DETAILED ASSESSMENT OF POTENTIAL IMPACTS

The potential impacts described in this appendix have been identified by the EIA project team with input from specialists, regulatory authorities and I&APs. The sequence in which these issues are listed are in no order of priority or importance. The assessment and rating of potential impacts has been informed by specialist studies, where relevant. These are attached as appendices to the EIA and EMPr.

Identified impacts are first discussed and assessed incrementally to understand the potential contribution to impacts as a result of the project. Cumulative assessment commentary is included in the impact assessment under the various aspect headings. This takes account of current operations including surface infrastructure changes, the WRDs extension.

The potential impacts are rated with the assumption that no mitigation measures are applied and then again with mitigation, unless otherwise stated.

1. GEOLOGY

1.1 ISSUE: STERILISATION OF A MINERAL RESOURCE

Mineral resources can be sterilized and/or lost through the deposition of minerals onto waste disposal facilities such as the proposed WRD's. The intensity of sterilising mineral resources is considered to be high because of the associated potential economic value that is lost when sterilisation occurs. If sterilisation of resources occurs, it is likely that the related impact will extend beyond the life of mine and will extend beyond the site boundary if one considers the economic nature of the impact.

Without mitigation the probability is definite, and the associated significance is **high**. In the mitigated scenario, with planning and co-ordination to prevent the unacceptable sterilisation of resources the impact can be reduced to **low**.

1.1.1 Impact Assessment

The impacts assessed in their respective phases are shown in Table 1-1.

Table 1-1: Significance rating for sterilisation of resources

Issue: Sterilisation of Mineral Resources		
Phases: Construction		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Medium (M)	Low (L)
Duration	Medium (M)	Low (L)
Extent	Medium (M)	Very Low (VL)
Consequence	Medium (M)	Low (L)
Probability	Medium (M)	Medium (M)
Significance	**Medium**	**Low (L)**
Nature of cumulative impacts	The cumulative severity rating assesses the impact of the changes to the operation within the context of the current approved mining operation. In this regard the severity of sterilising mineral resources is considered to be high because of the associated potential economic value that is lost when sterilisation occurs. In the mitigated scenario, planning and co-ordination between the project team can help to prevent the unacceptable sterilisation of resources, without compromising safety requirements. The mitigated	

	severity can be reduced, however given that some resources have been sterilised this reduces the mitigated severity to medium.
Degree to which impact can be reversed	Impact can be partially reversed during the construction if management measures are put in place and strictly adhered to.
Degree to which impact may cause irreplaceable loss of resources	Low
Residual impacts	Potential residual groundwater contamination risk associated with seepage of chemicals of concern from the Proposed Project.

1.1.1.1Management objective, mitigation measure and monitoring

The management objectives, management outcomes and mitigation measures and monitoring are represented in Table 1-2.

Table 1-2: Management objectives, management outcomes and mitigation measures and monitoring

Management objective	• *To prevent unacceptable mineral sterilisation*
Management outcome	• Rehabilitation that supports post-closure land uses.
Mitigation actions/measures	
Phases: Construction	
• Continued implementation of best mining practices to avoid the unnecessary sterilisation of mineral resources. • Continued implementation and where relevant the adaptation of the soil conservation management plan and waste management plan.	
Monitoring	Close supervision and monitoring of the stripping process is required to ensure that soils are stripped correctly.

2. AIR QUALITY

2.1 ISSUE: INCREASE IN PM10, PM2.5, DUST FALLOUT AND METALS

Establishing waste rock over backfilled portions of the East Pit (East OG WRD and West OG WRD):

Construction Phase: Construction activities were not assessed separately since most of the expansion operations will be on disturbed surfaces with little additional land clearing or preparation required. Also, these activities will occur concurrently with the current mining activities. The significance of air quality impacts due to construction are therefore expected to be **Low** without mitigation and **Very Low** with mitigation measures in place.

Current Operations PM_{10}: Simulated PM_{10} daily ground level concentrations (GLCs), with current mitigation measures in place, are in non-compliance with the NAAQS over a portion of the Maditlhokwa Community and to the north-east of the mining rights boundary, but at no other AQSRs. Annual average GLCs are within compliance with the NAAQS at all AQSRs, except at Maditlhokwa Community.

Future Project operations PM_{10}: PM_{10} GLCs without mitigation in place exceed the daily NAAQS at 14 of the AQSRs, including the communities of Lapologang and Madithlokwa, and the annual NAAQS at four (4) AQSRs. With mitigation

in place the area of exceedance is reduced to fall mostly within the mining rights boundary with non-compliance of the daily and annual NAAQS only at Madithlokwa.

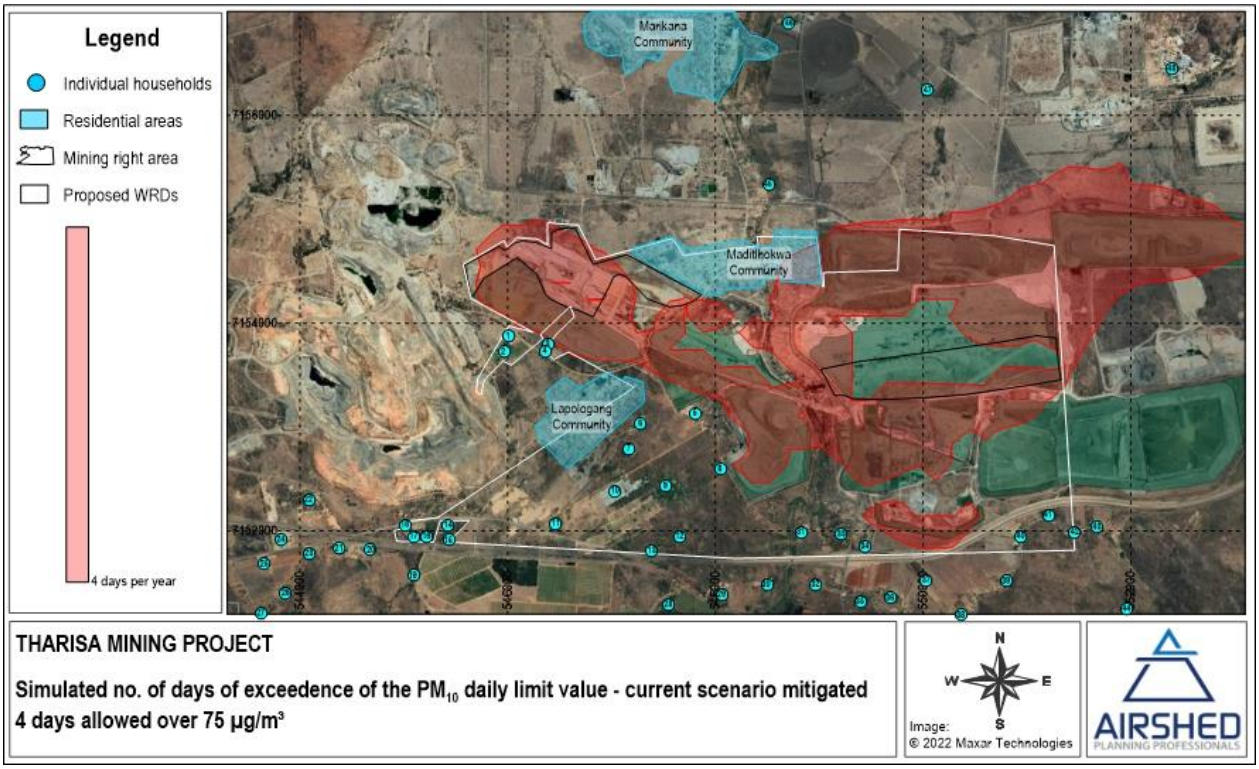

Figure 2-1: Current scenario – Area of non-compliance of daily PM10 NAAQS (mitigated)

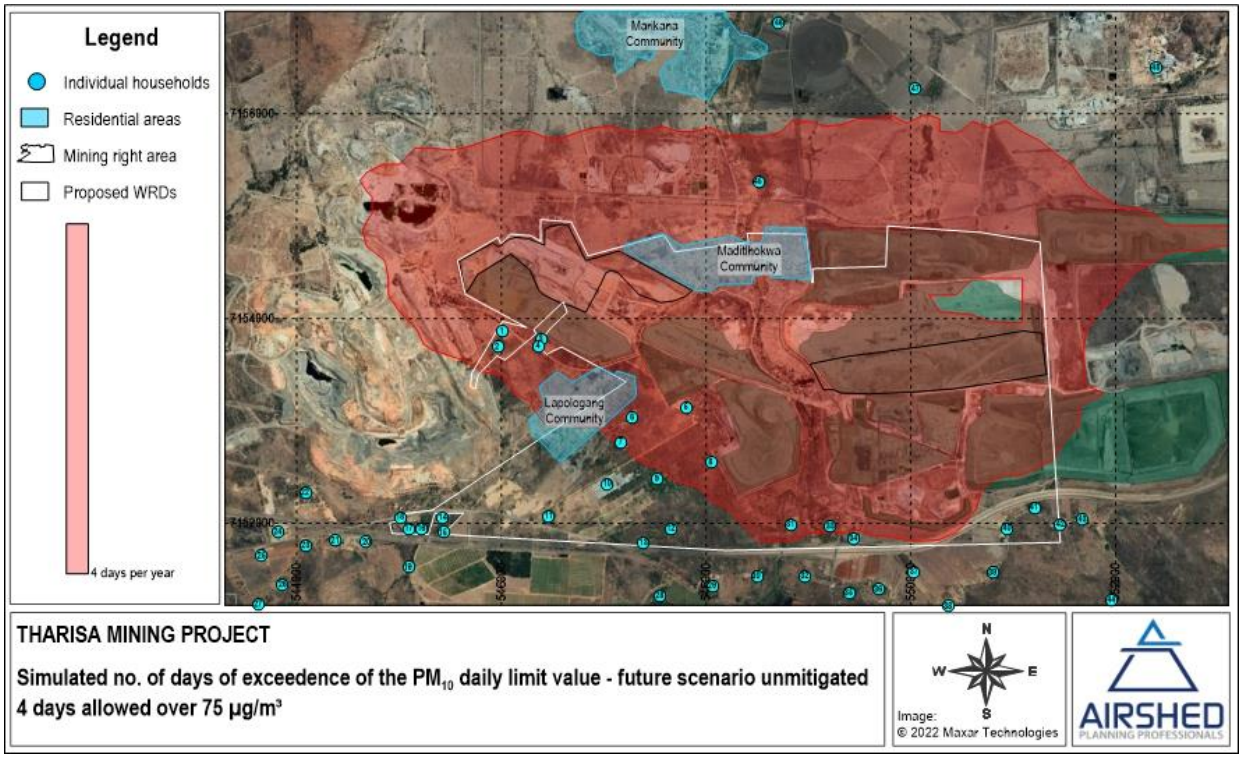

Figure 2-2 : Future Project scenario – Area of non-compliance of daily PM10 NAAQS (unmitigated)

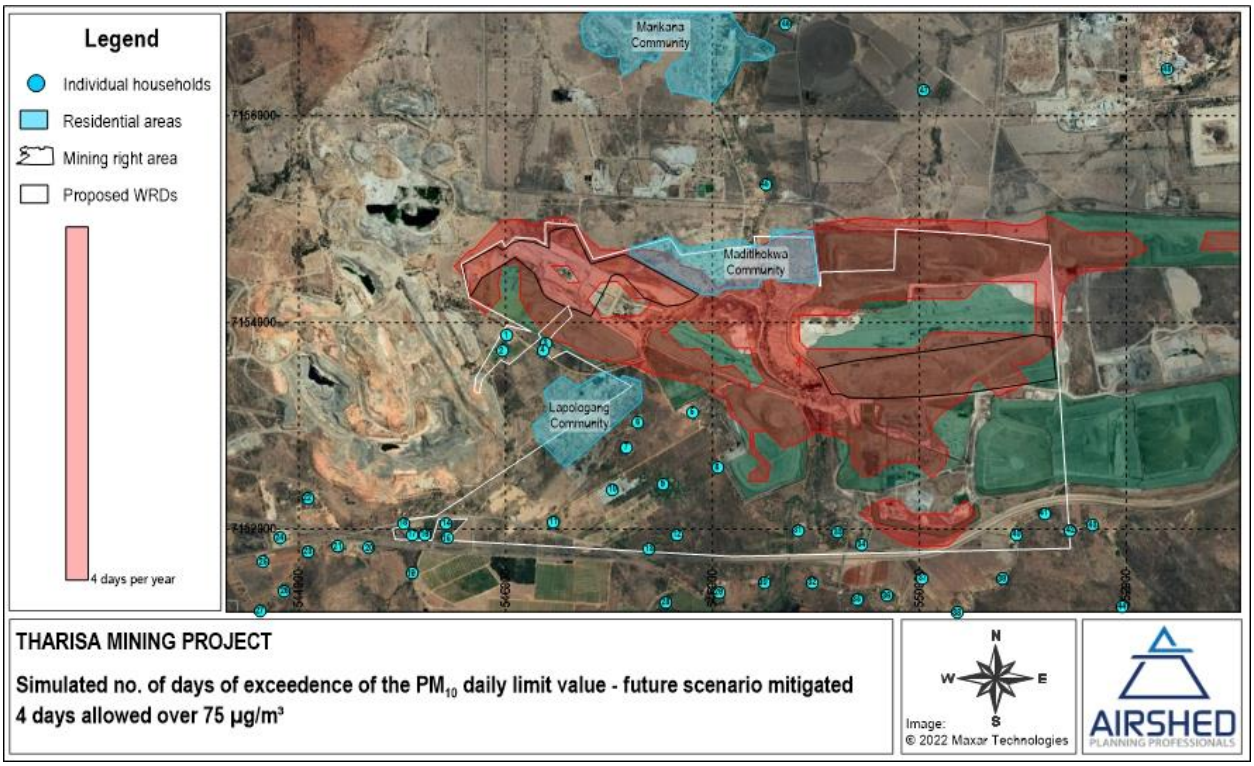

Figure 2-3: Future Project scenario – Area of non-compliance of daily PM10 NAAQS (mitigated)

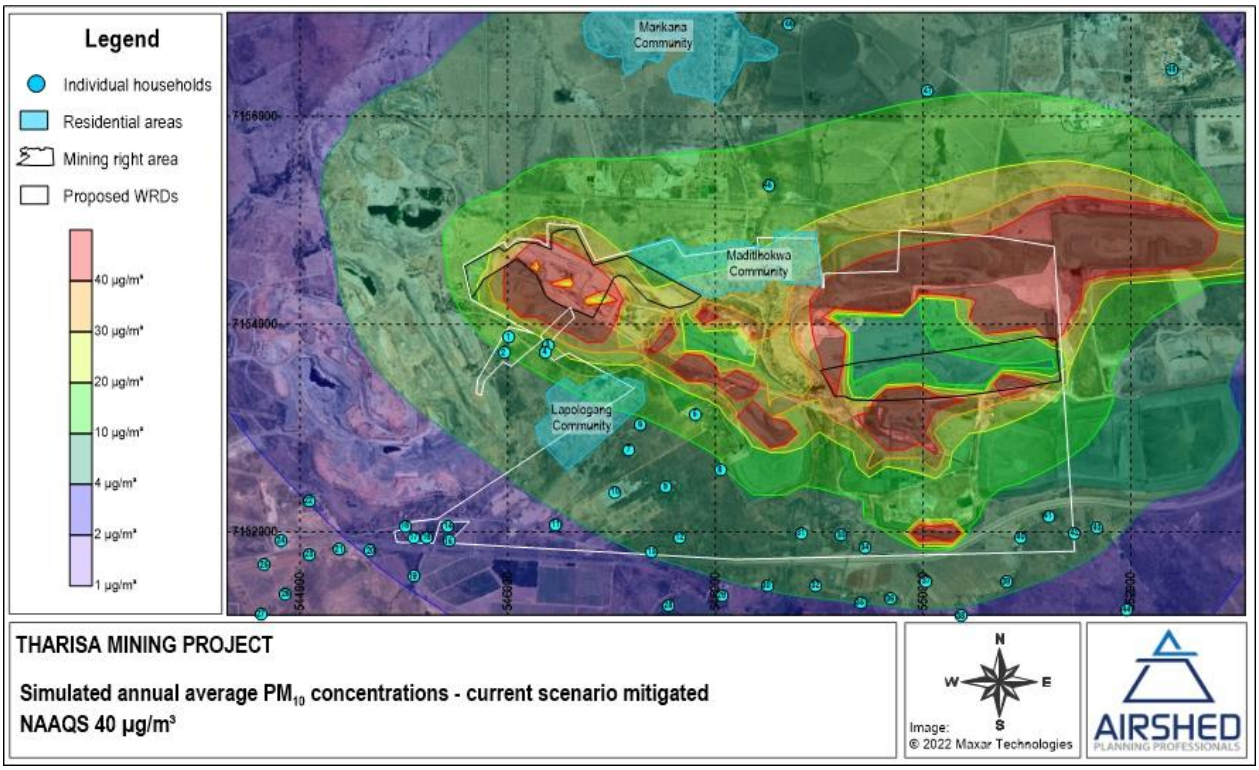

Figure 2-4: Current scenario – Area of non-compliance of annual PM10 NAAQS (mitigated)

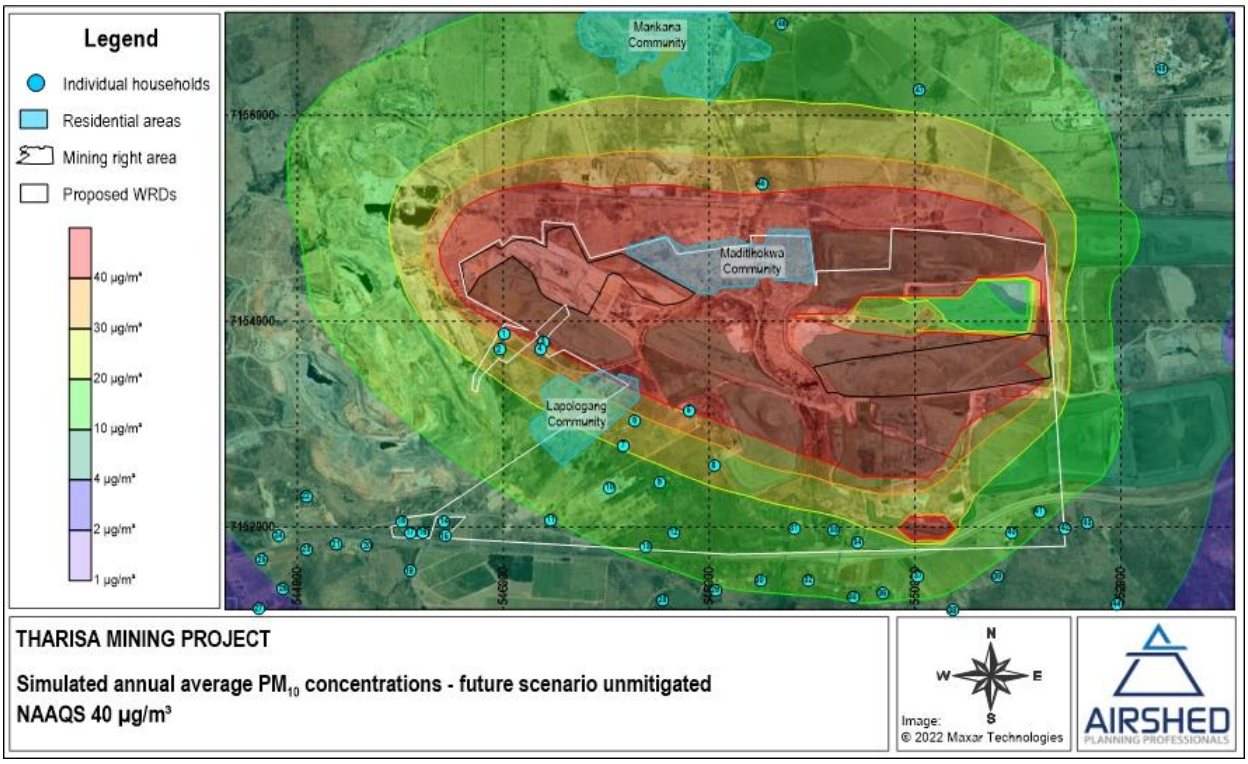

Figure 2-5: Future Project scenario – Area of non-compliance of annual PM10 NAAQS (unmitigated)

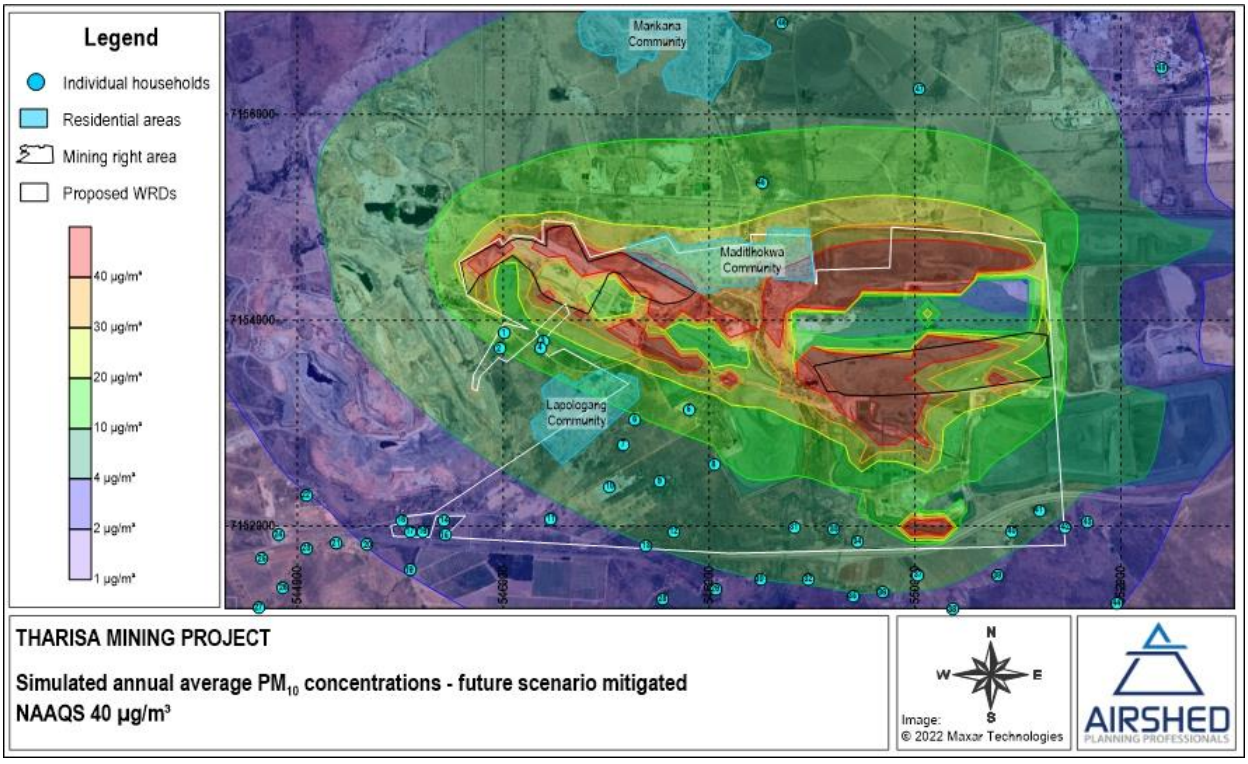

Figure 2-6: Future Project scenario – Area of non-compliance of annual PM10 NAAQS (mitigated)

Current Operations $PM_{2.5}$: $PM_{2.5}$ GLCs are much lower compared to PM_{10} with exceedances of the NAAQS only at Madithlokwa when no mitigation is applied and no exceedances at any of the AQSRs with mitigation measures applied.

Future Project operations $PM_{2.5}$: Without mitigation measures in place, $PM_{2.5}$ GLCs exceed only the daily NAAQS outside the mining rights boundary and at Madithlokwa. With mitigation in place the impact area reduces to fall within the mining rights boundary with no exceedances at any of the AQSRs.

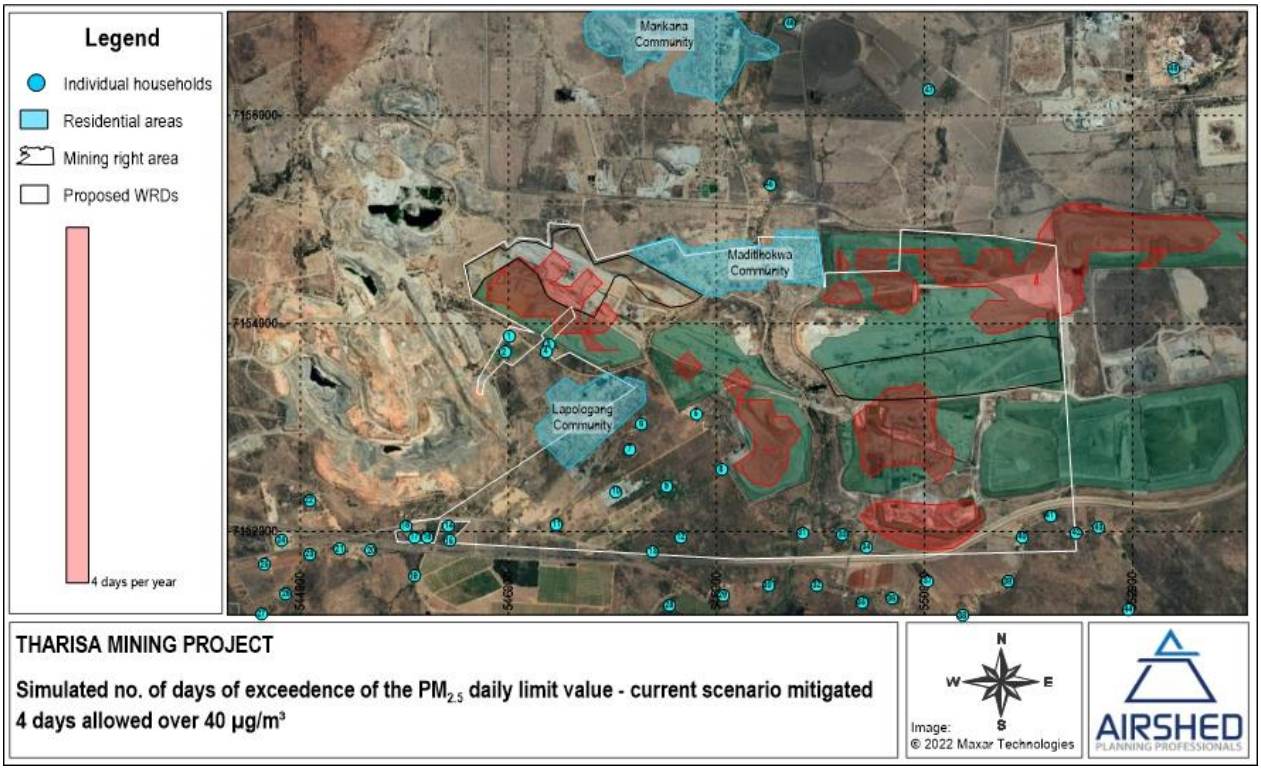

Figure 2-7: Current scenario – Area of non-compliance of daily PM2.5 NAAQS (mitigated)

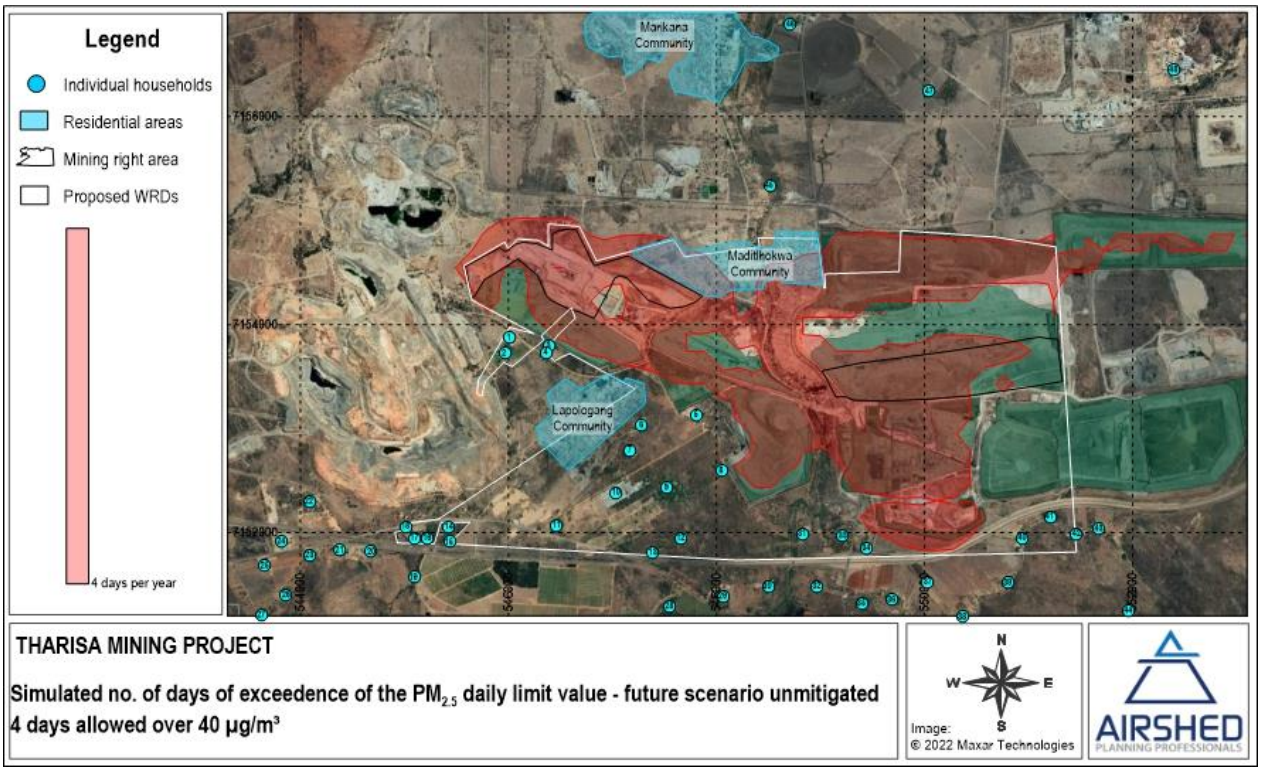

Figure 2-8: Future Project scenario – Area of non-compliance of daily PM2.5 NAAQS (unmitigated)

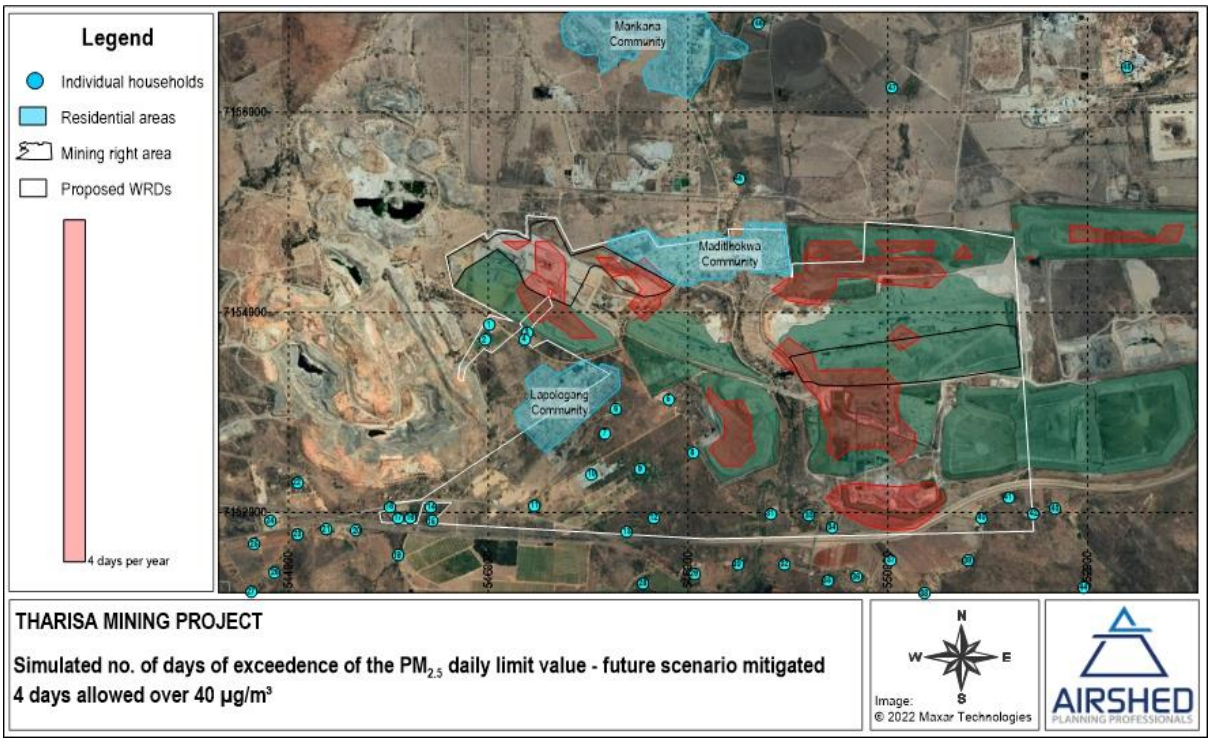

Figure 2-9: Future Project scenario – Area of non-compliance of daily PM2.5 NAAQS (mitigated)

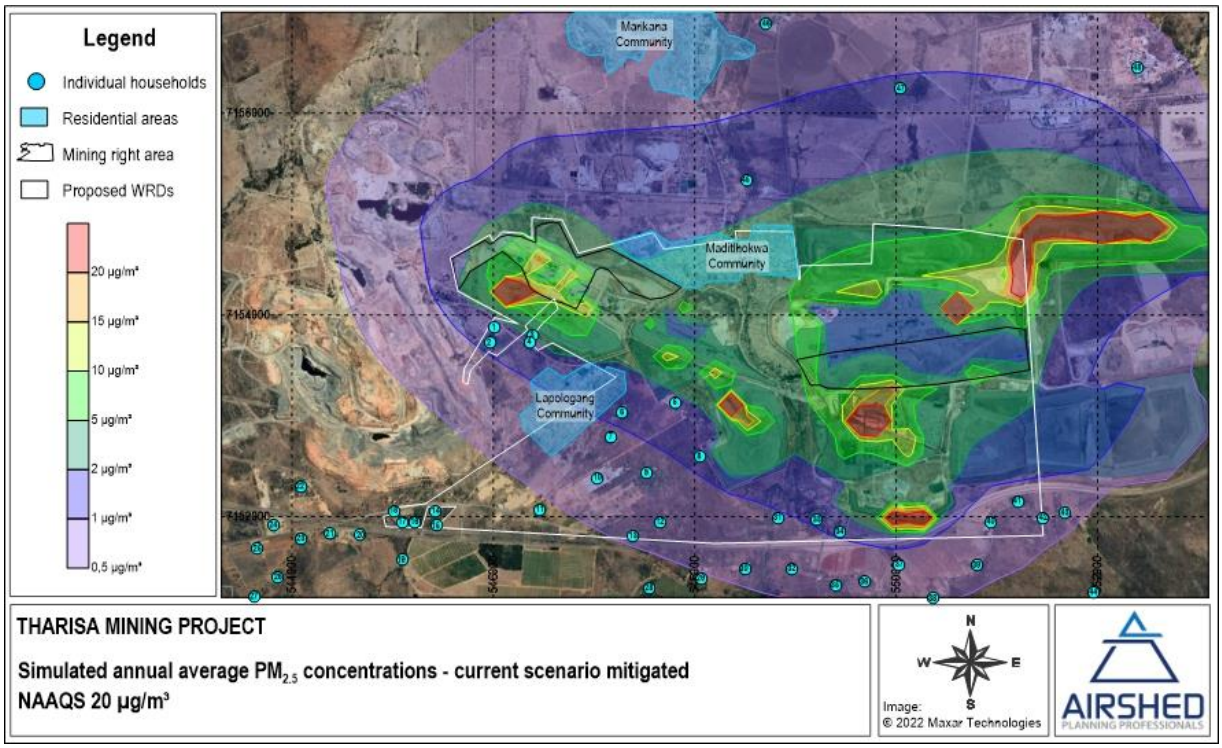

Figure 2-10: Current scenario – Area of non-compliance of annual PM2.5 NAAQS (mitigated)

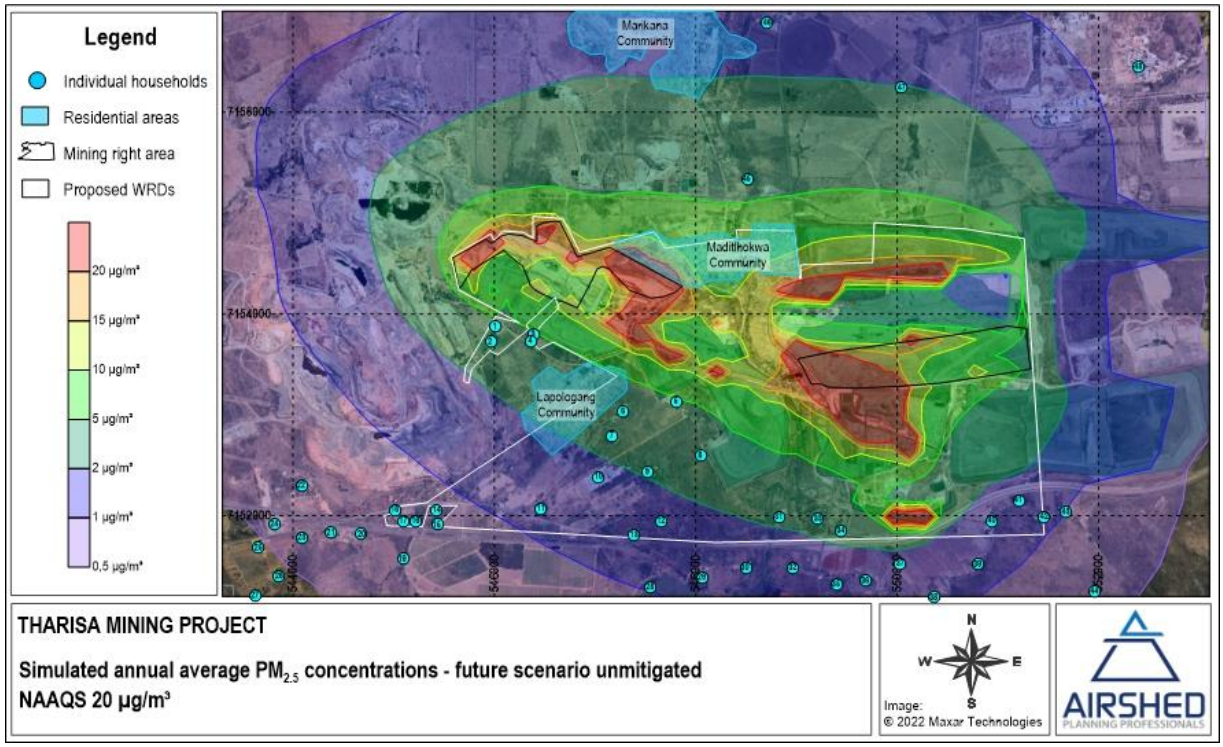

Figure 2-11: Future Project scenario – Area of non-compliance of annual PM2.5 NAAQS (unmitigated)

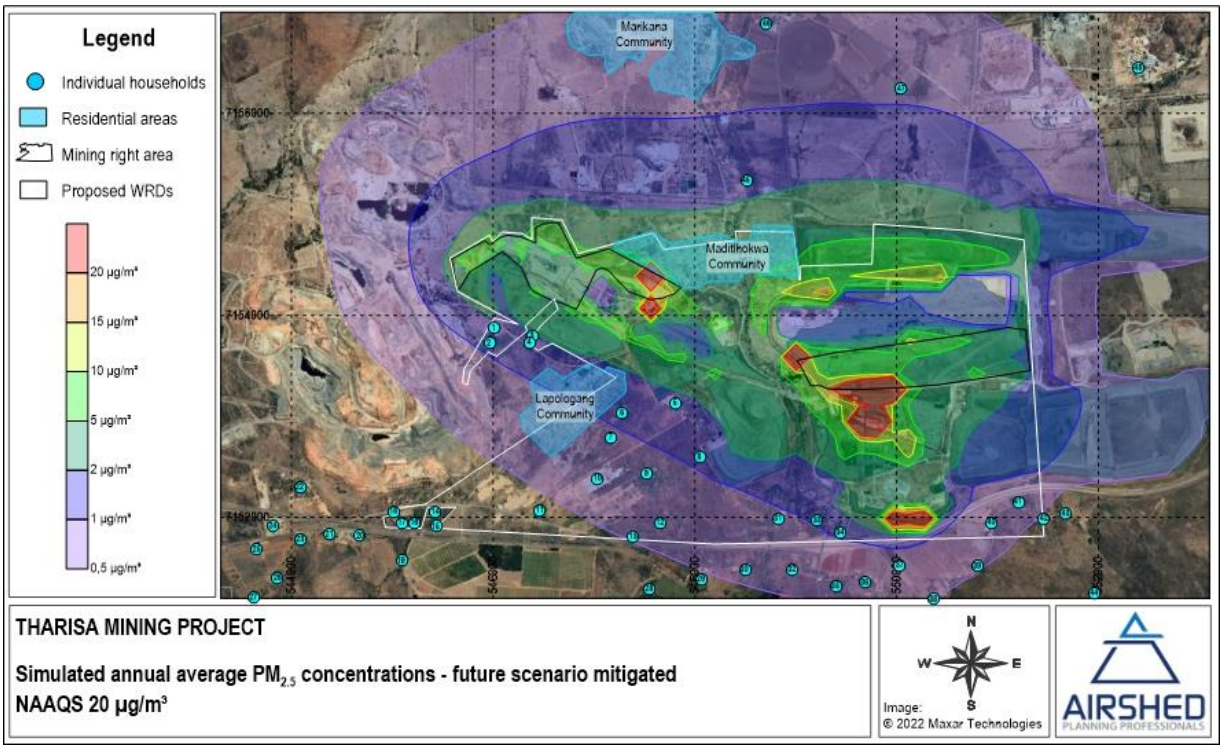

Figure 2-12: Future Project scenario – Area of non-compliance of annual PM2.5 NAAQS (mitigated)

Current Operations – Dust fallout: 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. The significance of air quality impacts due to the current operational activities are **High** without mitigation in place and **Medium** with mitigation measures.

Future Project Operations – Dust fallout: Dustfall rates only exceed the NDCR non-residential limit (1 200 mg/m²/day) and the residential limit (600 mg/m²/day) at the southeast of Madithlokwa without mitigation and reduce to a small area in the southeast of Madithlokwa with mitigation in place.

Closure – Dust fallout: The likely activities to result in dust impacts during closure will be similar to construction, resulting in a **Low** significance without mitigation and **Very Low** with mitigation measures in place.

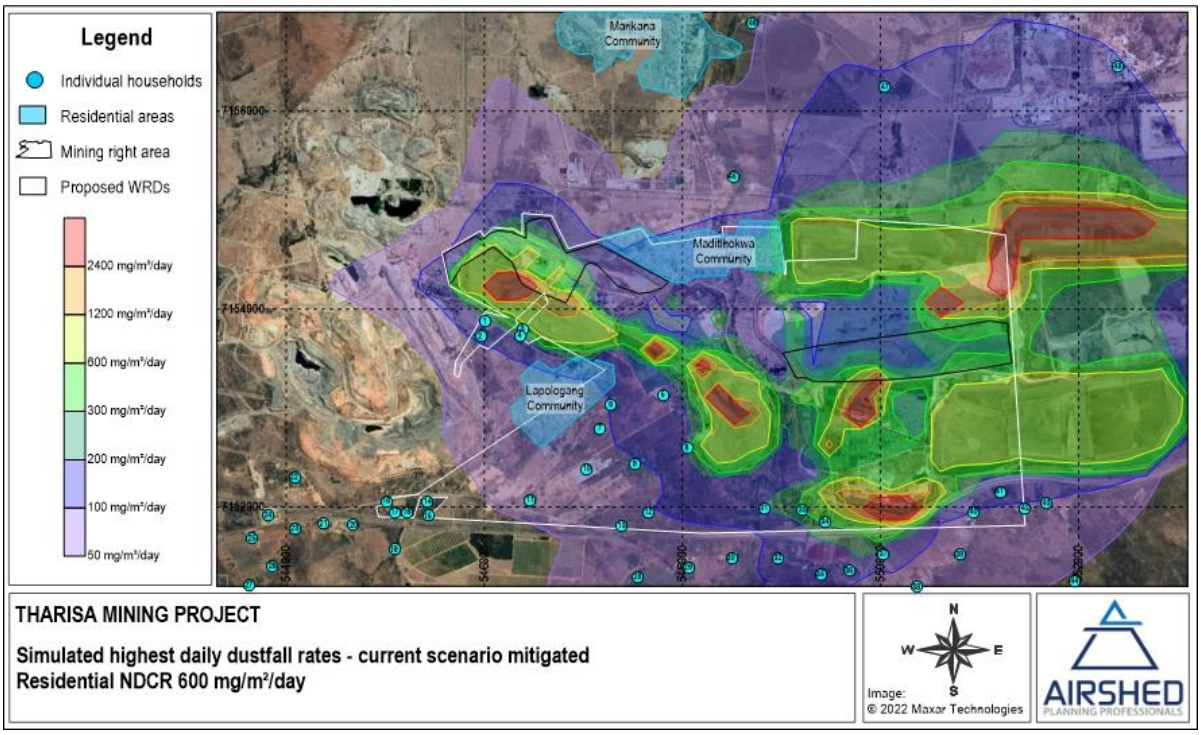

Figure 2-13: Current scenario – Area of non-compliance with monthly dustfall NDCR (mitigated)

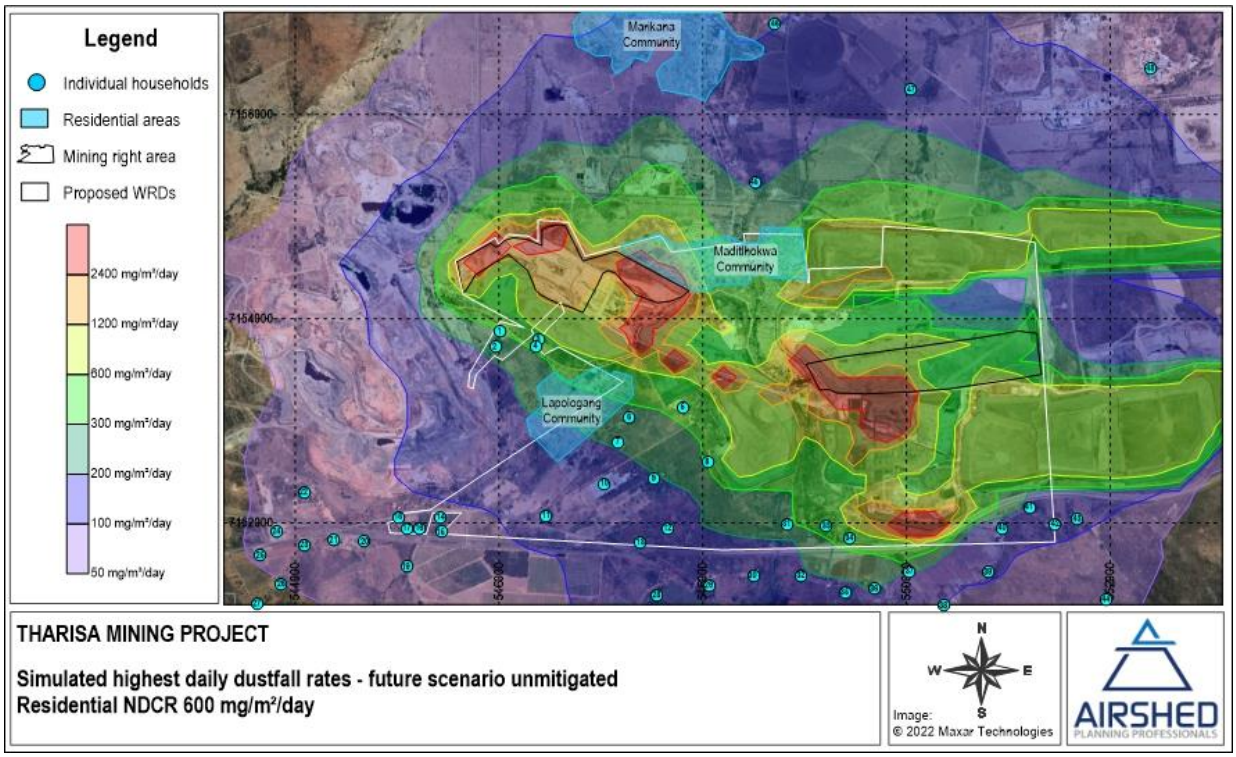

Figure 2-14: Future Project scenario – Area of non-compliance with monthly dustfall NDCR (unmitigated)

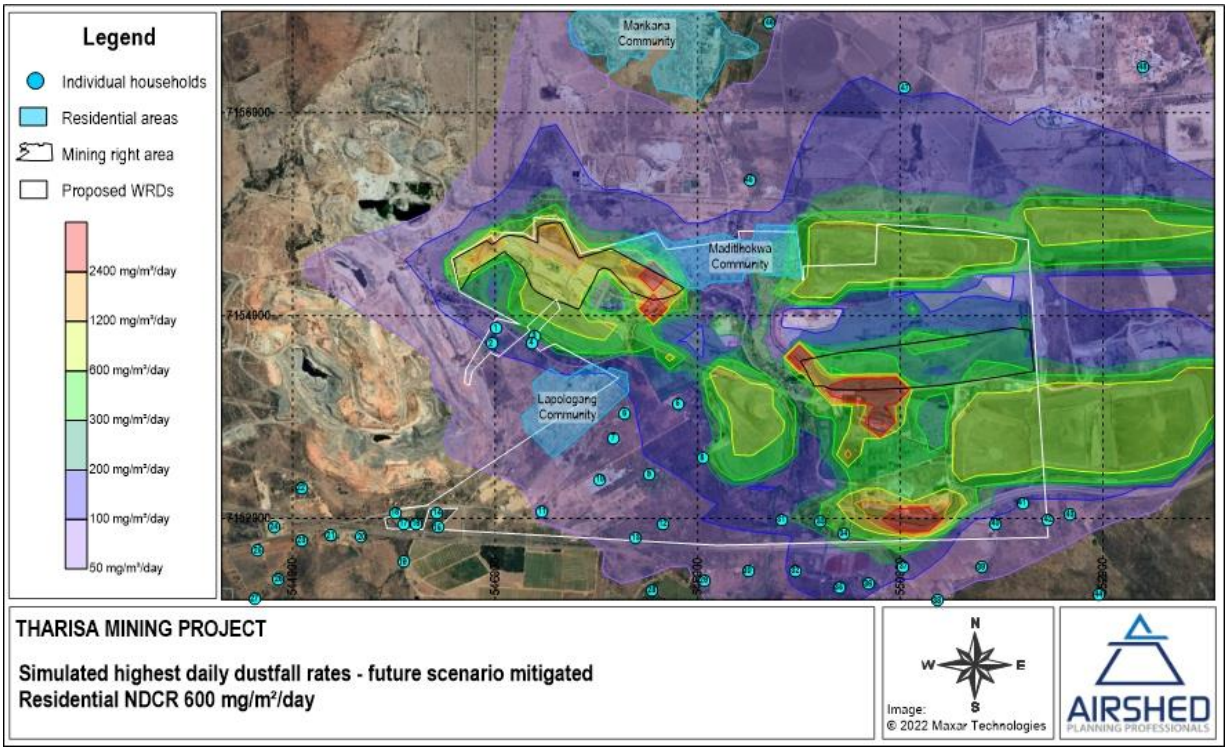

Figure 2-15: Future Project scenario – Area of non-compliance with monthly dustfall NDCR (mitigated)

Current Operations – Metals: Metals associated with the mine dust include aluminium (Al), barium (Ba), chromium (VI)(particulates), copper (Cu), iron (Fe), manganese (Mn), and nickel (Ni). 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 associated with CrVI exposure was Moderate (one in ten thousand to less than one in a thousand) with a low risk (greater than one in a million to less than one in ten thousand) associated to Fe and a very low risk (equal to or less than one in a million) to Ni. It should be noted that the assumption that all Cr is CrVI is regarded as overly conservative.

The future Project operations – Metals: will result in **High** significance without mitigation, reducing to **Medium** significance with mitigation measures in place.

2.1.1 Impact Assessment

The impacts assessed in their respective phases are shown in Table 2-1 to Table 2-3.
activities. The significance of air quality impacts due to construction are therefore expected to be Low without mitigation and Very Low with mitigation measures in place.

Table 2-1: Significance rating for air quality impacts due to the future Tharisa Mine Project activities (construction)

Issue: Air Quality Impacts on Human Health and the Environment		
Phases: Construction		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Low (L)	Very Low (VL)
Duration	Low (L)	Low (L)
Extent	Very Low (VL)	Very Low (VL)
Consequence	Low (L)	Very Low (VL)

Probability	Medium (M)	Low (L)
Significance	**Low (L)**	**Very Low (VL)**
Nature of cumulative impacts	Additional dust generating activities during construction.	
Degree to which impact can be reversed	Impact can be partially reversed during the construction if management measures are put in place and strictly adhered to.	
Degree to which impact may cause irreplaceable loss of resources	Very low	
Residual impacts	Residual impacts are anticipated to be very low. Potential residual impacts include: - nuisance dust impacts on nearby communities. - potential new dust generating sources due to land clearing.	

Table 2-2: Significance rating for air quality impacts due to the current Tharisa Mine Project activities (Operational)

Issue: Air Quality Impacts on Human Health and the Environment		
Phases: Operational Phase		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	High (H)	Medium (M)
Duration	High (H)	High (H)
Extent	Medium (M)	Medium (M)
Consequence	High (H)	Medium (M)
Probability	High (H)	High (H)
Significance	**High (H)**	**Medium (M)**
Nature of cumulative impacts	Dust generating activities from current mining and processing activities.	
Degree to which impact can be reversed	Impact can be partially reversed during the operations if management measures are put in place and strictly adhered to.	
Degree to which impact may cause irreplaceable loss of resources	High (impacts on human health)	
Residual impacts	Residual impacts are anticipated to be medium with mitigation measures in place. Potential residual impacts include: - respiratory health effects at nearby AQSRs due to PM_{10} and $PM_{2.5}$ concentrations from the proposed activities. - nuisance dust impacts on the nearby AQSRs.	

The significance of air quality impacts due to the current operational activities are **High** without mitigation in place and **Medium** with mitigation measures. Similarly, the future Project operations will result in **High** significance without mitigation, reducing to **Medium** significance with mitigation measures in place.

Table 2-3: Significance rating for air quality impacts due to the future Tharisa Mine Project activities (Decommissioning & Rehabilitation Phase)

Issue: Air Quality Impacts on Human Health and the Environment		
Phases: Decommissioning & Rehabilitation Phase		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Louw (L)	Very Louw (VL)
Duration	Louw (L)	Louw (L)
Extent	Very Low (VL)	Very Low (VL)
Consequence	Low (L)	Very Low (VL)
Probability	Medium (M)	Low (L)
Significance	**Low (L)**	**Very Low (VL)**
Nature of cumulative impacts	Dust generating activities during decommissioning & rehabilitation.	
Degree to which impact can be reversed	Impact can be partially reversed if management measures are put in place and strictly adhered to.	
Degree to which impact may cause irreplaceable loss of resources	Very low	
Residual impacts	Residual impacts are anticipated to be very low. Potential residual impacts include: - nuisance dust impacts on nearby communities.	

The likely activities to result in dust impacts during decommissioning and rehabilitation will be similar to construction, resulting in a **Low** significance without mitigation and **Very Low** with mitigation measures.

2.1.1.1Management objective, mitigation measure and monitoring

The management objectives, management outcomes and mitigation measures and monitoring are represented in Table 2-4.

Table 2-4: Management objectives, management outcomes and mitigation measures and Monitoring

Management objective	• *To prevent air pollution health impacts.*
Management outcome	Ensure that any pollutants emitted as a result of the project remains within acceptable limits so as to prevent health related impacts.
Mitigation actions/measures	
Phases: All phases	
• Air quality impacts during construction would be reduced through basic control measures such as limiting the speed of haul trucks; limit unnecessary travelling of vehicles on unpaved roads; and to apply water sprays on regularly travelled, unpaved sections. • When haul trucks need to use public roads, the vehicles need to be cleaned of all mud and the material transported must be covered to minimise windblown dust. • The access roads to the processing plants needs to be kept clean to minimise carry-through of mud on to public roads.	

• Regular water sprays on in-pit unpaved roads to ensure at least 75% control efficiency. Literature indicates an application rate >2 litre/m²/hour should achieve this. • Regular apply chemical suppressants on all regularly used surface haul roads to ensure a control efficiency of 90%. • Monthly physical inspection of road surface, daily visual observation of entrained dust emissions from unpaved road surfaces. • Controlled blasting techniques to be used to ensure minimal dust generation. • Blasting only to be conducted on cloudless days, if possible. • Addition of chemical surfactants to water sprays to lower water surface tension and increase binding properties. • Drill rigs to be fitted with dust suppression to achieve 97% control efficiency. • Drop height from excavator into haul trucks to be kept at a minimum for ore and waste rock. • Tipping onto ROM storage piles to be controlled through water sprays, should visible amounts of dust be generated. This should result in a 50% control efficiency. • Keep material handled by dozers moist to achieve a control efficiency of 50%, especially during dry periods. • Regular clean-up at loading areas. • Water sprays at primary and secondary crushers to achieve at least 50% control efficiency. • Enclosure with extraction systems would ensure better control efficiency. According to literature hooding with cyclones would achieve 65% CE, whereas scrubbers will achieve 75% and fabric filters would result in 83% CE. • Water sprays at ROM stockpiles can achieve 50% control efficiency. Increase in moisture content provides higher threshold friction velocity and ensures that particulates are not as easily entrained due to high surface winds. • Keep active areas on WRDs small and use water sprays to reduce the potential for wind erosion. • Reshape all disturbed areas to their natural contours. • Cover disturbed areas with previously collected topsoil and replant native species. • Rock cladding with larger pieces of waste rock is recommended to reduce wind erosion.	
Monitoring	• It is recommended that the current dustfall monitoring network be maintained and the monthly dustfall results used as indicators to tract the effectiveness of the applied mitigation measures. Dustfall collection should follow the ASTM method as per the NDCRs. The ASTM method covers the procedure of collection of dustfall and its measurement and employs a simple device consisting of a cylindrical container exposed for one calendar month (30 ±2 days). The method provides for a dry bucket, which is advisable in the dry environment. • It is recommended that PM10 sampling be conducted at Maditlokwa since PM10 concentrations were predicted to be non-compliant with the NAAQS, even with mitigation measures in place. A suitable location should be around dustfall unit TM D12 - Maditlokwa1 (S25.72764; E27.48858). It is proposed that particulate air concentration monitoring include the thoracic dust fraction which is typically denoted by the fraction with aerodynamic diameters less than 10 µm (or PM10). It is proposed that the sampling be done using one standalone sampler that can sample continuously with a datalogger, modem, solar power system and local WiFi access for viewing data. Data should be downloaded weekly and analysed on a monthly basis.

3. NOISE

3.1 ISSUE: NOISE EMISSIONS

The propagation of noise generated during the operational phase was calculated with CadnaA in accordance with ISO 9613.

Table 3-1provides a summary of simulated noise levels for the project operations at closest potential NSRs within the study area. Simulated noise levels due to project operations are also presented in isopleth form (Figure 3-1 and Figure 3-2).

Noise levels due to project operations are predicted to exceed the day-time IFC noise guideline of 55 dBA for residential areas up to a distance of ~110 m from the proposed West OG WRD and ~250 m from the East OG WRD. Noise levels due to project operations are predicted to exceed the night-time IFC noise guideline of 45 dBA for residential areas up to a distance of ~700 m from the proposed West OG WRD and ~1100 m from the East OG WRD. The NSRs where IFC noise guidelines for residential areas is exceeded, due to project activities, is as follows:

- Mmaditlhokwa Community (day- and night-time).
- NSR1 (night-time).
- NSR3 (night-time).
- NSR4 (night-time).

For a person with average hearing acuity an increase of less than 3 dBA in the general ambient noise level is not detectable. According to SANS 10103 (2008); the predicted increase in noise levels from the current baseline due to proposed project operations is expected to result in the following community reaction:

- Maditlhokwa Community:
    - Night-time – 'little' reaction with sporadic complaints

Tharisa Mine, however, has received complaints regarding current mining activities. It is thus clear that current operations are causing a noise nuisance. Assessment has therefore also been undertaken assuming an estimated background level (in the absence of Tharisa mining activities). The predicted increase in noise levels from an estimated background due to project activities would result in the following community reaction and, given current complaints, may be more in line with community response to the project:

- Mmaditlhokwa Community:
    - Day-time – 'medium' reaction with widespread complaints
    - Night-time – 'strong' to 'very strong' reaction with threats of community action or vigorous community action

Considering the estimated background noise levels, the noise levels due to the project exceed the 1992 Noise Control Regulations (The Republic of South Africa, 1992) definition of "disturbing noise" (greater than 7dBA from ambient sound levels) at the following sensitive receptors:

- Mmaditlhokwa Community (during day- and night-time conditions).

Table 3-1: Summary of simulated noise levels (provided as dBA) for proposed project operations at potential NSRs within the study area

Noise Sensitive Receptor	Project operations [a]		Background [b]		Increase Above Background [d]		Baseline [c]		Increase Above Baseline [d]	
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
Mmaditlhokwa Community	**59.7**	**60.0**	50	45	10.1	15.1	58	56	3.9	5.5
Lapologang Community	45.8	43.1	50	45	1.4	2.2	58	50	0.3	0.8
Marikana Community	35.1	36.5	55	45	0.0	0.6	54	48	0.1	0.3
NSR1	47.4	**46.1**	50	45	1.9	3.6	58	50	0.4	1.5
NSR2	46.3	44.8	50	45	1.5	2.9	58	50	0.3	1.1
NSR3 (Wolvaardt Residence)	49.2	**47.4**	50	45	2.6	4.4	58	50	0.5	1.9
NSR4 (van der Hoven Residence)	48.3	**46.5**	50	45	2.2	3.8	58	50	0.4	1.6
NSR5 (Piet Retief Primary School)	42.9	41.4	50	45	0.8	1.6	56	50	0.2	0.6
NSR6 (Pretorius Residence)	42.8	40.6	50	45	0.8	1.3	58	50	0.1	0.5
NSR7 (du Preez Residence)	40.0	37.5	50	45	0.4	0.7	60	55	0.0	0.1
NSR8	40.6	39.9	50	45	0.5	1.2	56	50	0.1	0.4
NSR9	37.6	36.6	50	45	0.2	0.6	60	55	0.0	0.1
NSR10 (industrial)	32.5	30.1	70	70	0.0	0.0	60	55	0.0	0.0
NSR11	0.0	0.0	60	50	0.0	0.0	57	55	0.0	0.0
NSR12	0.0	0.0	60	50	0.0	0.0	57	55	0.0	0.0
NSR13	0.0	0.0	60	50	0.0	0.0	57	55	0.0	0.0
NSR14	0.0	0.0	60	50	0.0	0.0	57	55	0.0	0.0
NSR15	0.0	0.0	60	50	0.0	0.0	57	55	0.0	0.0
NSR16	0.0	0.0	60	50	0.0	0.0	57	55	0.0	0.0
NSR17	0.0	0.0	60	50	0.0	0.0	57	55	0.0	0.0
NSR18	0.0	0.0	60	50	0.0	0.0	57	55	0.0	0.0
NSR19	0.0	0.0	60	50	0.0	0.0	54	48	0.0	0.0
NSR20	0.0	0.0	60	50	0.0	0.0	57	55	0.0	0.0
NSR21	0.0	0.0	60	50	0.0	0.0	57	55	0.0	0.0
NSR22	0.0	0.0	55	45	0.0	0.0	57	55	0.0	0.0
NSR23	0.0	0.0	60	50	0.0	0.0	57	55	0.0	0.0
NSR24	0.0	0.0	60	50	0.0	0.0	57	55	0.0	0.0
NSR25	0.0	0.0	60	50	0.0	0.0	57	55	0.0	0.0
NSR26	0.0	0.0	55	45	0.0	0.0	54	48	0.0	0.0
NSR27	0.0	0.0	55	45	0.0	0.0	54	48	0.0	0.0

Noise Sensitive Receptor	Project operations [a]		Background [b]		Increase Above Background [d]		Baseline [c]		Increase Above Baseline [d]	
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
NSR28	0.0	0.0	55	45	0.0	0.0	54	48	0.0	0.0
NSR29	0.0	0.0	55	45	0.0	0.0	54	48	0.0	0.0
NSR30	35.8	34.1	60	50	0.0	0.1	57	55	0.0	0.0
NSR31	39.6	38.0	60	50	0.0	0.3	54	48	0.2	0.4
NSR32	37.6	35.6	60	50	0.0	0.2	57	55	0.0	0.0
NSR33	41.3	39.4	60	50	0.1	0.4	57	55	0.1	0.1
NSR34 (Potgieter Residence)	41.2	39.0	60	50	0.1	0.3	57	55	0.1	0.1
NSR35	34.2	32.0	55	45	0.0	0.2	54	48	0.0	0.1
NSR36	37.5	35.3	60	50	0.0	0.1	54	48	0.1	0.2
NSR37	38.9	36.4	60	50	0.0	0.2	57	55	0.1	0.1
NSR38	0.0	0.0	55	45	0.0	0.0	54	48	0.0	0.0
NSR39	36.6	34.0	55	45	0.1	0.3	54	48	0.1	0.2
NSR40	43.2	40.8	60	50	0.1	0.5	57	55	0.2	0.2
NSR41	44.0	41.6	60	50	0.1	0.6	57	55	0.2	0.2
NSR42	39.8	37.4	60	50	0.0	0.2	54	48	0.2	0.4
NSR43	41.3	39.0	60	50	0.1	0.3	54	48	0.2	0.5
NSR44	0.0	0.0	60	50	0.0	0.0	54	48	0.0	0.0
NSR45	37.9	38.6	55	45	0.1	0.9	54	48	0.1	0.5
NSR46	0.0	0.0	55	45	0.0	0.0	54	48	0.0	0.0
NSR47	0.0	0.0	55	45	0.0	0.0	54	48	0.0	0.0
NSR48 (Lonmin Training Centre)	0.0	0.0	55	45	0.0	0.0	54	48	0.0	0.0

Notes:

(a) Exceedance of day- and night-time IFC guideline for residential areas is provided in bold

(b) Daytime and night-time background noise ratings in the absence of Tharisa Mine noise only. Derived from measurements and observations made in previous surveys undertaken by Acusolv. Rounded to the nearest 5 dB interval as per SANS 10103 practice.

(c) Baseline measurements based on closest sampling sites and reflective of current noise levels with existing Tharisa Mine activities.

(d) Likely community response in accordance with the SANS 10103:

< 3 dBA	*< 5 dBA*	*< 10 dBA*	*< 15 dBA*	*< 20 dBA*
Change imperceptible	*No reaction*	*'Little' reaction with sporadic complaints*	*'Medium' reaction with widespread complaints*	*'Strong' to 'very strong' reaction with threats of community action or vigorous community action.*

Figure 3-1: Simulated day-time noise levels due to proposed project operations

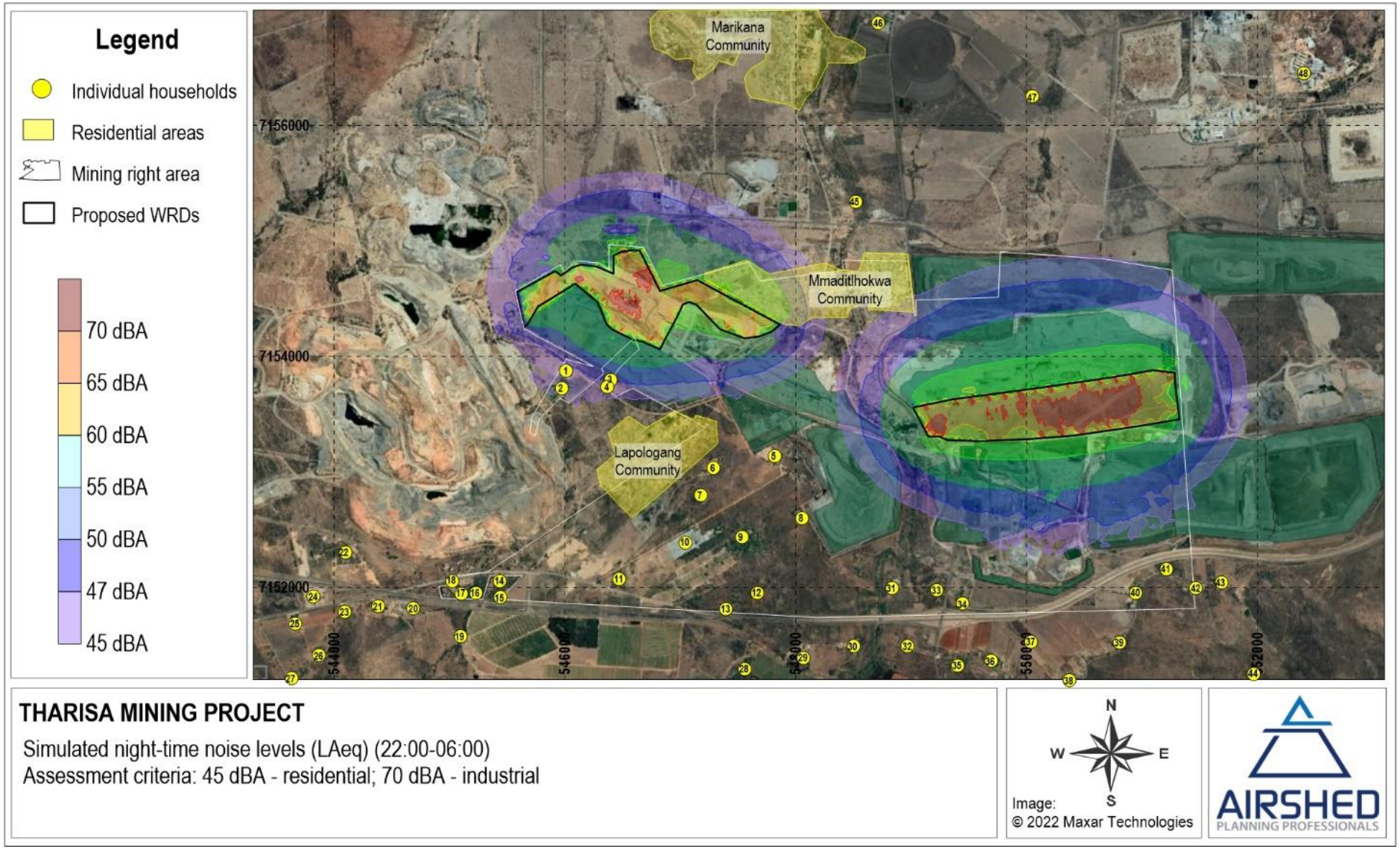

Figure 3-2: Simulated night-time noise levels due to proposed project operations

Given the potential elevated noise levels at close NSRs to the proposed project area, a mitigated scenario was modelled assuming a 5 m berm on the perimeter of the WRDs. The higher noise levels due to project operations decreased close to site with the IFC noise guideline for residential areas still predicted up to a distance of ~670 m for night-time (45 dBA) from the proposed West OG WRD and ~1100 m from the East OG WRD. The NSRs where IFC noise guidelines for residential areas is exceeded due to project activities is as follows:

- Mmaditlhokwa Community (night-time);
- NSR1 (night-time);
- NSR3 (night-time);
- NSR4 (night-time).

With the 5 m noise berm in place, the predicted increase in noise levels from the current baseline due to proposed project operations is not expected to result in a community reaction.

The predicted increase in noise levels from an estimated background due to project activities, assuming a 5 m noise berm, would result in the following community:

- Mmaditlhokwa Community:
    - Night-time – 'little' reaction with sporadic complaints

Considering the estimated background noise levels as provided, the noise levels due to the project with a 5 m berm on the perimeter of the proposed WRDs will not exceed the 1992 Noise Control Regulations (The Republic of South Africa, 1992) definition of "disturbing noise" (greater than 7dBA from ambient sound levels).

Table 3-2: Summary of simulated noise levels (provided as dBA) for proposed project operations (assuming 5 m noise berm on the perimeter of the proposed WRDs) at potential NSRs within the study area

Noise Sensitive Receptor	Project operations [a]		Background [b]		Increase Above Background [d]		Baseline [c]		Increase Above Baseline [d]	
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
Mmaditlhokwa Community	46.8	**48.4**	50	45	1.7	5.0	58	56	0.3	0.7
Lapologang Community	45.3	42.9	50	45	1.3	2.1	58	50	0.2	0.8
Marikana Community	34.9	36.4	55	45	0.0	0.6	54	48	0.1	0.3
NSR1	47.3	**45.9**	50	45	1.9	3.5	58	50	0.4	1.4
NSR2	45.2	43.7	50	45	1.2	2.4	58	50	0.2	0.9
NSR3 (Wolvaardt Residence)	48.7	**46.9**	50	45	2.4	4.1	58	50	0.5	1.7
NSR4 (van der Hoven Residence)	47.6	**45.8**	50	45	2.0	3.4	58	50	0.4	1.4
NSR5 (Piet Retief Primary School)	41.4	40.2	50	45	0.6	1.2	56	50	0.1	0.4
NSR6 (Pretorius Residence)	40.7	38.6	50	45	0.5	0.9	58	50	0.1	0.3
NSR7 (du Preez Residence)	37.7	35.2	50	45	0.2	0.4	60	55	0.0	0.0
NSR8	38.8	38.0	50	45	0.3	0.8	56	50	0.1	0.3
NSR9	36.1	35.1	50	45	0.2	0.4	60	55	0.0	0.0
NSR10 (industrial)	33.2	30.7	70	70	0.0	0.0	60	55	0.0	0.0
NSR11	0.0	0.0	60	50	0.0	0.0	57	55	0.0	0.0
NSR12	0.0	0.0	60	50	0.0	0.0	57	55	0.0	0.0
NSR13	0.0	0.0	60	50	0.0	0.0	57	55	0.0	0.0
NSR14	0.0	0.0	60	50	0.0	0.0	57	55	0.0	0.0
NSR15	0.0	0.0	60	50	0.0	0.0	57	55	0.0	0.0
NSR16	0.0	0.0	60	50	0.0	0.0	57	55	0.0	0.0
NSR17	0.0	0.0	60	50	0.0	0.0	57	55	0.0	0.0
NSR18	0.0	0.0	60	50	0.0	0.0	57	55	0.0	0.0
NSR19	0.0	0.0	60	50	0.0	0.0	54	48	0.0	0.0
NSR20	0.0	0.0	60	50	0.0	0.0	57	55	0.0	0.0
NSR21	0.0	0.0	60	50	0.0	0.0	57	55	0.0	0.0
NSR22	0.0	0.0	55	45	0.0	0.0	57	55	0.0	0.0
NSR23	0.0	0.0	60	50	0.0	0.0	57	55	0.0	0.0
NSR24	0.0	0.0	60	50	0.0	0.0	57	55	0.0	0.0
NSR25	0.0	0.0	60	50	0.0	0.0	57	55	0.0	0.0
NSR26	0.0	0.0	55	45	0.0	0.0	54	48	0.0	0.0

Noise Sensitive Receptor	Project operations [a]		Background [b]		Increase Above Background [d]		Baseline [c]		Increase Above Baseline [d]	
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
NSR27	0.0	0.0	55	45	0.0	0.0	54	48	0.0	0.0
NSR28	0.0	0.0	55	45	0.0	0.0	54	48	0.0	0.0
NSR29	0.0	0.0	55	45	0.0	0.0	54	48	0.0	0.0
NSR30	34.4	32.8	60	50	0.0	0.1	57	55	0.0	0.0
NSR31	39.5	37.9	60	50	0.0	0.3	54	48	0.2	0.4
NSR32	35.8	33.8	60	50	0.0	0.1	57	55	0.0	0.0
NSR33	40.6	38.7	60	50	0.0	0.3	57	55	0.1	0.1
NSR34 (Potgieter Residence)	40.2	38.1	60	50	0.0	0.3	57	55	0.1	0.1
NSR35	33.3	31.1	55	45	0.0	0.2	54	48	0.0	0.1
NSR36	35.5	33.3	60	50	0.0	0.1	54	48	0.1	0.1
NSR37	38.5	36.1	60	50	0.0	0.2	57	55	0.1	0.1
NSR38	0.0	0.0	55	45	0.0	0.0	54	48	0.0	0.0
NSR39	36.5	34	55	45	0.1	0.3	54	48	0.1	0.2
NSR40	41	38.5	60	50	0.1	0.3	57	55	0.1	0.1
NSR41	41.7	39.3	60	50	0.1	0.4	57	55	0.1	0.1
NSR42	39.6	37.2	60	50	0.0	0.2	54	48	0.2	0.3
NSR43	39.2	36.9	60	50	0.0	0.2	54	48	0.1	0.3
NSR44	0.0	0.0	60	50	0.0	0.0	54	48	0.0	0.0
NSR45	37.7	38.5	55	45	0.1	0.9	54	48	0.1	0.5
NSR46	0.0	0.0	55	45	0.0	0.0	54	48	0.0	0.0
NSR47	0.0	0.0	55	45	0.0	0.0	54	48	0.0	0.0
NSR48 (Lonmin Training Centre)	0.0	0.0	55	45	0.0	0.0	54	48	0.0	0.0

Notes:

(a) Exceedance of day- and night-time IFC guideline for residential areas is provided in bold

(b) Daytime and night-time background noise ratings in the absence of Tharisa Mine noise only. Derived from measurements and observations made in previous surveys undertaken by Acusolv. Rounded to the nearest 5 dB interval as per SANS 10103 practice.

(c) Baseline measurements based on closest sampling sites and reflective of current noise levels with existing Tharisa Mine activities.

(d) Likely community response in accordance with the SANS 10103:

< 3 dBA	*< 5 dBA*	*< 10 dBA*	*< 15 dBA*	*< 20 dBA*
Change imperceptible	*No reaction*	*'Little' reaction with sporadic complaints*	*'Medium' reaction with widespread complaints*	*'Strong' to 'very strong' reaction with threats of community action or vigorous community action.*

Figure 3-3: Simulated day-time noise levels due to proposed project operations (assuming 5 m noise berm on the perimeter of the proposed WRDs)

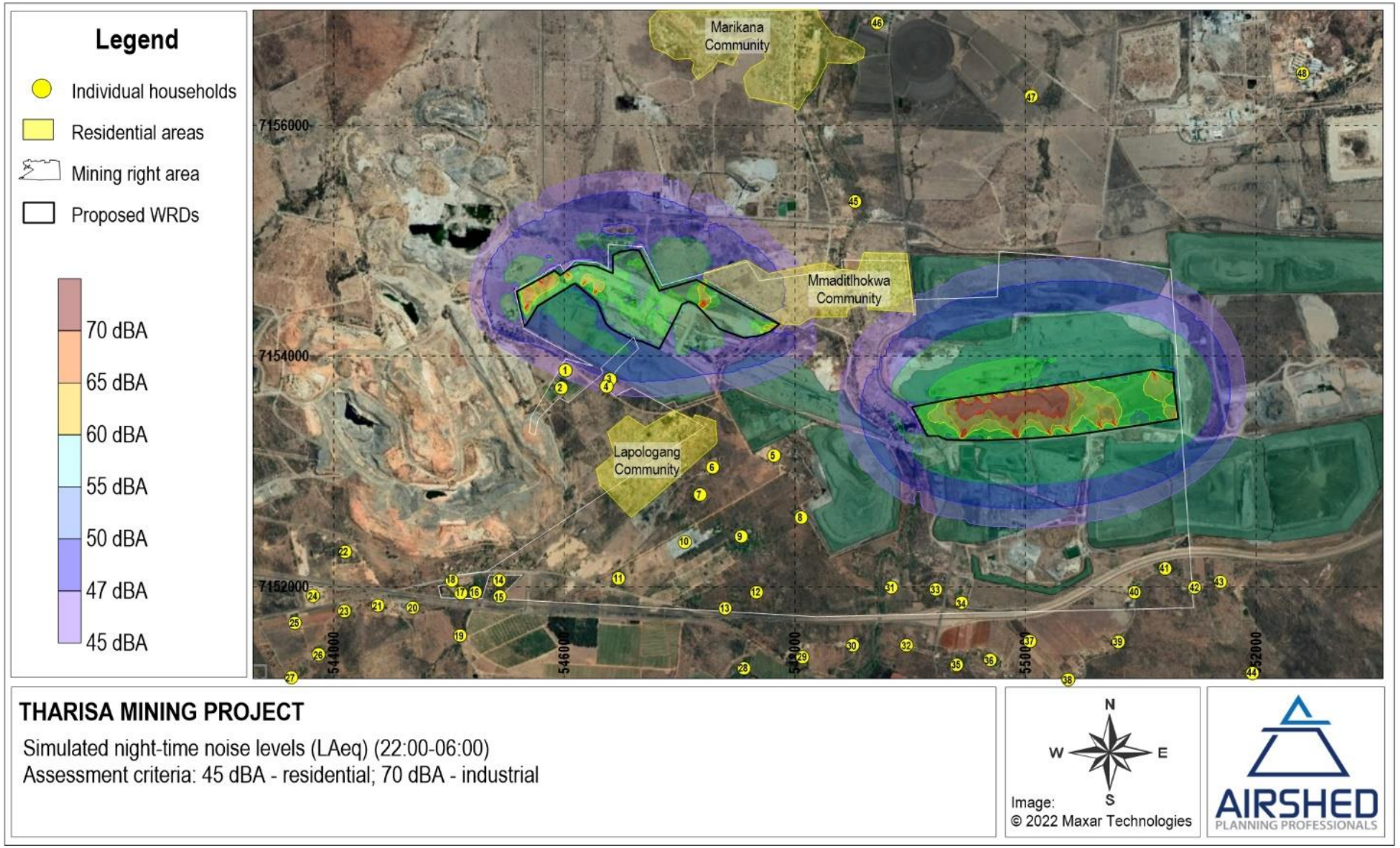

Figure 3-4: Simulated night-time noise levels due to proposed project operations (assuming 5 m noise berm on the perimeter of the proposed WRDs)

3.1.1 Impact assessment Construction

The significance of construction phase noise impacts on nearby NSRs is considered medium (without mitigation). Due to the close proximity to the NSRs (assuming no NSRs are relocated), it is unlikely the significance will reduce unless the Mmaditlhokwa and Lapologang communities can be relocated.

Table 3-3: Significance rating for potential noise impacts due to the construction phase of the project

Issue: increased noise levels		
Phases: Construction Phase		
Criteria	**Without Mitigation**	**With Mitigation (a)**
Intensity	High (H)	Medium (M)
Duration	Louw (L)	Low (L)
Extent	Medium (M)	Medium (M)
Consequence	Medium (M)	Medium (M)
Probability	High (H)	High (H)
Significance	**Medium (M)**	**Medium (M)**
Nature of cumulative impacts	The proposed project could further increase noise levels in the area.	
Degree to which impact can be reversed	Impacts will cease if activities stop.	
Degree to which impact may cause irreplaceable loss of resources	Low.	
Residual impacts	No residual impacts are expected as noise levels due to activities will cease when activities stop.	

3.1.1.1Management objective, mitigation measure and monitoring

The management objectives, management outcomes and mitigation measures and monitoring are represented in Table 4-4.

Table 3-4: Management objectives, management outcomes and mitigation measures and monitoring

Management objective	• *To prevent public exposure to disturbing noise.*
Management outcome	Ensure that any noise generated as a result of the project remains within acceptable limits to avoid the disturbance of third parties.
Mitigation actions/measures	
Phases: Construction	
• To reduce the nuisance effects of the proposed construction on the community, the following mitigation actions are to be applied:	

• Routine monitoring of ambient noise and to comply with the relevant estimated background noise levels as provided; • 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.	
Monitoring	Noise monitoring at sites where noise is an issue or may become an issue is essential. Annual noise sampling for day- and night-time at NSRs surrounding the project should be incorporated in an annual environmental noise monitoring programme. Noise monitoring should be undertaken at sampling sites as surveyed in 2021 and 2022. An additional sampling site at NSR2 is recommended to be included in the survey points.

3.1.2 Impact assessment Operations

The significance of operation phase noise impacts on nearby NSRs is considered high (without mitigation). It is recommended that the adoption of good practice noise mitigation and management measures be undertaken and that a noise berm be implemented along the perimeter of the West OG WRD. This would reduce the significance to medium but would still exceed IFC noise guidelines for residential areas at the closest NSRs to the West OG WRD. In order to reduce the significance to low, the project operations would have to (in addition to mitigation measures recommended, such as noise berm along the perimeter of the West OG WRD), limit project operations on West OG WRD to day-time hours only or relocate Mmaditlhokwa Community (directly east of West OG WRD), NSR1 (farmstead ~650 m south of West OG WRD), NSR3 (Wolvaardt residence ~400 m south of West OG WRD) and NSR4 (van der Hoven residence ~470 m south of west OG WRD)).

Table 3-5: Significance rating for potential noise impacts due to the operation phase of the project

Issue: increased noise levels		
Phases: Operation Phase		
Criteria	**Without Mitigation**	**With Mitigation (a)**
Intensity	High (H)	Medium (M)
Duration	High (H)	High (H)
Extent	Medium (M)	Medium (M)
Consequence	High (H)	Medium (M)
Probability	High (H)	High (H)
Significance	**High (H)**	**Medium (M) (b)**
Nature of cumulative impacts	The proposed project could further increase noise levels in the area.	

Issue: increased noise levels	
Degree to which impact can be reversed	Impacts will cease if activities stop.
Degree to which impact may cause irreplaceable loss of resources	Low.
Residual impacts	No residual impacts are expected as noise levels due to activities will cease when activities stop.

3.1.2.1Management objective, mitigation measure and monitoring

The management objectives, management outcomes and mitigation measures and monitoring are represented in Table 4-4.

Table 3-6: Management objectives, management outcomes and mitigation measures and monitoring

Management objective	• *To prevent public exposure to disturbing noise.*
Management outcome	Ensure that any noise generated as a result of the project remains within acceptable limits to avoid the disturbance of third parties.
Mitigation actions/measures	
Phases: Operational	
To reduce the nuisance effects of the proposed operation on the community, the following mitigation actions are to be applied: • Train operational staff on noise control plan during health & safety briefings; • Investigate use of alternatives to audible reversing alarms (such as broadband noise emitting models) or configure to maximise forward movements of mobile plant; • Avoid clustering of mobile plant near receptors and enforce rest periods for unavoidable maximum noise events; • Ensure periods of respite are provided in the case of unavoidable maximum noise level events; • Regular inspection and maintenance of all equipment. • Maintain haul road surfaces regularly to avoid corrugations, potholes etc. • Keep all roads well maintained and avoid steep inclines. • Using rubber linings in for instance dump trucks to reduce impact noise of dropped material. • Naturally, if noise activities can be minimised or avoided, the amount of noise reaching NSRs will be reduced. • Noise reduction berms along the perimeter of the proposed West OG WRD. • 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. • Noise monitoring locations (as surveyed in 2021 and 2022) should be incorporated into the annual noise sampling network for Tharisa Mine. • Monitored ambient noise levels should comply with the relevant estimated background noise levels as provided.	
Monitoring	Noise monitoring at sites where noise is an issue or may become an issue is essential. Annual noise sampling for day- and night-time at NSRs surrounding the project should be incorporated in an annual environmental noise monitoring programme. Noise monitoring should be undertaken at sampling sites as surveyed in 2021 and 2022. An additional sampling site at NSR2 is recommended to be included in the survey points.

3.1.3 Impact assessment Closure

The significance of closure and decommissioning phase noise impacts on nearby NSRs (assuming no NSRs are relocated) is considered medium (without and with mitigation).

Table 3-7: Significance rating for potential noise impacts due to the closure phase of the project

Issue: increased noise levels		
Phases: Closure Phase		
Criteria	**Without Mitigation**	**With Mitigation (a)**
Intensity	High (H)	Medium (M)
Duration	Low (L)	Low (L)
Extent	Medium (M)	Medium (M)
Consequence	Medium (M)	Medium (M)
Probability	High (H)	High (H)
Significance	**Medium (M)**	**Medium (M)**
Nature of cumulative impacts	The proposed project could further increase noise levels in the area.	
Degree to which impact can be reversed	Impacts will cease if activities stop.	
Degree to which impact may cause irreplaceable loss of resources	Low.	
Residual impacts	No residual impacts are expected as noise levels due to activities will cease when activities stop.	

3.1.3.1Management objective, mitigation measure and monitoring

The management objectives, management outcomes and mitigation measures and monitoring are represented in Table 4-4.

Table 3-8: Management objectives, management outcomes and mitigation measures and monitoring

Management objective	• *To prevent public exposure to disturbing noise.*
Management outcome	Ensure that any noise generated as a result of the project remains within acceptable limits to avoid the disturbance of third parties.
Mitigation actions/measures	
Phases: Closure	
To reduce the nuisance effects of the proposed construction on the community, the following mitigation actions are to be applied: • Routine monitoring of ambient noise and to comply with the relevant estimated background noise levels as provided; • 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.	
Monitoring	Noise monitoring at sites where noise is an issue or may become an issue is essential. Annual noise sampling for day- and night-time at NSRs surrounding the project should be incorporated in an annual environmental noise monitoring programme. Noise monitoring should be undertaken at sampling sites as surveyed in 2021 and 2022. An additional sampling site at NSR2 is recommended to be included in the survey points.

4. SOILS, LAND USE AND LAND CAPABILITIES

4.1 ISSUE: SOIL EROSION

The proposed WRD footprint areas are already comprised open void (pit) and waste rock material with limited natural soil. The soil erosion impact is therefore anticipated to be Low (L) during all phases. However, mitigation measures will be required to further reduce the impacts. The post mitigation measures the impact is anticipated to be Very Low (VL).

4.1.1 Impact assessment

The impacts assessed in the respective phases are presented in Table 4-1 to Table 4-3

Table 4-1: Summary of the impact significance on soil erosion for the proposed footprint areas during the construction phase.

Issue: Soil Erosion		
Phases: Construction		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Medium (M)	Low (L)
Duration	Low (L)	Low (L)
Extent	Very Low (VL)	Very Low (VL)
Consequence	Low (L)	Low (L)
Probability	High (H)	Low (L)
Significance	**Low (L)**	**Very Low (VL)**
Nature of cumulative impacts	Cumulative impacts from the proposed developments within the Proposed Footprint Areas are anticipated to be of Low significance without mitigation measures.	
Degree to which impact can be reversed	The impact can be fully reversed once the construction period is completed, and management measures are put in place and adhered to.	
Degree to which impact may cause irreplaceable loss of resources	Low	

Residual impacts	The residual impact is considered to be Very Low due to the proposed footprint areas being dominated by Witbank and Cullinan soil forms and being in close proximity to active mining area.

Table 4-2: Summary of the impact significance on soil erosion for the proposed footprint areas during the operational phase.

Issue: Soil Erosion		
Phases: Operational		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Medium (M)	Low (L)
Duration	Low (L)	Medium (M)
Extent	Very Low (VL)	Very Low (VL)
Consequence	Low (L)	Low (L)
Probability	High (H)	Medium (M)
Significance	**Low (L)**	**Very Low (VL)**
Nature of cumulative impacts	Cumulative impacts from the proposed developments within the Proposed Footprint Areas are anticipated to be of Low significance without mitigation measures	
Degree to which impact can be reversed	Low during operational phase.	
Degree to which impact may cause irreplaceable loss of resources	Low because the majority of the soils are disturbed already.	
Residual impacts	The residual impact is considered to be Very Low due to the proposed footprint areas being dominated by Witbank and Cullinan soil forms and being in close proximity to active mining area.	

Table 4-3: Summary of the impact significance on soil erosion for the proposed footprint areas during the decommissioning phase.

Issue: Soil Erosion		
Phases: Decommissioning		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Low (L)	Low (L)
Duration	Low (L)	Low (L)
Extent	Very Low (VL)	Very Low (VL)
Consequence	Low (L)	Low (L)
Probability	High (H)	Low (L)
Significance	**Low (L)**	**Very Low (VL)**
Nature of cumulative impacts	Cumulative impacts from the proposed developments within the Proposed Footprint Areas are anticipated to be of Low significance.	

Issue: Soil Erosion	
Degree to which impact can be reversed	The impact can be reversed to a degree once the mining activities cease and the impacted areas have been rehabilitated.
Degree to which impact may cause irreplaceable loss of resources	Very Low
Residual impacts	The residual impact is considered to be Very Low due to the proposed footprint areas being dominated by Witbank and Cullinan soil forms and being in close proximity to active mining area.

4.1.1.1Management objective, mitigation measure and monitoring

The management objectives, management outcomes and mitigation measures and monitoring are represented in Table 4-4.

Table 4-4: Management objectives, management outcomes and mitigation measures and monitoring

Management objective	• *To rehabilitate disturbed areas in line with the management plans.* • *To accommodate the present land uses of communal grazing and/or wilderness.*
Management outcome	• Rehabilitation that supports post-closure land uses.
Mitigation actions/measures	
Phases: All phases	
• Temporary erosion control measures around the topsoil stockpile areas should be used to protect the disturbed soils during the rehabilitation until adequate vegetation has established; • Bare soils within the access roads can be regularly dampened with water to suppress dust during the construction phase, especially when strong wind conditions are predicted according to the local weather forecast; • The footprint of the proposed development and construction activities should be clearly demarcated to restrict vegetation clearing activities within the infrastructure footprint as far as practically possible; and • All disturbed areas adjacent to the proposed development areas should be re-vegetated with an indigenous grass mix, if necessary, to re-establish a protective cover, to minimise soil erosion and dust emission.	
Monitoring	Close supervision and monitoring of the stripping process is required to ensure that soils are stripped correctly.

4.2 ISSUE: POTENTIAL SOIL COMPACTION

The severity of impact on soil compaction is anticipated to be low for the disturbed soils (i.e., Witbank and Cullinan) and high for the natural soils due to their high clay content. The impact significance can however be reduced significantly, should the proposed activities be restricted to access roads, vehicle hard stand areas and equipment and machinery laydown areas. Soil compaction will potentially lead to:

- Increased bulk density and soil strength, reduced aeration and lower infiltration rate
- Destroyed soil structure, causing it to become more massive with fewer natural voids with a high possibility of soil crusting.
- Soil biodiversity is also influenced by reduced soil aeration. Severe soil compaction may cause reduced microbial biomass. Soil compaction may not influence the quantity, but the distribution of macro fauna that is vital for soil structure including earthworms due to reduction in large pores.

4.2.1 Impact assessment

The impacts assessed in the respective phases are presented Table 4-5 to Table 4-7.

Table 4-5: Summary of the impact significance on soil compaction for the proposed footprint areas during the construction phase.

Issue: Soil erosion.		
Phases: Construction		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Medium (M)	Low (L)
Duration	Low (L)	Low (L)
Extent	Very Low (VL)	Very Low (VL)
Consequence	Medium (M)	Low (L)
Probability	High (H)	Low (L)
Significance	**Low (L)**	**Very Low (VL)**
Nature of cumulative impacts	Cumulative impacts from the proposed developments within the Proposed Footprint Areas are anticipated to be of Low significance without mitigation measures.	
Degree to which impact can be reversed	The impact can be fully reversed once the construction period is completed, and management measures are put in place and adhered to.	
Degree to which impact may cause irreplaceable loss of resources	Low	
Residual impacts	The residual impact is considered to be VERY LOW due to the proposed footprint areas being dominated by Witbank and Cullinan soil forms and being within an active mining area.	

Table 4-6: Summary of the impact significance on soil compaction for the proposed footprint areas during the operational phase.

Issue: Soil compaction		
Phases: Operational		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Medium (M)	Low (L)
Duration	Long-term (M)	Medium (M)
Extent	Very Low (VL)	Very Low (VL)
Consequence	Medium (M)	Low (L)
Probability	High (H)	Low (L)
Significance	**Medium (M)**	**Very Low (VL)**
Nature of cumulative impacts	Cumulative impacts from the proposed developments within the proposed footprint areas are anticipated to be of Medium significance without mitigation measures.	
Degree to which impact can be reversed	Low during operational phase.	

Issue: Soil compaction	
Degree to which impact may cause irreplaceable loss of resources	Low because the majority of the soils are disturbed already.
Residual impacts	The residual impact is considered to be VERY LOW due to the proposed footprint areas being dominated by Witbank and Cullinan soil forms and being in close proximity to active mining area.

Table 4-7: Summary of the impact significance on soil compaction for the proposed footprint areas during the closure and rehabilitation phase.

Issue: Soil Compaction		
Phases: Decommissioning and Closure Phases		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Low (L)	Low (L)
Duration	High (H)	High (H)
Extent	Very Low (VL)	Very Low (VL)
Consequence	Low (L)	Low (L)
Probability	High (H)	Low (L)
Significance	Low (L)	Very Low (VL)
Nature of cumulative impacts	Cumulative impacts from the mining activities within the proposed footprint areas are anticipated to be of Low significance.	
Degree to which impact can be reversed	The impact can be reversed to a large degree once the mining activities cease and the impacted areas have been rehabilitated.	
Degree to which impact may cause irreplaceable loss of resources	Very Low	
Residual impacts	The residual impact is considered to be VERY LOW due to the proposed footprint areas being dominated by Witbank and Cullinan soil forms and being in close proximity to active mining area.	

4.2.1.1Management objective, mitigation measure and monitoring

The management objectives, management outcomes and mitigation measures and monitoring are represented in Table 4-8.

Table 4-8: Management objectives, management outcomes and mitigation measures and monitoring

Management objective	• *To rehabilitate disturbed areas in line with the management plans.* • *To accommodate the present land uses of communal grazing and/or wilderness.*
Management outcome	Rehabilitation that supports post-closure land uses.
Mitigation actions/measures	
Phases: All phases	

• Compacted soils adjacent to the proposed developments during construction should be lightly ripped to at least 25 cm below ground surface to alleviate compaction. • Decommissioning activities should be scheduled to coincide with low rainfall conditions when soil moisture is anticipated to be relatively low, such that the soils are less prone to compaction. • Ensure all stockpiles (especially topsoil) are clearly and permanently demarcated and located in defined no-go areas. • Restrict the amount of mechanical handling, as each handling event increases that compaction level and the changes to the soil structure. Wherever possible, the 'cut and cover' technique (where the stripped soils is immediately placed in an area already prepared for rehabilitation, thus avoiding stockpiling) should be used. • Stockpile height should be restricted to that which can deposited without additional traversing by machinery. Stockpiles should be treated with temporary soil stabilisation methods, such as the application of organic matter to promote soil aggregate formation, leading to increased infiltration rate, thereby reducing soil erosion. Also, the use of lime to stabilise soil pH levels. • Soil erosion should be controlled on stockpiles by having control measures to reduce erosion risk such as erosion control blankets, soil binders, revegetation, contours, diversion banks and spillways. • Stockpiled soils should be stored for a maximum of 3-5 years to ensure that the soil quality does not deteriorate. In addition, concurrent rehabilitation must strongly be considered to reduce the duration of stockpile storage to ensure that the quality of stored soil material does not deteriorate excessively, especially with regard to leaching and acidification. • The topsoil stockpile should be vegetated and while vegetating, measures will be needed to contain erosion of the stockpile during rain events. • Temporary berms can be installed, around stockpile areas whilst vegetation cover has not established to avoid soil loss through erosion. • The recovered soils should be re-used to rehabilitate the mine footprint following mine closure. • A short-term fertilizer program should be based on the soil chemical status after levelling and should consists of a pre-seeding lime and fertilizer application, an application with the seeding process as well as a maintenance application for 2 to 3 years after rehabilitation or until the area can be declared as self-sustaining by an appropriately qualified soil scientist.	
Monitoring	Visual inspection and reporting

4.3 ISSUE: POTENTIAL SOIL CONTAMINATION

Contamination sources are mostly unpredictable and often occur as incidental spills or leaks during both the construction and operational phase. Thus, all the identified soils are considered equally predisposed to potential contamination. The significance of contamination is largely dependent on the nature, volume and/or concentration of the contaminant of concern as well as the rate at which contaminants are transported by water in the soil. Therefore, strict waste management protocols as well as product stockpile management and activity specific Environmental Management Programme (EMP) and monitoring guidelines should be adhered to during the construction and operational activities. If the management protocols are not well managed this will more likely lead to contaminants leaching into the soil and thus potentially rendering the soil sterile. reducing the yield potential of soils. The soil contamination impact is therefore anticipated to be **Medium** during the pre-construction, construction and operational phases. Hence it should have an influence on the decision and mitigation measures will be required. Post mitigation measures the significant impacts are anticipated to be **Very Low** during the construction, operational and rehabilitation phases.

4.3.1 Impact assessment

The impacts assessed in the respective phases are presented in Table 4-9 to Table 4-11.

Table 4-9: Summary of the impact significance on soil contamination for the proposed footprint areas during the construction phase.

Issue: Soil Contamination		
Phases: Construction		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Medium (M)	Low (L)
Duration	Low (L)	Low (L)
Extent	Very Low (VL)	Very Low (VL)
Consequence	Low (L)	Low (L)
Probability	High (H)	Low (L)
Significance	Low (L)	Very Low (VL)
Nature of cumulative impacts	Cumulative impacts from the proposed developments within the proposed footprint areas are anticipated to be of Low significance without mitigation measures.	
Degree to which impact can be reversed	The impact can be fully reversed once the construction period is completed, and management measures are put in place and adhered to	
Degree to which impact may cause irreplaceable loss of resources	Low	
Residual impacts	The residual impact is considered to be VERY LOW due to the proposed footprint areas being dominated by Witbank and Cullinan soil forms and being in close proximity to active mining area.	

Table 4-10: Summary of the impact significance on soil contamination for the proposed footprint areas during the operational phase.

Issue: Soil Contamination		
Phases: Operational		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Medium (M)	Low (L)
Duration	Low (L)	Low (L)
Extent	Very Low (VL)	Very Low (VL)
Consequence	Low (L)	Low (L)
Probability	High (H)	Low (L)
Significance	Low (L)	Very Low (VL)
Nature of cumulative impacts	Cumulative impacts from the proposed developments within the proposed footprint areas are anticipated to be of Medium significance without mitigation measures.	
Degree to which impact can be reversed	Low during operational phase	
Degree to which impact may cause irreplaceable loss of resources	Low because the majority of the soils are disturbed already.	

Issue: Soil Contamination	
Residual impacts	The residual impact is considered to be VERY LOW due to the proposed footprint areas being dominated by Witbank and Cullinan soil forms and being in close proximity to active mining area.

Table 4-11: Summary of the impact significance on soil contamination for the proposed footprint areas during the decommissioning phase.

Issue: Soil Contamination		
Phases: Decommissioning and Closure Phases		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Low (L)	Low (L)
Duration	High (H)	High (H)
Extent	Very Low (VL)	Very Low (VL)
Consequence	Low (L)	Low (L)
Probability	High (H)	Low (L)
Significance	Low (L)	Very Low
Nature of cumulative impacts	Cumulative impacts from the proposed developments within the proposed footprint areas are anticipated to be of Low significance.	
Degree to which impact can be reversed	The impact can be reversed to a large degree once the mining activities cease, and the impacted areas have been rehabilitated.	
Degree to which impact may cause irreplaceable loss of resources	Very Low	
Residual impacts	The residual impact is VERY LOW due to the proposed footprint areas being dominated by Witbank and Cullinan soil forms and being in close proximity to active mining area.	

4.3.1.1Management objective, mitigation measure and monitoring

The management objectives, management outcomes and mitigation measures and monitoring are represented Table 4-12.

Table 4-12: Management objectives, management outcomes and mitigation measures and monitoring

Management objective	• *To rehabilitate disturbed areas in line with the management plans.* • *To accommodate the present land uses of communal grazing and/or wilderness.*
Management outcome	• Rehabilitation that supports post-closure land uses.
Mitigation actions/measures	
Phases: All phases	
• The construction of toe paddocks and secondary toe paddock cross walls around the perimeter of the WRDs should be installed to limit seepage;	

• WRDs should be lined in accordance with the proposed design features to limit possible seepage and the subsequent soil contamination; • Burying of any waste including rubble, domestic waste, empty containers on the site should be strictly prohibited and all construction rubble waste must be removed to an approved disposal site; • A spill prevention and emergency spill response plan, as well as dust suppression, and fire prevention plans should also be compiled to guide the construction works; and • An emergency response contingency plan should be put in place to address clean-up measures should a spill and/or a leak occur, as well as preventative measures to prevent contamination.	
Monitoring	Inspection and reporting

4.4 ISSUE: LOSS OF AGRICULTURAL LAND CAPABILITY

The impact on soil land capability is anticipated to be Low without mitigation and Very Low with mitigation. However, mitigation measures are deemed necessary, particularly for the conservation of topsoil for use during the closure and rehabilitation phase to meet the post closure land use objectives.

4.4.1 Impact assessment

The impacts assessed in the respective phases are presented in Table 4-13 and Table 4-15.

Table 4-13: Summary of the impact significance on loss of agricultural land for the proposed footprint areas during the construction phase.

Issue: Loss of Agricultural Land Capability		
Phases: Construction		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Medium (M)	Low (L)
Duration	Low (L)	Low (L)
Extent	Very Low (VL)	Very Low (VL)
Consequence	Low (L)	Low (L)
Probability	High (H)	Low (L)
Significance	Low (L)	Very Low (VL)
Nature of cumulative impacts	Cumulative impacts from the proposed developments within the Proposed Footprint areas are anticipated to be of Low significance without mitigation measures.	
Degree to which impact can be reversed	The impact can be fully reversed once the construction period is completed, and management measures are put in place and adhered to	
Degree to which impact may cause irreplaceable loss of resources	Low	
Residual impacts	The residual impact is considered to be VERY LOW due to the proposed footprint areas being dominated by Witbank and Cullinan soil forms and being in close proximity to active mining area.	

Table 4-14: Summary of the impact significance on loss of agricultural land for the proposed footprint areas during the operational phase.

Issue: Loss of Agricultural Land Capability		
Phases: Operational		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Medium (M)	Low (L)
Duration	Low (L)	Low (L)
Extent	Very Low (VL)	Very Low (VL)
Consequence	Low (L)	Low (L)
Probability	High (H)	Low (L)
Significance	Low (L)	Very Low (VL)
Nature of cumulative impacts	Cumulative impacts from the proposed developments within the proposed footprint areas are anticipated to be of Medium significance without mitigation measures.	
Degree to which impact can be reversed	Low during operational phase	
Degree to which impact may cause irreplaceable loss of resources	Low because the majority of the soils are disturbed already.	
Residual impacts	The residual impact is considered to be VERY LOW due to the proposed footprint areas being dominated by Witbank soil and Cullinan forms and being in close proximity to active mining area.	

Table 4-15: Summary of the impact significance on loss of agricultural land for the proposed footprint areas during the decommissioning phase.

Issue: Loss of Agricultural Land Capability		
Phases: Decommissioning and Closure Phases		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Low (L)	Low (L)
Duration	High (H)	High (H)
Extent	Very Low (VL)	Very Low (VL)
Consequence	Low (L)	Low (L)
Probability	High (H)	Low (L)
Significance	Low	Very Low
Nature of cumulative impacts	Cumulative impacts from the proposed developments within the proposed footprint areas are anticipated to be of Low significance.	
Degree to which impact can be reversed	The impact can be reversed to a large degree once the mining activities cease and the impacted areas have been rehabilitated.	

Issue: Loss of Agricultural Land Capability	
Degree to which impact may cause irreplaceable loss of resources	Very Low
Residual impacts	The residual impact is considered to be VERY LOW due to the proposed footprint areas being dominated by Witbank and Cullinan soil forms and being in close proximity to active mining area.

4.4.1.1Management objective, mitigation measure and monitoring

The management objectives, management outcomes and mitigation measures and monitoring are represented Table 4-16.

Table 4-16: Management objectives, management outcomes and mitigation measures and monitoring

Management objective	• *To rehabilitate disturbed areas in line with the management plans.* • *To accommodate the present land uses of communal grazing and/or wilderness.*
Management outcome	• Rehabilitation that supports post-closure land uses.
Mitigation actions/measures	
Phases: All phases	
• Topsoil material should be stripped and stockpiled in areas demarcated as "No Go Areas"; • A stripping depth of 500 mm has been recommended by the previous soil studies and this should be adhered to as far as possible; • Close supervision and monitoring of the stripping process is required to ensure that soils are stripped correctly;. • Revegetate the disturbed soils with an indigenous grass mix, to re-establish a protective cover, in order to minimise soil erosion and dust emissions; and • The footprint areas should be lightly ripped to alleviate compaction.	
Monitoring	Visual inspection and reporting

5. SURFACE WATER

5.1 ISSUE: ALTERATION OF NATURAL DRAINAGE PATTERNS AFFECTING FLOW OF WATER IN DOWNSTREAM SYSTEMS

Natural drainage across the Tharisa Mine is via sheet flow. Rainfall and surface water run-off will be collected in areas that have been designed with water containment infrastructure. The collected rainfall and run-off will therefore be lost to the catchment and can result in the alteration of drainage patterns.

Existing Tharisa mining infrastructure has already altered the natural drainage patterns by reducing the volume of run-off into the downstream catchments through existing stormwater management infrastructure on site. Rainfall and surface water run-off will be collected in a series of toe paddocks and secondary toe paddocks around the perimeter of the WRD's that will be designed to contain dirty water.

In the absence of mitigation, the intensity of unmitigated impacts is expected to be very low given that monthly average evaporation rates recorded at the Buffelspoort weather station exceed the monthly average rainfall for all months. The duration of any loss of runoff to the catchment would extend post-closure in the absence of rehabilitation and the extent is expected to impact downstream areas beyond Tharisa mine. The probability of substantial runoff reduction to downstream systems in the unmitigated case is however expected to be unlikely. The unmitigated significance of this impact is therefore expected to be very low. In the mitigated scenario, with the focus on

rehabilitation of restoration of natural drainage lines (particularly at closure), the significance of the impact could be insignificant.

5.1.1 Impact Assessment

5.1.2 The significance of the impacts has been assessed and is presented in **Table 5-1.**

Table 5-1: Significance rating of alterations to drainage patterns

Issues: Alteration of natural drainage patterns affecting flow of water in downstream systems		
Phase: Construction		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Low (L)	Very Low (VL)
Duration	Low (L)	Low (L)
Extent	Low (L)	Low (L)
Consequence	Very Low (VL)	Very Low (VL)
Probability	Medium (M)	Very Low (VL)
Significance	**Very Low**	**Very Low**
Nature of cumulative impacts	N/A	
Degree to which impact can be mitigated	Low	
Degree to which impact may cause irreplaceable loss of resources	Unlikely	

5.1.2.1Management objective, mitigation measure and monitoring

The management objectives, management outcomes and mitigation measures and monitoring are represented Table 4-16.

Table 5-2: Management objectives, management outcomes and mitigation measures and monitoring

Management objective	*The objective is to prevent unacceptable alteration of drainage patterns and related reduction of downstream surface water flow.*
Management outcome	• Rehabilitation that supports post-closure land uses.
Mitigation actions/measures	
Phases: All phases	
• Management actions to be implemented in all mine phases include the following: • mine infrastructure will be constructed, operated and maintained so as to comply with the provisions of the Regulation 704 of 1999 in terms of the NWA. These include: o clean water systems are separated from dirty water systems. o the size of dirty water areas are minimized; and o clean water (run-off and rainfall) must be diverted around the mine/dirty areas and back into its normal flow in the environment.	
Monitoring	N/A

5.2 ISSUE: CONTAMINATION OF SURFACE WATER RESOURCES AFFECTING THIRD PARTY USE

There are a number of pollution sources that have the potential to pollute surface water, particularly in the unmitigated scenario.

Existing mining infrastructure and activities at the Tharisa Mine present numerous sources of contamination. The Proposed Project will present additional likely contamination sources in all phases that have the potential to contaminate surface water resources. These likely contaminants could include run-off from exposed surfaces, accidental spills of hydrocarbons and run-off from the side slopes of the WRD's. Although these likely contamination sources do not differ from those already present at the Tharisa Mine, additional contamination sources could contribute cumulatively to existing impacts from the Tharisa Mine infrastructure and activities.

In the absence of pollution containment measures the intensity of the potential impact is expected to be high. The East OG WRD is approximately 260 m from the Sterkstroom, the West OG WRD is approximately 267 m South from tributaries of the Brakspuit. Elevated concentrations of Aluminium have also been noted in the Sterkstroom River. It follows that without mitigation the contamination of surface water resources would probably occur for periods longer than the life of the project and would extend beyond the Tharisa Mine area to the nearby communities that utilise water from domestic and irrigation purposes. The unmitigated significance scenario is expected to be **high**. In the mitigated scenario that focuses on avoiding impacts through containment of potential contamination at source, the significance could be reduced to **low**.

5.2.1 Impact Assessment

The significance of the impacts has been assessed and is presented in Table 5-3.

Table 5-3: Significance rating for surface water quality

Issues: Impacts on Water Quality		
Phase: Construction		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	High (H)	Very Low (VL)
Duration	Low (L)	Low (L)
Extent	Medium (M)	Low (L)
Consequence	High (H)	Low (L)
Probability	Medium (M)	Medium (M)
Significance	**High (H)**	**Low**
Nature of cumulative impacts	When considering this impact cumulatively with the approved operations, the severity rating for the overall mine is high in the unmitigated scenario and reduces to medium in the mitigated scenario.	
Degree to which impact can be mitigated	Medium	
Degree to which impact may cause irreplaceable loss of resources	Low	
Residual impacts	In the construction and decommissioning phases these potential pollution sources are temporary in nature, usually existing for a few weeks to a few months. Although these sources may be temporary, the potential pollution may be long term.	

5.2.1.1Management objective, mitigation measure and monitoring

The management objectives, management outcomes and mitigation measures and monitoring are represented Table 4-16.

Table 5-4: Management objectives, management outcomes and mitigation measures and monitoring

Management objective	*The objective is to prevent pollution of surface water resources.*
Management outcome	Rehabilitation that supports post-closure land uses.
Mitigation actions/measures	
Phases: All phases	
• Management actions to be implemented in all mine phases include the following: o all hazardous chemicals (new and used), mineralized waste and non-mineralised waste must be handled in a manner that they do not pollute surface water. This will be implemented by means of the following: – pollution prevention through basic infrastructure design. – pollution prevention through maintenance of equipment. – pollution prevention through education and training of workers (permanent and temporary).	
Monitoring	Ongoing water monitoring

6. FRESHWATER ECOSYSTEMS

6.1 ISSUE: LOSS OF FRESHWATER HABITAT AND ECOLOGICAL STRUCTURE AND IMPACTS ON HYDROLOGY

As neither WRD is expected to encroach on the wetlands or the Sterkstroom River, the perceived impact significance is considered low to negligible

6.1.1 Impact Assessment

Table 6-1: Outcome of the Freshwater Impact Assessment.

Issues: • Loss of Freshwater Habitat and Ecological Structure and Impacts on Hydrology • Changes to Socio-Cultural and Ecological Service Provision • Impacts on the Hydrology and Sediment Balance • Impacts on Water Quality		
Phase: Construction		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Low (L)	Very Low (VL)
Duration	Very Low (VL)	Very Low (VL)
Extent	Low (L)	Low (L)
Consequence	Very Low (VL)	Very Low (VL)
Probability	Medium (M)	Very Low (VL)
Significance	**Very Low**	**Very Low**
Nature of cumulative impacts	• Potential further loss of catchment yield of the valley bottom wetlands due to the presence of additional stormwater / clean and dirty water management systems. • Potential increased sedimentation of the freshwater ecosystems, particularly the wetlands.	

Degree to which impact can be mitigated	low	
Degree to which impact may cause irreplaceable loss of resources	Unlikely. The WRDs are not likely to encroach on the freshwater ecosystems and will be placed within existing disturbed areas, with the exception of 1 ha of the West Above Ground WRD which although not within a disturbed area is not located within freshwater habitat.	
Residual impacts	Potential increased sedimentation of the freshwater ecosystems, particularly the wetlands which are located within 50 m of the West Above Ground WRD.	
Phase: Operational		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Low (L)	Very Low (VL)
Duration	High (H)	High (H)
Extent	Low (L)	Low (L)
Consequence	Low (L)	Low (L)
Probability	Medium (M)	Very Low (VL)
Significance	**Very Low**	**Very Low**
Nature of cumulative impacts	➢ Potential increased sedimentation of the freshwater ecosystems, particularly the wetlands which are located within 50 m of the West Above Ground WRD; ➢ Potential alteration of water quality.	
Degree to which impact can be mitigated	High	
Degree to which impact may cause irreplaceable loss of resources	Unlikely, provided that waste rock is only disposed of within the approved WRD footprint.	
Residual impacts	➢ Increased availability of sediment which may enter the freshwater ecosystems; ➢ Potential alteration of water quality should seepage from the WRD enter the freshwater ecosystems, specifically the wetlands.	
Phase: Closure / Rehabilitation		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Low (L)	Very Low (VL)
Duration	High (H)	High (H)
Extent	Low (L)	Low (L)
Consequence	Low (L)	Low (L)
Probability	Medium (M)	Very Low (VL)
Significance	**Very Low**	**Very Low**
Nature of cumulative impacts	As per operational phase.	
Degree to which impact can be mitigated	High	
Degree to which impact may cause irreplaceable loss of resources	Unlikely.	
Residual impacts	As per operational phase.	

6.1.1.1Management objective, mitigation measure and monitoring

The management objectives, management outcomes and mitigation measures and monitoring are represented in Table 6-2.

Table 6-2: Management objectives, management outcomes and mitigation measures and monitoring

Management objective	*Maintaining, or improving the ecological integrity of the watercourse in order to ensure continued ecological functionality.*
Management outcome	Limit the area of disturbance as far as practically possible.
Mitigation actions/measures	
Phases: Construction	
• Encroachment into the wetlands is highly unlikely since these are located outside of the existing boundary fence (albeit partially within the MRA). No encroachment within the riparian zone of the Sterkstroom River is deemed likely, due to the distance of the river from the proposed WRD. Therefore, no contractor laydown areas, material storage facilities or vehicle refuelling is likely to be placed within or occur within the boundaries or 32 m NEMA zone of regulation around these watercourses, however it must be ensured that no activities occur within the wetlands, riparian zone or the associated NEMA regulated zone. • Additional stormwater management and clean and dirty water systems are to be developed first prior to any other major earthworks to reduce risk of erosion and sedimentation; • The majority of the WRD footprints are planned within existing opencast mining and disturbed areas. Where there is marginal encroachment into areas not already cleared (1 ha of the West Above Ground WRD), then clearing must be limited to the approved footprint, and as much indigenous vegetation as possible retained; • It should be feasible to utilise existing roads to gain access to the sites and crossing the river in areas where no existing crossing is apparent should be unnecessary. Should new crossings be required for any reason, the necessary authorisations must be obtained in advance; • Further to the above, the proposed 4 m waste rock road around the perimeter of each WRD must take into consideration the delineations of the watercourses and be planned to avoid these, as much as feasible; • The watercourse areas beyond the proposed footprint of development and the NEMA zone of regulation (32m) should be clearly demarcated with danger tape except where located outside the existing boundary fence of the mine, and areas in which no activities are proposed should be marked as a no-go areas: • Topsoil stockpiling must be undertaken in accordance with the mine's existing topsoil conservation guide. Any soil stockpiles may not exceed the height recommended by the topsoil conservation guide.	
Operational	
• The structures must be stabilised to prevent failure, and must be regularly inspected to proactively manage any perceived risk of failure; • Should failure occur, and the CVB wetland in particular become blocked as a result, the waste rock must be removed immediately and stockpiled in another appropriate WRD to ensure continued hydraulic connectivity of the channel; and • Due to the distance between the East Above Ground WRD and the Sterkstroom River, the risk posed to the river is considered negligible. • Additional water inputs to watercourse via groundwater are anticipated to be unlikely due to distance of the WRDs from the respective watercourses; • Notwithstanding the above, monitoring of seepage water contained in the perimeter toe paddocks and of boreholes around the perimeter of each WRD must be undertaken to allow for proactive management; • Although the geochemical work undertaken for waste rock samples at Tharisa indicate that the waste rock is non-acid generating, based on leachate tests chemicals of concern that are likely to leach from the WRDs when compared to water quality standards include: Elevated concentrations of Al, Chromium (Cr), Iron	

	(Fe), Manganese (Mn), Lead (Pb). Thus the WRDs must be appropriately lined with a Class D liner to prevent pollution of groundwater
Monitoring	Regular monitoring of groundwater quality must be undertaken in accordance with existing recommendations by the groundwater specialist or if such recommendations have not been provided, a monitoring plan must be developed by a suitably qualified specialist.

7. GROUNDWATER

7.1 ISSUE: GROUNDWATER DRAWDOWN

One area of concern would be the dewatering effects and potential loss of groundwater yield to adjacent I&APs and informal settlements which are within the cone of depression. The modelling results show that the West Pit cone extends ± 700 m to the south and would potentially affect 4 I & APs near the mine (1 – 10 m drawdown). These include borehole AMG11, The Retief Primary School borehole, as well as the Wolvaart and van der Hoven residences.

Considering that the impacts from WRD facilities are governed by rainfall and therefore recharge, as well as the influence of the pit dewatering and rewatering creating a sink, the nitrate does not travel > 500 m from the mine residue facilities with localised impacts.

7.1.1 Impact assessment

The impacts assessed in the respective phases are presented in Table 8-1 and Table 8-3.

Table 7-1: **Assessment of impact for the Mining Phase: Dewatering and loss of yield from I & AP boreholes in close proximity to mining developments (South of West Pit) due to maximum impact ZOI**

Issue: GROUNDWATER DRAWDOWN		
Phases: Operational Phase		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	High (H)	Low (L)
Duration	High (H)	Medium (M)
Extent	Medium (M)	Low (L)
Consequence	High (H)	Low (L)
Probability	High (H)	High (H)
Significance	**High**	**Low (L)**
Nature of cumulative impacts	Unavailability of groundwater for use from boreholes	
Degree to which impact can be reversed	The simulated maximum cone of depression is < 700 m from the pits boundaries and potentially impact 4 I & APs. Groundwater level and chemistry monitoring based on the updated monitoring protocol and if impacts are measured, mitigate by supply of alternative water to any impacted users. If specific fractures are intersected during mining these could be grouted/sealed to manage the impact.	
Degree to which impact may cause irreplaceable loss of resources	Moderate.	
Residual impacts	- Destruction and closure of boreholes	

Potential groundwater users within the Marikana informal settlement are also situated within the modelled ZOI (1 -10 m drawdown). The source of their water needs to be verified as it is inferred that they receive Magalies water. All the hydrocensus boreholes downstream of the site will be affected to an extent (1 – 10 m drawdown). It must be noted that most of the land uses are industrial and mining related.

Table 7-2: **Dewatering and loss of yield from boreholes downstream of mining developments (Marikana Informal settlement) due to maximum impact ZOI**

Issue: Groundwater Drawdown		
Phases: Operational Phase		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	High (H)	Low (L)
Duration	High (H)	Medium (M)
Extent	Medium (M)	Low (L)
Consequence	High (H)	Low (L)
Probability	High (H)	High (H)
Significance	**High**	**Low (L)**
Nature of cumulative impacts	Unavailability of groundwater for use from boreholes	
Degree to which impact can be reversed	The simulated maximum cone of depression is < 700 m from the pits boundaries and potentially impact the Marikana Informal Settlement. Groundwater level and chemistry monitoring based on the updated monitoring protocol and if impacts are measured, mitigate by supply of alternative water to any impacted users. If specific fractures are intersected during mining these could be grouted/sealed to manage the impact.	
Degree to which impact may cause irreplaceable loss of resources	moderate.	
Residual impacts	Destruction and closure of boreholes	

Due to the East Pit and West Pit's proximity to the Sterkstroom, the stream section directly adjacent to the open pits will most likely experience a drawdown effect (10 – 25 m). The modelling shows that based on the low flow (P5) monthly catchment runoff flows, a 6 - 10 % impact would be observed from April – Oct. During these months, piping, or discharge from dewatered flow volumes in the Sterkstroom from an upstream point before the mine to a downstream point after mining activities can be employed to minimize the impact on the Sterkstroom groundwater baseflow. These dewatering effects can be managed and mitigated to a large extent.

Table 7-3: **Drawdown effect on the Sterkstroom due to open pit dewatering from East and West Pit**

Issue: Groundwater Drawdown		
Phases: Operational Phase		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	High (H)	Low (L)
Duration	High (H)	Medium (M)

Extent	Low (L)	Low (L)
Consequence	High (H)	Low (L)
Probability	High (H)	High (H)
Significance	High	**Low (L)**
Nature of cumulative impacts	The proposed project could further impact on river flow	
Degree to which impact can be reversed	Moderate - Monitor upstream and downstream Strekstroom flows, and specific boreholes located adjacent to the stream for early detection; Diversion of non-contact runoff to the Sterkstroom. Verification of mine dewatering impacts on the Sterkstroom based on specialist surface water studies and monitoring. If impacts are significant piping or discharge of dewatered volumes in the Sterkstroom to a downstream point after mining activities during low flow months.	
Degree to which impact may cause irreplaceable loss of resources	Low-moderate.	
Residual impacts	- Impact on river functionality and flow.	

7.1.2 Management objective, mitigation measure and monitoring

The management objectives, management outcomes and mitigation measures and monitoring are represented Table 7-4.

Table 7-4: Management objectives, management outcomes and mitigation measures and monitoring

Management objective	• *To prevent the loss of groundwater resources.*
Management outcome	Limit the area of disturbance as far as practically possible.
Mitigation actions/measures	
Phases: Construction and Operational Phase	
Development footprint • The simulated maximum cone of depression is < 700 m from the pits boundaries and potentially impact 4 I & APs. Groundwater level and chemistry monitoring based on the updated monitoring protocol and if impacts are measured, mitigate by supply of alternative water to any impacted users. If specific fractures are intersected during mining these could be grouted/sealed to manage the impact. • The simulated maximum cone of depression is < 700 m from the pits boundaries and potentially impact the Marikana Informal Settlement. Groundwater level and chemistry monitoring based on the updated monitoring protocol and if impacts are measured, mitigate by supply of alternative water to any impacted users. If specific fractures are intersected during mining these could be grouted/sealed to manage the impact. • Monitor upstream and downstream Strekstroom flows, and specific boreholes located adjacent to the stream for early detection; Diversion of non-contact runoff to the Sterkstroom. Verification of mine dewatering impacts on the Sterkstroom based on specialist surface water studies and monitoring.	

• If impacts are significant piping or discharge of dewatered volumes in the Sterkstroom to a downstream point after mining activities during low flow months.	
Monitoring	Biomonitoring should be included in the water monitoring protocol, up and downstream of Tharisa to determine the cumulative impact of the nitrate build-up on the downstream ecosystem

7.2 ISSUE: NITRATE MASS MIGRATION

Both the East Pit and West Pit backfilling is scheduled to be completed in January 2034, some 2 – 2.5 years after the completion of both the open pits (based on the schedules provided and approved). The East Pit backfilling was simulated to occur in three main stages, whilst the Far West Pit and West Pit is modelled in 4 main stages with the fourth being the merger of the two pit sections. These assumptions are based on open pit expansion utilising google maps, as well as the scheduling data provided.

At decommissioning / full backfilling, the nitrate plume from the West Pit is modelled to travel no more than 200 m north/northwest (due to the sink created from the Sibanye pit to the northwest). According to the model seepage towards the Sterkstroom (east) is observed, and travels ± 400 m downstream at elevated concentrations before it reaches the Marikana informal settlement to the north (contribution from the east pit and quarry also observed).

From the monitoring data and modelling results, nitrate mass migration within the Sterkstroom is limited and of local extent, as TM SW04 (located ± 1 km downstream) showed no nitrate exceedances during the July 2022 hydrocensus. Some build-up of nitrate directly downstream of the mining operations can be observed through LoM (Figure 6 24), but as seen with the long term monitoring data concentrations would seldomly exceed the SANS 241 nitrate concentration limit.

The modelling results show that at low flow (P5) Sterkstroom flows, the nitrate concentrations owing to mining can be elevated up to ± 9 mg/l at end of mine life (not considering monitoring data spikes (pulse events) in concentration which is due to seasonal wet and dry cycles and the contribution of changes in production of current arisings (ore) and waste rock rate over time). At median (P50) and mean Sterkstroom flows, nitrate build-up does not exceed ± 6 mg/l. It is proposed that additional Biomonitoring studies be conducted up and downstream of Tharisa to determine the cumulative impact of the nitrate build-up on the downstream ecosystem.

I&APs directly south of Far west WRD 1 (The Wolvaart and van der Hoven residences) have simulated nitrate concentrations (± 50 – 100 mg/l) as localised seepage to the south is observed (± 100 m). Water would need to be provided to these residences should nitrate concentrations be observed from monitoring.

Considering the East mine section, nitrate migration above SANS 241 limits from the backfilled East Pit migrates < 100 m northeast towards the Marikana Informal settlement. Nitrate migration is also observed towards the east along the dyke contacts owing to SAMANCOR Underground rewatering.

Generally, nitrate migration is contained within the mine lease area and does not travel < 400 m from the mining infrastructure (localised Impacts). Seepage from the waste rock facilities is governed by rainfall (recharge is estimated at 12% - 15% of rainfall), and therefore multiple mitigation measures can be employed to limit rainfall infiltration and therefore seepage. Resulting runoff can also be effectively managed.

The additional WRD facilities are planned above both the fully backfilled East Pit and Far west section of the West Pit. Both the East Pit and West Pit OG WRD's are planned to be commissioned March 2023, with the West Pit OG WRD constructed in 4 zones within the model domain.

The simulated East Pit OG WRD maximum nitrate mass plume footprint is mostly confined to the East Pit footprint due to dewatering and rewatering of the fully backfilled pit (created sink). De-nitrification of the backfilled waste rock is also observed as the plume concentrations dissipate towards the north. Some nitrate mass migration is observed towards the east (most likely due to Samancor Underground rewatering), with the plume migrating no more than ± 400 m.

For the West Pit OG WRD, most of the nitrate migration occurs from the far west section of the pit, as the construction of the WRD occurs from a westerly to an easterly direction. The Far West WRD 1 also contributes to nitrate mass migration here.

Nitrate migration occurs in a north-westerly direction, with the plume modelled to travel no more than ± 200 m affecting no direct receptors. This movement can most likely be attributed to the Sibanye open pit sink created to the northwest of the facility. As mentioned, I&APs directly south of Far W WRD 1 could experience elevated nitrate concentrations (± 50 – 100 mg/l) as seepage to the south is observed (± 100 m). With the construction of the third and fourth sections of the West Pit OG WRD, I&APs would need to be moved (Marikana Settlement), with the nitrate concentrations lower than the first two sections due to less time for nitrate build-up to occur. Nevertheless, the nitrate mass plume migrates no more than ± 150 m from the proposed footprints.

7.2.1 Impact assessment

The impacts assessed in the respective phases are presented in Table 7-5 and Table 7-9.

Table 7-5: **Existence of hydraulic connections between the East Pit, Quarry an Sterkstroom which allows mass migration towards Sterkstroom;**

Issue: Nitrate Migration		
Phases: Operational Phase		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	High (H)	Medium (M)
Duration	Low (L)	Low (L)
Extent	Medium (M)	Medium (M)
Consequence	Medium (M)	Medium (M)
Probability	High (H)	Medium (M)
Significance	Medium (M)	**Low (L)**
Nature of cumulative impacts	The groundwater sink created by East and West pit dewatering minimises mass migration.	
Degree to which impact can be reversed	Medium	
Degree to which impact may cause irreplaceable loss of resources	Low	
Residual impacts	Post closure re-watering and mass migration is not a significant impact. The flooded backfilled pits would form excellent artificial aquifers with usable water quality during the post-operational phase. Options to use these as water resources and enhance recharge yield by diverting surface water into these during flood conditions should be considered and	

	evaluated via further modelling and studies. Nitrate degradation due to denitrification also causes the plumes to dissipate within a maximum of 5 - 10 years after closure.

Table 7-6: **Nitrate migration from current mine residue facilities (TSF and WRDs) downstream**

Issue: Nitrate migration from current mine residue facilities (TSF and WRDs) downstream: • **North from Choppies WRD and East WRD,** • **West from East Pit and the quarry towards the Sterkstroom; and** • **East from west pit towards the Sterkstroom.**		
Phases: Operational Phase		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Medium (M)	Medium (M)
Duration	High (H)	High (H)
Extent	Medium (M)	Medium (M)
Consequence	Medium (M)	Medium (M)
Probability	High (H)	Medium (M)
Significance	**Medium (M)**	**Low (L)**
Nature of cumulative impacts	Nitrate migration from current mine residue facilities (TSF and WRDs) downstream: • North from Choppies WRD and East WRD, • West from East Pit and the quarry towards the Sterkstroom; and • East from west pit towards the Sterkstroom.	
Degree to which impact can be reversed	Medium	
Degree to which impact may cause irreplaceable loss of resources	Low	
Residual impacts	• Nitrate accumulation	

Table 7-7: **Nitrate migration from current mine residue facilities (TSF and WRDs) downstream**

Issue: Nitrate migration from current mine residue facilities (TSF and WRDs) downstream: • **Nitrate migration from current Far West WRD 1 and West WRD 1 towards I & APs directly adjacent to these facilities:** • **The Wolvaart and van der Hoven residences; and** • **Retief Primary School borehole.**		
Phases: Operational Phase		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Medium (M)	Medium (M)

Duration	High (H)	High (H)
Extent	Medium (M)	Medium (M)
Consequence	Medium (M)	Medium (M)
Probability	High (H)	Medium (M)
Significance	**Medium (M)**	**Low (L)**
Nature of cumulative impacts	Nitrate migration from current Far West WRD 1 and West WRD 1 towards I & APs directly adjacent to these facilities: • The Wolvaart and van der Hoven residences; and • Retief Primary School borehole.	
Degree to which impact can be reversed	Medium	
Degree to which impact may cause irreplaceable loss of resources	Low	
Residual impacts	• Nitrate accumulation	

Table 7-8: **Nitrate migration from current mine residue facilities (TSF and WRDs) downstream**

Issue: Nitrate migration from planned new facilities (open pit backfilling and OG WRDs) downstream: • **East Pit backfilling northeast towards the Marikana Informal settlement;** • **East Pit backfilling east along the dyke contacts owing to SAMANCOR Underground rewatering;** • **West Pit backfilling northwest towards Sibanye pits; and** • **West Pit backfilling east towards Sterkstrroom.**		
Phases: Operational Phase		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Medium (M)	Medium (M)
Duration	High (H)	High (H)
Extent	Medium (M)	Medium (M)
Consequence	Medium (M)	Medium (M)
Probability	High (H)	Medium (M)
Significance	**Medium (M)**	**Low (L)**
Nature of cumulative impacts	Nitrate migration from planned new facilities (open pit backfilling and OG WRDs) downstream: • East Pit backfilling northeast towards the Marikana Informal settlement; • East Pit backfilling east along the dyke contacts owing to SAMANCOR Underground rewatering; • West Pit backfilling northwest towards Sibanye pits; and • West Pit backfilling east towards Sterkstrroom.	

Degree to which impact can be reversed	Medium
Degree to which impact may cause irreplaceable loss of resources	Low
Residual impacts	• Nitrate accumulation

Table 7-9: **Nitrate mass transport and seepage from Mine Residue (TSFs and WRDs) downstream.**

Issue: Nitrate migration:		
Phases: Operational Phase		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Low (L)	Low (L)
Duration	Medium (M)	Low (L)
Extent	Medium (M)	Medium (M)
Consequence	Medium (M)	Low (L)
Probability	High (H)	Medium (M)
Significance	**Medium (M)**	**Very Low (VL)**
Nature of cumulative impacts	Nitrate migration downstream	
Degree to which impact can be reversed	Medium	
Degree to which impact may cause irreplaceable loss of resources	Low	
Residual impacts	• Nitrate accumulation	

7.2.2 Management objective, mitigation measure and monitoring

The management objectives, management outcomes and mitigation measures and monitoring are represented Table 8-2.

Table 7-10: Management objectives, management outcomes and mitigation measures and monitoring

Management objective	• *To prevent the loss of groundwater resources.*
Management outcome	Limit the area of disturbance as far as practically possible.
Mitigation actions/measures	
Phases: Operational and Closure Phase	
Development footprint	

• The monitoring network needs to be reviewed and a formal monitoring protocol developed. A parameter optimisation study should be conducted to only analyse for the critical control parameters (CCP) as there are only ± 5 important chemical parameters. This would save on lab analysis costs. Additional downstream monitoring locations for both surface water and groundwater are required. Monitoring data should be archived on a digital data base that should serve as a future reference. Monitoring reports should be issued on a quarterly (summary) and annual (detailed) basis. Management and mitigation measures should be adapted based on the monitoring results to effectively mitigate the impacts. • A hydrocensus should be conducted on an annual basis to evaluate the status of the potential surface water and groundwater receptors surrounding the site and proposed facilities. • The recommended Sustainable Multiple-Capturing-Barrier-System and sustainable groundwater management and mitigation plan should be included in the EMPR and IWWMP. • More detailed site characterization and modelling for implementation level accuracy to verify subsurface flow zones and hydraulic parameters with specific reference to: o Clay layer thickness and continuity. o Geophysical surveys to verify existence of dyke, dyke-contacts and fault/fracture zones and the thickness of the weathered zone. o Drilling of site characterization holes (4 - 6 holes, 45 m to 70 m deep, 0.165 m diameter) and subject to aquifer tests to verify hydraulic parameters. o Downhole geophysical surveys and lugeon tests on selected holes to verify depth permeability relationships. o Sampling for chemical and isotope analysis. o Update and recalibration of flow and mass transport model for implementation level accuracy. o Sterkstroom wet and dry season flow data and based on hydrological, aquatic ecological and water use impact modelling. • The additional monitoring boreholes should be optimized during the pre- and operational phase site characterization (geophysics, drilling and aquifer testing) phases. • Options to use the fully backfilled open pits as water resources and enhance recharge yield by diverting surface water into them during flood conditions should be considered and evaluated via further modelling and studies. • The mine dewatering and mass transport model should be reviewed and updated every two years and/or once the KMLCS pit dewatering modelling are completed as the open pits form important sinks in the mass transport model (for dewatering planning purposes). • Phytoremediation (e.g., Planting of Searsia Lancea trees), rehabilitation of facilities, shaping and rehab of the waste rock facilities. Natural decay of nitrates due to de-nitrification. Modelling shows that nitrates decrease to below SANS 241 Drinking Water Standards within < 10 years post closure	
Monitoring	Biomonitoring should be included in the water monitoring protocol, up and downstream of Tharisa to determine the cumulative impact of the nitrate build-up on the downstream ecosystem

8. BIODIVERSITY

8.1 ISSUE: LOSS OF FLORAL HABITAT AND SPECIES DIVERSITY

The proposed mining activities will result in the minimal clearance of vegetation within habitat that is deemed to be of a low floral sensitivity.

Low significance impacts are anticipated for the Transformed Habitat Unit due to the transformed nature of this habitat. Overall, this habitat supported a low diversity of floral species. Given that the floral communities within this habitat unit have shifted significantly away from the reference vegetation type a significant loss of floral communities is not anticipated.

Negative impacts likely to be associated with the floral ecology within and around the study area include, but are not limited to, the following:

- Mining footprint creep and placement of infrastructure within natural habitat outside of the authorised footprint, including surrounding freshwater features; and
- AIP proliferation and erosion in disturbed areas.

8.1.1 Impact assessment

The impacts assessed in the respective phases are presented in Table 8-1 and Table 8-3.

Table 8-1: **Assessment of impact for the Mining Phase: Loss of habitat and species diversity in the Transformed Habitat.**

Issue: loss of floral habitat and diversity		
Phases: Operational Phase		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Medium (M)	Low (L)
Duration	Medium (M)	Low (L)
Extent	Low (L)	Low (L)
Consequence	Medium (M)	Low (L)
Probability	Very High (VH)	Very High (VH)
Significance	**Medium (M)**	**Low (L)**
Nature of cumulative impacts	The proposed project could further impact on the floral habitat and diversity through edge effect impacts, including AIP proliferation) – this is relevant to all surrounding areas (including surrounding freshwater features).	
Degree to which impact can be reversed	Moderate. The impact can be somewhat reversed once the Mining Phase is completed, and management measures are put in place and adhered to.	
Degree to which impact may cause irreplaceable loss of resources	Low-moderate.	
Residual impacts	Residual impacts are anticipated to be low. Potential residual impacts include: - Permanent loss of and altered floral species diversity because of poorly managed edge effects (such as further AIP proliferation).	

8.1.1.1Management objective, mitigation measure and monitoring

The management objectives, management outcomes and mitigation measures and monitoring are represented Table 8-2.

Table 8-2: Management objectives, management outcomes and mitigation measures and monitoring

Management objective	• *To prevent the unacceptable disturbance and loss of biodiversity and related ecosystem functionality through physical destruction and general disturbance.*
Management outcome	Limit the area of disturbance as far as practically possible.

Mitigation actions/measures
Phases: Construction and Operational Phase
Development footprint • Minimise loss of vegetation where possible through adequate planning and, where necessary, by incorporating the sensitivity of the biodiversity report as well as any other specialist studies; • The construction footprint must be kept as small as possible in order to minimise impact on the surrounding environment (edge effect management); • Removal of vegetation must be restricted to the approved development footprint. • Vehicles should be restricted to travelling only on designated roadways to limit the ecological footprint of the mining activities. Additional road construction should be limited to what is absolutely necessary, and the footprint thereof kept to a minimal; • No collection of indigenous floral species must be allowed by construction personnel; • Care should be taken during the construction of the proposed infrastructure development to limit edge effects to surrounding natural habitat. This can be achieved by: • Ensuring continued demarcation all footprint areas during mining activities; • No construction rubble or cleared AIP species are to be disposed of outside of demarcated areas, and should be taken to a registered waste disposal facility or low sensitivity areas allocated specifically for waste dumping; • All soils compacted as a result of mining activities should be ripped and profiled and reseeded once these areas become available for rehabilitation; • Manage the spread of AIP species, which may affect remaining natural habitat within surrounding areas (especially nearby freshwater features). Specific mention in this regard is made to Category 1b species identified within the development footprint areas; and • No dumping of litter, rubble or cleared vegetation on site should be allowed. Infrastructure and rubble removed because of mining activities should be disposed of at an appropriate registered dump site away from the development footprint. No temporary dump sites should be allowed in areas with natural vegetation. Waste disposal containers and bins should be provided during the construction and maintenance phase for all construction rubble and general waste. Vegetation cuttings must be carefully collected and disposed of at a separate waste facility or demarcated low sensitivity site. • If any spills occur, they should be immediately cleaned up to avoid soil contamination that can hinder floral rehabilitation later down the line. Spill kits should be kept on-site within workshops. In the event of a breakdown, maintenance of vehicles must take place with care, and the recollection of spillage should be practised, preventing the ingress of hydrocarbons into the topsoil; • Suppress dust to mitigate the impact of dust on flora within a close proximity of construction activities (Sett 2017) – any chemicals used for this purpose must not be permitted to enter the Freshwater habitats; and • Upon completion of mining activities, it must be ensured that no bare areas remain, and that indigenous species be used to revegetate the disturbed area. • Ensure sound geotechnical design and carefully plan future WRD utilization and closure; • Slope monitoring should be carried out regularly to manage the slope angle and height with variation in material properties. • Ensure that the slope ratio is not excessively steep which may induce slope failure or implement mechanisms to improve slope stability where necessary. • Ensure that where berms and/or cut of trenches are developed and appropriately sized around the WRDs they are sufficient in design to capture any sediment and water runoff and stop such spreading into the surrounding soils in line with the requirements of Regulation GN704 of 2016; • The drains and associated clean and dirty water separation structures must be maintained in good working order.

- Regular monitoring should be undertaken to assess the footprint area of the WRD and to measure the degree of sedimentation and soil disturbance in order to allow for adaptive management;
- Where high levels of sediment are collecting at the base of the various WRDs, these areas should be revegetated to stabilise these sections to minimise further dispersion of sediment into the surrounding soils during high rainfall events. Should this not be feasible, this material should be collected, transported, and stored in a suitable waste facility where it cannot be transported further through erosive agents. The remaining bare soil areas are then to be revegetated accordingly;
- Any areas where there is increased risk that water runoff and sediment will enter into any freshwater systems, appropriate drainage infrastructure must be developed to minimise this risk; and
- An alien plant control plan must be implemented, and all alien plants controlled, with focus on the bases of the WRDs within 50 m of the toe of each WRD. All alien plants in the freshwater systems must be controlled in line with relevant legislation to minimise further dispersal of alien plant propagules. The relevant legislation is listed below:
    - The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) (CARA)
    - The National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA);
    - Government Notice (GN) number R.1020: Alien and Invasive Species Regulations, 2020, in Government Gazette 43735 dated 25 September 2020 as it relates to the NEMBA; and
    - GN number 1003: Alien and Invasive Species Lists, 2020, in Government Gazette 43726 dated 18 September 2020, as it relates to the NEMBA.

Alien Vegetation

- Prior to the commencement of the proposed mining activities, the current AIP Management/Control Plan should be updated by a qualified specialist and subsequently implemented:
- Removal of AIPs should occur regularly throughout the mining phase and continue throughout the i) Mining Phase, and ii) the Decommissioning & Rehabilitation Phase;
- The existing AIP Management/Control Plan should be regularly updated (and implemented) by a qualified professional. No use of uncertified chemicals may be used for chemical control of AIPs. Only trained personnel are to use chemical and mechanical control methods of AIPs. Chemical control may not be used near freshwater features (e.g., within the surrounding areas of the mining area).
- Edge effects arising from the proposed mining activities, such as erosion and AIP proliferation, which may affect adjacent natural areas, need to be strictly managed. Specific mention in this regard is made of Category 1b AIP species (as listed in the NEMBA Alien species lists, 2020), in line with the NEMBA Alien and Invasive Species Regulations (2020). Ongoing monitoring and clearing/control should take place throughout the i) Mining and ii) Decommissioning & Rehabilitation Phases of the proposed mining activities; and
- Alien vegetation that is removed must not be allowed to lay on unprotected ground as seeds might disperse upon it. All cleared plant material to be disposed of at a licensed waste facility which complies with legal standards or an area demarcated specifically for cleared vegetation and waste.

Fire

- No illicit fires must be allowed during the construction of the proposed development.

Monitoring	

8.1.2 Impact assessment

The impacts assessed in the respective phases are presented in Table 8-3.

Table 8-3: **Assessment of impact for the Decommissioning & Rehabilitation Phase: Loss of habitat and species diversity in the Transformed Habitat.**

Issue: loss of floral habitat and diversity		
Phases: Decommissioning & Rehabilitation Phase		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Medium (M)	Low (L)
Duration	High (H)	Low (L)
Extent	Medium (M)	Low (L)
Consequence	Medium (M)	Very Low (VL)
Probability	High (H)	Medium (M)
Significance	**Medium (M)**	**Very Low (VL)**
Nature of cumulative impacts	The proposed project could further impact on the floral habitat and diversity through edge effect impacts, including AIP proliferation – this is relevant to all surrounding areas (including surrounding freshwater features).	
Degree to which impact can be reversed	Impact can be partially reversed during the decommissioning phase if management measures are put in place and strictly adhered to.	
Degree to which impact may cause irreplaceable loss of resources	Very low	
Residual impacts	Residual impacts are anticipated to be low. Potential residual impacts include: - Permanent loss of and altered floral species diversity; - Edge effects such as further habitat fragmentation and AIP proliferation.	

8.1.2.1Management objective, mitigation measure and monitoring

The management objectives, management outcomes and mitigation measures and monitoring are represented in Table 8-4.

Table 8-4: Management objectives, management outcomes and mitigation measures and monitoring

Management objective	• *To prevent the unacceptable disturbance and loss of biodiversity and related ecosystem functionality through physical destruction and general disturbance.*
Management outcome	Limit the area of disturbance as far as practically possible.
Mitigation actions/measures	
Phases: Decommissioning & Rehabilitation Phase	
• Development footprint • No additional habitat is to be disturbed during the Decommissioning & Rehabilitation Phase of the development; • No vehicles are allowed to indiscriminately drive through sensitive habitat and natural areas; and • No dumping of litter must be allowed on-site. • Alien Vegetation	

• Edge effects, such as erosion and alien plant species proliferation, which may affect adjacent natural areas, need to be strictly managed; • Ongoing alien and invasive plant monitoring and clearing/control should take place throughout the Decommissioning & Rehabilitation Phase, and the project perimeters should be regularly checked for AIP establishment to prevent spread into surrounding natural areas; • Alien vegetation that is removed must not be allowed to lay on unprotected ground as seeds might disperse upon it. All cleared plant material to be disposed of at a licensed waste facility, which complies with legal standards; and • Floral monitoring should be done annually during rehabilitation activities. • Rehabilitation • All infrastructure footprints that will be decommissioned should be concurrently rehabilitated in accordance with a rehabilitation plan compiled by a suitable specialist; • All soils compacted because of mining activities falling outside of the project area should be ripped and profiled. Special attention should be paid to alien and invasive control within these areas; • Any natural areas beyond the direct footprint, which have been affected by the construction activities, must be rehabilitated using indigenous species; • All rehabilitated areas should be rehabilitated to a point where natural processes will allow the ecological functioning and biodiversity of the area to be re-instated as per the post-closure land-use objective; and • Rehabilitation efforts must be implemented for a period of at least five years after decommissioning. A mix of indigenous grass seeds can be used during rehabilitation activities.	
Monitoring	

8.2 ISSUE: LOSS OF FLORAL SCC

No floral SCC were observed at the time of assessment, and suitable habitat to support SCC was lacking within the study area (likely attributed to the level of transformation and location of the study area within an existing and operational mining area).

8.2.1 Impact Assessment

The impacts assessed in the respective phases are presented in Table 8-5 and Table 8-6.

Table 8-5: Loss of Floral SCC within the Transformed Habitat.

Issue: Loss of Floral SCC Habitat and Diversity		
Phases: Operational Phase		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Medium (M)	Low (L)
Duration	Medium (M)	Low (L)
Extent	Medium (M)	Low (L)
Consequence	Medium (M)	Low (L)
Probability	Medium (M)	Low (L)
Significance	**Low (L)**	**Very low (VL)**
Nature of cumulative impacts	The proposed project could further impact on the floral habitat and diversity as well as floral SCC through fragmentation of habitat of increased biodiversity importance and sensitivity.	

Degree to which impact can be reversed	Moderate - high.
Degree to which impact may cause irreplaceable loss of resources	Low.
Residual impacts	Potential residual impacts include: - The ongoing loss of SCC/protected floral species and suitable habitat for such species in the surrounding areas due to unmanaged edge effects (e.g., AIP proliferation).

Table 8-6: **Assessment of impact for the <u>Decommissioning & Rehabilitation Phase</u> for the Loss of Floral SCC within the Transformed Habitat.**

Issue: loss of floral SCC habitat and diversity		
Phases: Decommissioning & Rehabilitation Phase		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Low (L)	Low (L)
Duration	Low (L)	Low (L)
Extent	Low (L)	Very Low (VL)
Consequence	Low (L)	Very Low (VL)
Probability	Low (L)	Low (L)
Significance	**Very low (VL)**	**Very Low (VL)**
Nature of cumulative impacts	The proposed project could further impact on the floral habitat and diversity as well as floral SCC through edge effects (e.g., AIP proliferation).	
Degree to which impact can be reversed	Moderate - high.	
Degree to which impact may cause irreplaceable loss of resources	Low-moderate	
Residual impacts	Potential residual impacts include: - The loss of suitable habitat for floral species.	

8.3 ISSUE: IMPACT ON CBAS, ESAS, THREATENED VEGETATION AND PROTECTED AREAS

The study area is located within areas of conservation significance, including a CBA2, ESA1, ESA2 and the remaining extent of the VU Marikana Thornveld threatened ecosystem (of national importance). The impact of the proposed mining activities on these areas within the study area (i.e., immediate local area) are not anticipated to be detrimental as the areas in which the proposed WRDs are located are within existing transformed habitat.

8.3.1.1Impact Assessment

The site visit confirmed that there is no CBA habitat within the study area with the only the river (outside of the study area) being considered representative of the CBA. As there is no confirmed CBA habitat within the study area no impact assessment was undertaken for this.

8.4 ISSUE: IMPACT ON FAUNAL HABITAT AND DIVERSITY

The impact assessment was undertaken on all aspects of faunal ecology deemed likely to be affected by the proposed mining activities.

Prior to mitigation measures the i) Mining (i.e., Construction and Operational) Phase and ii) Decommissioning & Rehabilitation Phase scored an impact significance as follows:

- Mining Phase: this phase scored an impact significance ranging between medium (prior to mitigation implementation) and very low (with mitigation implemented); and
- Decommissioning & Rehabilitation Phase: this phase scored an impact significance ranging between low (prior to mitigation implementation) and insignificant (with mitigation implemented).

The proposed mining activities will result in the clearance of small areas of potential faunal habitat. These vegetated areas, like the rest of the study area, are considered to be of low sensitivity to faunal species. Low to very low significance impacts are anticipated due to the transformed nature and the low diversity of faunal species. Many of the faunal species within this habitat are common and widely occurring in the region and of low abundances, as such, the proposed WRD expansion is unlikely to result in a significant loss of these faunal species.

8.4.1 Impact Assessment

The impacts assessed in the respective phases are presented in Table 8-5 and Table 8-6.

Table 8-7: Loss of faunal habitat and species diversity in the Transformed Habitat.

Issue: loss of faunal habitat and diversity		
Phases: Operational Phase		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Low (L)	Very Low (VL)
Duration	M (Medium)	Medium (M)
Extent	M (Medium)	Very Low (VL)
Consequence	M (Medium)	Low (L)
Probability	Very High (VH)	Very High (VH)
Significance	**Medium (M)**	**Low (L)**
Nature of cumulative impacts	The proposed mining activities may further impact on the faunal habitat and species diversity in the surrounding areas of the mine as a result of edge effect impacts. This may lead to habitat and species loss beyond that of the mining footprint.	
Degree to which impact can be reversed	Moderate. The impact can be somewhat reversed once the Mining Phase is completed, and management measures are put in place and adhered to.	
Degree to which impact may cause irreplaceable loss of resources	Low	
Residual impacts	Residual impacts are anticipated to be low. Potential residual impacts include: - Permanent loss of and altered faunal species diversity because of poorly managed edge effects.	

The proposed mining activities will likely have a decreased impact during this phase. This is as a result of no further vegetation clearance and active mining taking place. However, ongoing, or permanent loss of faunal habitat and species diversity may occur during the Decommissioning and Rehabilitation Phase if:

- AIP Management and/or control programmes are poorly implemented leding to further habitat transformation;
- Further disturbance of soils, impacting on rehabilitation and revegetation effectiveness, limiting recolonisation of faunal species;
- Continued contamination from mining facilities beyond closure if not decommissioned effectively; and
- Poorly implemented and monitored rehabilitation effort leaving the landscape fragmented and with substandard revegetation taking place.

Table 8-8: Assessment of impact for the Decommissioning & Rehabilitation Phase: Loss of faunal habitat and species diversity in the Transformed Habitat.

Issue: loss of Faunal Habitat and Diversity		
Phases: Decommissioning & Rehabilitation Phase		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Low (L)	Very Low (VL)
Duration	High (H)	Low (L)
Extent	Medium (M)	Low (L)
Consequence	Medium (M)	Very Low (LV)
Probability	High (H)	Medium (M)
Significance	**Medium (M)**	**Very Low (VL)**
Nature of cumulative impacts	Unmanaged edge effects may lead to further habitat loss in the surrounding areas, which when combined with substandard rehabilitation of the mining site will cumulatively add to long term, possibly permanent loss of habitat and faunal species in the area	
Degree to which impact can be reversed	Impact can be partially reversed during the decommissioning phase if management measures are put in place and strictly adhered to. WRDs, even when rehabilitated will not replace the habitat originally lost, but a semblance of habitat can be recreated.	
Degree to which impact may cause irreplaceable loss of resources	Very low	
Residual impacts	Residual impacts are anticipated to be low. Potential residual impacts include: - Permanent loss of and altered faunal species diversity; and - Edge effects such as further habitat fragmentation and habitat loss.	

8.4.1.1Management objective, mitigation measure and monitoring

The management objectives, management outcomes and mitigation measures and monitoring are represented in

Table 8-9: Management objectives, management outcomes and mitigation measures and monitoring

Management objective	• *To prevent the unacceptable disturbance and loss of biodiversity and related ecosystem functionality through physical destruction and general disturbance.*
Management outcome	Limit the area of disturbance as far as practically possible.
Mitigation actions/measures	

Phases: Construction and Operational Phase

Development footprint

- The footprint and daily operation of all mining surface infrastructure areas must be strictly monitored to ensure that edge effects from the operational facilities do not affect the surrounding faunal habitat beyond the allowed footprint;
- The footprint areas of all proposed surface infrastructure must be minimised to what is absolutely essential and within a designated and approved boundary. It should be ensured that no mining related activities take place outside of this demarcated footprint;
- Faunal habitat beyond the demarcated area should not be altered or disturbed, therefore vegetation outside of the footprints is not to be cleared;
- Where topsoil is excavated, it must be stored with associated native vegetation debris for subsequent rehabilitation use;
- No dumping of waste on site should take place. As such it is advised that waste disposal containers and bins be provided during the construction phase for all dilapidates, rubble and general waste;
- Active dust suppression must be undertaken;
- The future WRDs must be planned in such a way as to help maximise rehabilitation and habitat restoration post mining. Suitable designing and dumping of waste rock during the operational phase will help limit post closure costs and time as the WRD will not have to be significantly reshaped;
- The base of the WRDs should be revegetated and monitored. This will help trap sediment runoff, promote natural vegetation re-establishment, provide a vegetated buffer between the WRD and the surrounding natural areas and help limit alien plant proliferation in these areas.
- If any spills occur, they should be immediately cleaned up to avoid soil contamination that can hinder faunal rehabilitation later down the line. Spill kits should be kept on site within workshops. In the event of a breakdown, maintenance of vehicles must take place with care, and the recollection of spillage should be practised preventing the ingress of hydrocarbons into the topsoil;
- No hunting/trapping or collecting of faunal species is allowed;
- No informal fires by construction personnel are allowed; and
- Smaller species of invertebrates and reptiles are likely to be less mobile during the colder period, as such should any be observed in the footprint areas during clearing and operational activities, they are to be carefully and safely moved to an area of similar habitat outside of the disturbance footprint. Operational personnel are to be educated about these species and the need for their conservation. Harmless reptiles should be carefully relocated by a suitably nominated construction person or nominated mine official. For larger venomous snakes, a suitably trained mine official should be contacted to affect the relocation of the species, should it not move off on its own.

Fauna SCC

- No collection of faunal SCCs may be allowed by mining personnel; and
- In the unlikely event that a faunal SCC be found, and should it not relocate outside of the disturbance area itself, it should be relocated by a suitably qualified specialist once the appropriate permits have been obtained.

Phases: Decommissioning and Closure Phase

Development footprint

- No additional habitat is to be disturbed during the Decommissioning & Rehabilitation Phase.
- No vehicles are allowed to indiscriminately drive through undisturbed habitat and natural areas.
- No dumping of litter must be allowed on-site.
- Edge effects must be continually monitored and controlled, notably erosion and alien plant proliferation.

Rehabilitation

• All mining footprints that will be decommissioned should be concurrently rehabilitated in accordance with a rehabilitation plan compiled by a suitable specialist. • Where needed, the WRDs should be re-sloped and profiled in order to give them a more natural profile that not only fits in with the landscape, but which also allows for the establishment of a diversity of plants and faunal species. In the regard, the WRD should be designed to have terraces and troughs so as to create areas of unique plant growth and faunal habitat. • Stormwater must be suitably managed so that surface water runoff is captured on the WRD and not simply discharged down the slope. • All soils compacted because of construction activities falling outside of the project area should be ripped and profiled. Special attention should be paid to alien and invasive control within these areas. • Any natural areas beyond the direct footprint, which have been affected by the mining activities, must be rehabilitated using indigenous species. • All rehabilitated areas should be rehabilitated to a point where natural processes will allow the ecological functioning and biodiversity of the area to be re-instated as per the post-closure land-use objective; and • Rehabilitation efforts must be implemented for a period of at least five years after decommissioning. A mix of indigenous grass seeds can be used during rehabilitation activities.	
Monitoring	

8.5 ISSUE: LOSS OF FAUNAL SCC

No faunal SCC were observed at the time of assessment, and suitable habitat to support SCC was completely lacking within the study area (attributed to the level of transformation and location of the study area within an active mining area).

Impacts associated with the Mining Phase: this phase will result in the clearing of the remaining small patches of vegetation for the proposed WRD development. The clearance activities may lead to a loss of impacted habitat in the footprint area, though no loss of faunal SCC are expected. In addition to this, there may be a loss of habitat and outside of the direct mining footprint during the Mining Phase if:

- Edge effects are poorly managed leading to the surrounding vegetated areas outside of the study area being impacted upon.

If mitigation measures as presented in the EMPr are implemented, then the significance ratings of the impacts can be reduced. The significance i) prior to mitigation measures is expected to be low, and ii) post mitigation the significance is expected to be very low.

Table 8-10: Loss of Faunal SCC within the Transformed Habitat

Issue: loss of faunal SCC habitat and diversity		
Phases: Operational		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Low (L)	Very Low (VL)
Duration	Medium (M)	Medium (M)
Extent	Medium (M)	Low (L)
Consequence	Medium (M)	Very Low (LV)
Probability	Low (L)	Low (L)
Significance	Low (L)	**Very Low (VL)**

Nature of cumulative impacts	The current mining activities have already resulted in the loss of potential faunal SCC. Impacts to the surrounding habitats outside of the study area may lead to further habitat impacts, decreasing the remaining useable areas for SCC whilst also impacting on future opportunities for SCC to recolonise these areas post mining.
Degree to which impact can be reversed	Moderate. The impact can be somewhat reversed once the Mining Phase is completed, and management measures are put in place and adhered to.
Degree to which impact may cause irreplaceable loss of resources	Low
Residual impacts	Residual impacts are anticipated to be low. Potential residual impacts include: • Permanent loss of potential SCC habitat both in the mining area and possibly the surrounding areas.

9. VISUAL

9.1 ISSUE: CHANGE TO THE LANDSCAPE CHARACTERISTICS

Operational activities include the removal of vegetation and topsoil from the footprint of the WRDs that is not above the existing pit areas. excavation in the pit areas, trucks moving overburden to the WRDs, and material being transferred to the processing plant, graders maintaining the haul roads and water tankers wetting the roads, expansion of the WRD as the mining progresses and light security instillations and lights associated with the movement of vehicles at night.

The impact on the visual environment during the operational phase is assessed to have a low intensity and would occur over the long term (anticipated to be approximately twenty years). The unmitigated impact would be localized but extend beyond the site boundary, affecting neighbours (at least to 3,0km) resulting in a **medium** consequence. The significance of impact is rated **low** (i.e. Medium Consequence and Possible/frequent probability of exposure to impacts). Mitigation measures will not significantly reduce the visual impact of the mine and its infrastructure.

The impact on the visual environment during the closure phase is assessed to have a very low intensity and would occur over the short term (less than five years). The unmitigated impact would be localized but extend beyond the site boundary and effect neighbours and is assessed to be **low** consequence. The significance of impact is rated **very low** (i.e. Low Consequence and Possible/frequent probability of exposure to impacts). The impact would not be significantly reduced, even with the implementation of mitigation measures. After closure, when the rehabilitation of the WRDs takes hold, the impact could reduce significantly to Insignificant.

9.1.1 Impact Assessment

The impacts assessed in their respective phases are presented in Table 9-1 and Table 9-2.

Table 9-1:Impact Summary: Change of landscape characteristics and key views in Operational Phase

Issue: Change to the Landscape Characteristics and Key Views During the Operational Phase		
Phases: Operational Phase		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Low (L)	Low (L)
Duration	High (H)	High (H)
Extent	Medium (M)	Medium (M)

Consequence	Medium (M)	Medium (M)
Probability	Medium (M)	Medium (M)
Significance	Low (L)	Low (L)
Degree to which impact can be reversed	Low as the reversal of the change to key elements/features/ characteristics of the baseline landscape and key views is not realistically feasible.	
Degree to which impact may cause irreplaceable loss of resources	Low	

Table 9-2: Impact Summary: Change of landscape characteristics and key views in the Closure Phase

Issue: Change to the Landscape Characteristics and Key Views During the Decommissioning and Closure Phases		
Phase: Closure Phase		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Very Low (VL)	Very Low (VL)
Duration	Medium (M)	Medium (M)
Extent	Medium (M)	High (H)
Consequence	Low (L)	Low (L))
Probability	Possible (M)	Possible (M)
Significance	Very Low (VL)	Very Low (VL)
Degree to which impact can be reversed	Reasonable as the reversal of the change to key elements/features/ characteristics of the baseline landscape and key views is feasible once the effects of rehabilitation take hold.	
Degree to which impact may cause irreplaceable loss of resources	Reasonable as there would be an improvement key elements/features/ characteristics of the baseline causing a minor positive change over a localized area.	
Cumulative Impact	The proposed Project would have a moderate cumulative effect with respect to existing mining activities due to the intervisibility of the proposed WRDs with existing WRDs and other mining infrastructure.	

9.1.1.1Management objective, mitigation measure and monitoring

The management objectives, management outcomes and mitigation measures and monitoring are represented in Table 9-3.

Table 9-3: Management objectives, management outcomes and mitigation measures and monitoring

Management objective	*Keeping the integrity of the sense of place*
Management outcome	Reduce the visual impact
Mitigation actions/measures	

Phases: Operational Phase	
• Good housekeeping to reduce dust from the mine, WRD and in all working areas and the access roads, to an absolute minimum. • Where new vegetation is proposed to be introduced to the site, an ecological approach to rehabilitation, as opposed to a horticultural approach, should be adopted. For example, communities of indigenous plants will enhance biodiversity, a desirable outcome for the area. This approach can significantly reduce long-term costs as less maintenance would be required over conventional landscaping methods as well as the introduced landscape is more sustainable. • Install light fixtures that provide precisely directed illumination to reduce light "spillage" beyond the immediate surrounds of the site, i.e. lights (spotlights) are to be aimed away from sensitive viewing areas. • Avoid high pole top security lighting along the periphery of the site and use only lights that are activated on illegal entry to the site. • Minimise the number of light fixtures to the bare minimum, including security lighting.	
Monitoring	Monitoring or reporting of adherence to the proposed management measures should be conducted by the Mine's Environmental Officer on a regular monthly basis, specifically as it relates to the negative effects of night lighting.
Phases: Operational Phase	
• At closure, all residual waste rock dump areas should be formed, contoured, and revegetated to appear natural and blend with the surrounding topographic features. • Where new vegetation is proposed to be introduced to the site, an ecological approach to rehabilitation, as opposed to a horticultural approach should be adopted. For example, communities of indigenous plants will enhance biodiversity, a desirable outcome for the area. This approach can significantly reduce long-term costs as less maintenance would be required over conventional landscaping methods as well as the introduced landscape being more sustainable.	
Monitoring	Monitoring or reporting of adherence to the proposed management measures should be conducted by the Environmental Control Officer (ECO) on a regular monthly basis to ensure effective rehabilitation in the long term.

10. SOCIO-ECONOMIC

10.1 ISSUE: POSITIVE AND NEGATIVE SOCIO-ECONOMIC IMPACT

Mining projects tend to bring with them an expectation of employment in all project phases prior to closure. This expectation can lead to the influx of job seekers to an area which in turn increases pressure on existing communities, housing, basic service delivery and raises concerns around safety and security. In addition to this, mining has a positive economic impact on the national, local and regional economy. Direct benefits are derived from wages, taxes and profits. Indirect benefits are derived through the procurement of goods and services, and the increased spending power of employees.

The Proposed Project forms part of existing approved operations and as such the development of the Proposed Project will not generate any additional employment opportunities. However, in the absence of the additional storage, the mine will have difficulties continuing mining operations which could lead to negative socio-economic impacts. In this regard, the Proposed Project is required to provide additional capacity to store waste rock to allow for the optimisation of mining. It follows that negative project-related socio-economic impacts including inward migration are not expected to occur and the economic benefits associated with mining have previously been accounted for. This significance of this impact is therefore rated as being insignificant in both the unmitigated and mitigated scenarios.

The "no-go" option would not allow for the optimisation of the current mining operations and could potentially result in significant negative socio-economic impacts (i.e. the closure of the mine would result in the cessation of current employment).

The development of the project components which results in the continuation of the mine will therefore have a medium positive severity until closure. This positive impact may be enhanced with the implementation of management and mitigation measures. After closure, the positive economic impact from mining will cease but with rehabilitation, the respective pre-mining activities can resume in appropriate areas.

10.1.1 Impact assessment

The impacts assessed in the respective phases are presented in Table 10-1.

Table 10-1: Continuation of Mine Development

Issue: Socio-economic Impact		
Phases: Operational Phase and closure		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Low (L)	Low (L)
Duration	Medium (M)	Medium (M)
Extent	Medium (M)	Medium (M)
Consequence	Medium (M)	Medium (M)
Probability	Medium (M)	Medium (M)
Significance	**Medium (M) +**	**Medium (M) +**
Nature of cumulative impacts	When considering this impact cumulatively with the approved operations, the significance rating for the overall mine is medium positive in the unmitigated and mitigated scenarios.	
Degree to which impact can be reversed	Low	
Degree to which impact may cause irreplaceable loss of resources	Low	
Residual impacts	- Economic loss to the surrounding communities during the closure phase.	

10.1.1.1Management objective, mitigation measure and monitoring

The management objectives, management outcomes and mitigation measures and monitoring are represented in Table 8-9.

Table 10-2: Management objectives, management outcomes and mitigation measures and monitoring

Management objective	*The objective of the mitigation measures is to enhance the positive economic impacts and limit the negative economic impacts. Part of this objective is to enhance the contribution to the local economy in particular.*
Management outcome	• Work with existing structures and organisations to establish and maintain a good working relationship with surrounding communities, local authorities and landowners in order to limit the impacts associated with inward migration. • Enhance the positive economic impacts by working together with existing structures and organisations.
Mitigation actions/measures	
Phases: All phases	
• The mine will continue to implement the commitments in its social and labour plan in accordance with the employment, procurement and social investment principles of the Mining Charter.	

• The administration/human resource manager is responsible for implementing these actions during all mine phases. • Land within affected mining zones should be purchased by the mine as and when necessary. Land outside these zones should not be significantly affected. Taking the various mitigated impact types into account the approximate guideline is 500m. • Procurement of local services as far as reasonability possible	
Monitoring	Implementation of SLP

10.2 ISSUE: DISTURBANCE TO THIRD PARTY ROAD USERS BY PROJECT RELATED TRAFFIC

The key potential traffic related impacts are on road capacity and public safety when additional traffic is added to the existing transport network.

The Proposed Project will not generate additional traffic and as such the intensity of the impact in the unmitigated scenario is expected to be very low as no noticeable change in existing traffic volumes are anticipated. It follows that the probability of any project-related road disturbance and traffic safety impacts are unlikely to occur even in the unmitigated scenario. This significance of this impact is therefore rated as being insignificant in both the unmitigated and mitigated scenarios.

10.2.1 Impact assessment

As no substantial traffic related impacts are anticipated, additional work is not proposed in order for this to be assessed qualitatively by SLR.

10.3 ISSUE: HAZARDOUS EXCAVATIONS AND INFRASTRUCTURE THAT POSE A SAFETY RISK TO THIRD PARTIES AND ANIMALS

Hazardous excavations and infrastructure include all structures into, or off which third parties and animals can fall and be harmed.

Existing mining infrastructure and activities at the Tharisa Mine present hazardous infrastructure and excavations that can be harmful to both people and animals, particularly when considering that communities such as Lapologang and Maditlhokwa are located within the Mining Right area. The Proposed Project presents additional infrastructure that has the potential to further alter the natural topography and in turn present additional hazardous excavations and infrastructure. The Proposed Project could therefore contribute cumulatively to existing impacts from the Tharisa Mine infrastructure and activities.

In the absence of management measures that focus on access control, the intensity of the potential impact is high. Any loss or injury is considered long term and can extend beyond the mine boundary to the communities to which the injured people and/or animals belong. The likelihood of occurrence, in the absence of management measures, is likely given that Maditlhokwa is directly adjacent to the proposed West OG WRD. The unmitigated scenario is expected to be high. In the mitigated scenario with a focus on access-controlled site, the significance of the potential impact could reduce to low.

10.3.1 Impact Assessment

The impacts assessed in the respective phases are presented in Table 10-1.

Table 10-3: Hazardous Excavation Significance Rating

Issue: Hazardous Excavation		
Phases: Operational Phase and closure		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	High (H)	High (H)
Duration	High (H)	High (H)
Extent	Medium (M)	Low (L)

Consequence	Medium (M)	Medium (M)
Probability	Very High (VH)	Low (L)
Significance	**Medium (M)**	**Low (L)**
Nature of cumulative impacts	The cumulative severity rating assesses the impact of the changes to the operation within the context of the current approved mining operation where there are already potential hazardous excavations and infrastructure. It follows that this has a high severity in the unmitigated scenario when considered cumulatively within the context of the current approved operations, reducing to low with management actions.	
Degree to which impact can be reversed	High through the implementation of safety measures	
Degree to which impact may cause irreplaceable loss of resources	High due to critical injury and death	
Residual impacts	N/A	

10.3.1.1Management objective, mitigation measure and monitoring

The management objectives, management outcomes and mitigation measures and monitoring are represented in Table 8-9.

Table 10-4: Management objectives, management outcomes and mitigation measures and monitoring

Management objective	*The objective is to prevent physical harm to third parties and animals from potentially hazardous excavations and infrastructure.*
Management outcome	• Reduce workplace injury and potential loss of life
Mitigation actions/measures	
Phases: All phases	
• Each hazardous excavation will have a barrier around it to prevent access by people and animals. The barrier may be in the form of fences, walls or berms. In addition, the barriers must have warning signs at appropriate intervals. These warning signs must be in picture format and/or written in English, Afrikaans and Tswana. • Any hazardous structure or excavations will be designed and constructed in a manner to ensure that stability and safety risks to third parties and animals are addressed. These issues will be monitored according to a schedule that is deemed relevant to the type of facility. • Tharisa will update its surface use area map on a routine basis to ensure that the position and extent of all potentially hazardous excavations, infrastructure is known. • If people or animals fall off or into hazardous excavations or infrastructure causing injury, the Tharisa emergency response procedure will be initiated. • Any hazardous structure or excavations will be closed in a manner to ensure that stability and safety risks to third parties and animals are addressed. These issues will be monitored according to a schedule that is deemed relevant to the type of facility. • Where Tharisa has caused injury to third parties and/or animals, appropriate compensation will be provided. • If people or animals fall off or into hazardous excavations or infrastructure causing injury, the Tharisa emergency response procedure will be initiated.	
Monitoring	N/A