Mamatwan Mine Impact Assessment for Changes to Infrastructure

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DETAILED ASSESSMENT OF POTENTIALLY SIGNIFICANT IMPACTS

The potential impacts described in this appendix have been identified by the Environmental Impact Assessment (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 have been provided by specialists. These are attached as appendices to the EIA and Environmental Management Programme (EMPr).

The impacts are assessed cumulatively where the potential impacts assessed represent the cumulative impact of the proposed project in the context of the baseline environment, i.e. with existing impacts.

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

The mitigated assessment assumes that technical design controls, as included in the project scope (see Section 3.2), would be included in the detailed design of the project and implemented when the project components are constructed and operated.

Note that impacts of very low or negligible significance have not been assessed within this appendix.

A) IMPACT ON BIOPHYSICAL ENVIRONMENT

1. ISSUE: SOIL EROSION

1.1 DESCRIPTION OF IMPACT

The parameters determining the extent and severity of soil erosion are highly complex, with water and wind as the main geomorphic agents Soil erosion is largely dependent on land use and soil management and is generally accelerated by human activities. In absence of detailed South African guidelines on erosion classification, the erosion potential and interpretation are based on field observations and the observed soil profile characteristics. In general, soils with a high clay content have a high-water holding capacity and are less prone to erosion in comparison to sandy textured soils, which are more susceptible to erosion.

The proposed mining related development would be located on flat and gently sloping terrain, which limits the erosion risk. If the top cut stockpile incline, height and management (i.e. revegetation) is kept within the acceptable ranges in compliance with the Chamber of Mines guidelines (2007), the risk of soil erosion has likely increased due to decrease in vegetation basal cover associated with vegetation clearing and disturbance as a result of current mining and related activities, and the soils are exposed to wind and stormwater. Soil erosion impact is considered moderate for all soil types in the area. The significance of soil erosion impact rating is illustrated in the tables below.

1.2 IMPACT ASSESSMENT

Soil erosion impact significance results for the proposed mining related infrastructure including railway loop construction.

Table 1-1: Impact Assessment for Soil Erosion

	Pre Mitigation Impacts	Post-Mitigation Impacts
Activity	Establishment of mining related infrastructure	
Probability	H	H
Intensity	M	M
Spatial extent	M	L
Duration	H	H
Consequence	Medium	Medium
Significance	Medium	Medium
Activity	Establishment of the dewatering boreholes and pipeline	
Probability	H	H
Intensity	M	M
Spatial extent	M	L
Duration	H	H
Consequence	Medium	Medium
Significance	Medium	Medium

2. ISSUE: SOIL COMPACTION

2.1 DESCRIPTION OF IMPACT

Heavy equipment traffic during top cut stockpiling is anticipated to cause significant soil compaction. The severity of this impact is rated moderate post mitigation for soils such as Ermelo, Hutton and Witbank soil forms due to the loamy sand tecture. Whereas compaction on areas that will be traversed by the proposed pipeline route option is considered to be of a very low significance post mitigation. As the proposed pipeline will be constructed on top of the ground surface, limited soil disturbances are foreseen.

2.2 IMPACT ASSESSMENT

Table 2-1: Impact Assessment for Soil Compaction

	Pre Mitigation Impacts	Post-Mitigation Impacts
Activity	Establishment of mining related infrastructure	
Probability	H	H
Intensity	M	M
Spatial extent	M	L
Duration	H	H
Consequence	Medium	Medium
Significance	Medium	Medium

Activity	Establishment of the dewatering boreholes and pipeline	
Probability	M	M
Intensity	L	L
Spatial extent	M	L
Duration	M	M
Consequence	Medium	Low
Significance	Low	Very Low

3. ISSUE: POTENTIAL SOIL CONTAMINATION

3.1 DESCRIPTION OF IMPACT

All the identified soil forms are considered equally predisposed to potential contamination, as contamination sources are generally unpredictable and often occur as accidental spills or leaks for mining operations. The significance of soil contamination is considered medium post-mitigation for all identified soil forms, largely depending on the nature, volume or concentration of the contaminant of concern. Sources of contamination include spillage of hydrocarbons resulting from leakages from machinery, seepage of nitrates from blasting and ore spillages during transportation. Therefore, strict waste management protocols and an activity specific Environmental Management Programme (EMP) should be adhered to during mining activities.

3.2 IMPACT ASSESSMENT

Table 3-1: Impact Assessment for Soil Contamination

	Pre Mitigation Impacts	Post-Mitigation Impacts
Activity	Establishment of mining related infrastructure	
Probability	H	H
Intensity	M	M
Spatial extent	M	L
Duration	H	H
Consequence	Medium	Medium
Significance	Medium	Medium

4. ISSUE: LOSS OF AGRICULTURAL LAND CAPABILITY

4.1 DESCRIPTION OF IMPACT

The proposed mining related activities and the associated pipeline is not anticipated to result in significant loss of agricultural land potential since the proposed mining related infrastructure is located within the focus areas which have already been withdrawn from agricultural related land uses. However, the cultivation agricultural importance soils (i.e. Ermelo and Hutton soil forms) occurring focus areas will be impacted specifically by the

proposed railway loop and top cut stockpile. The preferred pipeline route will be located along the dirt road which constitutes already disturbed soils (Witbank soil forms). Witbank soil forms are of low and/or no importance on the agricultural production, and a such the impacts on these soils are anticipated to be low post-mitigation If the pipeline route alternatives 2 and 3 were to be considered, agriculturally important soils (Hutton soil form) would be impacted to a limited extent along the pipeline route. However, prevailing climatic conditions are not conducive to cultivated agriculture, thus these soils are not anticipated to contribute to the food production grid.

4.2 IMPACT ASSESSMENT

Table 4-1: Impact Assessment for Agricultural Land Capability

	Pre Mitigation Impacts	Post-Mitigation Impacts
Activity	Establishment of mining related infrastructure	
Probability	H	H
Intensity	M	M
Spatial extent	M	L
Duration	H	H
Consequence	Medium	Medium
Significance	Medium	Medium
Activity	Establishment of the dewatering boreholes and pipeline	
Probability	M	M
Intensity	L	L
Spatial extent	M	L
Duration	M	M
Consequence	Medium	Low
Significance	Low	Very Low

5. ISSUE: FLORAL HABITAT AND DIVERSITY

5.1 DESCRIPTION OF IMPACT

Based on the impact assessment results it is evident that the most significant impacts will occur during the construction and operational phase where vegetation clearing will result in a loss of floral habitat, diversity and species of conservation concern (SCC). Of importance is the design and implementation of an Alien Invasives Plant (AIP) control plan during the planning phase. Permits to remove / destroy, as well as rescue and relocate floral SCC should be obtained during the planning phase.

The habitat sensitivity associated with the study area ranges from intermediate to low. The water pipeline route, as well as the top-cut stockpile, crushing and screening plant and the railway loop fall within the Kathu Bushveld Habitat which is considered to be of intermediate floral sensitivity. The habitat to the south east of

the railway is within the Degraded Bushveld Habitat unit, classified to be of moderately low sensitivity. The south western area is considered to be transformed habitat.

The most significant impact is expected to arise from the development of the top-cut stockpile due to the large development footprint located within a habitat of increased sensitivity. The pipeline route is situated within an existing road reserve, where edge effect impacts need to be considered. From a floral perspective the upgrade of the railway loop will impact on the floral ecology of the area as a result of vegetation clearing.

5.2 IMPACT ASSESSMENT

Table 5-1: Impact Assessment for Floral Habitat and Biodiversity

	Pre Mitigation Impacts	Post-Mitigation Impacts
Activity	Top-cut stockpile	
Probability	H	M
Intensity	H	M
Spatial extent	M	L
Duration	H	M
Consequence	High	High
Significance	High	Medium
Activity	Crushing and Screening Plant	
Probability	M	L
Intensity	H	M
Spatial extent	L	VL
Duration	M	L
Consequence	High	Medium
Significance	Medium	Very Low
Activity	Borehole Drilling	
Probability	VL	VL
Intensity	L	VL
Spatial extent	VL	VL
Duration	VL	VL
Consequence	Medium	Low
Significance	Very Low	Insignificant
Activity	Dewatering Pipeline	
Probability	M	L
Intensity	H	M
Spatial extent	L	VL
Duration	M	L

Consequence	High	Medium
Significance	Medium	Low
Activity	Offices, stockpile area and contractor laydown	
Probability	L	L
Intensity	L	L
Spatial extent	M	L
Duration	L	L
Consequence	Low	Low
Significance	Low	Very Low
Activity	Railway Loop, road and security checkpoint	
Probability	H	M
Intensity	H	M
Spatial extent	M	L
Duration	H	M
Consequence	High	High
Significance	High	Medium

6. ISSUE: FLORAL SCC

6.1 DESCRIPTION OF IMPACT

During the field assessment a number of NFA and NCNCA protected floral species were observed throughout the study area. Removal or destruction of any of these species will require permits from DOFF and NCDENC. Due to the drought onsite conditions at the time of the field assessment, identification of all protected herbaceous species/individuals was difficult. A summer walk down of all final development areas will need to be carried out and protected individuals should be marked. Failure to initiate a summer walkdown and implement a subsequent rescue and relocation will result n the permanent loss of these protected floral species.

None of the species associated with the study area are considered threatened and are generally species with large distribution ranges within the Northern Cape and the country as a whole. Loss of individuals from the study area is therefore not considered detrimental for the conservation of these species within the province. Loss of individuals should still be minimised through a search and rescue plan and the minimisation of the development footprint as far as practical.

6.2 IMPACT ASSESSMENT

Table 6-1: Impact Assessment for Floral SCC

	Pre Mitigation Impacts	Post-Mitigation Impacts

Activity	Top-cut stockpile	
Probability	M	L
Intensity	H	M
Spatial extent	M	L
Duration	M	L
Consequence	High	Medium
Significance	Medium	Low
Activity	Crushing and Screening Plant	
Probability	L	L
Intensity	M	M
Spatial extent	M	L
Duration	M	L
Consequence	Medium	Medium
Significance	Low	Low
Activity	Borehole Drilling	
Probability	VL	VL
Intensity	L	VL
Spatial extent	VL	VL
Duration	VL	VL
Consequence	Medium	Low
Significance	Very Low	Insignificant
Activity	Dewatering Pipeline	
Probability	H	L
Intensity	H	M
Spatial extent	L	VL
Duration	M	L
Consequence	High*	Medium
Significance	Medium	Low
Activity	Offices, stockpile area and contractor laydown	
Probability	L	L
Intensity	L	L
Spatial extent	M	L
Duration	L	L
Consequence	Low	Low
Significance	Low	Very Low
Activity	Railway Loop, road and security checkpoint	

Probability	M	L
Intensity	H	M
Spatial extent	M	L
Duration	M	L
Consequence	High	Medium
Significance	Medium	Low

**note that the EAP has reduced this from Very High, as the species of concern are widespread and the consequence of the loss of individuals on site has no impact on the conservation of the species within the province.*

7. ISSUE: LOSS OF FAUNAL HABITAT AND ECOLOGICAL STRUCTURE

7.1 DECRIPTION OF IMPACT

Construction of most of the railway loop and the pipeline route, as well as the development of the top cut stockpile, will result in the loss of faunal habitat of intermediate sensitivity within the natural Kathu Bushveld. Construction of the preferred pipeline route will occur adjacent a gravel road within Kathu Bushveld, which has a reduced sensitivity due to the existing constant road traffic which has likely resulted in disturbances to reduce habitat suitability. For the linear developments, i.e. the railway loop and the pipeline route, activities are anticipated to have less of an impact to the faunal assemblages as they generally have smaller footprints that do not encompass whole habitat units and thus leave enough suitable habitat adjacent the development. Similarly, the impacts are predominantly of a short duration, during the construction phase and once installed (specifically associated with the pipelines) the natural habitat can be re-established. The development of the top cut stockpile will have a medium impact on the local fauna as evidence of several faunal species was observed here and the impact will be long lasting. With the implementation of mitigation measures, the impact significance will be reduced within all habitat units.

7.2 IMPACT ASSESSMENT

Table 7-1: Impact Assessment for Faunal Habitat and Ecological Structure

	Pre Mitigation Impacts	Post-Mitigation Impacts
Activity	Top-cut stockpile	
Probability	H	M
Intensity	H	H
Spatial extent	VL	VL
Duration	M	M
Consequence	Medium	Medium
Significance	Medium	Medium
Activity	Crushing and Screening Plant	
Probability	L	VL
Intensity	M	M

Spatial extent	VL	VL
Duration	M	VL
Consequence	Medium	Medium
Significance	Medium	Very Low
Activity	Borehole Drilling	
Probability	VL	VL
Intensity	L	VL
Spatial extent	VL	VL
Duration	VL	VL
Consequence	Very Low	Very Low
Significance	Very Low	Insignificant
Activity	Dewatering Pipeline	
Probability	M	L
Intensity	L	L
Spatial extent	L	VL
Duration	M	L
Consequence	Low	Low
Significance	Low	Very Low
Activity	Offices, stockpile area and contractor laydown	
Probability	L	L
Intensity	L	L
Spatial extent	VL	VL
Duration	L	L
Consequence	Low	Low
Significance	Very Low	Very Low
Activity	Railway Loop, road and security checkpoint	
Probability	M	L
Intensity	H	M
Spatial extent	VL	VL
Duration	M	L
Consequence	High	High
Significance	Medium	Low

8. ISSUE: IMPORTANT FAUNAL SPECIES OF CONSERVATION CONCERN

8.1 DESCRIPTION OF IMPACT

Eight protected faunal species may inhabit different regions of the study area. *Chamaeleo dilepis* (Common flap-neck chameleon), *Python sebae* (African rock python), *Orycteropus afer* (Aardvark) have suitable habitat within the Kathu bushveld. *Opistophthalmus ater* (Steinkopf Burrowing Scorpion), *Aquila verreauxii* (Black eagle), *Anthus crenatus* (African Rock Pipit) and the Burrowing scorpions: *Opistophthalmus carinatus* and *Opistophthalmus wahlbergii* have a high likelihood of occurring in both the Kathu and Degraded Bushveld and within the Transformed habitat units.

Chamaeleo dilepis (Common flap-neck chameleon) will occupy the Kathu Bushveld where shrubby habitat will favour its arboreal lifestyle and insect abundance (prey) was at its highest abundances. *Orycteropus afer* (Aardvark) utilise a broad array of habitats within the region. Within the study area the Kathu Bushveld was the primary vegetation unit in which signs of Aardvark were observed. This species appeared to be completely absent from the disturbed Kathu bushveld and the transformed habitat units, keeping away from any form of disturbance to the veld. *Python sebae* (African rock python) are likely to mimic the distribution of Aardvark within the Kathu Bushveld as they will utilise burrows discarded by Aardvarks.

Contrary to logic the SCC's *Aquila verreauxii* (Black eagle) and *Anthus crenatus* (African Rock Pipit) are likely to utilise the Degraded and Transformed habitat units. *Aquila verreauxii* (Verreaux's eagle) will utilise the transformed unit to actively search out its primary prey item (Rock Hyrax) which have inhabited the waste rock dumps and soil stockpiles. A possible breeding pair of *Anthus crenatus* (African Rock Pipit) had been observed within the North Eastern portion of the study area in both the degraded and transformed habitat units where the mining activities have created suitable habitat beyond its normal range. The Burrowing scorpions will find suitable habitat throughout the site, utilising degraded and natural areas where suitable burrowing substrate is available.

The impact associated with the loss of habitat for the above-mentioned species is of Very Low to Medium significance during the construction and operational phase and Very Low to Medium significance during the rehabilitation phase, prior to the implementation of mitigation measures. With the implementation of mitigation measures, the impact significance of the loss of important species may be further reduced, as mitigation measures will ensure that habitat for these species will be better protected.

8.2 IMPACT ASSESSMENT

Table 8-1: Impact Assessment for Faunal SCC

	Pre Mitigation Impacts	Post-Mitigation Impacts
Activity	Top-cut stockpile	
Probability	M	L
Intensity	M	M
Spatial extent	VL	VL
Duration	M	M
Consequence	High*	High*
Significance	Medium	Medium
Activity	Crushing and Screening Plant	
Probability	L	VL
Intensity	M	M
Spatial extent	VL	VL
Duration	L	VL
Consequence	High*	High*
Significance	Medium	Very Low
Activity	Borehole Drilling	
Probability	H	H
Intensity	M	VL
Spatial extent	VL	VL
Duration	VL	M
Consequence	Very Low	Very Low
Significance	Very Low	Very Low
Activity	Dewatering Pipeline	
Probability	M	L
Intensity	L	L
Spatial extent	L	VL
Duration	M	L
Consequence	Low	Low
Significance	Low	Very Low
Activity	Offices, stockpile area and contractor laydown	
Probability	L	L
Intensity	M	VL
Spatial extent	VL	VL

Duration	H	H
Consequence	Low	Low
Significance	Very Low	Very Low
Activity	Railway Loop, road and security checkpoint	
Probability	H	H
Intensity	M	L
Spatial extent	VL	VL
Duration	H	H
Consequence	Medium	Low
Significance	Medium	Low

**note that the EAP has reduced this from Very High to High as the loss of an individual will not affect the conservation of the species within the province.*

9. ISSUE: CONTAMINATION OF SURFACE WATER RESOURCES AFFECTING THIRD PARTY USE

9.1 DESCRIPTION OF IMPACT

Several contamination sources exist in all project activities and in various phases that have the potential to contaminate surface water resources in unmitigated scenario. In the construction, decommissioning and closure phases these potential pollution sources are temporary and diffuse in nature. Although these sources may be temporary, the potential pollution may be long term. The operational phase will present the longer-term potential pollution sources.

9.2 IMPACT ASSESSMENT

Table 9-1: Impact Assessment for Surface Water Contamination

	Pre Mitigation Impacts	Post-Mitigation Impacts
Phase	Construction	
Probability	M	L
Intensity	M	L
Spatial extent	M	L
Duration	H	H
Consequence	Medium	Low
Significance	Medium	Low
Phase	Operation	
Probability	M	L
Intensity	M	L
Spatial extent	M	L

Duration	H	H
Consequence	High	Medium
Significance	High	Medium
Activity	Decommissioning and Closure	
Probability	M	L
Intensity	M	L
Spatial extent	L	VL
Duration	M	L
Consequence	Medium	Medium
Significance	Medium	Low

10. ISSUE: SOIL EROSION AND SEDIMENTATION

10.1 DESCRIPTION OF IMPACT

Site clearing, digging of trenches and topsoil removal will be undertaken during construction of various infrastructures such as the beneficiation plant, offices, workshops, the discard stockpile, and open pit might lead to erosion and consequently siltation of watercourses.

The project could cause water resources pollution through sediment transport and other chemical parameters from runoff from the surface operations. The impact of sedimentation is directly linked to erosion, as eroded soil particles will end up in nearby watercourses as sedimentation. The resultant consequences of sedimentation may be elevated turbidity that is likely to impact macroinvertebrates and other aquatic species.

10.2 IMPACT ASSESSMENT

Table 10-1: Impact Assessment for Soil Erosion and Sedimentation

	Pre Mitigation Impacts	Post-Mitigation Impacts
Phase	Construction	
Probability	M	L
Intensity	M	L
Spatial extent	M	L
Duration	M	L
Consequence	Medium	Low
Significance	Medium	Low
Phase	Operation	
Probability	M	L
Intensity	M	L
Spatial extent	M	L

Duration	M	L
Consequence	Medium	Low
Significance	Medium	Low
Activity	Decommissioning and Closure	
Probability	M	L
Intensity	H	M
Spatial extent	M	L*
Duration	L	M
Consequence	Medium	Medium
Significance	High	Medium

**note that the EAP has reduced this to Low, while the specialist indicated an increase in extent post-mitigation.*

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

11.1DESCRIPTION OF IMPACT

Natural drainage across the project area is via preferential flow paths (natural drainage line). The development of the mine will alter the affected area's hydrologic response and, potentially, the entire catchment. Development of the mine and associated surface infrastructure implies that beneficial vegetation will be replaced by impervious surfaces, reducing the site's pre-developed evapotranspiration and infiltration rates. The proposed mine infrastructure covers 0.28% of quaternary catchment D41K.

With adequate rehabilitation and closure, some of the catchment is returned to self-sustaining systems, and natural drainage patterns will be restored.

11.2IMPACT ASSESSMENT

Table 11-1: Impact Assessment for Alternation of Natural Drainage Patterns

	Pre Mitigation Impacts	Post-Mitigation Impacts
Phase	Construction	
Probability	M	L
Intensity	M	L
Spatial extent	M	L
Duration	M	L
Consequence	Medium	Low
Significance	Medium	Low
Phase	Operation	
Probability	M	VL

Intensity	L	VL
Spatial extent	M	L
Duration	M	L*
Consequence	Medium	Very Low
Significance	Medium	Very Low
Activity	Decommissioning and Closure	
Probability	M	L
Intensity	M	L
Spatial extent	L	VL
Duration	M	L
Consequence	Medium	Medium
Significance	Medium	Low

**EAP has reduced this to Low while the specialist indicated and increased duration post-mitigation.*

12. ISSUE: CONTAMINATION OF GROUNDWATER AFFECTING THIRD PARTY USE

12.1DESCRIPTION OF IMPACT

There are a number of sources in all mine phases that have the potential to pollute groundwater. Some sources are permanent (WRDs) and some sources are transient (starting later and at different time-steps) and becoming permanent (pit backfilling). Even though some sources are temporary in nature, related potential pollution can be long term. The operational phase will present more long-term potential sources (waste rock dumps and pit backfill, as the major source term) and the closure phase included in the period of simulation will present final landforms, such as the backfilled open pit may have the potential to pollute water resources through long term seepage and/or run-off.

The watercourses in the project area are not expected to be in hydraulic continuity with the main water table and therefore no groundwater related quality impacts are expected on rivers. This impact is therefore not assessed further and the discussion below focusses on potential human health impacts.

12.2IMPACT ASSESSMENT

Table 12-1: Impact Assessment for Groundwater Contamination

	Pre Mitigation Impacts	Post-Mitigation Impacts
Phase	Operation and Closure	
Probability	H	L
Intensity	M	L
Spatial extent	M	M
Duration	H	H

Consequence	Medium	Medium
Significance	Medium	Low

13. ISSUE: DEVELOPMENT OF THE CONE OF DRAWDOWN AS A RESULT OF MINING

13.1DESCRIPTION OF IMPACT

During mining, groundwater will be removed from the open pit and also from the underground storage. The groundwater volumes removed are increasing as the open pit becomes deeper and larger. At the end of the mining period, the removal of groundwater for the system will cease and the groundwater is allowed to recover.

13.2IMPACT ASSESSMENT

Table 13-1: Impact Assessment for development of Drawdown

	Pre Mitigation Impacts	Post-Mitigation Impacts
Phase	Operation and Closure	
Probability	H	M
Intensity	M	L
Spatial extent	M	M
Duration	H	H
Consequence	Medium	Medium
Significance	Medium	Low

B) IMPACT ON SOCIO-ECONOMIC ENVIRONMENT

14. ISSUE: INCREASE IN AMBIENT AIR CONCENTRATIONS

14.1DESCRIPTION OF IMPACT

The project activities present emission sources that can have a negative impact on ambient air quality and surrounding land uses in all project phases. The increase in materials handling operations (e.g. top-cut handling, increased train loading capacity, sale of waste rock as aggregate and re-processing of material in Adams pit) could result in an increase in particulate emissions. Other emission sources include land clearing activities for construction, wind erosion of disturbed areas, vehicle movement along unpaved roads and exhaust emissions. The sources are expected to be associated with the use of the expanded internal haul road, the establishment of stormwater management infrastructure and the establishment of the water pipelines from the decommissioned Middelplaats Mine to MMT. The main contaminants of concern, as a result of the project, include particulate matter (PM) and dustfall.

The closest potentially sensitive receptors from the decommissioned Middelplaats Mine include the farm workers and A. Pyper (located 4.7 km to the west of the central pit). The closest receptor from the MMT is Michael Kruger (1.8 km southeast of the sinter plant).

Dispersion modelling was undertaken by Airshed (2020/ 2021) to determine the highest daily and annual average ground level concentrations (GLCs). Pollutants with the potential to result in human health impacts which were assessed include $PM_{2.5}$ and PM_{10}. Dustfall was assessed for its nuisance potential.

Baseline: Simulated PM_{10} daily GLC), with no mitigation in place, are in non-compliance with the NAAQS for distances up to 4 km from the mining rights boundary (Figure 14-1). Simulated daily $PM_{2.5}$ GLCs, with no mitigation in place, are likely to be in non-compliance with the 2030 NAAQS for distances of up to 2 km from the mining rights boundary (Figure 14-2) and simulated maximum daily dustfall rates for baseline operations (unmitigated) are in compliance with the NDCR residential limit (600 mg/m²/day). Figure 14-3 shows the simulated monthly baseline dustfall rates.

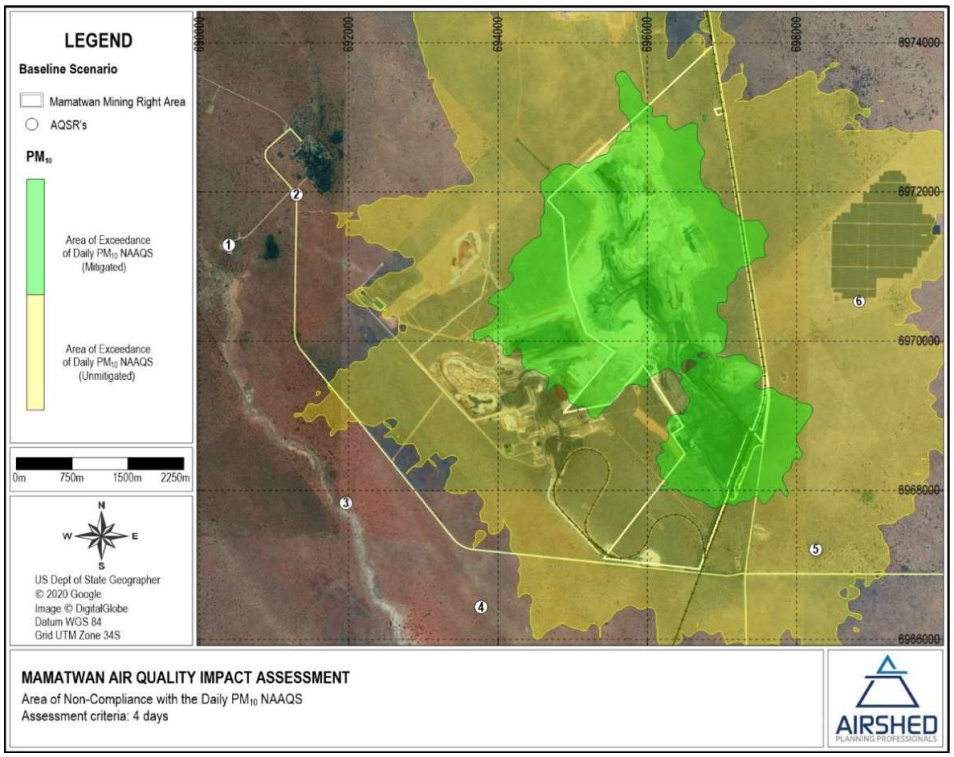

Figure 14-1 Baseline scenario – Area of non-compliance of daily PM10 NAAQS (all sources)

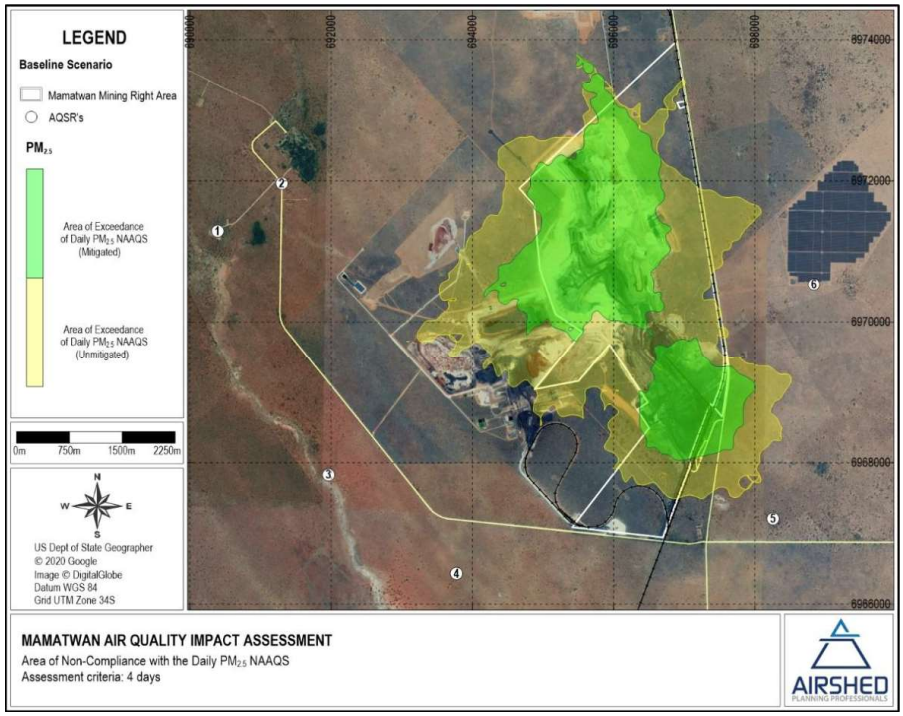

Figure 14-2 Baseline scenario – Area of non-compliance of daily PM2.5 NAAQS (all sources)

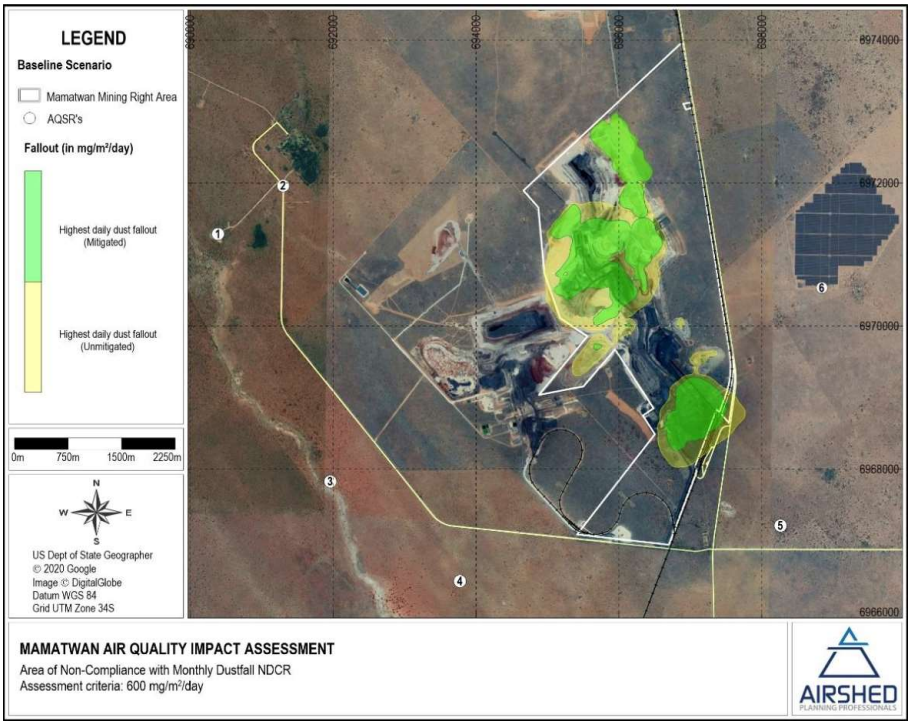

Figure 14-3 Baseline scenario – Area of non-compliance with monthly dustfall NDCR (all sources)

14.2IMPACT ASSESSMENT

Table 14-1: Impact Assessment for Change in Ambient Air Quality during Construction

	Pre Mitigation Impacts	Post-Mitigation Impacts
Phase	Construction (PM_{10})	
Probability	M	M
Intensity	M	L
Spatial extent	L	L
Duration	L	L
Consequence	Medium	Low
Significance	Medium	Low
Phase	Operation (PM_{10})	
Probability	M	M
Intensity	M	VL
Spatial extent	H	M
Duration	M	M
Consequence	High	Low
Significance	High	Low
Activity	Operation ($PM_{2.5}$)	
Probability	M	M
Intensity	M	VL
Spatial extent	H	M
Duration	M	M
Consequence	High	Low
Significance	High	Low
Activity	Operation (Dustfall)	
Probability	M	M
Intensity	L	L
Spatial extent	L	L
Duration	M	M
Consequence	Low	Low
Significance	Low	Low
Activity	Closure (PM_{10})	
Probability	M	M
Intensity	M	L
Spatial extent	L	L

Duration	L	L
Consequence	Medium	Low
Significance	Medium	Low

15. ISSUE: INCREASE IN DISTURBING NOISE LEVELS AFFECTING POTENTIAL HUMAN RECEPTORS

15.1DESCRIPTION OF IMPACT

The propagation of noise generated during the operational phase was calculated with CadnaA in accordance with ISO 9613. Site specific acoustic parameters with source data were applied in the model.

The simulated equivalent continuous day-time rating level (LReq,d) of 55 dBA (IFC residential guideline level and SANS rating for urban districts) due to project operations extends ~340 m to the east of the Mamatwan mining right area for railway loadout station (with and without crushing and screening activities on the waste rock material). The simulated equivalent continuous day/night-time rating level (LReq,dn) of 55 dBA (SANS rating for urban districts) due to project operations extends ~30 m to the east of the Mamatwan mining right area for railway loadout station (with and without crushing and screening activities on the waste rock material).

The project activities are predicted to be within IFC residential and industrial guideline levels and SANS rating for urban and industrial districts at all potential NSRs. 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); 'little' to 'medium' reaction with 'sporadic' to 'widespread' complaints expected from the community for increased noise levels up to 10 dBA. 'Strong' reaction with 'threats of community action' is expected from the community for increased noise levels of between 10 dBA to 15 dBA. With the approach adopted for the assessment the predicted increase in noise levels at all NSRs less than 1 dBA for all options simulated. The increase in noise levels at NSRs due to project operations should therefore not be detectable.

15.2IMPACT ASSESSMENT

Table 15-1: Impact Assessment for Noise Disturbance

	Pre Mitigation Impacts	Post-Mitigation Impacts
Phase	Construction	
Probability	M	M
Intensity	L	L
Spatial extent	M	L
Duration	L	L
Consequence	Low	Low
Significance	Low	Very Low

Phase	Operation	
Probability	M	M
Intensity	VL	VL
Spatial extent	M	M
Duration	H	H
Consequence	Low	Low
Significance	Low	Very Low
Activity	Closure	
Probability	M	M
Intensity	M	L
Spatial extent	M	L
Duration	L	L
Consequence	Low	Low
Significance	Low	Very Low

16. ISSUE: LOSS OR DAMAGE TO HERITAGE AND/OR PALEONTOLOGICAL RESOURCES

16.1DESCRIPTION OF IMPACT

It is possible that subsurface heritage resources will be exposed during construction and may be recoverable, keeping in mind delays can be costly during construction and as such must be minimised. Development surrounding infrastructure and construction of facilities results in significant disturbance, however foundation holes do offer a window into the past and it thus may be possible to rescue some of the data and materials. It is also possible that substantial alterations will be implemented during this phase of the project and these must be catered for. Temporary infrastructure, such as construction camps and laydown areas, is often changed or added to the project as required. In general, these are low impact developments as they are superficial, resulting in little alteration of the land surface, but still need to be catered for.

During the construction phase, it is important to recognize any significant material being unearthed, making the correct judgment on which actions should be taken. It is recommended that the following chance find procedure is implemented. The study area occurs within a greater archaeological site as identified during the fieldwork.

Clearing of vegetation can uncover the following:

- Stone artefact;
- Stone foundations;
- Ash middens associated with the farmsteads and homesteads that can contain bone, glass and clay ceramics, ash, metal objects such as spoons, forks, and knives; and
- Possible burials.

16.2IMPACT ASSESSMENT

No heritage/cultural resources were identified within the proposed project areas. It follows that the assessment of the loss of heritage/cultural resources is not applicable to this HIA, however management actions are provided in the event of a chance find.

17. ISSUE: ALTERATION OF THE VISUAL ENVIRONMENT AFFECTING SENSE OF PLACE

17.1DESCRIPTION OF IMPACT

Since the proposed top-cut stockpile is situated adjacent to existing waste rock dumps which are of the same height, the visual impact is already present in the area and receptors (i.e. farmers and farm workers traveling along the R380 on a regular basis) within the vicinity thereof have grown accustomed to the dumps. As a result, the proposed establishment of the proposed top-cut stockpile is likely to have a minimal visual impact on the receiving environment. A visual impact will only be experienced if there are sensitive receptors present to experience the impact, thus in this context the receptors that are present are sparse and far from the proposed top-cut stockpile area, thus there are not likely to be many visual impacts experienced.

In addition to the sparse receptors the bushveld vegetation of the area limits the view of the observer to the immediate vicinity, rendering a very low visual intrusion of the proposed top-cut stockpile and mobile crushing and screening plant. It should be noted that the R380 roadway is situated directly east of the proposed expansion activities, thus the proposed expansion activities are in the foreground of motorists traveling along the road and will observe the proposed expansion activities. Due to the landscape already degraded by existing anthropogenic structures (OHPL, waste rock dumps, stockpiles etc.) the proposed MMT expansion activities will not have a significant visual impact on the R380 roadway. Additionally, the road is utilised predominantly by mine and farm workers which are accustomed to the existing mining infrastructure and they have momentary views of the surroundings. Furthermore, the proposed expansion activities are situated within the Gamagara Corridor which is the mining belt of the Northern Cape, thus it does not stray from the land use of the Corridor.

When considering the development phases of the proposed project, the construction and operational phase will have the highest visual intrusion due to the removal of vegetation and levelling of the ground in preparation for the proposed expansion activities, thus increased vehicular movement in the area. Additionally, the stockpiling of material and thus the increase in the height of the proposed top-cut stockpile will also likely have a high visual intrusion. The points below briefly describe the visual impacts the proposed project will have during the mining and associated construction phase:

- The sense of place of the area will shift from calmness and tranquillity to busy due to vehicular and mine worker movement in the area during the preparation of the area and removal of vegetation for the proposed stockpiling and handling of material. The MMT will only be observable within a small radius and a short distance along the R380 roadway;
- Visual contrast to the surrounding environment may occur as the red / yellow mobile crushing and screening plant may be clearly noticeable from the green and brown background formed by the vegetation and the waste rock dumps;

- Direct visual exposure of the mining activities will occur for road users (mine workers, farmers and occasional tourists) traveling on the R380, as well as indirectly through fugitive dust generated by the earthworks and dumping of the top-cut stockpile material on a windy day. Fugitive dust generated from the workings at the mobile crushing and screening plant will also be visible from the R380 roadway;
- The only form of lighting that will be associated with the proposed top cut stockpile is in the event that the mine requires mining vehicles to dump the material at night on occasion, thus the visual impact associated with night time lighting is negligible.
- The product stockpile stacker and reclaimer associated with the railway loop and the mobile crushing and screening plant will have limited stationary security lighting, thus it is likely to contribute in a limited manner to the effects of skyglow, however the lighting associated with other infrastructure of the MMT and Thsipi Mine will be more visible due to the larger scale of these operations; and
- Since the proposed top-cut stockpile will be the same height as the existing adjacent waste rock dumps and similar in colour, the proposed top-cut stockpile will be indistinguishable from the surrounding environment, as is evident in Figure 6 below. Since the proposed project is situated within the mining belt of the Northern Cape (Gamagara Corridor) the project will not be discordant with the land use and landscape character of the area. Furthermore, due to the bushveld vegetation and distance of the sensitive receptors from the proposed project, situated further than 3km, the proposed top cut stockpile will not be visible to these receptors.

17.2IMPACT ASSESSMENT

Table 17-1: Impact Assessment for Visual Effects

	Pre Mitigation Impacts	Post-Mitigation Impacts
Phase	All Phases (Day and Nighttime Impacts)	
Probability	M	M
Intensity	L	L
Spatial extent	L	L
Duration	L	L
Consequence	Low	Low
Significance	Low	Very Low

18. MITIGATION MEASURES

18.1 SOIL EROSION AND MANAGEMENT

- Temporary erosion control measures may be used to protect the disturbed soils until adequate vegetation has established; and
- All disturbed areas can be re-vegetated with an appropriate indigenous veld reclamation mix, if necessary, to re-establish a protective cover, to minimise soil erosion.
- Construction must be undertaken during the dry season. This will significantly reduce the potential for sedimentation through erosion due to construction activities.
- Concurrent rehabilitation of disturbed land and revegetation should be carried out to minimise the amount of time that bare soils are exposed to the erosive effects of rain and subsequent runoff.
- A service/maintenance plan must be compiled and implemented. The plan must encompass procedures to minimise soil erosion impacts on the surrounding environment.
- Concurrent rehabilitation is encouraged during the operation of the mine to minimise the amount of time that bare soils are exposed to the erosive effects of rain and subsequent runoff.
- Decommissioning activities must be undertaken during the dry season. This will significantly reduce the potential for sedimentation and erosion.

18.2 SOIL COMPACTION MANAGEMENT

- Avoid vehicular movement on arable soils as far as practically possible; and
- Compacted soils adjacent to disturbed areas should be ripped at 25cm as soon as possible to alleviate compaction and potential crusting.

18.3 WASTE MANAGEMENT

- Contractors and mining crew conducting the works on site should be informed about approved waste disposal facilities.

18.4 SOIL LOSS AND STOCKPILE MANAGEMENT

- Stockpiles should be revegetated to establish a vegetation cover as an erosion control measure. These stockpiles should also be kept alien vegetation free at all times to prevent loss of soil quality;
- Temporary berms can be constructed, around stockpile areas whilst vegetation cover has not established to avoid soil loss through erosion;
- The stockpiled soil should only be used for intended purposes of rehabilitation at closure of mine operation. Soil stockpiles should be clearly demarcated with No Go areas and monitored regularly;
- Dumping of waste material next to or on the stockpiles must be prohibited at all times. Integrated soil stockpile management plans and monitoring programmes as well as an employee awareness programme must be put in place to significantly reduce the risk of soil stockpile robbery and/or contamination; and
- The recovered soils should be re-used to rehabilitate the development footprint following mine closure.

18.5LOSS OF LAND CAPABILITY AND AGRICULTURAL POTENTIAL MANAGEMENT

- During the decommissioning phase the footprint should be thoroughly cleaned, and all waste material should be removed to a suitable disposal facility;
- The footprint should be ripped to alleviate compaction where necessary;
- Stored topsoil should be replaced and the footprint graded to a smooth surface;
- The landscape should be backfilled and reprofiled to mimic the natural topography for potential agricultural activities and grazing opportunities post mining. If possible, ensure a continuation of the pre-mining surface drainage pattern;
- Slopes of the backfilled surface should change gradually since abrupt changes in slope gradient increase the susceptibility for erosion initiation;
- The topsoil should be ameliorated according to soil chemical analysis taken on the undisturbed areas;
- The soil fertility status should be determined by soil chemical analysis after levelling and before seeding / revegetation. Soil amelioration should be done according to soil analyses as recommended by a sol specialist, to correct the pH and nutrition status before revegetation; and
- The footprint should be revegetated with a grass seed mixture as soon as possible, preferably in spring and early summer to stabilise the soil and prevent soil loss during the rainy season.

18.6 FLORAL HABITAT AND DIVERSITY

- Minimise loss of indigenous vegetation where possible through effective planning and limiting the development footprint as far as practical. The designs must further adhere to all legislation and all possible precautions taken to prevent spills and leaks.
- It is recommended that prior to the commencement of construction activities the entire construction servitude be fenced off, and clearly demarcated to limit footprint creep and edge effects.
- The footprint areas of all surface infrastructure must be minimised to what is absolutely essential and within the designated and approved boundary.
- No additional habitat is to be disturbed during the operational phase of the development. All material placed on the top-cut stockpile should be restricted to the footprint area that is authorised. Weekly monitoring and recording of the footprint area must be done.
- Vehicles should be restricted to travelling only on designated roadways to limit the ecological footprint of the construction activities. Additional road construction should be limited to what is absolutely necessary, and the footprint thereof kept to a minimum. Any temporary roads should be rehabilitated as soon as they are no longer in use to prevent effects of habitat fragmentation.
- 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 construction rubble and general waste.
- Cut vegetation from site clearing to be removed immediately and not allowed to accumulate within surrounding natural habitat.
- 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.

- Natural habitat outside of the direct mining footprint areas must be avoided, and no construction vehicles, personnel, or any other construction-related activities are to encroach upon these areas.
- The footprint of daily operational activities must be strictly monitored to ensure that edge effects from the operational facilities do not affect the surrounding floral habitat.

18.7 FLORAL SCC

- Prior to construction or earth moving activities a detailed walkdown of all-natural areas falling within the final expansion footprint area be undertaken and all protected floral species be marked.
- The walkdown should be undertaken during the summer season when most herbaceous floral species will be more easily identified.
- Once all floral SCC and NCNCA protected floral species within the development footprint have been identified, a rescue and relocation plan should be designed specifically for each species. Rescue and relocation activities need to be overseen by a qualified contractor or mine employee. The success of the relocation actions need to be monitored quarterly for a minimum period of three years post-relocation.
- The necessary permits need to be obtained from DOFF and NCDENC prior to the implementation of the rescue and relocation activities.
- During the surveying and site-pegging phase of surface infrastructure, all potential floral SCC as well as protected floral species that will be affected by surface infrastructure must be marked and, where possible, relocated to suitable habitat surrounding the disturbance footprint. The removal and/or rescue and relocation should be overseen by a qualified specialist, in association with a suitably qualified horticulturist. The relevant permits must be applied for from the various authorities prior to the commencement of the construction phase.
- No collection of floral SCC or medicinal floral species within the site boundary must be allowed by construction personnel.
- Edge effect control needs to be implemented to prevent further degradation and potential loss of floral SCC and protected floral species outside of the proposed expansion footprint area.

18.8 AIP CONTROL AND ONGOING REHABILITATION

- Removal of alien invasive species should commence during the pre-construction phase and continue through all future phases of the mining development. AIPS should be cleared within areas where they become proliferate within the existing mining and infrastructure areas as well as where new infrastructure is planned before construction activities commence.
- An AIP Management / Control Plan should de implemented by a qualified professional. No chemical control of AIPs is to occur without a certified professional.
- Of particular importance is the control of *Prosopis glandules*, which comprises of a deep-rooted taproot as well as an extensive lateral root system. This species subsequently not only competes with the indigenous *Vachellia erioloba* for deep groundwater but also takes up sparse precipitation within the soil profile.
- Prior to the commencement of construction activities on site, a rehabilitation plan should be developed for implementation throughout the development phases.
- Edge effects of all construction activities, such as erosion and alien plant species proliferation, which may affect adjacent Kathu Bushveld Habitat, need to be strictly managed adjacent to the project footprint areas. Specific mention in this regard is made of Prosopis glandules and all

Category 1b AIP species, in line with the NEMBA Alien and Invasive Species Regulations (2016), as identified within the study area.

- An Alien and Invasive Plant Management and Control Plan must be designed and implemented in order to monitor and control alien floral recruitment.
- Ongoing alien and invasive plant monitoring and clearing/control should take place throughout all phases of the development, and the project perimeters should be regularly checked for AIP proliferation and to prevent spread into surrounding natural areas.
- AIP management for construction-phase activities should be focused on limiting their spread, e.g. roadsides (gravel and tarred roads) should be monitored, as they serve as common corridors along which AIP species are introduced and dispersed, and disturbed areas should regularly be monitored for AIP recruitment until successfully rehabilitated.
- 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.
- Edge effects of decommissioning and closure activities, such as erosion and alien plant species proliferation, which may affect adjacent sensitive habitat, need to be strictly managed adjacent to the expansion footprint.
- Ongoing alien and invasive vegetation monitoring and eradication should take place throughout the closure/ decommissioning phase of the development, and the Mamatwan Operations and immediate surrounding area (50 m from the perimeters) should be regularly checked during the decommissioning phase for alien vegetation proliferation to prevent spread into surrounding natural area.

An Alien and Invasive Plant Management and Control Plan must be designed and implemented in order to monitor and control alien floral recruitment in disturbed areas. The alien floral control plan must be implemented for a period of at least 5 years after decommissioning and closure.

18.9 FAUNAL HABITAT, SPECIES AND SCC

- It is recommended that prior to the commencement of construction activities the entire proposed top cut be fenced off and clearly demarcated, any burrows should be monitored after fencing has been established to ensure no SCC are utilizing the area. If SCC are noted permits for their removal are necessary.
- Where possible, and feasible, all access roads should be kept to existing roads so to reduce fragmentation of existing natural habitat.
- Development should consider sensitive habitats for fauna within the study area.
- Prior to the commencement of construction activities on site an alien vegetation management plan should be compiled for implementation throughout all development phases.
- Prior to the commencement of construction activities on site a rehabilitation plan should be developed for implementation throughout the development phases.
- As part of the planning and preparation phase, a Fire Management Plan and Erosion plan should be developed and be in place before construction activities can commence.
- Design of infrastructure should be environmentally sound, and all possible precautions taken to prevent potential spills and /or leaks.
- At all times, ensure that sound environmental management is in place during the planning phase.

- The footprint areas of all surface infrastructure must be minimised to what is absolutely essential and within the designated and approved MMT expansion activities boundary.
- Vegetation outside of the footprint area is not to be cleared.
- Vegetation clearance and commencement of construction activities should either be scheduled to coincide with low rainfall conditions when erosive stormwater is anticipated to be limited or alternatively stormwater controls must be established at the start of construction and dust suppression implemented.
- Excavated topsoil must be stored with associated native vegetation debris for subsequent use in rehabilitation.
- Any railway infrastructure and mining related activities including stockpiles should be placed within transformed areas or where possible, existing infrastructure should be used.
- No dumping of general waste or construction material on site should take place. As such it is advised that waste disposal containers and bins be provided during the construction phase for all construction rubble and general waste.
- 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.
- Natural habitat outside of the direct mining footprint areas must be avoided, and no construction vehicles, personnel, or any other construction related activities are to encroach upon these areas.
- No hunting/trapping or collecting of faunal species is allowed.
- During the surveying and site-pegging phases, all faunal SCC that will be affected by surface infrastructure must be marked and, where possible, relocated to suitable habitat surrounding the disturbance footprint. The relevant permits must be applied for from the Northern Cape Department of Environment and Nature Conservation (NCDENC) prior to the commencement of the construction phase.
- Should any other faunal species protected under National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) or the Northern Cape Nature Conservation Act, 2009 (Act No. 9 of 2009) (NCNCA) be encountered within the study area authorisation to relocate such species must be obtained from the NCDENC or the Department of Environmental Affairs (DEA).
- Edge effect control needs to be implemented to ensure no further degradation and potential loss of faunal SCC outside of the proposed project footprint area.
- Should any SCC be observed on the site a biodiversity specialist should be contacted in order to map the best way forward.
- Prior to vegetation clearing activities in the Kathu Bushveld habitat, the site should be inspected for the presence of burrowing scorpion burrows, pythons and Aardvark. If located, these species should be carefully excavated ensuring no harm to fauna, and relocated to similar surrounding habitat outside of the footprint area.
- Smaller species such as scorpions and reptiles are likely to be less mobile during the colder period, as such should any be observed in the construction site during clearing and construction activities, they are to be carefully and safely moved to an area of similar habitat outside of the disturbance footprint.
- Construction personnel are to be educated about these species and the need for their conservation. Smaller scorpion species and 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.

- Should any snakes be encountered, either a suitably trained staff member or expert should be contacted to capture and relocate the specimen. No harm should done to any snakes located within the study area.

18.10 AIR QUALITY

- Construction and closure phases:
    - Air quality impacts during construction would be reduced through basic control measures such as limiting the speed of haul trucks, limiting unnecessary travelling of vehicles on unpaved roads and applying water sprays on regularly travelled, unpaved roads.
    - 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 road to the sinter plant needs to be kept clean to minimise carry-through of mud to the public roads.
- Operational phase:
    - Regular water sprays on unpaved roads to ensure at least 75% control efficiency. Literature indicates an application rate >2 litre/m²/hour should achieve this.
    - 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, as practical.
    - 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.
    - Increase in-pit material moisture content.
    - 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 handling by dozers and wheeled loaders moist to achieve a control efficiency of 50%, especially in dry periods.
    - Regular clean-up at loading areas.
    - Water sprays at ROM stockpile 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.
    - 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 emissions from the overburden storage piles.
    - Revegetation of overburden stockpile is recommended.
    - Water sprays at mobile crushers to achieve at last 50% control efficiency.

18.11 DUST

- Dust pollution has been associated with poor photosynthetic functionality in plants. There is evidence of dust pollution leading to a reduction in chlorophyll, including chlorophyll degradation and reduced photosynthetic activity resulting from dust deposition on leaf surfaces. Dust deposition also result in stomata clogging, which causes a decreased rate of carbon dioxide exchange, carbon assimilation, transpiration, and therefore decreased net photosynthesis.
- An effective dust management plan must be designed and implemented in order to mitigate the impact of dust on flora throughout the construction and operational phase.

18.12 NOISE

In the quantification of noise emissions and simulation of noise levels as a result of the project, it was found that environmental noise evaluation criteria for residential, educational, and institutional receptors will be exceeded at the closest off-site noise sensitive receptor to the east of the Mamatwan Mine during the day.

- Train staff on noise control plan during health & safety briefings.
- Avoid clustering of equipment near receptors.
- Ensure periods of respite are provided in the case of unavoidable maximum noise level events.
- Ensure high level of maintenance on all equipment. Any change in the noise emission characteristics of equipment should serve as trigger for withdrawing it for maintenance.
- Where possible, other non-routine noisy activities such as construction, decommissioning, start-up and maintenance, should be limited to day-time hours.
- As the site or activity is in close proximity to NSRs, equipment and methods to be employed should be reviewed to ensure the quietest available technology is used. Equipment with lower sound power levels must be selected in such instances and vendors/contractors should be required to guarantee optimised equipment design noise levels.
- As far as is practically possible, source of significant noise should be enclosed. The extent of enclosure will depend on the nature of the machine and their ventilation requirements.
- Machines used intermittently should be shut down between work periods and not left running unnecessarily. This will reduce noise and conserve energy.
- Equipment from which noise generated is known to be particularly directional, should be orientated so that the noise is directed away from NSRs.
- A noise complaints register must be kept.

18.13 VISUAL

- The development footprint and disturbed areas surrounding the proposed top-cut stockpile should be kept as small as possible and the areas cleared of natural vegetation and topsoil must be kept to a minimum;
- All construction areas must be kept in a neat and orderly condition at all times;
- Existing vegetation, with particular reference to tall trees and larger shrubs adjacent to the R380 and in the vicinity of the proposed expansion activities must be retained, in order to partly obscure the view toward the proposed top-cut stockpile and railway loop;
- Should it be deemed feasible, the topsoil stockpile should be vegetated with indigenous species to reduce the visual impact of the soil contrast;

- Construction and operation activities should be limited to be undertaken between 6am and 6pm, in order to limit the need for bright floodlighting and the potential for skyglow;
- It is recommended that the mobile crushing and screening plant as well as the product stockpile stacker and reclaimer make use of neutral colours and the use of highly reflective material should be avoided. Any metal surfaces should be painted to fit in with the natural environment in a colour that blends in effectively with the background;
- All lights used for illumination at the mobile crushing and screening plant and product stockpile stacker and reclaimer (except for lighting associated with security) should be faced inwards and shielded to avoid light escaping above the horizon; and
- Security lighting required at night during the operational phase of the product stockpile stacker and reclaimer at the railway loop and mobile crushing and screening plant, should use minimum lumen or wattage in light fixtures. Furthermore, making use of motion detectors on security lighting, where possible, ensures that the site will remain in relative darkness, until lighting is required for security or operational purposes.

18.14 FIRE

- No illicit fires must be allowed during the construction and operational phases of the proposed expansion activities.
- Fire breaks should be maintained during the operational phase.

18.15 STORMWATER

- Adequate stormwater management must be incorporated into the design of the proposed development in order to prevent erosion of topsoil and the loss of floral habitat through the discharge of dirty water into the receiving environment. In this regard, special mention is made of:
    - Sheet runoff from cleared areas, paved surfaces and access roads needs to be curtailed; and
    - Runoff from paved surfaces should be slowed down by the strategic placement of bioswales.

18.16 SURFACE WATER QUALITY

- Drip trays should be placed under all standing machinery.
- Oil recovered from any vehicle or machinery on-site should be collected, stored and disposed of by accredited vendors for recycling.
- Traffic and movement over stabilised areas should be controlled (minimised and kept to specific paths), and damage to stabilised areas should be repaired timeously.
- A water quality monitoring plan must be formulated before construction.
- Water quality monitoring as per the described monitoring plan.
- A stormwater management plan has been designed to minimize the potential to contaminate surface water and separates dirty and clean water must be developed.
- The stormwater design recommended that the mine adopt a practice of utilising (reusing). The mine will have to abstract and reuse the amount of water that based on PCD option selected (SLR, 2021).
- The abstraction rate recommended will ensure that the risk of spill is minimized.

- Good housekeeping practices must be implemented and maintained by clean-up of accidental spillages, as well as ensuring all dislodged material like run-of-mine stockpile are kept within the confined storage footprints. In addition clean-up material and materials safety data sheets for chemical and hazardous substances should be kept on site for immediate clean-up of accidental spillages of pollutants.
- Regularly schedule inspection and maintenance of water management facilities, to include inspection of drainage structures and liners for any in channel erosion or cracks; de-silting of silt traps/sumps and PCDs; and any pumps and pipelines should be maintained according to manufacturer's specifications.
- Vehicles and plant equipment servicing must be undertaken within suitably equipped facilities, either within workshops, or within bunded areas, from which any stormwater is conveyed to a pollution control dam, after passing through an oil and silt interceptor.
- Pollutant storage – any substances which may potentially pollute surface water must be stored within a suitably sized bunded area and where practicable covered by a roof to prevent contact with rainfall and/or runoff.
- Water conservation and water demand management (WC/WDM) measures to ensure that as much water as is possible, is collected and reused.
- From operations onwards, grading of disturbed area and application of the final layers of growth medium, must be contoured as far as can be achieved in a safe and practical manner; and vegetation of disturbed areas including seeding should be performed immediately following application of the growth medium to avoid erosion.

18.17 ALTERATION OF DRAINAGE

- The development of a stormwater infrastructure will result in positive impacts such as pollution control however clean water must be released into the environment to minimize alteration of natural drainage flow.
- A stormwater management plan has been designed to channels runoff and separate dirty and clean water must be formulated as per the requirements of GN704.
- Clean water must be allowed to flow back into the natural environment.
- Re-use of water from the PCDs must be prioritised as well as the use of water from Middelplaats Shaft.

18.18 GROUNDWATER

- Mamatwan will update the hydrocensus to check for any new third party water uses prior to initiating activities associated with the proposed surface infrastructural changes.
- Mamatwan should continue groundwater monitoring per existing monitoring protocols for the existing monitoring network.
- All potentially affected boreholes will be included in the water monitoring programme for boreholes located both on and off the mine site.
- If any mine related loss of water supply through a reduction in quality is experienced by third party borehole users, Mamatwan will provide compensation which could include an alternative water supply of equivalent water quality.
- Should any off-site contamination be detected, the mine will immediately notify DWS. The mine, in consultation with DWS and an appropriately qualified person, will then notify potentially

affected users, identify the source of contamination, identify measures for the prevention of this contamination (in the short term and the long term) and then implement these measures.

- At decommissioning, the potential pollution sources (residual waste rock left on surface) will either be removed or rehabilitated to manage rainfall and seepage.

18.19 HERITAGE AND PALAEONTOLOGY

In the event of a chance find, the following actions should be taken:

- A heritage practitioner should be appointed to develop a heritage induction program and conduct training for the ECO, as well as team leaders, in the identification of heritage resources and artefacts.
- An appropriately qualified archaeologist must be identified to be called upon in the event that any possible heritage resources or artefacts are identified.
- Should an archaeological site or cultural material be discovered during any project phase, the area should be demarcated, and activities be halted.
- The qualified archaeologist will then need to come out to the site and evaluate the extent and importance of the heritage resources and make the necessary recommendations for mitigating the find and impact on the heritage resource.
- South32 must have a contingency plan so that operations/activities could move elsewhere temporarily away from the activity area while the material and data are recovered.
- Construction can commence as soon as the site has been cleared and signed off by the archaeologist.

18.20 REHABILITATION

- Rehabilitation of natural vegetation should proceed in accordance with a rehabilitation plan compiled by a suitable specialist. This rehabilitation plan should consider all development phases of the project indicating rehabilitation actions to be undertaken during and once construction has been completed, ongoing rehabilitation during the operational phase of the project as well as rehabilitation actions to be undertaken during decommissioning and closure.
- The construction process should be phased to limit the extent of exposed areas at any one time and ensure that the time between initial disturbance and completion of construction is as short as possible with rehabilitation occurring concurrently where feasible.
- Any natural areas beyond the expansion footprint, that have been affected by the construction and operational activities, must be rehabilitated using indigenous species.
- As part of a Biodiversity Action Plan (BAP), floral monitoring should be done annually during operational activity. Please also refer to the monitoring guidelines below.
- Rehabilitation must be implemented concurrently, and disturbed areas must be rehabilitated as soon as such areas become available. This will not only reduce the total disturbance footprint but will also reduce the overall rehabilitation effort and cost.
- All soils compacted as a result 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.
- When rehabilitating a footprint site, it is imperative that as far as possible the habitat that was present prior to disturbances is recreated, so that faunal species that were displaced by vegetation clearing activities are able to recolonize the rehabilitated area.

- 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.
- Following heavy rains, access roads are to be inspected for signs of erosion, which if found must be immediately rectified through appropriate erosion control measures.
- All infrastructure and mining operation footprints should be rehabilitated in accordance with a rehabilitation plan compiled by a suitable specialist.
- 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 objective.
- Rehabilitation efforts must be implemented for a period of at least five years after decommissioning and closure.

19. ENVIRONMENTAL MONITORING

19.1 BIODIVERSITY

It is recommended that a floral monitoring plan be designed and implemented throughout all phases of the proposed expansion activities, should it be approved. The following points aim to guide the design of the monitoring plan. The monitoring plan should be continually updated and refined for site-specific requirements:

- Permanent monitoring plots must ideally be established in areas surrounding the expansion activities, particularly to the north and east of the top cut stockpile. These plots should be designed in such a way to accurately monitor the following parameters:
    - Recruitment of indigenous species and of alien and invasive species, particularly the establishment of Prosopis glandules;
    - Alien vs Indigenous plant ratio, especially *Vachellia erioloba* vs. *P. glandules*;
    - Erosion levels and the efficacy of erosion control measures; and
    - Monitoring to be undertaken annually for the first three years of the operational phase. Should no significant recruitment of additional AIPs be observed during this time, monitoring can be undertaken every two years for the remainder of the operational phase, as well as three years post closure.
- Monitoring of footprint area as well as a 50 m buffer surrounding the footprint area should persist throughout the operational phase to ensure these areas are not adversely affected by the mining operations;
- Monitoring of concurrent rehabilitation must also take place throughout all phases of the proposed mining development and for a period of five years after decommissioning and closure of each rehabilitated or infrastructure area;
- The rehabilitation plan should be continuously updated in accordance with the monitoring results in order to ensure that optimal rehabilitation measures are employed;
- Results of the monitoring activities must be taken into account during all phases of the proposed mining expansion activities and action must be taken to mitigate impacts as soon as negative effects from these activities become apparent; and
- The method of monitoring must be designed to be subjective and repeatable in order to ensure consistent results.

19.2 SURFACE WATER

The proposed monitoring to be carried out for surface water is discussed in the table below.

Description	Monitoring Location	Frequency of sampling	Frequency of Reporting
Soil Erosion			
Soil erosion and sedimentation monitoring in all soil erosion potential sources	Cleared and compacted areas where the infrastructure will be built. The downstream areas of dams and road crossings.	Monitoring of erosion should occur during construction after every rainstorm or flood event, and during the operational phase monthly during first	After every major rainstorm / flood. Monthly monitoring report compiled by the appointed ECO during the

Description	Monitoring Location	Frequency of sampling	Frequency of Reporting
		the wet season or during routine maintenance inspections, as applicable.	construction phase.
Surface Water Quality			
Ensure that water quality monitoring is implemented up and downstream at the periphery of the 200 m working area	Fourteen water quality monitoring points have been established and provided in the water quality assessment section.	Motoring should be undertaken quarterly.	Reporting should be undertaken after each sampling activity.
Ensure that monitoring is implemented up and downstream at the periphery of the 100 m working area	Monitoring must be undertaken at precisely the same locality as the pre-construction, operation and closure phases monitoring.	Once a month for six months after completion of construction.	Monthly report should be compiled.
Leakage events			
A leak and spill management plan must be formulated to monitor and detect as soon as possible. Site walkovers to determine the condition of facilities and identify any leaks or overflows, blockages, overflows, and system malfunctions for immediate remedial action	Roads and areas where vehicles commute and areas where chemical storage containers are located. Areas where leakage is visible/detected.	Identification of any leakage events should occur monthly during the rehabilitation and construction phase, or directly after a leakage has been detected and for the operational phase, during maintenance activities	Monthly monitoring report compiled by the appointed ECO during the construction, operational and closure phases; and Report should be compiled for three phases of the project.
Infrastructure Monitoring			
Inspection of the temporary channels, and bridges for signs of erosion, cracking and silting to ensure the performance of these remains acceptable.	All proposed infrastructure	Daily during maintenance	Daily. Should erosion occur, measures should be reinstated.

The monitoring plan should be reviewed periodically to ensure appropriateness of the sites and sampling frequency during operation. The parameters of concern are provided in the table below and these constituents should be included in all surface water monitoring.

pH	Nitrate as N
Electrical conductivity	Ammonia
Total dissolved solids	Potassium
Total suspended solids	Nickel
Aluminium	Manganese

Calcium	Magnesium
Fluoride as F	Iron
Total alkalinity as $CaCO_3$	Copper
Chloride as Cl	Lead
Sulphate as SO_4	Sodium
Uranium	*E.coli*

19.3 GROUNDWATER MONITORING

Some of the boreholes included in the monitoring network might be damaged/lost due to Mamatwan pit expansion and WRD/backfill expansion.

Therefore, SLR recommends that replacement boreholes, as well as cone of drawdown and contaminant plume monitoring boreholes to be drilled and added to the monitoring network.

Figure 19-1 shows the existing and the proposed groundwater monitoring boreholes for the Mamatwan Monitoring System. Unfortunately, the Tshipi Mine property and WRD are situated on the Western side of Mamatwan boundary. If suitable location can be found, then it is advisable to locate one monitoring borehole on the Western side of Mamatwan Pit.

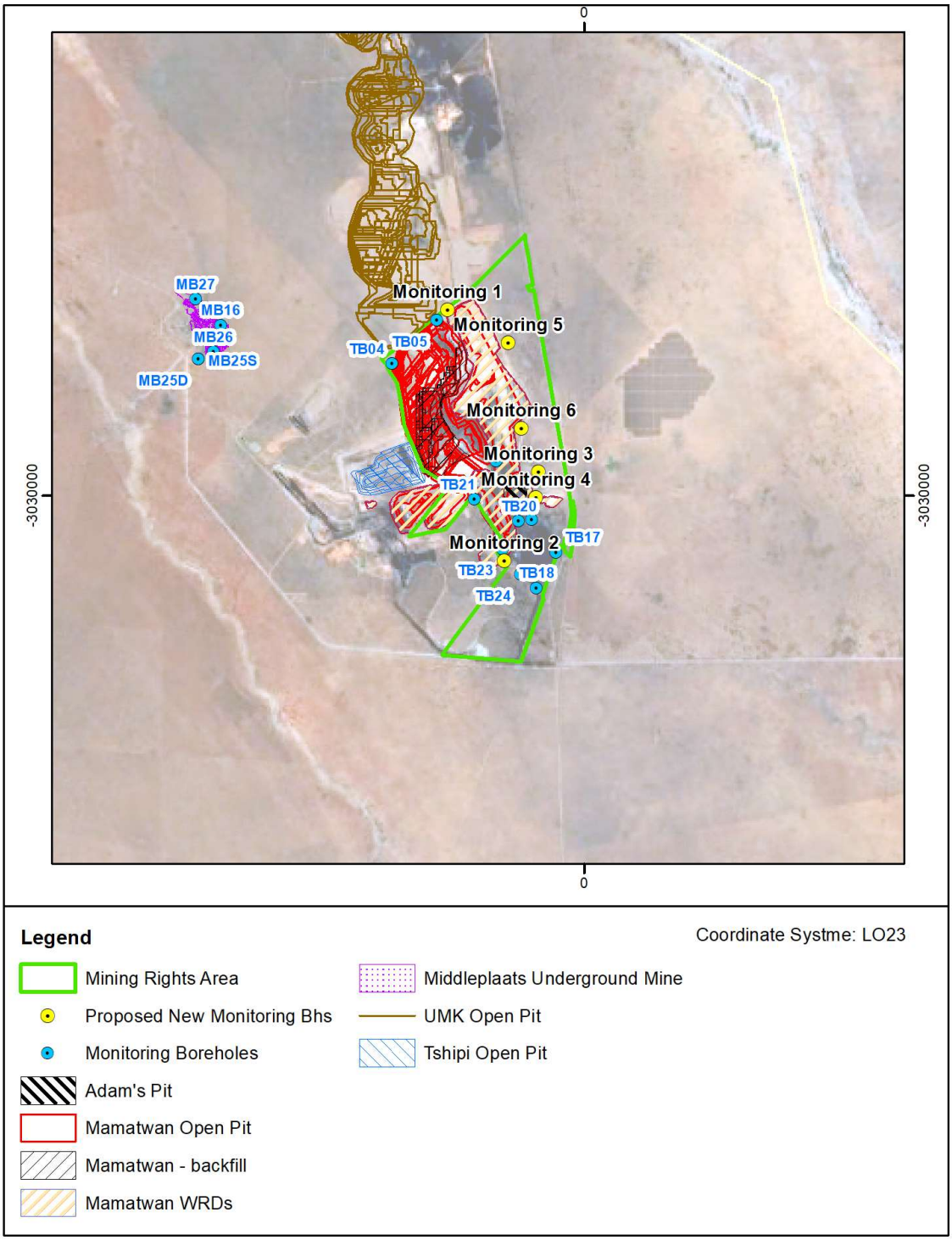

Figure 19-1: Proposed new monitoring locations

Table shows the coordinates (LO23) for the proposed new monitoring boreholes.

Table 19-1: Proposed new monitoring boreholes

Name	X	Y
Monitoring 1	-2237.85	-3026946.57
Monitoring 2	-1303.49	-3031070.54
Monitoring 3	-744.83	-3029613.59
Monitoring 4	-789.03	-3030028.59
Monitoring 5	-1236.85	-3027486.59
Monitoring 6	-1019.53	-3028895.89

Please note that the proposed locations must be verified to confirm accessibility, and that the locations are safe (they will not be covered by waste).

19.4 AIR QUALITY

Ambient air quality monitoring can serve to meet various objectives, such as:

- Compliance monitoring;
- Validate dispersion model results;
- Use as input for health risk assessment;
- Assist in source apportionment;
- Temporal and spatial trend analysis;
- Source quantification; and,
- Tracking progress made by control measures.

To ensure that mitigation is effective, it is recommended that the dustfall monitoring network at the mine be expanded to include single dust buckets at AQSR 4 and AQSR 5 (Figure 32). It is also recommended that PM10 sampling be conducted at AQSR 5 (or AQSR 6 if it is more secure). This can be done as an annual campaign before the project commences (as part of the baseline) and again once mitigated project operations are in place.

19.4.1 Periodic Inspections and Audits

Periodic inspections and audits are essential for progress measurement, evaluation and reporting purposes. It is recommended that sire inspections and progress reporting be undertaken at regular intervals (at least quarterly), with annual environmental audits being conducted. Annual environmental audits should be continued at least until closure. Results from site inspections and monitoring efforts should be combined to determine progress against source- and receptor-based performance indicators. Progress should be reported to all IAPs, including authorities and persons affected by pollution.

The criteria to be taken into account in the inspections and audits must be made transparent by way of minimum requirement checklists included in the management plan. Corrective action or the implementation of contingency measures must be proposed to the stakeholder forum in the event that progress towards targets is indicated by the quarterly review to be unsatisfactory.

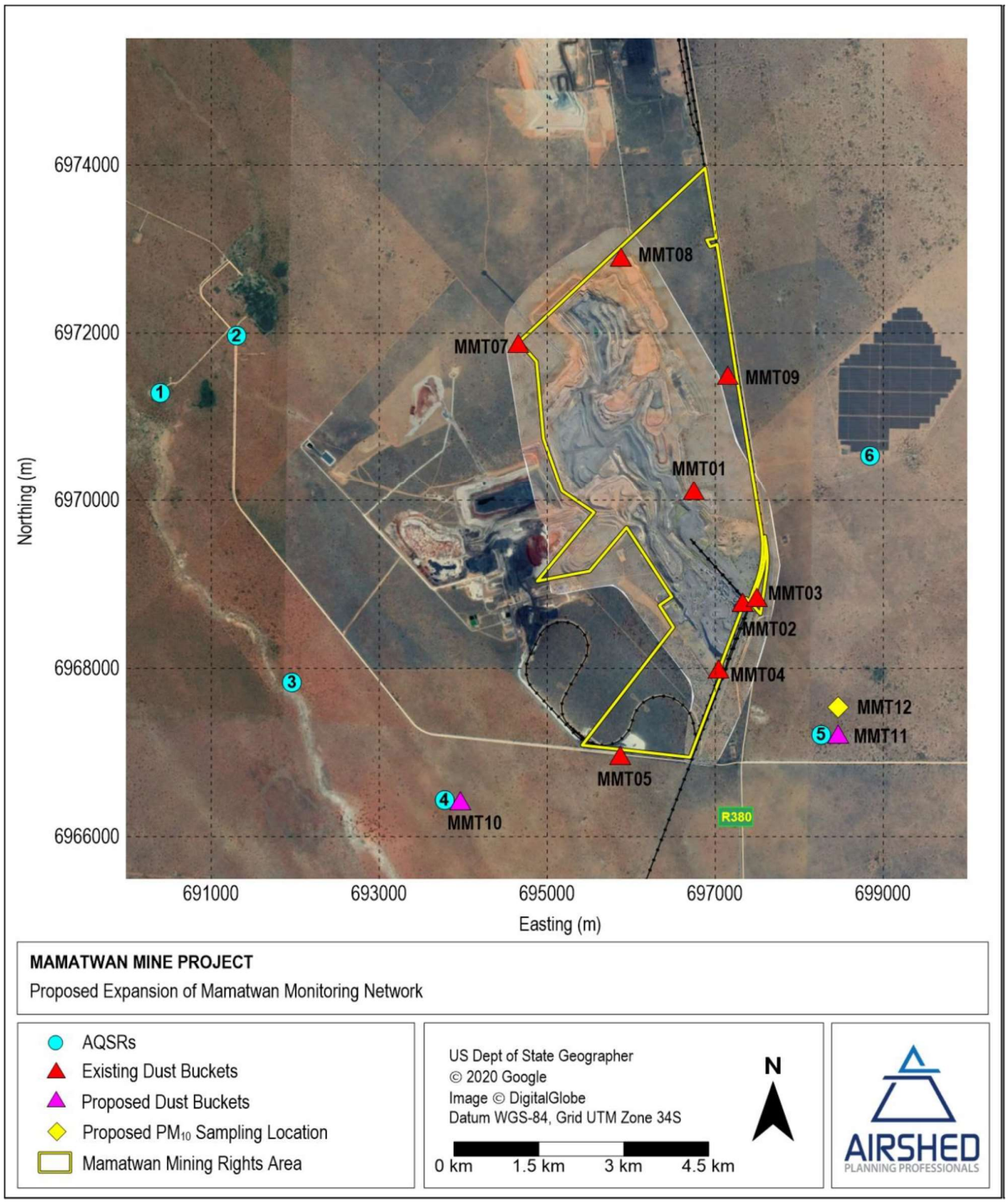

Figure 19-2: Recommended additions to the current air quality monitoring network

19.4.1 Liaison Strategy for Communication with IAPs

Stakeholder forums provide possibly the most effective mechanisms for information dissemination and consultation. Management plans should stipulate specific intervals at which forums will be held and

provide information on how people will be notified of such meetings. Given the proximity of the study site to the nearby farmsteads, it is recommended that such meetings be scheduled and held at least on an annual basis. A complaints register must be kept at all times.

19.4.2 Financial Provision

The budget should provide a clear indication of the capital and annual maintenance costs associated with dust control measures and dust monitoring plans. It may be necessary to make assumptions about the duration of aftercare prior to obtaining closure. This assumption must be made explicit so that the financial plan can be assessed within this framework. Costs related to inspections, audits, environmental reporting and I&APs liaison should also be indicated where applicable. Provision should also be made for capital and running costs associated with dust control contingency measures and for security measures. The financial plan should be audited by an independent consultant, with reviews conducted on an annual basis.

19.5 NOISE

Regular and effective maintenance of equipment and plants are essential to noise control. Increases in equipment noise are often indicative of eminent mechanical failure. Also, sound reducing equipment/materials can lose effectiveness before failure and can be identified by visual inspection.

Noise generated by vibrating machinery and equipment with vibrating parts can be reduced through the use of vibration isolation mountings or proper balancing. Noise generated by friction in conveyor rollers, trolley etc. can be reduced by sufficient lubrication.

In the event that noise related complaints are received, short term ambient noise measurements should be conducted as part of investigating the complaints. The results of the measurements should be used to inform any follow up interventions. The investigation of complaints should include an investigation into equipment that likely result or resulted in noise levels annoying to the community. This could be achieved with source noise measurements.

The following procedure should be adopted for all noise surveys:

- Any surveys should be designed and conducted by a trained specialist.
- Sampling should be carried out using a Type 1 SLM that meets all appropriate IEC standards and is subject to annual calibration by an accredited laboratory.
- The acoustic sensitivity of the SLM should be tested with a portable acoustic calibrator before and after each sampling session.
- Samples sufficient for statistical analysis should be taken with the use of portable SLM's capable of logging data continuously over the period. Samples representative of the day- and night-time acoustic environment should be taken.
- The following acoustic indices should be recoded and reported: LAeq (T), statistical noise level LA90, LAFmin and LAFmax, octave band or 3rd octave band frequency spectra.
- The SLM should be located approximately 1.5 m above the ground and no closer than 3 m to any reflecting surface.
- Efforts should be made to ensure that measurements are not affected by the residual noise and extraneous influences, e.g. wind, electrical interference and any other non-acoustic interference,

and that the instrument is operated under the conditions specified by the manufacturer. It is good practice to avoid conducting measurements when the wind speed is more than 5 m/s, while it is raining or when the ground is wet.

- A detailed log and record should be kept. Records should include site details, weather conditions during sampling and observations made regarding the acoustic environment of each site.

APPENDIX A: APPENDIX TITLE HERE

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