EMPr.
- **Draft EIA&EMPr published:** The draft EIA&EMPr will be circulated to key I&APs for comment for a period of 60 days.
- **Revise Draft EIA&EMPr:** The draft report will be updated by addressing and responding to the issues raised by I&APs.
- **Final EIA&EMPr:** The revised final report will be published with the various specialist reports appended. This will be submitted to the DMRE for consideration.

[84] Required as per the EIA regulations Appendix 2 (h) a plan of study for undertaking the environmental impact assessment process to be undertaken, including (viii) a description of the tasks that will be undertaken as part of the environmental impact assessment process;

20.9 MEASURES TO AVOID, REVERSE, MITIGATE, OR MANAGE IDENTIFIED IMPACTS AND TO DETERMINE THE EXTENT OF THE RESIDUAL RISKS THAT NEED TO BE MANAGED AND MONITORED [85]

Table 47: Preliminary Mitigation Types[86]

Activity (whether listed/not listed)	Aspect Affected	Potential Impact	Nature (Negative or Positive Impact)	Mitigation Type	Potential for Residual Risk
Agro-Ecosystem					
Planning Phase					
Siting of WRD on sensitive soils and close to watercourses	Soils and land capability	Delay of mining onset	Negative	• Prevent project delays • Prevent edge effects	No
Construction Phase					
Topsoil & subsoil stripping	Soils and land capability	Soil destruction and sterilisation	Negative	Topsoil management	No
Heavy machinery and vehicle movement to and on WRD and topsoil facilities	Soils and land capability	Soil compaction	Negative	Prevent soil loss and compaction	No
Topsoil & subsoil stripping, exposure of soils to wind and rain during construction causing erosion and sedimentation of watercourses	Soils and land capability	Soil erosion and sedimentation	Negative	• Erosion and dust control • Prevent soil loss, compaction and contamination • Topsoil management	No
Heavy machinery and vehicle movement on site	Soils and land capability	Spillages of harmful substances	Negative	Prevent soil contamination	No
Topsoil & subsoil stripping, clearing of vegetation for establishment of WRD	Soils and land capability	Loss of land capability	Negative	Prevent edge effects	No
Operational Phase					
Topsoil & subsoil stripping, WRD laydown area	Soils and land capability	Soil destruction and sterilisation	Negative	Topsoil management	No
Heavy machinery and vehicle movement to and on WRD and topsoil facilities	Soils and land capability	Soil compaction	Negative	Prevent soil loss and compaction	No
Increased hardened surfaces around infrastructure, laydown areas of waste rock	Soils and land capability	Increased soil erosion and sedimentation of watercourses	Negative	• Erosion and dust control • Prevent soil loss, compaction and contamination • Topsoil management	No
Heavy machinery and vehicle movement on site.	Soils and land capability	Spillages of harmful substances resulting in soil pollution	Negative	Prevent soil contamination	No
Establishment of WRD	Soils and land capability	Loss of land capability	Negative	Prevent edge effects	No
Closure and Decommissioning Phase					
Rehabilitation of mining site	Soils and land capability	Improvement of eroded soils and compaction	Positive	Remedy through rehabilitation	No
Cessation of mining / Rehabilitation of WRD	Soils and land capability	Increased soil erosion and sedimentation	Negative	• Erosion and dust control • Prevent soil loss, compaction and contamination • Topsoil management	No
Rehabilitation of WRD, heavy machinery and vehicle movement on site	Soils and land capability	Soil compaction	Negative	Prevent soil loss and compaction	No
Rehabilitation of WRD, heavy machinery and vehicle movement on site	Soils and land capability	Spillages of harmful substances resulting in soil pollution	Negative	Prevent soil contamination	No
Closure and Post closure					
Rehabilitation / Natural processes	Soils and land capability	Improvement of land capability	Positive	Remedy through rehabilitation	No
Exposed surfaces / unrehabilitated areas on site post closure / poor monitoring during LoM	Soils and land capability	Soil erosion and sedimentation	Negative	Remedy through rehabilitation	No
Terrestrial Biodiversity					
Planning Phase					

[85] Required as per the EIA regulations Appendix 2 (h) a plan of study for undertaking the environmental impact assessment process to be undertaken, including identify suitable measures to avoid, reverse, mitigate or manage identified impacts and to determine the extent of the residual risks that need to be managed and monitored.

[86] Note that the above mitigation measures are subject to being updated during the EIA phase subsequent to further and more detailed work being conducted as may be required or as new information becomes available (these being for scoping purposes at present). Monitoring is listed as part of the mitigation measures; however it must be noted that monitoring in itself is not a mitigation measure. Monitoring is important to quantify and verify impacts against pre-development baseline and must be used to pro-actively determine when mitigations should be required.

Activity (whether listed/not listed)	Aspect Affected	Potential Impact	Nature (Negative or Positive Impact)	Mitigation Type	Potential for Residual Risk
Obtaining of IWUL establishment of WRD and location of WRD with zone of regulation of watercourses	Fauna & Flora	Delay of mining onset	Negative	Prevent project delays	No
Obtaining permits for the eradication of protected trees / flora	Fauna & Flora	Delay of WRD construction	Negative	Prevent project delays	No
Construction Phase					
Clearing of vegetation for WRD construction, access roads etc. causing direct habitat destruction / fragmentation	Fauna & Flora	Habitat destruction / fragmentation of fauna habitats	Negative	• Prevent edge effects • Prevent habitat destruction and fragmentation	No
Topsoil & subsoil stripping, exposure of soils and rock to wind and rain during construction causing erosion and sedimentation	Fauna & Flora	Soil erosion and sedimentation	Negative	• Erosion and dust control • Prevent soil loss, compaction and contamination • Topsoil management	No
Vegetation clearing / vehicle movement	Flora	Spreading and establishment of alien invasive species	Negative	Control spread of alien invasive species	No
Vegetation clearing / vehicle movement	Flora & Fauna	Habitat degradation due to dust	Negative	Dust control	No
Heavy machinery and vehicle movement on site	Fauna & Flora	Spillages of harmful substances	Negative	Control spillages	No
Heavy machinery and vehicle movement on site; construction of infrastructure, roads etc. on site	Fauna	Road mortalities of fauna / impact of human activities on site	Negative	Prevent fauna mortalities	No
Operational Phase					
Laydown areas of WRD and topsoil stockpile	Fauna & Flora	Habitat destruction / fragmentation of fauna habitats	Negative	Remedy through rehabilitation	No
Increased hardened surfaces around infrastructure and exposed areas around laydown area of WRD and topsoil stockpile	Flora	Soil erosion and sedimentation	Negative	• Erosion and dust control • Prevent soil loss, compaction and contamination • Topsoil management	No
Heavy machinery and vehicle movement on site	Flora	Spreading and establishment of alien invasive species	Negative	Control spread of alien invasive species	No
Heavy machinery and vehicle movement on site	Flora & Fauna	Habitat degradation due to dust	Negative	Dust control	No
Heavy machinery and vehicle movement on site	Flora	Spillages of harmful substances	Negative	Control spillages	No
Heavy machinery and vehicle movement on site; workers accommodated on site causing poaching, wood collection, fires etc.	Fauna	Road mortalities of fauna / impact of human activities on site	Negative	Prevent fauna mortalities	No
Closure and Decommissioning Phase					
Rehabilitation of mining site	Fauna & Flora	Improvement of habitat through revegetation / succession over time	Positive	Remedy through rehabilitation	No
Demolition of mining infrastructure / cessation of mining / rehabilitation of mining site	Flora	Soil erosion and sedimentation	Negative	• Erosion and dust control • Prevent soil loss, compaction and contamination • Topsoil management	No
Demolition of mining infrastructure / cessation of mining / rehabilitation of mining site	Flora	Spreading and establishment of alien invasive species	Negative	Control spread of alien invasive species	No
Demolition of mining infrastructure / cessation of mining / rehabilitation of mining site / vehicle movement on site	Fauna & Flora	Habitat degradation due to dust	Negative	Dust control	No
Heavy machinery and vehicle movement on site	Fauna & Flora	Spillages of harmful substances	Negative	Control spillages	No
Heavy machinery and vehicle movement on site	Fauna	Road mortalities of fauna / impact of human activities on site	Negative	Prevent fauna mortalities	No
Post-Closure & Rehabilitation Phase					
Rehabilitation / Natural successional processes	Fauna & Flora	Improvement of habitat through revegetation / succession over time	Positive	Remedy through rehabilitation	No
Exposed surfaces / unrehabilitated areas on site post closure / poor monitoring during LoM	Flora	Soil erosion and sedimentation	Negative	• Erosion and dust control • Prevent soil loss, compaction and contamination • Topsoil management • Stormwater management	No
Exposed surfaces / poor monitoring of revegetation on site	Flora	Spreading and establishment of alien invasive species	Negative	Control spread of alien invasive species	No
Wetland & Riparian					
Planning Phase					

Activity (whether listed/not listed)	Aspect Affected	Potential Impact	Nature (Negative or Positive Impact)	Mitigation Type	Potential for Residual Risk
Obtaining of IWUL for crossings, establishment of WRD and location of WRD within zone of regulation of watercourses / riparian zones	Rivers / watercourses	Delay of mining onset	Negative	Prevent project delays	No
Construction Phase					
Clearing of vegetation for WRD and close to riparian zones and watercourses as well as road crossings	Rivers / watercourses	Riverine destruction / fragmentation of riparian habitats	Negative	• Prevent edge effects • Prevent habitat destruction and fragmentation	No
Topsoil & subsoil stripping, exposure of soils and rock to wind and rain during construction causing erosion and sedimentation in rivers	Rivers / watercourses	Soil erosion and sedimentation	Negative	• Erosion and dust control • Prevent soil loss, compaction and contamination • Topsoil management • Stormwater management	No
Vegetation clearing, topsoil & subsoil stripping, vehicle movement on site	Rivers / watercourses	Potential establishment and spread of declared weeds and alien invader plants in rivers / watercourses	Negative	Control spread of alien invasive species	No
Heavy machinery and vehicle movement on site	Water quality in permanent watercourses	Spillages of harmful substances	Negative	• Prevent water contamination • Control spillages	No
Operational Phase					
Increased hardened surfaces around infrastructure and exposed areas around laydown areas of WRD and stockpiles, road crossings	Wetlands / watercourses	Soil erosion and sedimentation in wetland / watercourses	Negative	Remedy through rehabilitation	No
Heavy machinery and vehicle movement on site	Wetlands / watercourses	Spreading and establishment of alien invasive species in rivers	Negative	Control spread of alien invasive species	No
Heavy machinery and vehicle movement on site	Wetlands / watercourses	Spillages of harmful substances leading to water pollution in rivers	Negative	• Prevent water contamination • Control spillages	No
Decommissioning Phase					
Rehabilitation of mining site	Wetlands / watercourses	Improvement of riparian habitat through revegetation / succession over time	Positive	Remedy through rehabilitation	No
Cessation of mining / rehabilitation of disturbed areas	Wetlands / watercourses	Soil erosion and sedimentation in rivers	Negative	• Erosion and dust control • Prevent soil loss, compaction and • Contamination • Topsoil management • Stormwater management	No
Cessation of mining / rehabilitation of disturbed areas	Wetlands / watercourses	Spreading and establishment of alien invasive species in rivers	Negative	Control spread of alien invasive species	No
Heavy machinery and vehicle movement on site	Wetlands / watercourses	Spillages of harmful substances	Negative	• Prevent water contamination • Control spillages	No
Closure and Post-Closure Phase					
Rehabilitation / Natural successional processes	Wetlands / watercourses	Improvement of wetland habitat at crossings through revegetation / succession over time	Positive	Remedy through rehabilitation	No
Exposed surfaces / unrehabilitated areas on site post closure / poor monitoring during LoM	Wetlands / watercourses	Soil erosion and sedimentation	Negative	• Remedy through rehabilitation • Erosion control	No
Exposed surfaces / poor monitoring of revegetation on site	Wetlands / watercourses	Spreading and establishment of alien invasive species	Negative	Control spread of alien invasive species	No
Hydrogeological					
Construction Phase					
Contamination to ground- and surface water systems from oil, grease and diesel spillages from construction vehicles.	Hydrogeological	Contamination to groundwater systems and surface runoff	Negative	• Prevent groundwater contamination • Control spillages	No
Storage of chemicals and building materials during construction of waste facility.	Hydrogeological	Contamination to groundwater systems through baseflow and surface runoff	Negative	Control spillages	No
Operational Phase					
Surface water runoff from facility to Sterkstroom River during large rainfall events	Hydrogeological	Contamination to baseflow and groundwater systems	Negative	Stormwater management	No
Cumulative impact of nitrate mass migration from existing facilities (TSF 3 and West WRD1) towards	Hydrogeological	Contamination to groundwater and surface water systems	Negative	• Remedy through rehabilitation • Control through monitoring	No

Activity (whether listed/not listed)	Aspect Affected	Potential Impact	Nature (Negative or Positive Impact)	Mitigation Type	Potential for Residual Risk
the Sterkstroom River, and along preferential groundwater pathways towards boreholes north and northwest.					
Nitrate mass migration from planned new facility (TSF 3 WRD Extension 1) downstream along preferential groundwater pathways: • Sterkstroom west of proposed facility	Hydrogeological	Contamination to groundwater and surface water (Sterkstroom) systems	Negative	• Remedy through rehabilitation • Control through monitoring	No
Closure and Post closure					
Nitrate mass transport and seepage from the proposed TSF 3 WRD Extension 1 downstream along preferential groundwater pathways.	Hydrogeological	Contamination to groundwater and surface water (Sterkstroom) systems	Negative Negative	• Remedy through rehabilitation • Control through monitoring	No No
Heritage					
Construction Phase					
Surface alteration activities associated with the project development.	Burial Sites / Graves (TWRD-BP01) if site was not previously relocated.	Damage/destruction of sites, potential loss of human burial sites	Negative	• Avoid through implementation of buffers • Control through monitoring, permitting and grave relocation	No
Surface alteration activities associated with the project development.	Built Environment Heritage Features (TWRD-HP01, TWRD-HP02)	Damage/destruction of sites	Negative	Control through monitoring	No
Operational Phase					
All activities associated with operations and mining.	Burial Sites / Graves (TWRD-BP01) if site was not previously relocated.	Damage/destruction of sites, potential loss of human burial sites	Negative	• Avoid through implementation of buffers • Control through monitoring	No
All activities associated with operations and mining.	Built Environment Heritage Features (TWRD-HP01, TWRD-HP02)	Damage/destruction of sites	Negative	Control through monitoring	No
Closure and Post closure					
All activities associated with closure and post closure of the mine.	Burial Sites / Graves (TWRD-BP01) if site was not previously relocated.	Damage/destruction of sites, potential loss of human burial sites	Negative	• Avoid through implementation of buffers • Control through monitoring	No
All activities associated with closure and post closure of the mine.	Built Environment Heritage Features (TWRD-HP01, TWRD-HP02)	Damage/destruction of sites	Negative	Control through monitoring	Yes
Air Quality					
Construction Phase					
Grading of new roads to the new WRD; Vehicle (trucks) on newly graded unpaved roads; and Land clearing for new WRD section	Air Quality	Vehicle entrainment of dust, wind erosion	Negative	Control through monitoring	No
Operational Phase					
All mining activities related to the storage of waste rock on the proposed TSF 3 WRD Extension 1	Air Quality	Dust emissions from material off-loading onto the WRD, disturbances by strong wind currents and dust from the movement of haul trucks	Negative	Control through monitoring	No
Closure and Post closure					
Topsoil recovered from stockpiles for rehabilitation and re-vegetation of surroundings; and Vehicle activity on unpaved road surfaces during rehabilitation	Air Quality	Vehicle entrainment of dust, windblown dust from WRD. Post-closure should not result in significant air quality impacts provided the WRD has been fully vegetated and rehabilitated	Negative	Control through monitoring	No
Noise					
Construction Phase					
Land clearing in the footprint of the TSF3 WRD Extension 1	Noise	Nuisance and health risks caused by an increase in the ambient noise level as a result of noise impacts associated with the construction of the TSF 3 WRD Extension 1	Negative	• Noise control measures • Control through monitoring	No
Operational Phase					

Activity (whether listed/not listed)	Aspect Affected	Potential Impact	Nature (Negative or Positive Impact)	Mitigation Type	Potential for Residual Risk
All activities associated with operations on the TSF3 WRD Extension 1	Noise	Nuisance and health risks caused by an increase in the ambient noise level as a result of noise impacts associated with the operation of the TSF 3 WRD Extension 1	Negative	• Noise control measures • Control through monitoring	No
Closure and Post closure					
All activities associated with closure and rehabilitation of the TSF3 WRD Extension 1	Noise	Nuisance and health risks caused by an increase in the ambient noise level as a result of noise impacts associated with the closure and rehabilitation of the TSF 3 WRD Extension 1	Negative	• Noise control measures • Control through monitoring	No
Visual					
Construction Phase					
Vegetation clearance and construction of the toe drainage, access roads and stormwater diversions	Physical (visual) presence	Change to the visual environment observed by sensitive receptors. No sense of place impact	Negative	• Dust control measures • Avoid night-time work	No
Operational Phase					
Trucks moving overburden to the WRD dumps, graders maintaining the haul roads and water tankers wetting the roads. Growth of the WRD as mining progresses	Physical (visual) presence	Change to the visual environment observed by sensitive receptors. No sense of place impact	Negative	• Dust control measures • Avoid night-time work • Remedy through rehabilitation	No
Closure and Post closure					
Final shaping and rehabilitation of the WRD dump	Physical (visual) presence	Improvement of the visual quality (over operational baseline) of the project area visible from nearby residential receptors as well as public roads	Negative	Remedy through rehabilitation	No
Socio- Economic					
Construction Phase					
Improved household income resulting in increased business sales in the local economy	Economic	Temporary increase in production and GDP in the local economy	Positive	Enhance local procurement and employment	No
Employment of local community members	Socio-economic	Creation of temporary employment opportunities on-site	Positive	The proposed mitigation measures will possibly increase the positive impact on the local employment rates	No
Construction activities resulting in dust, noise, visual, water supply, water pollution and other environmental impacts	Social	Deterioration of quality of life due to dust, noise, visual, water supply, water pollution and other environmental impacts	Negative	• Dust control measures • Noise control measures • Spillage control • Prevent water pollution • Remedy through rehabilitation	No
Influx of people seeking employment	Social	Temporary increase in crime associated with the influx of people	Negative	• Enhance local employment • Control through safety measures	No
Increased pollution levels and the removal of natural habitats through vegetation clearance	Social	Degradation of the natural environment resulting in impacts on ecosystem services	Negative	• Prevent edge effects • Dust control measures • Spillage control • Prevent soil and water pollution • Remedy through rehabilitation	No
Operational Phase					
Improved household income resulting in increased business sales in the local economy	Economic	Long-term increase in production and GDP in the local economy	Positive	Enhance local procurement	No
Employment of local community members	Socio-economic	Creation of permanent employment opportunities in the local and regional economy	Positive	Enhance local employment	No
Operational activities resulting in dust, noise, visual, water supply and water pollution and other environmental impacts	Social	Deterioration of quality of life due to dust, noise, visual, water supply, water pollution and other environmental impacts	Negative	• Dust control measures • Noise control measures • Spillage control • Prevent water pollution • Remedy through rehabilitation	No
Increased pollution levels and the removal of natural habitats through vegetation clearance	Social	Degradation of the natural environment resulting in impacts on ecosystem services	Negative	• Prevent edge effects	No

Activity (whether listed/not listed)	Aspect Affected	Potential Impact	Nature (Negative or Positive Impact)	Mitigation Type	Potential for Residual Risk
				• Dust control measures • Spillage control • Prevent soil and water pollution • Remedy through rehabilitation	
No-Go Alternative					
Project does not go ahead, and the area stays as is	Socio-economic	No increase in production, GDP and employment in the local economy	Negative	N/A	No

21 OTHER INFORMATION REQUIRED BY THE COMPETENT AUTHORITY[87]

21.1 COMPLIANCE WITH THE PROVISIONS OF SECTIONS 24(4)(A) AND (B) READ WITH SECTION 24 (3) (A) AND (7) OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (ACT NO. 107 OF 1998) THE EIA REPORT MUST INCLUDE THE

21.1.1 IMPACT ON THE SOCIO-ECONOMIC CONDITIONS OF ANY DIRECTLY AFFECTED PERSON

The following potential socio-economic impacts were identified and assessed in the Socio-Economic Scoping Report (**ANNEXURE G**).

Construction Phase

- Temporary stimulation of the local economy and growth in the regional Gross Value Added (GVA).
- Temporary employment creation in local communities.
- Temporary change to the sense of place
- Temporary increase in crime and social conflicts associated with influx (or removal) of people.
- Impact on the environment

Operational Phase

- Employment creation in local communities
- Local economic development benefits
- Impact on the environment
- Change in sense of place

Decommissioning/Closure Phase

- Temporary stimulation of the economy and growth in the regional GVA;
- Temporary increase in government earnings;
- Temporary employment creation; and
- Deterioration of quality of life due to noise, visual and other environmental impacts.

The significance of the above preliminary impacts without mitigation (WOM) is rated in **Table 44** and the relevant mitigation measures are provided in **Table 46** of this report. The Socio-Economic Impact Assessment Report will be submitted along with the EIA&EMPr.

21.1.2 IMPACT ON ANY NATIONAL ESTATE REFERRED TO IN SECTION 3(2) OF THE NATIONAL HERITAGE RESOURCES ACT

The following potential socio-economic impacts were identified and assessed in the Heritage Impact Assessment Report (**ANNEXURE G**).

[87] Required as per the EIA regulations Appendix 2 (k) where applicable, any specific information required by the competent authority

Construction Phase

The remains of two Historical Period farmsteads (TWRD-HP01, TWRD-HP02) noted in the proposed TSF 3 WRD Extension 1 area will probably be impacted and the site will require monitoring during the construction phase.

The cemetery at TWRD-BP01 - **if present** – will be impacted on by the project and a probable high impact on the site should be mitigated during the construction phase by means of a no-go development buffer (of the site is not relocated). It should be noted that graves and cemeteries do not only occur around farmsteads in family burial grounds, but they are also randomly scattered around archaeological and historical settlements in the rural areas of the North West Province. The probability of informal human burials encountered during the construction phase should thus not be excluded.

Operational Phase

It is understood that no new areas will be disturbed and/or impacted during the operational phase of the project and the risk and severity of heritage impacts should decrease once the projects activate. Furthermore, the majority of sites of archaeological and heritage significance would have been recorded and/or assessed in preceding phases. However, impact on previously undetected arkeological sites, human burials and the cultural landscape might occur as a result of operational activities (site access, movement, maintenance, trespassing, natural elements, hazards etc). During the Operations Phase, the implementation of mitigation and management measures for the cemetery at TWRD-BP01 - **if present** – should be tracked and continuous ECO site monitoring will be required (should these site/s be retained).

Decommissioning Phase

Similar to the Operations Phase, no new areas are expected to be disturbed and/or impacted and no additional sites of archaeological and heritage significance are expected to be impacted on during decommissioning. During the decommissioning and closure phase, it may be recommended that the ECO review management procedures (and particularly those recommended for sites TWRD-BP01, TWRD-HP01 and TWRD-HP01) and ensure that required measures were implemented.

21.2 OTHER MATTERS REQUIRED IN TERMS OF SECTIONS 24(4)(A) AND (B) OF THE ACT[88]

No fatal flaws were identified during the specialist scoping assessments except. Please refer to the Alternatives Assessment **Section 8**.

[88] Required as per the EIA regulations Appendix 2 (l) any other matter required in terms of section 24(4)(a) and (b) of the Act and where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a scoping report, the requirements as indicated in such notice will apply (motivation if no reasonable or feasible alternatives, as contemplated in sub-regulation 22(2)(h) exist)

22 UNDERTAKING REGARDING CORRECTNESS OF INFORMATION

I, Reneé Kruger, herewith undertake that the information provided in the foregoing report is correct, and that the comments and inputs from stakeholders and Interested and Affected parties has been correctly recorded in the report.

_____

Signature of the EAP

DATE:

23 UNDERTAKING REGARDING LEVEL OF AGREEMENT

I, Reneé Kruger, herewith undertake that the information provided in the foregoing report is correct, and that the level of agreement with interested and Affected Parties and stakeholders has been correctly recorded and reported herein.

Signature of the EAP

7 August 2023

DATE:

END OF REPORT

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ANNEXURE A EAP'S QUALIFICATIONS

ANNEXURE B COMPANY PROFILE

ANNEXURE C LOCALITY MAPS OF THE PROJECT AREA

ANNEXURE D LAYOUT MAPS

ANNEXURE E DFFE ENVIRONMENTAL SCREENING TOOL REPORT

ANNEXURE F PUBLIC PARTICIPATION

ANNEXURE G SPECIALIST ASSESSMENTS

G.1 AIR QUALITY BASELINE ASSESSMENT

G.2 NOISE ASSESSMENT

G.3 SOCIO-ECONOMIC ASSESSMENT

G.4 HERITAGE ASSESSMENT

G.5 VISUAL ASSESSMENT

G.6 TERRESTRIAL BIODIVERSITY ASSESSMENT

G.7 AGRO-ECOSYSTEM ASSESSMENT

G.8 WETLAND AND RIPARIAN ASSESSMENT

G.9 HYDROGEOLOGICAL ASSESSMENT