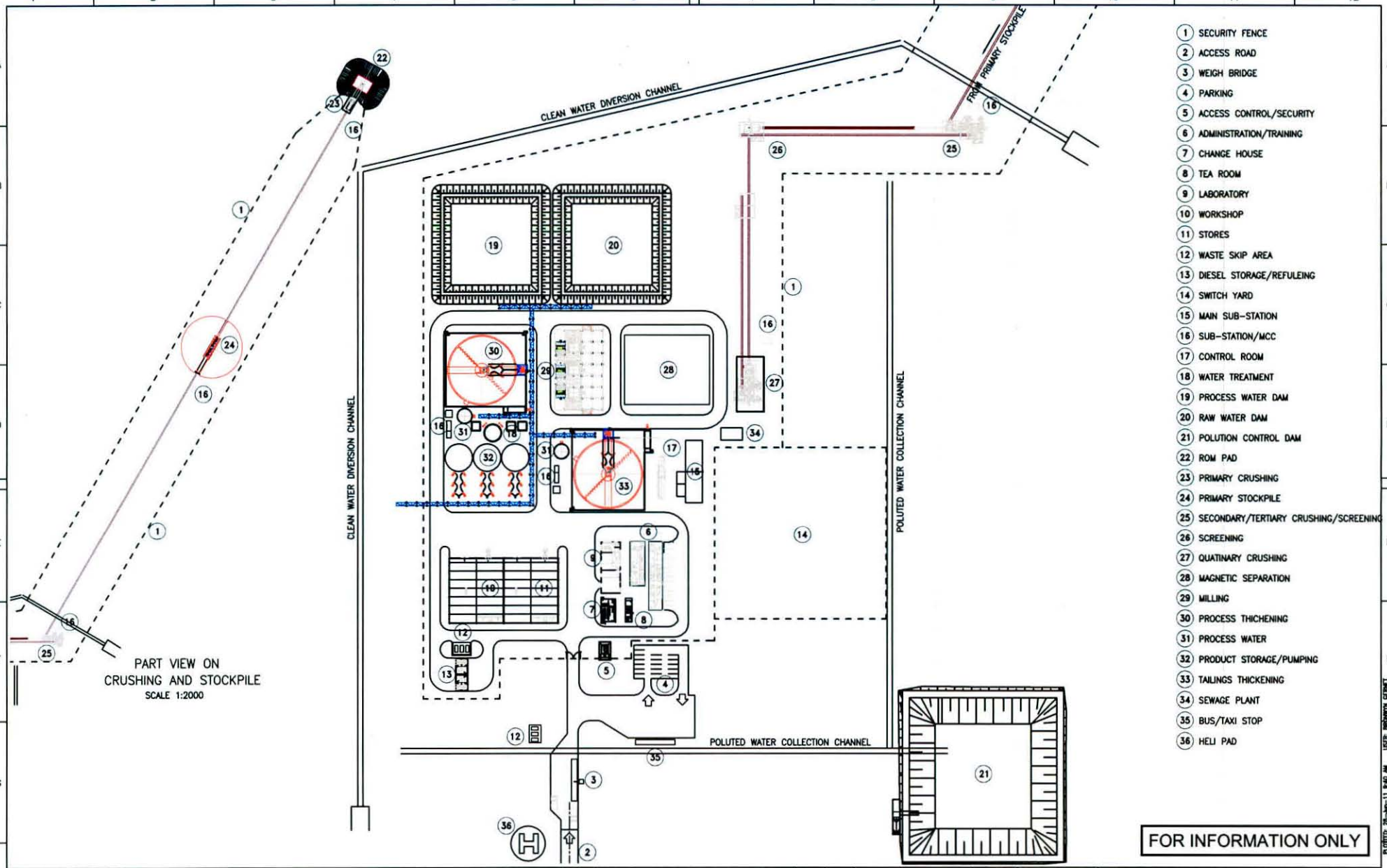

FOR INFORMATION ONLY

No.	BY	DATE	REVISION	CHECKED	APPROV.
F	G.B.	23.5.11	PART VIEW AND STORM WATER DRAINS ADDED		
E	G.B.	5.5.11	UPDATED		
D	G.B.	5.4.11	UPDATED TO NEW PLANT POSITION		
C	G.B.	28.2.11	UPDATED TO SUIT NEW PLANT POSITION		
B	G.B.	23.2.11	UPDATED TO SUIT SITE		
A	G.B.	21.2.11	FOR INFORMATION ONLY		

	BY	DATE
PROJECT APPR.		
DESIGN APPR.		
DESIGNED		
CHECKED		
DRAWN	G.BAXENDALE	21.2.2011

DRAWING No. | REFERENCE DRAWINGS

amec

SCALE 1:1000

CLIENT FERRUM CRESCENT LTD

TITLE FIGURE 17
MOONLIGHT IRON ORE PROJECT
PROCESSING PLANT
LAYOUT

PROJECT No. S2159 | DRG SIZE A1

DRAWING No. S2159-03000-05-121-002 | REV No. F

PLOTTED: 28-Jun-11 9:40 AM | USER: BROWN GERRET | SAVED: 22-Jun-11 8:54 AM

2.5 LISTED ACTIVITIES IN TERMS OF EIA REGULATIONS (NEMA AND NEM:WA)

The list of activities applied for under NEMA is included in Table 16. The list of waste-related activities applied for is presented in Table 17. These activities have been incorporated into the list of project activities as presented in Table 15.

TABLE 16: NEMA LISTED ACTIVITIES APPLIED FOR (AS PER APPLICATION DATED JULY 2010)

Notice and activity no:	Activity description
R386, 1(a)	The construction of facilities or infrastructure, including associated structures or infrastructure, for the generation of electricity where output is >10 megawatts but <20 megawatts.
R387, 1(a)	The construction of facilities or infrastructure, including associated structures or infrastructure, for the generation of electricity where (i) the electricity output is ≥20 megawatts; or (ii) the elements of the facility cover a combined area in excess of 1 hectare.
R386, 1(k)	The construction of facilities or infrastructure, including associated structures or infrastructure, for the bulk transportation of sewage and water, including stormwater in pipelines with (i) an internal diameter of ≥0.36m or (ii) peak throughput of ≥120 l/s or more.
R386, 1(l)	The construction of facilities or infrastructure, including associated structures or infrastructure, for the transmission and distribution of electricity above ground with a capacity of >33kv but <120kv.
R387, 1(l)	The construction of facilities or infrastructure, including associated structures or infrastructure, for the transmission and distribution of above ground electricity with a capacity of 120 kV or more.
R386, 1(n)	The construction of facilities or infrastructure, including associated structures or infrastructure, for the off stream storage of water, including dams and reservoirs, with a capacity of ≥50 000m^3, unless such storage falls within the ambit of the activity listed in item 6 of Government Notice No R387 of 2006.
R387, 6	The construction of a dam where the highest part of the dam wall as measured from the outside toe of the wall to the highest part of the wall is ≥5 metres or where the high-water mark of the dam covers an area of ≥10 hectares.
R386, 7	The aboveground storage of a dangerous good, including petrol, diesel, liquid petroleum gas or paraffin, in containers with a combined capacity of >30 cubic metres but <1000 cubic metres at any one location or site.
R387, 1(h)	The construction of facilities or infrastructure, including associated structures or infrastructure, for the manufacturing, storage or testing of explosives, including ammunition, but excluding licensed retail outlets and the legal end use of such explosives.
R387, 1(c)	The construction of facilities or infrastructure, including associated structures or infrastructure, for the above ground storage of a dangerous good, including petrol, diesel, liquid petroleum gas or paraffin in containers with a combined capacity of ≥1000 cubic metres at any one location or site including the storage of one or more dangerous goods in a tank farm.
R386, 13	The abstraction of groundwater at a volume where any general authorization issued in terms of the National Water Act 1998 (Act No 36 of 1998) will be exceeded.
R386, 15	The construction of a road that is wider than 4 metres or that has a reserve wider than 6 metres, excluding roads that fall within the ambit of another listed activity or which are access roads of less than 30 metres long.
R387, 5	The route determination of roads and design of associated physical infrastructure, including roads that have not yet been built, for which routes have been determined before the publication of this notice and which has not been authorized by a competent authority in terms of the EIA regulations 2006 made under section 24(5) of the Act and published in Government Notice No. R385 of 2006, where (a) it is a national road as defined in section 40 of the South African National Roads Agency Limited and National Roads Act, 1998 (Act No. 7 of 1998), (b) it is a road administered by a provincial authority, (c) the road reserve is wider than 30 metres; or (d) the road will cater for more than one lane of traffic in both directions.
R387, 1(e)	The construction of facilities or infrastructure, including associated structures or infrastructure, for any process or activity which requires a permit or license in terms of legislation governing the generation or release of emissions, pollution, effluent or waste and which is not identified in Government Notice No R386 of 2006 or included in the list of waste management activities published in terms of Section 19 of the National Environmental Management : Waste Act, 2008

Notice and activity no:	Activity description
	(Act No. 59 of 2008) in which case the activity is regarded as excluded from this list.
R387, 1(j)	The construction of facilities or infrastructure, including associated structures or infrastructure, for the bulk transportation of dangerous goods using pipelines, funiculars or conveyors with a throughput capacity of 50 tons or 50 cubic metres or more per day.
R387, 2	Any development activity, including associated structures and infrastructure, where the total area of the developed areas is, or is intended to be, 20 hectares or more.
R386, 1(c)	The construction of facilities or infrastructure, including associated structures or infrastructure, for the storage of 250 tons or more but less than 100 000 tons of coal.
R387, 1(s)	The construction of facilities or infrastructure, including associated structures or infrastructure, for rail transportation, excluding railway lines and sidings in industrial areas and underground railway lines in mines, but including (i) railway lines, (ii) stations, or (iii) shunting yards.
R386, 16	The transformation of undeveloped, vacant or derelict land to (a) establish infill development covering an area of 5 hectares or more, but less than 20 hectares; or (b) residential, mixed, retail, commercial, industrial or institutional use where the total area to be transformed is bigger than 1ha
R386, 20	The transformation of an area zoned for use as public open space or for a conservation purpose to another use.
R386, 17	Phased activities where any one phase of the activity may be below a threshold specified in this schedule but where a combination of the phases, including expansions or extensions, will exceed a specified threshold.
R386, 12	The transformation or removal of indigenous vegetation of ≥3 hectares or any size where the transformation or removal would occur within a critically endangered or an endangered ecosystem listed in terms of section 52 of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004).
R386, 1(v)	The construction of facilities or infrastructure, including associated structures or infrastructure, for the advertisements as defined in classes 1(a), 1(b), 1(c), 3(a), 3(b), 3(l) of the South African Manual for Outdoor Advertising Control.
R386, 1(b)	The construction of facilities or infrastructure, including associated structures or infrastructure, for the above ground storage of ore (>1000 tons but <100 000 tons).
R386, 1(q)(i)	The construction of facilities or infrastructure, including associated structures or infrastructure, for the landing, parking and maintenance of aircraft including helicopter landing pads, excluding helicopter landing facilities and stops used exclusively by emergency services.
R386, 14	The construction of masts of any material or type and of any height, including those used for telecommunication broadcasting and radio transmission, but excluding – (a) masts of 15 metres and lower exclusively used (i) by radio amateurs; or (ii) for lighting purposes; (b) flag poles; and (c) lightning conductor poles.

TABLE 17: NEM:WA LISTED ACTIVITIES RELEVANT TO THE PROJECT (GN32368, OF 3 JULY 2009)

Activity no:	Activity description
Category A3 (1)	The storage, including the temporary storage, of general waste at a facility that has the capacity to store in excess of 100m^3 of general waste at any one time, excluding the storage of waste in lagoons.
Category A3 (2)	The storage including temporary storage of hazardous waste at a facility that has the capacity to store in excess of 35m^3 of hazardous waste at any one time, excluding the storage of hazardous waste in lagoons.
Category A3 (11)	The treatment of effluent, wastewater or sewage with an annual throughput capacity of more than 2 000 cubic metres but less than 15 000 cubic metres.
Category B4 (7)	The treatment of effluent, wastewater or sewage with an annual throughput capacity of ≥15000m^3.
Category A3 (18)	The construction of facilities for activities listed in Category A of this Schedule (not in isolation to associated activity).
Category B4 (11)	The construction of facilities for activities listed in Category B of this schedule (not in isolation to associated activity).

2.6 INDICATION OF PHASES AND TIMEFRAMES ASSOCIATED WITH THE MAIN ACTIONS / ACTIVITIES / PROCESSES

An indication of the phases and estimated timeframes in relation to the main actions, activities or processes and infrastructure is provided in Table 15 above.

2.7 ADDITIONAL INFORMATION

Additional relevant information is included as follows:

- Appendix A – conceptual management plans for the following aspects of the mining operations:
  - Appendix A1: Security and Access Control
  - Appendix A2: Stockpile Management
  - Appendix A3: Soil Management (Conservation and Use)
  - Appendix A4: Non-Mineralised Waste Management
  - Appendix A5: Tailings Management
  - Appendix A6: Waste (Overburden/Rock) Management
  - Appendix A7: Biodiversity Management
  - Appendix A8: Water Use and Management
  - Appendix A9: Stormwater Management System
  - Appendix A10: Dust Management
  - Appendix A11: Noise Management
  - Appendix A12: Visual Management
  - Appendix A13: Blast Management
  - Appendix A14: Traffic Management
  - Appendix A15: Heritage Management
  - Appendix A16: Recruitment, Training, Procurement, Housing and Safety and Crime Management
  - Appendix A17: Involuntary Resettlement
  - Appendix A18: Compensation Plan
- Appendix B – project alternatives considered in the development of the project plan as presented in this EIA

3 POTENTIAL IMPACTS ON THE BIO-PHYSICAL ENVIRONMENT

3.1 LIST OF POTENTIAL IMPACTS ON ENVIRONMENTAL ASPECTS

This section provides a list of potential impacts on environmental aspects (excluding social and cultural aspects – see Section 6) separately in respect of each of the main project actions / activities and processes including activities listed in the NEMA and NEM:WA EIA regulations. The potential impacts are presented for each of the project phases in tabular format (Table 18).

TABLE 18: LIST OF POTENTIAL IMPACTS AS THEY RELATE TO PROJECT ACTIONS / ACTIVITIES / PROCESSES (EXCLUDING SOCIAL AND CULTURAL)

Activity	Phase	Impacts (unmitigated)
Exploration Drilling, trenching, sample analysis	Construction Operation	Loss of soil resources and land capability Physical destruction and disturbance of biodiversity Alteration of drainage patterns Air pollution Disturbing noise
Site preparation Bush clearing, removal of infrastructure, establishing construction area	Construction Operation	Physical destruction and disturbance of biodiversity Alteration of drainage patterns Air pollution Disturbing noise Negative landscape and visual impact
Earthworks Stripping and stockpiling soils, bulldozing, temporary gravel roads, trenches, foundation excavation and compaction, construction borrow pits, establishing stormwater controls, road grading	Construction Operation	Hazardous excavations Loss of soil resources and land capability Physical destruction and disturbance of biodiversity Alteration of drainage patterns Pollution of surface water Air pollution Disturbing noise Negative landscape and visual impact
Civil works Building activities, erection of structures, concrete work, steel work, electrical installation, establishing pipelines	Construction Operation Decommissioning	Hazardous excavations Loss of soil resources and land capability Pollution of surface water resources Contamination of groundwater Air pollution Disturbing noise Negative landscape and visual impact
Open pit mining Drilling, blasting, load, hauling, dewatering	Operation Decommissioning and closure (final land form)	Hazardous excavations Loss of soil resources and land capability Pollution of surface water resources Dewatering impacts Air pollution Disturbing noise Negative landscape and visual impact

Activity	Phase	Impacts (unmitigated)
Waste rock management Storage, final disposal	Operation Decommissioning and closure (final land form)	Hazardous excavations Loss of soil resources and land capability Disturbance of biodiversity Pollution of surface water resources Contamination of groundwater Air pollution Disturbing noise Negative landscape and visual impact
Mineral processing operations Materials handling and storage (including stockpiling), crushing and screening (dry), grinding (dry and wet), magnetic separation, concentrate handling	Operation	Hazardous excavations Loss of soil resources and land capability Disturbance of biodiversity Pollution of surface water resources Contamination of Air pollution Disturbing noise Negative landscape and visual impact
Tailings management Storage, final disposal	Operation Decommissioning and closure (final land form)	Hazardous excavations Loss of soil resources and land capability Disturbance of biodiversity Pollution of ephemeral surface water resources Contamination of groundwater Air pollution Disturbing noise Negative landscape and visual impact
Power supply and use Delivery on site, distribution, temporary generation, alternative power generation	Construction Operation Decommissioning	Physical destruction and disturbance of biodiversity Negative landscape and visual impact
Water supply Delivery on site, storage of clean water	Construction Operation Decommissioning	Hazardous excavations Disturbing noise
Process water management Collection, storage of dirty for re-use, recycling	Construction Operation Decommissioning	Hazardous excavations Loss of soil resources and land capability Pollution of surface water resources Contamination of groundwater Disturbing noise
Stormwater management Stormwater channels and berms, collection of dirty, storage for re-use	Construction Operation Decommissioning	Hazardous excavations Loss of soil resources and land capability Alteration of drainage patterns Pollution of surface water resources Contamination of groundwater Disturbing noise
Transport systems Use of access points, road transport to and from site for employees and supplies, movement within site boundary (haul roads, conveyors, pipelines), taxi and bus areas, helipad, pumping concentrate off-site	Construction Operation Decommissioning Closure (limited road)	Physical destruction and disturbance of biodiversity Pollution of surface water resources Air pollution Disturbing noise Negative landscape and visual impact

Activity	Phase	Impacts (unmitigated)
Non-mineralised (general and industrial hazardous) waste management Collection, separation, temporary storage, sorting, removal for recycling or final disposal off site, temporary facilities, ablutions on site, treatment plant on site, re-use sludge in rehabilitation	Construction Operation Decommissioning Closure (limited)	Loss of soil resources and land capability Pollution of surface water resources Contamination of groundwater Disturbing noise Negative landscape and visual impact
Site support services Operating offices, canteen, clinic, communications tower, parking vehicles	Construction Operation Decommissioning Closure (limited)	Loss of soil resources and land capability Disturbance of biodiversity Air pollution Negative landscape and visual impact
Storage and maintenance services/ facilities Washing and servicing vehicles and machinery, storage and handling non-process materials	Construction Operation Decommissioning	Loss of soil resources and land capability Pollution of surface water resources Contamination of groundwater Disturbing noise
Housing – non planned on site	-	-
Site/contract management Appointment of workers/contractors, site management (monitoring, inspections, maintenance, security, access control), awareness training, emergency response, implementing and maintaining programmes	Construction Operation Decommissioning Closure	Management of the site plays a significant role in all identified impacts
Demolition Dismantling, demolition, removal of equipment	Operation (as part of maintenance) Decommissioning	Loss of soil resources and land capability Disturbance of biodiversity Air pollution Disturbing noise Negative landscape and visual impact
Rehabilitation Replacing soil, slope stabilisation, landscaping, re-vegetation, restoration	Construction Operation Decommissioning Closure	Hazardous excavations Loss of soil resources and land capability Disturbance of biodiversity Alteration of drainage patterns Pollution of surface water resources Contamination of groundwater Air pollution Disturbing noise Negative landscape and visual impact
Maintenance and aftercare Inspection and maintenance of remaining facilities and rehabilitated areas	Closure	Loss of soil resources and land capability Disturbance of biodiversity Pollution of surface water Air pollution Negative landscape and visual impact

3.2 LIST OF POTENTIAL CUMULATIVE IMPACTS

Potential cumulative impacts associated with the project, were identified by considering the existing land uses together with the proposed mine development, and include increased pressure on water resources, disturbance to biodiversity, contamination of groundwater resources and increased air pollution.

3.3 POTENTIAL FOR ACID MINE DRAINAGE OR GROUNDWATER CONTAMINATION

Information in this section was sourced from the groundwater study (MWG[a] 2011) and waste design report (Metago[d] 2011) and should be read with reference to Figure 3 (Section 1.4).

3.3.1 GEOLOGY

The regional geology is dominated by the Archaean basement lithologies (ultramafic, mafic and pelitic gneisses) of the Beit Bridge Complex within the Limpopo Mobile Belt (LMB). The LMB is subdivided into three domains, namely the Central, the South Marginal and the Northern Marginal Zones. The Moonlight deposit is located within the Central Zone of the LMB. The study area lies north of the junction between the highly metamorphic rocks of the Central zone of the LMB and the Waterberg Group Strata overlying the Kaapvaal Craton. The LMB is truncated by large east-west trending faults (for example, Melinda Fault) with younger cover rocks (for example, Waterberg Group) and the northern lobe of the Bushveld Complex on the down faulted side of the fault (MWG 2011) (Figure 3).

The iron ore to be mined occurs mainly in coarse-grained magnetite within the well-developed mineral layered metapelitic migmatitic gneisses (Banded Iron Formations (BIFs)) of the Mount Dowe Group. Information on the presence of mineralisation within this area is based on exploration data collected by Turquoise Moon since 2005.

Outcrop in the area is poor with most of the ore body overlain by approximately 50 to 65m of alluvium, sand and calcrete. The BIFs within the Moonlight deposit strike east-northeast with a flat shallow dip towards the north. The BIF units vary from a few metres to 40 m in thickness.

3.3.2 MINERALOGY OF THE ORE BODY

At and near the surface, the magnetite is often totally oxidised to hematite, goethite and limonite. Alteration and oxidation of the magnetite decreases fairly rapidly downwards, with the result that the iron minerals are highly magnetic (maghemite) within a few metres of the surface. Hematite is also found at depth far below the weathered zone, as a subordinate to very minor mineral with the magnetite. The hematite was probably formed during metamorphism under slightly oxidising conditions (Amec 2011). The gangue minerals consist of essentially quartz (20-64%) with varying amounts of K-feldspar (0-5%), calcite (0-5%), actinolite and hornblende (<5%) and plagioclase (<5%). Minor accessory minerals include talc, chlorite, epidote and very rare garnet, clay minerals, apatite and grunerite (Badenhorst 1992 as cited). The average in situ chemistry of the Moonlight ore body is shown in Table 19. It is worth noting that sulphur occurs in trace amounts.

TABLE 19: SUMMARY OF IN-SITU CHEMICAL ANALYSIS OF MOONLIGHT DEPOSIT

Major oxide or element	Formula	Percentage (%)
Iron (total)	Fe(total)	33.8
Silicon Oxide	SiO_2	44.7
Aluminium Oxide	Al_2O_3	1.20
Potassium oxide	K_2O	0.10
Phosphorus	P	0.04
Manganese	Mn	0.06
Titanium Oxide	TiO_2	0.16
Calcium Oxide	CaO	1.90
Magnesium Oxide	MgO	2.60
Chromium Oxide	Cr_2O_3	0.03

3.3.3 GEOCHEMICAL TESTWORK

No tailings or waste rock sample were available for testing during the EIA. Project specific samples of core material (oxidised and fresh mineralisation) from the 2008 drilling program were used for geochemical analyses (a mineralogical assessment, acid base accounting and paste pH testing). A selection of 45 samples (representing the lithologies of the iron ore deposit) was used to predict the likely geochemical characteristics of the tailings. The analyses were managed by the project feasibility team (Amec) with the analyses being undertaken by SGS Laboratories. The analyses were conducted in April 2011. It is planned by the feasibility team to undertake leachate tests during the definitive feasibility study.

3.3.4 SUMMARY OF RESULTS

The results of the mineralogical assessment and Acid Base Accounting tests indicate that the risk of acid generation is unlikely given the low percentage of pyrite, as well as, the neutralizing potential of alkali materials (e.g. apatite, calcite, dolomite etc.). Furthermore, there is unlikely to be any metal leachability issues since the tailings contains only small amounts of magnesium (Mg), aluminium (Al), calcium (Ca), titanium (Ti) and potassium (K). Leachate from the TSF is therefore unlikely to adversely impact the quality of the groundwater in the vicinity of the TSF. The result of this study was taken into consideration in the groundwater modelling exercise and conceptual design of the TSF.

3.3.5 OVERVIEW OF ASSESSMENT AND EVALUATION OF IMPACT

Potential groundwater pollution impacts are discussed and assessed in Section 7.2.7. In the unmitigated scenario, the TSF and waste dumps have the potential to significantly impact the quality of groundwater. While geochemistry-related tests show that limited to no potential for acid rock drainage exists, there is potential for salt and/or metal-related pollution. In the unmitigated scenario, the significance of potential impacts on downstream groundwater users is high in the operational, decommissioning and closure phases. In the mitigated scenario the significance reduces to low. Key to this is professionally designed

facilities, pollution prevention, on-going modelling of potential impacts, monitoring and compensation (if mine-related loss occurs) (see Table 31, Section 19).

3.3.6 RECOMMENDATIONS MADE BY GEO-HYDROLOGY STUDY

The waste design and groundwater studies recommend the following (Appendix K and Appendix U):

- Re-run of the groundwater model including element specific retardation or transformation once additional geochemistry data on leachates and site data from on-going monitoring can be used to verify the model parameters.
- On-going modelling of the TSF contaminant plume to determine the post-closure operation and to determine the need for a seepage interception system (if required). Following closure of the TSF, seepage rates (and the movement of the contaminant plume) are expected to drop.

4 ALTERNATIVE LAND USE OR DEVELOPMENT

4.1 DESCRIPTION OF ALTERNATIVE LAND USE OF THE AREA

The site is currently used for game farming, cattle farming, hunting and residential. Surrounding land uses are similar to this with the addition of irrigated crop farming and larger scale hunting and tourism operations (farms providing accommodation) (see Section 1.3.1 for a detailed description of existing land uses in the area).

As an alternative to the development of the mine, these current land uses would continue. It is possible that the landowners on the site could consider venturing into larger scale agriculture or tourism operations. This could include increasing their cattle and game farming practises, establishing accommodation facilities and additional irrigated farming. This would tie in with land uses in the surrounding area. A key factor, as identified by the land use specialist, is the availability of water resources (see Section 1.3.1). No other land uses are considered feasible at this stage.

4.2 MAIN FEATURES AND INFRASTRUCTURE RELATED TO ALTERNATIVE LAND USE / DEVELOPMENT

Potential features and infrastructure that could be associated with the alternative land use/development are listed below and fall within the type of infrastructure found in the surrounding area (see Section 1.3.4).

Feature / infrastructure	Description
Game farming / hunting	Introducing additional/new game to the farms Establishing watering holes
Livestock farming	Introducing additional/new livestock to the farms Establishing watering holes
Accommodation / facilities	Building hunting or tourism-type accommodation facilities (such as campsites, self-catering units, and lodges) of varying scales. Building farm work / service staff accommodation and facilities
Roads	Gravel roads providing access around the farms for visitors and tourists
Water supply	Drilling and establishing additional boreholes and pipelines for water supply
Power supply	Establishing low voltage power supply lines to service accommodation units / facilities
Communication	Establishing telephone lines
Agriculture	Preparing and working agricultural fields Establishing farms dams

4.3 PLAN SHOWING LOCATION AND EXTENT OF ALTERNATIVE LAND USE / DEVELOPMENT

A plan showing the location and extent of the alternative land use / development is not possible to present at this stage as this would depend on the individual landowners preferences and financial situation.

5 POTENTIAL IMPACTS OF ALTERNATIVE LAND USE OR DEVELOPMENT

5.1 LIST OF POTENTIAL IMPACTS

Potential impacts, expected to occur as a result of the alternative land use / development described in Section 4 above, are listed below:

Feature / infrastructure	**Potential impacts**
Game farming / hunting Livestock farming	Increased pressure on veld resources Loss of soils through incorrect management Increased income and associated socio-economic benefits Increased pressure on water resources
Accommodation / facilities	Loss of natural vegetation Loss of soils through incorrect management Surface and/or groundwater pollution through unmanaged sanitation facilities Increased income and associated socio-economic benefits
Roads	Dust generation Accidents
Water supply	Increased pressure on water resources
Power supply	Negative impacts on bird species
Communication	No impacts expected
Agriculture	Alteration of natural drainage patterns Surface and/or groundwater pollution through the use of fertilisers Dust generation from exposed areas Increased income and associated socio-economic benefits

5.2 LIST OF POTENTIAL CUMULATIVE IMPACTS

Potential cumulative impacts associated with the alternative land use, when compared to the existing land use on site and in the surrounding area, are expected to include:

- Increased pressure on water resources
- Increased pressure on veld resources for grazing purposes

6 POTENTIAL SOCIAL AND CULTURAL IMPACTS

6.1 LIST OF POTENTIAL IMPACTS ON SOCIO-ECONOMIC CONDITIONS OF THIRD PARTY LAND USE ACTIVITIES

Potential impacts on the socio-economic conditions of other parties land use activities both on site and in the surrounding area are discussed in detail in Section 7 and listed below. This list includes potential impacts on cultural and heritage resources (Section 6.3).

- Loss of current land uses through impacts on the bio-physical environment
- Blasting hazards
- Project-related road use and traffic
- Destruction of heritage resources
- Disturbance (indirect) of heritage resources
- Loss of palaeontological resources
- Economic impacts (positive and negative)
- Informal settlements, safety, security and services and associated social ills
- Relocation
- Change in land values

6.2 CULTURAL ASPECTS AND POTENTIAL IMPACTS THEREON

Cultural aspects are discussed as part of heritage discussion below.

6.3 HERITAGE FEATURES AND POTENTIAL IMPACTS THEREON

6.3.1 HERITAGE (AND CULTURAL) FEATURES

Heritage (and cultural) features on site include three graveyards and one historical house (see Section 1.3.3 for further detail). At least two of the graveyards will be affected by the development of the open pit mine. A further graveyard and one historical house (older than 60 years) could also be disturbed by the project. In most instances the disturbance of graves is avoided where possible through the positioning of surface infrastructure. However the position of the ore body makes the disturbance of the two graveyards unavoidable. It is also possible that further heritage resources, such as unmarked graves, are uncovered during the development of the mine and site. This is expected to be unlikely but still possible.

Potential impacts on heritage (including cultural) features include the loss of these resources for future generations through physical destruction and/or disturbance (described further in Sections 7.2.14 and

7.2.15). These resources are protected by national legislation and require mitigation prior to any disturbance.

6.3.2 PALAEONTOLOGICAL FEATURES

Geological formations on site have the potential to host fossils. It is considered (by the specialist) highly unlikely that any will be uncovered during the development of the mine (see Section 1.3.3 for further detail).

Potential impacts on Palaeontological resources include the loss of these resources for future generations through physical disturbance (described further in Section 7.2.16). Although unlikely, should any fossils be uncovered during the development of the site, a palaeontologist or palaeoanthropologist should be consulted as this could open up possibilities for research.

6.4 QUANTIFICATION OF IMPACT ON SOCIO-ECONOMIC CONDITIONS

Land use and socio-economic studies were undertaken for the project. Results from the studies informed the impact assessment described in Section 7. In this regard, it was identified that the proposed project has the potential to impact on surrounding land uses and economic activity (contributing impact factors are air, noise, visual, blasting, dewatering, traffic). A key mitigation is establishing a base case valuation prior to the commencement of mining activities (see Table 44, Section 19).

A summary of the findings of the specialist studies are included below.

- The number of farms that could potentially be impacted on and for which economic value is likely to be lost in the agricultural sector is eight based on input from the land use specialist (this includes the three farms that form part of the application boundary).
- Telephonic interviews with farmers indicate an average of 10 workers per farm. This equates to a potential loss of 80 employees, against a potential creation of 455 operational mine employees.
- Given that the 80 agricultural jobs is a certainty (based on current economic activity) and that the mine is a new venture, the employment creation is reduced to 227 (to cater for the uncertainty).
- An estimated regional job multiplier (as opposed to a national one as there is generally a lot of leakage out of a region) was applied (1:4 for the mining sector and 1:1.2 for the agricultural sector) resulting in a total employment of 910 for the mine versus a loss of 96 agricultural jobs.
- Applying average gross geographic product (GGP) ratios based on Quantec Research for Lephalale Municipality, the economic value added equates to approximately R7.35 billion gained over a 30 year period (for the mine) and R580 million lost over a 50 year period (to the agricultural sector).
- Based on economic value added and jobs created, the mining land-use is economically better.

- The net present value comparison between the alternative land uses and the proposed mining operation indicates that the economic benefit associated with the mining development would outweighs the potential loss of agriculture or hunting.

7 ASSESSMENT AND EVALUATION OF POTENTIAL IMPACTS

7.1 LIST OF EACH POTENTIAL IMPACT

Potential environmental impacts were identified by Metago in consultation with IAPs, regulatory authorities, specialist consultants and Turquoise Moon. The impacts are discussed under issue headings in this section. All identified impacts are considered in a cumulative manner such that the current baseline conditions on site and in the surrounding area and those potentially associated with the project are discussed and assessed together.

Potential impacts identified for the project include:

- Hazardous structures / excavations
- Loss of soil resources and associated natural land capabilities
- Physical destruction and general disturbance of biodiversity
- Alteration of drainage patterns (including ephemeral pan-like structures)
- Pollution of surface water resources
- Dewatering impacts on third party users
- Contamination of groundwater
- Increase in air pollution
- Increase in disturbing noise levels
- Negative landscape and visual impacts
- Loss of current land uses
- Blasting hazards
- Project-related road use and traffic
- Destruction of heritage resources
- Disturbance (indirect) of heritage resources
- Loss of palaeontological resources
- Loss of mineral resources through sterilisation
- Economic impacts (positive and negative)
- Informal settlements, safety, security and services and associated social ills
- Relocation
- Change in land values

7.2 IMPACT RATING FOR EACH POTENTIAL IMPACT

The impact rating for each potential impact listed above (Section 7.1) is provided in the section below. The criteria used to rate each impact is outlined in Section 7.3. The potential impacts are rated with the assumption that **no mitigation measures** are applied and then again with mitigation. An indication of the

phases in which the impact will occur is provided below and summarised in Section 7.4 together with the estimated timeframes for each rated impact.

TOPOGRAPHY

7.2.1 ISSUE: HAZARDOUS STRUCTURES / EXCAVATIONS

Introduction

Hazardous structures include all excavations, infrastructure or land forms into or off which third parties (non-mine personnel) and animals can fall and be harmed. Included in this category are facilities that can fail (such as the tailings storage facility (TSF)). Hazardous excavations and infrastructure occur in all project phases from construction through operation to decommissioning and closure (see Section 3, Table 18 for further detail). In the construction and decommissioning phases these hazardous excavations and infrastructure are temporary in nature, usually existing for a few weeks to a few months. The operational phase will present more long term hazardous excavations and infrastructure and the closure phase will present final land forms that are considered hazardous (open pit, TSF, waste dumps).

Rating of impact

Severity / nature

In all project phases, most of the identified hazardous excavations and infrastructure present a potential risk of injury and/or death to both animals (wildlife, livestock and game relating to the existing farming and hunting land uses) and third parties resulting in a potentially high severity.

Duration

In the context of this assessment, death or permanent injury to humans and animals is considered a long term and permanent, regardless of the project phase.

Spatial scale / extent

For the most part, the direct impacts will be located within the site boundary, but the indirect impacts will extend to the communities to which the people / animals belong. This is applicable to all project phases.

Probability

In the case of third parties, in the unmitigated scenario, there is a high possibility that the hazardous excavations and infrastructure will present a risk to unaccompanied third parties on-site, people travelling on the section of the re-routed D1347 gravel road downstream of and adjacent to the TSF, third parties visiting or hunting on properties downstream of the TSF and free-roaming animals during construction, operation and decommissioning. After closure, the final landforms may present a risk to third parties depending on infrastructure stability and access to the site.

Significance

In the unmitigated scenario, the significance of this potential impact is high.

Unmitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	M	H	H	H

Mitigated – summary of the rated impact per phase of the project

This rating assumes the mitigation measures as included in Table 25 (Section 19) and Appendix A are implemented by the mine. Key mitigation measures are the establishment and maintenance of access control and security measures, public awareness, personnel training, professionally designed land forms, rehabilitation of final land forms and emergency response.

In this regard, the significance of the mitigated impact will reduce to low in the construction, operation and decommissioning phases due to a reduced severity and likelihood of the impact occurring. In the closure phase, the significance of the mitigated impact will either be medium or low depending on access to the site, and more specifically the open pit, by third parties.

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation and decommissioning						
Mitigated	L	H	M	M	L	L
Closure						
Mitigated	L	H	M	M	M-L	M-L

SOIL AND LAND CAPABILITY

7.2.2 ISSUE: LOSS OF SOIL RESOURCES AND ASSOCIATED NATURAL LAND CAPABILITIES

Information based on soil specialist study (ESS 2011) (Appendix G).

Introduction

Soil is a valuable resource that supports a variety of ecological systems. The project has the potential to damage soil resources through physical disturbance and/or contamination. Contamination of soils also has the potential to enter both surface and groundwater resources (see Sections 7.2.5 and 7.2.7, respectively). The loss of soil resources has a direct impact on the potential loss of the natural capability of the land. This section therefore focuses directly on the potential for disturbance and contamination of the soil resource and the effect this has on land capability. Any potential direct impacts on soil will potentially have secondary impacts on the ecological systems that make use of the soil for survival.

The project will disturb approximately 1,020ha of soil resources with a range of natural capabilities. The majority of the area to be disturbed comprises arable (achievable with good water management) and low intensity grazing. Areas of wet soils will be disturbed by the placement of the TSF, return water dam and southern waste dump. The site layout has aimed to place infrastructure in as close a proximity to each other as possible, governed by the position of the ore body.

There are a number of activities/infrastructure in all phases that have the potential to result in a loss of soils and associated land capabilities (see Section 3, Table 18 for further detail). In the construction and decommissioning phases these activities are temporary in nature, usually existing from a few weeks to a few months. The operational phase will present more long term activities and the closure phase will present final land forms that may be susceptible to erosion. In rehabilitation, soil is the key to re-establishing post closure land capability that will support agricultural type land uses.

Rating of impact

Severity / nature

In the unmitigated scenario, physical disturbance (including contamination) of soil resources can result in a loss of soil functionality as an ecological driver (soil is the medium in which most vegetation grows) and may impact on the soils ability to sustain ecological systems post-project. In the case of erosion (through wind or water), the soils will be lost to the area of disturbance and in the case of compaction the soils functionality will firstly be compromised through a lack of rooting ability and aeration, and secondly the compacted soils are likely to erode because with less inherent functionality there will be little chance for the establishment of vegetation and other matter that naturally protects the soils from erosion. In the case of potential contamination, the use and handling of fuels, lubricants, other potential contaminants and poor waste management could result in a permanent loss of soil resources. Potential seepage and/or dirty runoff from mineralised waste stockpiles could alter the soil composition, negatively impacting on the chemistry of the soils such that current growth conditions (which are already less optimal) are further impaired. Although there is limited potential for acid rock drainage, high concentrations of suspended solids and dissolved salts within these seepage/runoff waters could negatively impact soil resources. This is complicated by the sensitive nature of some of the soils found on site, namely the wet base soils and calcrete layer. All aspects discussed above, will lead to a reduction and possibly a permanent loss of the natural capability of the soils if not managed. In the unmitigated scenario, the severity is high for all phases.

Duration

In the unmitigated scenario the loss of soil and related functionality is long term and will continue after the life of the mine.

Spatial scale / extent

In the unmitigated scenario for all phases of the project, the potential loss of soil resources and associated land capabilities will be restricted to within the site boundary.

Consequence

In all project phases, the consequence of the impact is high in the unmitigated scenario.

Probability

In the unmitigated scenario, a loss of soil resource and associated land capability is definite for all phases.

Significance

For all project phases, the significance of the impact is high in the unmitigated scenario.

Unmitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	L	H	H	H

Mitigated – summary of the rated impact per phase of the project

This rating assumes the mitigation measures as included in Table 26 (Section 19) and Appendix A are implemented by the mine. Key to this is limiting the disturbance footprint, establishing containment measures for hazardous substances, establishing stormwater controls, good "housekeeping", implementing a waste management procedure for general and industrial hazardous waste and implementing a site-specific soil management procedure that is aimed at conserving soil resources for re-use in rehabilitation of disturbed areas.

In this regard, the significance of the mitigated impact will reduce to medium-low in all phases as although the severity, duration and likelihood of the impacts occurring is reduced, careful monitoring is needed to ensure mitigation measures are implemented effectively. At closure, the land capability of approximately 851.5ha comprising the open pit, TSF and waste dumps will be changed in perpetuity.

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Mitigated	L	L	L	L	M-L	M-L

7.2.3 ISSUE: PHYSICAL DESTRUCTION AND GENERAL DISTURBANCE OF BIODIVERSITY

Information based on biodiversity specialist study (Ecorex 2011) (Appendix H).

Introduction

In the broadest sense, biodiversity provides value for ecosystem functionality, aesthetic, spiritual, cultural, and recreational reasons. The known ecosystem related value is listed as follows:

- soil formation and fertility maintenance
- primary production through photosynthesis, as the supportive foundation for all life
- provision of food and fuel
- provision of shelter and building materials
- regulation of water flows and water quality
- regulation and purification of atmospheric gases
- moderation of climate and weather
- control of pests and diseases
- maintenance of genetic resources (key for medicines, crop, livestock breeding and game breeding).

There are a number of activities/infrastructure in all phases (see Section 3, Table 18 for further detail) that have the potential to destroy biodiversity through loss and/or transformation of habitat, increased pressures from harvesting and poaching, alien plant invasion, impoverishment and/or loss of important plant and animal species and disruption of animal movements. It is in this context that impacts on biodiversity are assessed below. Secondary impacts on biodiversity associated with soil erosion, compaction and pollution, dust fallout and noise have been assessed in Sections 7.2.2, 7.2.8 and 7.2.9, respectively, and will not be repeated below.

Rating of impact

Severity / nature

With reference to the conservation importance/sensitivity map which considers vegetation communities, vertebrates and invertebrates (Figure 7), the proposed project will be located within areas ranging from very low to medium-high conservation importance. Disturbance of the more sensitive communities is unavoidable given their spatial extent and predominant occurrence across the project site. A number of isolated, shallow temporary pan-like structures occur on site. A few water-dependent species such as frogs and butterflies were found to occur both at the pan-like structures and at man-made dams in the project area. No riparian type vegetation was found at the pan-like structures.

The clearing of vegetation, destruction of habitats and pan-like structures and possible destruction of faunal species unable to move from the area is expected to have a medium severity in the unmitigated construction and operational scenario, when considering vegetation and vertebrate communities alone. However with the inclusion of the invertebrate communities, the severity increases to medium-high given the importance of invertebrate species within the vegetation communities that will be disturbed as well as the size of the area to be disturbed (approximately 1,020ha). Decommissioning phase activities will for the most part take place on already cleared areas however further loss of biodiversity may occur if incorrect rehabilitation practises are employed resulting in a medium severity. During these phases, potential impacts are exacerbated by the presence of the mine on site through potential dust fallout, blast fumes and fly rock from blasting activities and water-related losses (through dewatering and pollution) as well as humans on site and the increased potential for illegal harvesting and poaching. During the life of the mine and especially in the closure phase, exposed unmitigated landscapes and disturbed areas will be prone to the colonisation of secondary pioneer species or alien/invasive plants which is high severity given the relatively low numbers of alien plants within the project site.

Duration

In the unmitigated scenario the loss of biodiversity and related functionality and subsequent colonisation of alien/invasive species is long term and will continue after the life of the mine.

Spatial scale / extent

Biodiversity processes are not confined to the project site. In the unmitigated scenario of all phases, the potential exists for impacts to extend beyond the site of disturbance.

Consequence

In the unmitigated scenario, the consequence of this potential impact is high in all project phases.

Probability

In the unmitigated scenario for all phases, a long term loss or transformation of biodiversity and colonisation by alien plants is definite.

Significance

In the unmitigated scenario, the significance of this potential impact is high.

Unmitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation and closure						
Unmitigated	H	H	M	H	H	H
Decommissioning						
Unmitigated	M	H	M	H	H	H

Mitigated – summary of the rated impact per phase of the project

This rating assumes the mitigation measures as included in Table 27 (Section 19) and Appendix A are implemented by the mine. Key to this is developing and implementing a biodiversity management plan, limiting the disturbance footprint, planning on flora and fauna removal and/or relocation, obtaining the necessary permits, pollution prevention, dust control, monitoring and rehabilitation.

In this regard, the significance of the mitigated impact will reduce to medium in all phases, as although the severity, duration and likelihood of the impact occurring reduces to medium; the successful implementation of mitigation measures will require monitoring at closure to ensure that a certain level of biodiversity is regained.

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Mitigated	M	M	M	M	M	M

SURFACE WATER

7.2.4 ISSUE: ALTERATION OF DRAINAGE PATTERNS (INCLUDING EPHEMERAL PAN-LIKE STRUCTURES)

Information based on hydrology study (Metago[c] 2011) (Appendix J), soils specialist study (ESS 2011) (Appendix G) and biodiversity specialist study (Ecorex 2011) (Appendix H).

Introduction

There are a number of activities/ infrastructures which could alter drainage patterns and result in the reduction of surface runoff throughout all phases of the project (see Section 3, Table 18 for further detail). Important to note is that apart from man-made dams (usually fed by borehole water) and the temporary shallow pan-like structures, there are no natural drainage lines on site and therefore there is no direct reliance on this resource by humans. The nearest to the site are non-perennial drainage lines located northwest and downstream of the site. Drainage across the site is via overland sheet flow. This discussion therefore focuses on the alteration of patterns as they relate to ecological resources and commercial livestock and game associated with surrounding land uses.

Rainfall and surface water run-off in all areas that have been designed with water containment infrastructure (the disturbed site) will be collected in the stormwater management system. The alteration of patterns will occur during the construction phase and remain until decommissioning, where the above activities will continue until such time as project infrastructure can be removed and areas rehabilitated. During the closure phase, final landforms such as the open pit, TSF and waste dumps will remain. Measures to manage stormwater on site have been built into the design of the project and are detailed in Appendix A. These measures, also detailed in the management programme, are included when

assessing the unmitigated scenario. Erosion-related issues as a result of altering drainage patterns are discussed in Section 7.2.2.

Rating of impact

Severity / nature

Given the relatively flat topography of the site, natural drainage across the site is via overland sheet flow. During the construction, operation and decommissioning phases, project-related infrastructure will occupy a relatively large piece of land (approximately 1,020ha). Clean stormwater controls will be in place diverting as much clean water as possible around the site. During the closure phase, final landforms such as the open pit, TSF and waste dumps, covering a total area of approximately 760ha, will remain. Some of the ephemeral pan-like structures will be destroyed by the mining of the ore body (approximately 0.65ha). Apart from these and one other pan located immediately downstream of a dirty water berm (approximately 0.3ha) (i.e. will receive limited surface water runoff), the remaining pan-like structures (relatively small in extent - approximately 1.8ha in total) will be outside the dirty area of the mine and therefore should continue to receive runoff after rainfall events. In the unmitigated scenario, for all project phases, alteration of drainage patterns resulting in the reduction in flow is expected to have a medium severity for downstream ecological users and commercial livestock and game on site. These pan-like structures are sensitive to disturbance and cannot be recreated once lost.

Duration

In the unmitigated scenario, for all project phases, the alteration of drainage patterns and loss of natural pan-like structures would extend beyond closure.

Spatial scale / extent

Due to the nature of the topography (relatively flat), in the unmitigated scenario for all project phases, changes in drainage patterns and loss of the pan-like structures would be confined to the site boundary.

Consequence

In the unmitigated scenario, the consequence is medium for all phases.

Probability

In the unmitigated scenario, in all project phases, it is definite that some pan-like structures will be destroyed by the proposed mining activities. For the remaining pan-like structures, it is possible that there will be a reduction in contribution to the pan-like structures during high intensity rainfall events and in turn reduce the availability of the pan-like structures for use by ecological systems.

Significance

In the unmitigated scenario, a medium impact is expected for all phases.

Unmitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	M	H	L	M	M-H	M

Mitigated – summary of the rated impact per phase of the project

This rating assumes the mitigation measures as included in Table 28 (Section 19) and Appendix A are implemented by the mine. The measures however to minimise the destruction of the pan-like structures and collection of runoff are limited, therefore the significance remains medium in the mitigated scenario.

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Mitigated	M	H	L	M	M	M

7.2.5 ISSUE: POLLUTION OF SURFACE WATER RESOURCES

Information based on hydrology study (Metago[c] 2011) (Appendix J).

Introduction

There are a number of pollution sources in all phases that have the potential to pollute surface water and impact on downstream water users (see Section 3, Table 18 for further detail). It is important to note that apart from man-made dams (usually fed by borehole water) and the temporary isolated pan-like structures, there are no natural drainage lines on site. The nearest watercourses to the site are non-perennial drainage lines located northwest and downstream of the site. Given this there is no direct reliance on surface water resources by humans. This discussion therefore focuses on the pollution potential as it relates to ecological resources and commercial livestock and game associated with surrounding land uses, and provides comment on potential human health impacts post closure.

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. The operational phase will present more long term potential sources and the closure phase will present final land forms that may have the potential to contaminate surface water through long term seepage and/or run-off. Rainfall and surface water occurs infrequently and for short durations after rainfall events. Some of this water seeps into the topsoil. The related pollution issues have been assessed as soil pollution issues in 7.2.2.

Rating of impact

Severity / nature

In the unmitigated scenario, especially in the construction, operation and decommissioning phases, surface water (from rainfall) may collect contaminants (hydrocarbons, salts, chemicals, metals) from mine

activities and infrastructure and flow into the isolated pan-like structures downstream of the site and the downstream non-perennial drainage lines (off-site northwest). Due to the structure of the pan-like structures, polluted water could collect in the pan-like structures and evaporate over time leaving behind contaminated sediment. At elevated pollution concentrations these contaminants can be harmful to ecological users and commercial livestock and game. The dilution effect of flood water has not been studied in detail but it will reduce the concentration of any contaminants. In the unmitigated closure phase, the contaminants of concern are suspended particles emitted from final land forms and any concentrated contamination that collects in the open pit. This impact has a potentially high severity without mitigation.

Duration

In the unmitigated scenario, although the frequency and duration of the flood events are limited, the potential health impacts associated with the use of contaminated water by flora, fauna, livestock, game and humans (if humans make use of pit water after closure) could be long term.

Spatial scale / extent

In the unmitigated construction, operation and decommissioning phases, the spatial scale of the potential impacts will be restricted to potential surface water use at the natural pan-like structures and towards drainage lines (northwest of the project site), for as far as the surface water travels before it evaporates or seeps into the ground.

Consequence

In the unmitigated scenario, the consequence of this potential impact is high.

Probability

During the construction, operation and decommissioning phases, without any mitigation, the probability of impacting on fauna, livestock and game health through pollution events is medium because:

- There will be polluted water bodies containing process water on site. Without mitigation these water bodies will not be fenced off and straying animals may obtain access.
- The closest surface water resource is a non-perennial drainage line 2km to the northwest.
- For polluted water to reach this drainage line there would need to be a significant rainfall event that is likely to reduce the concentration of any pollution.
- Even if polluted water reaches this resource, the pollution needs to be above levels that will be harmful and for the limited period of time that the surface water is available, it would need to be consumed in sufficient quantities by animals.

At closure, it is unclear whether water will collect in the open pit. Although it is clear that evaporation exceeds rainfall in the area which could result in a dry pit, the uncertainties relate to the level of the post-

mining water table (this is expected to rebound and create a new stable water table – the level is unknown at this stage) and the volume of polluted seepage from the TSF and waste dumps that will collect in the pit post closure. What is further unclear is if the water within the pit will be polluted, if yes at what concentrations, if the water will be used and for what purposes. Given the existing surrounding land uses, it is possible that should water collect in the pit, it would be used by animals and/or humans. Given these uncertainties, the precautionary approach was used and the probability of impacting animals and/or humans is high.

Significance

In the unmitigated scenario, the significance of this potential impact is high in all project phases.

Unmitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	M	H	M	H

Mitigated – summary of the rated impact per phase of the project

This rating assumes the mitigation measures as included in Table 29 (Section 19) and Appendix A are implemented by the mine. Key to this is pollution prevention, zero discharge policy, good housekeeping, implementing and maintain a stormwater management plan, establishing professionally designed facilities, monitoring and emergency response.

In this regard, the significance of the mitigated impact will reduce to low in the construction, operation and decommissioning phases due to a reduced severity, duration and likelihood of the impact occurring. In the closure phase, the significance of the mitigated impact will either remain high or reduce to medium due to the uncertainty associated with the quantity and quality, and use of water (if water collects) in the open pit.

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation and decommissioning						
Mitigated	L	L	L	L	L	L
Closure						
Mitigated	H-L	H	M	H	M-L	H-M

GROUNDWATER

7.2.6 ISSUE: DEWATERING IMPACTS ON THIRD PARTY USERS

Information based on groundwater specialist study (MWG 2011) (Appendix K).

Introduction

There is one main activity that has the potential to reduce the local groundwater level: active dewatering of the pit (see Section 3, Table 18 for further detail). This activity will commence in the operational phase and will cease in the decommissioning phase. The impacts on biodiversity have been assessed in Section 7.2.3 therefore this section focuses on third party groundwater users and associated land uses (livestock and game farming, hunting and localised irrigation farming).

Rating of impact

Severity / nature

Groundwater in the project area (within 15km of the site) is used almost exclusively for domestic purposes, stock-watering, game ranching and localised irrigation, although large scale irrigation from boreholes does occur towards the east and north east near Baltimore (approximately 20km) and Tolwe (approximately 40km). Land users in the area (landowners and farmers) have raised concerns regarding water supply as from their viewpoint water is a scarce resource and a loss or reduction of the groundwater resource would impact on their livelihoods.

The specialist groundwater study (MWG 2011) used a regional groundwater model to estimate pit inflows and to determine the extent of the drawdown depression from active mining activities. Dewatering of the pit, excluding any seepage influences from the TSF which would minimise the cone of depression, is expected to create drawdown propagating outward from the open pit. Dewatering effects will be most significant in the vicinity of the open pit, decreasing with distance away from the pit. The dewatering influence is expected to increase as the open pit develops in extent and depth. Groundwater users within the zone of impact may experience lower borehole yields and/or total water loss during the operational phase of the mine. Review of regional datasets by the groundwater specialist has shown in some areas an already declining water level that may be attributed to over-abstraction in addition to below average rainfall years. Mine dewatering could exacerbate this trend.

Based on groundwater modelling results and available hydrocensus data, a total of 11 boreholes have been identified within the zone of influence; of these six will be physically destroyed by the development of the mining activities/structures while the remaining five will either be owned by Turquoise Moon or continue to be used by landowners. These boreholes are all located within the boundaries of the mining right application area. It is however possible that boreholes not identified during the hydrocensus survey, due to limited access to surrounding farms, may occur within the zone of influence. When taking into consideration the effect of potential seepage from the TSF and waste dumps, the zone of influence may reduce due to enhanced artificial recharge from the TSF and waste dumps located in close proximity to the open pit. From decommissioning, once mining stops, it is predicted that the water level will slowly rebound but will not reach the pre-dewatering level due to evaporation eventually exceeding inflow

(rainfall and runoff) in the pit (pit will remain open at closure). The open pit is expected to act as a sink resulting in a zone of depressed water levels, post closure.

Given the above discussion, in the unmitigated scenario, the severity of potential impacts during the operation and decommissioning phases will be high until such time as the groundwater levels recover, after which the severity could reduce to medium at closure.

Duration

In close proximity to the pit, in the unmitigated scenario, impacts on some third party boreholes may be felt beyond closure (high).

Spatial scale / extent

In the unmitigated scenario, when mining occurs at depth, the drawdown and related potential for impacts will be localised, but will extend beyond the site boundary (between 3km west, 3.5km southwest, 2km east and 4km northwest of the pit extent). This is a medium spatial scale.

Consequence

In the unmitigated scenario the consequence is high in all phases.

Probability

The probability of third party groundwater users suffering a loss of water, to varying extents, through the mine's dewatering activities is possible in the unmitigated scenario for all phases. The boreholes identified within the modelled zone of influence are all located within the boundaries of the mining right application area. It is however possible that boreholes not identified during the hydrocensus survey, due to limited access to some neighbouring farms, may occur within the zone of influence.

Significance

In the unmitigated scenario, the significance of this potential impact is high in all phases.

Unmitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction – not applicable						
Operational and decommissioning						
Unmitigated	H	H	M	H	M	H
Closure						
Unmitigated	M	H	M	H	M	H

Mitigated – summary of the rated impact per phase of the project

This rating assumes the mitigation measures as included in Table 30 (Section 19) and Appendix A are implemented by the mine. Key to this is purchasing/leasing of farms within the application boundary,

verification of potential users within zone of influence, verification of the groundwater model, licensing the dewatering use with the Department of Water Affairs, monitoring water levels on site and at third party boreholes, maintaining an up to date groundwater model and compensation (if mine-related loss occurs).

In this regard, the significance of the mitigated impact will reduce to medium in the operation and decommissioning phases due to a reduced severity and duration. In the closure phase, the significance of the mitigated impact could remain high due to the uncertainty with the rebounding groundwater levels. Depending on the outcome of the groundwater user verification survey and the measures implemented, this significance could reduce to medium-low at closure.

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction – not applicable						
Operation and decommissioning						
Mitigated	L	L	M	L	M	M
Closure						
Mitigated	M	H	M	H	M	H

7.2.7 ISSUE: CONTAMINATION OF GROUNDWATER

Information based on groundwater specialist study (MWG 2011) (Appendix K).

Introduction

Groundwater in the project area (within 15km of the site) is used almost exclusively for domestic purposes, stock-watering, game ranching and localised irrigation. There are a number of sources in all phases that have the potential to pollute groundwater particularly in the unmitigated scenario (see Section 3, Table 18 for further detail). In the construction and decommissioning phases these potential pollution sources are temporary and diffuse in nature, usually existing for a few weeks to a few months. Even though the sources are temporary in nature, related potential pollution can be long term. The operational phase will present more long term potential sources and the closure phase will present final land forms that may have the potential to pollute water resources through long term seepage. The impacts on biodiversity have been assessed in Section 7.2.3 therefore this section focuses on third party groundwater users and associated land uses (livestock and game farming, hunting and localised irrigation farming).

Rating of impact

Severity / nature

In the unmitigated scenario, pollution of groundwater from numerous pollution sources has the potential to negatively impact downstream water users. Two types of pollution sources are broadly considered. The one type is diffuse pollution which includes ad hoc spills and discharges of polluting substances. The other type is point source pollution which includes more long term pollution associated with longer term structures such as mineralised stockpiles, the TSF and waste dumps. In this regard, the most

significant potential pollution is associated with the TSF and waste dumps. While geochemistry-related tests show that limited to no potential for acid rock drainage exists, there is some potential (although limited) for salt and/or metal-related pollution. This could present a number of pollution parameters that can have animal and human health impacts depending on how they are transported from the pollution source and at what concentrations they might occur in areas where animals and people have access to groundwater.

In this assessment a precautionary approach has been adopted such that if groundwater downstream of the project site is consumed by animals and/or humans this has potential health related impacts. In the unmitigated scenario, the severity is rated as a low for the construction phase due to the limited diffuse and point sources and medium for the operation, decommissioning and closure phases due to the presence of the TSF and waste dumps.

Duration

In the unmitigated scenario, if animal and/or human health impacts occur, these are potentially long term in nature.

Spatial scale / extent

The spatial scale of the potential impact is directly related to the spatial scale of the dispersion of any groundwater pollution that in turn has the potential to impact on animal and/or human health. In the unmitigated scenario, for all phases, the groundwater model indicates that the plume migration is predominantly vertical, with a trend of lateral migration at depth. The lateral spreading of potential pollutants is limited to the close proximity of the TSF and waste dumps. Any contaminated groundwater plume is not expected to extend beyond the site boundaries as the open pit will act as a long term groundwater sink by pulling the plume towards the pit. However, if contamination reaches any structural features (e.g. faults) that were not identified and accounted for in the model, then the plume could extend beyond the site boundary. A precautionary approach has therefore been taken and a spatial scale of medium is used for the unmitigated operation, decommissioning and closure phases.

Consequence

In the unmitigated scenario, the consequence of this potential impact is medium in the construction phase and high in all other project phases.

Probability

Without any mitigation the probability of off-site pollution from both diffuse and point sources is unlikely in the construction phase and possible in the operation, decommissioning and closure phases. Whether this will result in animal and/or human health impacts depends on the extent of the pollution plume, the concentration of the different pollution parameters, and the exposure of animals and/or humans to the

pollution both in terms of pre-exposure health profiles and the nature of exposure to the polluted water. It is however unclear at this stage if the pollution will reach downstream third-party boreholes.

Significance

In the unmitigated scenario, the significance of this potential impact is low for the construction phase and high for all other phases.

Unmitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction						
Unmitigated	L	H	L	M	L	L
Operational, decommissioning and closure						
Unmitigated	M	H	M	H	M	H

Mitigated – summary of the rated impact per phase of the project

This rating assumes the mitigation measures as included in Table 31 (Section 19) and Appendix A are implemented by the mine. Key to this is professionally designed facilities with pollution control measures for managing and storing dirty water and mine residues on site, good housekeeping, maintaining an up to date groundwater model, monitoring of groundwater qualities on site and at third party boreholes and compensation (if mine-related loss occurs). These measures aim at eliminating most of the diffuse pollution sources and significantly reducing the point source pollution potential through a number of design and operational interventions to prevent any groundwater pollution plumes from reaching areas that are or may in future be used by third parties.

In this regard, the significance of the mitigated impact remains low in the construction phases and reduces to low in all other phases due to a reduced severity and duration.

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Mitigated	L	L	L	L	L	L

AIR QUALITY

7.2.8 ISSUE: INCREASE IN AIR POLLUTION

Information based on air quality specialist study (Airshed 2011) (Appendix L).

Introduction

There are a number of sources in all phases that have the potential to pollute the air in the unmitigated scenario (see Section 3, Table 18 for further detail). In the construction and decommissioning phases these potential pollution sources are temporary in nature, usually existing for a few weeks to a few

months. The operational phase will present more long term potential sources and the closure phase will present final land forms that may have the potential to pollute the air through long term wind erosion. This section focuses on human, animal and plant health impacts.

With projects of this nature, the main emissions include: inhalable particulate matter less than 10 microns in size (PM10), larger total suspended particulates (TSP), and limited gas emissions. Gaseous pollutants (such as sulphur dioxide, oxides of nitrogen, carbon monoxide, etc.) derived from vehicle exhausts are regarded as negligible in comparison to particulate emissions. The inhalable components of particulates can cause human health impacts at high concentrations over extended periods, while the larger particulate component can cause animal and plant health impacts. In the case of animals, grazing on soiled vegetation over extended periods reduces teeth life which can reduce animal life expectancy. In the case of plants, soiling of vegetation can reduce growth and productivity and can lead to vegetation die-off.

The comparison of predicted pollutant concentrations to guidelines and standards facilitates a preliminary screening of potential impacts. The following set of health and nuisance evaluation criteria have been used (full details and references are provided in Airshed 2011, Appendix L):

- South African national ambient air quality standards (NAAQS) – daily PM10 (75 microgram/m^3) and annual PM10 (40 microgram/m^3) for human and animal receptors (in the absence of South African or international standards for animal receptors)
- South African TSP (dust fallout) limits and standards for residential (600mg/m^2/day)
- Assumed a limit of 400mg/m^2/day for vegetation based on a European study (in the absence of South African or international standards).

Sensitive receptor points include: the mine boundary (mining right application boundary), and off-site farmhouses and homesteads (and associated land uses) located on neighbouring properties.

Rating of impact

Severity / nature

The air specialist made use of a theoretical model to conservatively predict air quality impacts during the operational phase and qualitatively described impacts from the construction, decommissioning and closure phases. In this regard, all mine phases present air pollution related impacts and the most significant mine phase is expected to be the operational phase. During the construction and decommissioning phases, the most significant sources are expected to be clearing of vegetation, stripping of topsoil, loading and unloading of topsoil, wind erosion from topsoil stockpiles and vehicle entrainment on unpaved road surfaces. The main contributing sources during the operational phase are roads, materials handling (specifically crushing and screening), dust from the TSF and waste dumps and blasting. At closure, the main contributor is expected to be windblown dust.

In the unmitigated construction (24 months), decommissioning and closure phases, it is expected that off-site impacts may exceed the PM10 daily standards and dust fallout limits. In the unmitigated operational phase, the model predicted that daily PM10 standards will be exceeded both at the mine boundary and at two of the identified receptor sites but that the predicted annual average will comply with standards. The exceedances are predicted to occur not more than twice a year at the two receptor sites. For dust fallout during the operational phase, the model predicted that the dust fallout rate at the mine boundary and therefore off-site will be within the dust fallout limit for residential areas and within the European vegetation limit at the mine boundary.

When considered collectively (PM10 and dust fallout impacts), the severity of potential off-site impacts is rated as medium-high for all phases, given the presence of potential receptor sites within the zone of influence.

Duration

In the unmitigated scenario, if human, animal or plant health impacts occur these are potentially long term in nature.

Spatial scale

The spatial scale of the potential impact is directly related to the spatial scale of the dispersion of any air pollution that has the potential to cause human, animal and plant health impacts. In the unmitigated scenario, the potential impacts extend beyond the site boundary.

Consequence

In the unmitigated scenario, the consequence of this potential impact is high, in all project phases.

Probability

Whether the predicted air pollution will result in human, animal or plant health impacts depends on the extent of the pollution plume, the concentration of the different pollution components, and the exposure of receptors to exceedances of the relevant evaluation criteria.

The neighbouring land is used for residential purposes and for livestock/game farming, hunting and some irrigation farming. Limited exceedances of the standards are expected at residential farmsteads (not more than twice a year at two of the farmsteads located north east and south of the site) and therefore limited potential exists for human health impacts.

For off-site animals and plants, the model predicts a very low probability for fallout related impacts. For on-site animals and plants, impacts are probably in close proximity to sources.

Of most concern are off site impacts, the probability of which is medium to low.

Significance

In the unmitigated scenario, the significance of this potential impact is high-medium.

Unmitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	M-H	H	M	H	M-L	H-M

Mitigated – summary of the rated impact per phase of the project

This rating assumes the mitigation measures as included in Table 32 (Section 19) and Appendix A are implemented by the mine. Key to this is the layout of the site facilities as close as possible to each other, developing and implementing an air quality management plan, establishing dust collection measures, implementing dust suppression techniques and monitoring the potential impact (PM10 and dust fallout).

In this regard, the significance of the mitigated impact reduces to medium-low in all phases, as although the severity and duration reduces, exceedances of the PM10 daily standard are predicted to occur at the southern mine boundary four times a year thereby requiring careful monitoring and management.

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Mitigated	M-L	L	L	L	M-L	M-L

AMBIENT NOISE

7.2.9 ISSUE: INCREASE IN DISTURBING NOISE LEVELS

Information based on noise specialist study (Acusolv 2011) (Appendix M).

Introduction

There are limited activities on site and in the area that contribute to current ambient noise levels. There are a range of construction, operation and decommissioning project activities that have the potential to generate noise (disturbance and nuisance) and cause related pollution at sensitive receptors (see Section 3, Table 18 for further detail). No noise-related impacts are expected at closure.

General noise disturbance can be defined as an increase in ambient noise levels. Although the legal limit for an increase in ambient noise is 7 dB (national noise regulations), this should not be construed as the upper limit of acceptability. SANS 10103 identified that an increase of 5 dB is considered a significant impact. Noise nuisance on the other hand is defined by SANS 10103 as any sound which disturbs, or

impairs the convenience or peace of any person. These noises are either difficult to capture, or are noises for which the readings registered on sound level meters do not correlate satisfactorily with the annoyance it causes when assessed against standard criteria. Noise nuisance sources presented by the proposed project consist of blasting, reverse alarms and hooters.

For on-site activities, the assessment below focuses on night-time conditions when ambient noise levels are lower and the sensitivity of the environment increases. Given the 24-hour operation of the site, it is expected that if the night-time impact is contained within acceptable levels, then the daytime impact will also fall within acceptable limits.

For off-site transport related activities, the assessment below focuses on day-time (for commuting and supplies transport) conditions when these types of activities are likely to occur the most.

This section focuses on the potential human related noise impacts and comments on potential impacts on animal receptors. In the absence of objective criteria, it is recommended by the specialist that the findings with respect to human impacts be used as a rough indication for animals as well.

Rating of impact

Severity / nature

Noise pollution will have different impacts on different receptors because some are very sensitive to noise and others are not. For example, mine workers in general do not expect an environment free of work related noise and so they will be less sensitive to environmental noise pollution at work. In contrast, local farmsteads, and visitors (including hunters) to lodges in the area are likely to be sensitive to unnatural noises and so any change to ambient noise levels because of mine related noise will have a negative impact on them and their wilderness experience. Due to the predicted difference in impacts from: a) activities on site and b) the use of road for transporting materials, these two aspects of the project are assessed separately below.

During the construction and decommissioning phases, noise generated by on-site activities is expected to be of a lower level and therefore not discernable above existing ambient noise levels, even in the unmitigated scenario. This does not apply to nuisance noises such as reverse hooters and alarms and blasting-related noise, discussed further below. In the operational phase, the noise specialist study has predicted that in the unmitigated scenario, the average noise from the project will significantly raise the night-time ambient noise levels for properties bordering the project site. Although as the open pit deepens the acoustic screening provided for by the pit walls will attenuate mining noise, surface activities on-site will continue to contribute to audible noise. When considering nuisance noises, in all relevant phases, material handling and vehicle movement on site will make use, to varying degrees, of machinery with reverse alarms and hooters. Movement of vehicles on top of waste dumps are likely to be one of the

main contributors to audible noise at night. Blasting-related noise during the construction (if needed) and operational phases will have a significant impact in the quiet surroundings of the project site, even though the noise source will be intermittent. Given this discussion, in the unmitigated scenario, during the construction phase, potential impacts from on-site activities will have a medium severity for the nearest receptor sites when including blasting noise. During the operational phase, unmitigated impacts will have a high severity. During the decommissioning phase (similar to construction but excluding blasting), unmitigated impacts will have a low severity.

As it is proposed to transport the concentrate product by pipeline thereby reducing the volume of traffic on public roads, this discussion focuses on noise-related impacts from commuting and services traffic. In all applicable project phases, in the unmitigated scenario, commuting and service traffic will result in a disturbing noise footprint (an increase of 5dB above the daytime ambient noise level) of between 125m (along the N11) and 140m (along the D1347) either side of the road. In the unmitigated scenario, in all project phases, the severity of potential impacts is expected to be low-medium depending on the sensitivity of receptors within this footprint.

Duration

In the unmitigated scenario the noise pollution impacts will continue until the closure phase of the mine. Whether noise impacts discussed above will have any secondary long term health effects, beyond the life of the project, is unknown. In this regard, it's possible for noise induced stress and related health issues to be felt beyond closure.

Spatial scale / extent

In the unmitigated scenario the noise impacts will extend beyond the on-site and transport route boundary, regardless of the project phase.

Consequence

For all project activities, during the construction and operational phases, in the unmitigated scenario the consequence is medium even though the severity of impacts differs. During the decommissioning phase, the consequence is low.

Probability

In the unmitigated scenario, noise from on-site activities, at the nearest receptor sites, will be definite during all project phases. For road-related activities discussed above, there will be a possible impact on receptor sites within the noise footprint of the transport routes in the unmitigated scenario.

Significance

In all project phases, for all project activities, the significance of potential impacts is medium in the unmitigated construction and decommissioning scenarios and high in the unmitigated operational scenario.

Unmitigated – summary of the rated impact per phase of the project – on-site activities

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction and decommissioning						
Unmitigated	M-L	M	M	M-L	H	M
Operational						
Unmitigated	H	H	M	H	H	H
Closure – not applicable						

Unmitigated – summary of the rated impact per phase of the project – transport routes

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation and decommissioning (commuting and services traffic only)						
Unmitigated	M-L	M	M	M	H	M
Closure – not applicable						

Mitigated – summary of the rated impact per phase of the project – on-site activities and transport routes

This rating assumes the mitigation measures as included in Table 33 (Section 19) and Appendix A are implemented by the mine. Key to this is maintenance of equipment and machinery, establishing noise berms, reducing operating hours of noise polluting equipment, acoustic barriers, personnel training, monitoring of potential impacts at noise receptor sites, compensation (if mine-related noise is disturbing after mitigation) and implementing a grievance procedure.

In this regard, the significance of the mitigated impact reduces to medium-low due to a reduced severity, duration and likelihood of occurrence.

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation and decommissioning						
Unmitigated	M-L	L	M	M-L	M	M-L
Closure – not applicable						

VISUAL ASPECTS

7.2.10 ISSUE: NEGATIVE LANDSCAPE AND VISUAL IMPACTS

Information based on visual specialist study (NLA 2011) (Appendix N).

Introduction

Visual impacts will be caused by activities and infrastructure in all project phases (see Section 3, Table 18 for further detail). These activities will be visible, to varying degrees from varying distances around the project site. During construction, this will be influenced by the increase in activities and removal of vegetation on site. During operation this will be influenced by the presence of infrastructure and development of the TSF and waste dumps and during decommissioning and closure by the closure objectives and effectiveness of rehabilitation measures. The more significant activities and structures are considered to be construction activities, the presence of plant buildings, the TSF and waste dumps and night lighting needed for safety purposes. Potential visual impacts on surrounding land uses are addressed in Section 7.2.11.

Rating of impact

Severity / nature

The severity of visual impacts is determined by assessing the change to the visual landscape. The visual landscape is that of an open wilderness bushveld with limited man-made intrusions. Key issues are: visual intrusion, visibility and visual exposure, and viewer sensitivity. Each of these is discussed below.

In the unmitigated scenario, the visual intrusion of the proposed project will be high as mining activities are introduced into a natural environment, and will remain high for the rest of the life of the project as activities continue and the TSF and waste dumps develop. Even at closure, the presence of the unmitigated TSF and waste dumps will keep the visual intrusion as high. The visual intrusion of the project at night, from construction through to decommissioning, will be high in the unmitigated scenario given the current absence of significant artificial night lighting.

Visual exposure is the extent to which project infrastructure and activities will be visible. It follows that the closer the infrastructure and activities, the greater the visual exposure. In the unmitigated day scenario views from local roads (used by residents and visitors/tourists) will present the greatest visual exposure with farmsteads and lodges on surrounding farms experiencing a moderate visual exposure. Tourists travelling along the N11 will have low exposure. At night, the visual exposure will be greatest for the lodges and ecotourism activities within the surrounding area.

Sensitivity of receptors relates to the way in which people will view the visual intrusion. In this regard, it is anticipated that receptors along local roads, at farmsteads and at lodges will be highly sensitive, especially in the unmitigated scenario. These receptors include both local residents and local and international visitors.

Given the above, the unmitigated severity is high.

Duration

In the unmitigated scenario, visual impacts will be experienced after the life of mine.

Spatial scale / extent

By using a viewshed analysis tool the specialist determined that the project, during the day, will be highly visible within a 0.8km radius around the site. Between 0.8 and 3km, the project will have a moderate visibility and beyond 3km, would have lower visibility. At night, the visual exposure of the project will be high beyond 10km. It follows that the spatial scale of the impacts will extend beyond the site boundary in the unmitigated scenario for all project phases.

Consequence

In all phases, in the unmitigated scenario the consequence is high.

Probability

The probability of the visual impact occurring is high in the unmitigated scenario.

Significance

In the unmitigated scenario, in all project phases, the significance of potential impacts is high.

Unmitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	M	H	H	H

Mitigated – summary of the rated impact per phase of the project

This rating assumes the mitigation measures as included in Table 34 (Section 19) and Appendix A are implemented by the mine. Key to this is limiting the disturbance footprint, dust control, maintaining (and establishing) vegetation buffers/screens, good housekeeping, correct lighting, rehabilitation of disturbed areas and final land forms and compensation (if mine related disturbance occurs with mitigation).

In this regard, the significance of the mitigated impact remains high-medium even though the severity reduces to medium, due to the intrusive nature of the mine in an area where these types of activities are non-existent.

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Mitigated	M	H	M	H	M-L	H-M

7.2.11 ISSUE: LOSS OF CURRENT LAND USES

Information based on land use specialist study (SAS & TerraAfrica 2011) (Appendix P).

Introduction

When considering impacts on land use, the land use specialist took into consideration the range of environmental impacts that could occur as a result of the project. These include: groundwater, noise, visual, air, traffic, heritage, soils, blasting, grazing capacity and socio-economic. With this in mind, the main activity that could have an impact on existing land uses is the development of the mine site as a whole (see Section 3, Table 18 for further detail). These activities will commence in the construction phase and continue for the current planned life of the mine (±30 years but this could increase if additional reserves are identified during the on-going exploration work). At closure, final land forms will remain on site in perpetuity. This section focuses on the potential loss and/or change of the land uses. Socio-economic related issues are discussed in Sections 7.2.18, 7.2.19, 7.2.20 and 7.2.21.

Rating of impact

Severity / nature

The project site is located in an area where mining related activities are scarce and currently concentrated near the main towns of Lephalale, approximately 60km south west, and Mokopane, approximately 100km south east. The area is characterised by open undisturbed wilderness bushveld where the main economic activities are agriculture (cattle and game farming and some irrigated crop farming) and tourism (hunting and accommodation). It has been identified by the land use specialist that for each of these land uses the availability of water is identified to be the most important resource for sustainable land use. The loss of groundwater (either through dewatering or pollution) is predicted to outweigh the impacts from noise pollution, air quality, visual impacts, traffic, blasting. Loss of groundwater resources on a farm will result in the farm (and economic activity) not being able to function at its current activity, unless an alternative supply source is identified, while other environmental impacts are only expected to result in a partial loss and/or change in land use. Current land uses on the site will be significantly impacted and lost through the development of the mine. The immediately neighbouring farms to the site are expected to experience significant impacts when considering groundwater, noise, blasting, air and visual collectively. This includes 12 farm units.

The severity of potential impacts (when considering all relevant environmental aspects cumulatively) is high, in the unmitigated scenario for the construction, operation and decommissioning phases. At closure, the severity is expected to reduce to medium as mining activities stop, save for more clarity being required on the groundwater level recharge, and dust and alien invasive proliferation from un-rehabilitated final land forms.

Duration

In the unmitigated scenario, and using a conservative approach, land use impacts could be experienced after the life of mine.

Spatial scale / extent

Based on the predictions by other specialists, the land use specialist has identified that a cumulative project impact on land uses, when considering all environmental aspects, will extend beyond the site boundary (approximately 3km in all directions).

Consequence

In all phases, in the unmitigated scenario the consequence is high.

Probability

The probability of the land use impacts occurring during the construction, operation and decommissioning phases is high in the unmitigated scenario, as this assumes that impacts associated with environmental aspects such as groundwater, noise pollution, air quality, visual impacts, traffic and blasting are unmitigated. At closure, impacts are possible save for more clarity being required on the groundwater level recharge, and dust and alien invasive proliferation from un-rehabilitated final land forms.

Significance

In the unmitigated scenario, in all project phases, the significance of potential impacts is high.

Unmitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation, decommissioning						
Unmitigated	H	H	M	H	H	H
Closure						
Unmitigated	M	H	M	H	M	H

Mitigated – summary of the rated impact per phase of the project

This rating assumes the mitigation measures as included in Table 35 (Section 19) and Appendix A are implemented by the mine. Key to this is purchasing/leasing the three farms that form part of the application boundary, effectively implementing the mitigation measures outlined in this report to minimise impacts on various aspects of the environment and compensation (if mine-related loss occurs after mitigation).

In this regard, the significance of the mitigated impact reduces to medium-low in all phases due to a reduced severity, duration and likelihood of occurrence. At closure, it is expected that the land use potential on surrounding farms could return to current levels save for more clarity being required on the

groundwater level recharge. For the project site, approximately 760ha associated with open pit, TSF and waste dumps will be compromised forever but the remaining areas could be used for grazing and hunting.

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Mitigated	L	M	M	M	M-L	M-L

7.2.12 ISSUE: BLASTING HAZARDS

Information sourced from the blast specialist study (Blast Management 2011) (Appendix O).

Introduction

The main activity that has the potential to cause blasting hazard is mining of the pit (see Section 3, Table 18 for further detail). This activity will occur during the operational phase only. Some blasting may occur during the construction phase, for foundation establishment, but this will be limited (if needed).

Blasting activities have the potential to impact on people, animals and structures located in the vicinity of the operation. Blast hazards include ground vibration, airblast, fly rock, blast fumes and dust. Ground vibrations travel directly through the ground and have the potential to cause damage to surrounding structures. Airblasts result from the pressure released during the blast resulting in an air pressure pulse (wave), which travels away from the source and has the potential to damage surrounding structures. Fly rock is the release of pieces of rock over a distance and can be harmful to people and animals and damage structures and property. Blast fumes and dust, caused by the explosion, can be considered significant nuisance factors. Ground vibrations and airblasts have the potential to cause nuisance to people and animals even if blasts occur within legal limits.

The impacts on air quality have been assessed in Section 7.2.8. This section focuses on the impacts of ground vibration, airblast and flyrock, collectively, as they relate to people, biodiversity and associated land uses (livestock and cattle farming, hunting, and localised irrigation farming).

Rating of impact

Severity / nature

In the unmitigated scenario, ground vibrations and airblasts can cause damage to third party structures and can be a nuisance for animals and people, within the zone of influence. The blast specialist, through the use of modelling techniques, has predicted that the more significant impacts are expected to occur to the north, east and south of the site where the pit extent is located in close proximity to the site boundary.

When considering fly rock, in the unmitigated scenario, fly rock (of varying sizes) has the potential to travel far distances from the blast site and cause injury and death to people and animals and damage to plants and structures.

Given the proximity of the pit to the eastern site boundary and the presence of third party land uses (including farmsteads, farms dams, crop fields) and a historical house located (on-site) within the zone of influence, the severity of potential unmitigated impacts from blasting hazards is high.

Duration

In the unmitigated scenario, although the blasting hazards (ground vibrations, airblasts, fly rock) will be limited mainly to the operational phase, any injury or death to people and/or animals and damage to structures, plants and/or property will be felt beyond closure.

Spatial scale / extent

In the unmitigated scenario, potential impacts will be felt outside of the mine boundary but for the most part will still be localised. Injury and/or or death to people will, however, be felt by families and communities beyond the site boundary.

Aspect	**On-site**	**Surrounding farms (including neighbouring farms)**
Residential	Farmsteads with associated outbuildings Local farm worker houses	Farmsteads with associated outbuildings Local farm worker houses
Tourism & hunting	Game and/or livestock Hunting and accommodation facilities Watering holes	Game and/or livestock Hunting and accommodation facilities Watering holes
Roads	Gravel district road (D1347) providing access to farms from the N11 Numerous gravel tracks	N11 (approximately 5km north of site boundary) Gravel district roads (D1347 and D1754) Numerous gravel tracks
Water supply	Boreholes and private pipelines	Boreholes and private pipelines
Power supply	Low voltage power supply lines	Low voltage power supply lines
Communication	Telephone lines	Telephone lines
Agriculture	Agricultural fields (fallow) Farms dams	Agricultural fields (active but limited) Farm dams
Heritage	Graves and a historical house	Graves, historical buildings
Historic exploration	Exploration boreholes	Unknown

Consequence

In the unmitigated scenario, the consequence of potential impacts from blasting hazards is high.

Probability

In the unmitigated scenario, the probability of blasting hazards resulting in either damage and/or creating a nuisance is possible. Using modelling techniques the specialist has predicted that in the unmitigated

scenario, the recommended blast thresholds could be exceeded at third party structures where people, animals and third party property occur.

Significance

In the unmitigated scenario, the significance of blasting-related impacts is high.

Unmitigated – summary of the rated impact per phase of the project – ground vibrations

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction – negligible, when compared to the operational phase						
Operation						
Unmitigated	H	H	M-H	H	M	H
Decommissioning and closure – not applicable						

Mitigated – summary of the rated impact per phase of the project

This rating assumes the mitigation measures as included in Table 36 (Section 19) and Appendix A are implemented by the mine. Key to this is undertaking a pre-blast survey within 1.5km of the site, implementing a design blast that meets recommended threshold criteria, restricting daily blasts, creating public awareness, monitoring of potential impacts on site and at third party structures and compensation.

In this regard, the significance of the mitigated impact reduces to low in the operational phase due to a reduced severity and likelihood of the impact occurring.

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction – negligible, when compared to the operational phase						
Operation						
Mitigated	L	H	M-H	M	L	L
Decommissioning and closure – not applicable						

7.2.13 ISSUE: PROJECT-RELATED ROAD USE AND TRAFFIC

Information based on traffic specialist study (Siyazi 2011) (Appendix T).

Introduction

The project will make use of the surrounding road network (N11 – tarred, D1553 – gravel, D1347 – gravel and R518 – tarred) with the addition of a dedicated mine access road off the public Road D1347 (gravel). Traffic on the existing road network is limited and is a combination of private, community access, small businesses and tourism-related traffic. As quantified in Section 2.3 (Table 15), traffic volumes and road use patterns are expected to differ during the different project phases. In this regard, the road use and safety related impacts of the project include:

- the impact on public roads of the increased traffic for workers and supplies;
- the impact of transporting product off-site by truck; and
- the diversion of a section of the district gravel Road D1347 (potentially in perpetuity).

An increased traffic on existing public road networks and diversion of a section of the Road D1347 can result in an inconvenience to current road users, greater accidents (for people and animals) and/or increased road damage. This in turn can put pressure on the relevant roads authority to increase the maintenance programmes and/or upgrade the roads.

It is the view of the traffic specialist that the diversion of a section of the gravel Road D1347 is expected to have a negligible effect on people who make use of this road. The length of the road will increase but will be of equal or better quality than the current road. The development of the mine site will also block access to one (possibly two) of the neighbouring farms. Alternative access to the farms will be provided by the mine and will be agreed in consultation with the relevant landowners.

It is the view of the traffic specialist that project-related traffic will not significantly change the level of service required on the network of public roads in the vicinity of the project. From a capacity perspective, no changes to the road network are required. This however does not consider the adequacy of the road surface. This section therefore focuses on safety related impacts. Safety related impacts have the potential to occur during the construction, operation and decommissioning phases with negligible road use taking place during the closure phase. The impacts are therefore assessed for the first three phases only.

Rating of impact

Severity / nature

During the construction, operation and decommissioning phases, increases in traffic volumes and change in traffic patterns can result in road safety concerns. These could potentially result in serious injury or death to third parties. In the unmitigated scenario, the severity of potential injury or death to a third party is high.

Duration

In the context of this assessment, injury or death of third parties is considered a permanent impact for all assessed phases.

Spatial scale / extent

If someone is injured or dies, the impact (including secondary socio-economic impacts) will extend beyond the project area regardless of the project phase in which the potential incident may occur.

Consequence

The consequence of unmitigated impacts is high for all assessed phases.

Probability

The increase in traffic volumes as a result of the project will be greater during the operational phase than during the construction and decommissioning phases. Therefore, in the unmitigated scenario, the probability of severe injury or death of a third party is high during the operational phase. During the construction and decommissioning phases, a lower volume of associated traffic is expected for a limited duration. In the unmitigated scenario, the potential for injury or death to a third party is therefore medium during these phases.

Significance

During all assessed phases, the significance of safety related impacts is high in the unmitigated scenario.

Unmitigated – summary of the rated impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation and decommissioning						
Unmitigated	H	H	M-H	H	M	H
Closure – not applicable						

Mitigated – summary of the rated impact per phase of the project

This rating assumes the mitigation measures as included in Table 37 (Section 19) and Appendix A are implemented by the mine. Key to this is upgrading the relevant intersection as per the traffic specialist recommendations, re-routing the D1347, providing alternative access to landowners, obtaining approval from the roads authorities, working together with the roads departments to ensure the mine's safe use of public roads, providing dedicated taxi/bus points near the mine entrance, monitoring the emergency response and compensation (if mine-related traffic causes disturbance after mitigation).

In this regard, the significance of the mitigated impact reduces to medium, as although the severity of injury or death, and the associated duration and spatial scale is high, it is unlikely that any impacts will occur.

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation, decommissioning						
Mitigated	H	H	M-H	H	L	M
Closure – not applicable						

HERITAGE (AND CULTURAL)

7.2.14 ISSUE: DESTRUCTION OF HERITAGE RESOURCES

Information based on heritage specialist study (Pistorius 2011) (Appendix Q).

Introduction

There is a number of activities/infrastructure in all phases that have the potential to damage heritage resources and result in the loss of the resource for future generations (see Section 3, Table 18 for further detail). Heritage resources include sites of archaeological, cultural or historical importance. The more significant of these are expected to occur during the construction and operational phases when most of the project infrastructure will be established on site and open pit mining advances. No impacts are expected to occur during the decommissioning and closure phases however the potential for uncovering new heritage resources during the operational and decommissioning phases does exist.

Rating of impact

Severity / nature

Heritage resources that will be impacted on by the positioning of project-related infrastructure include two graveyards. These sites are considered to have a high significance and therefore destruction of these sites without proper mitigation has a high severity. If any heritage resources such as unmarked graves/graveyards are uncovered during the construction, operation and decommissioning of the site, the loss of these resources unmitigated has a high severity.

Duration

In the unmitigated scenario, in all applicable phases, the loss of heritage resources will be long term and will continue after the life of the project.

Spatial scale / extent

Although the actual loss of the resource will be within the site boundary, the unmitigated impact will extend beyond the site boundary.

Consequence

In all applicable phases, the consequence of this potential impact is high.

Probability

In the unmitigated construction and operational phases, the loss of heritage resources will be definite. In the unmitigated decommissioning phase, it is less likely that impacts will occur as most of the project development, where ground disturbance takes place, would have occurred.

Significance

The significance of this potential impact is high in the unmitigated construction and operational phases and medium in the unmitigated decommissioning phase.