The remaining organic emissions are composed largely of compounds emitted from combustion sources in a condensed phase. These compounds can almost exclusively be classed into a group known as polycyclic organic matter (POM), and a subset of compounds called polynuclear aromatic hydrocarbons (PAH or PNA). There are also PAH-nitrogen analogs. Information available in the literature on POM compounds generally pertains to these PAH groups.

Formaldehyde is formed and emitted during combustion of hydrocarbon-based fuels including coal and oil. Formaldehyde is present in the vapor phase of the flue gas. Formaldehyde is subject to oxidation and decomposition at the high temperatures encountered during combustion.

Thus, larger units with efficient combustion (resulting from closely regulated air-fuel ratios, uniformly high combustion chamber temperatures, and relatively long gas retention times) have lower formaldehyde emission rates than do smaller, less efficient combustion units.

Trace elements are also emitted from the combustion of oil. The quantity of trace elements entering the combustion device depends solely on the fuel composition. The quantity of trace metals emitted from the source depends on combustion temperature, fuel feed mechanism, and the composition of the fuel. The temperature determines the degree of volatilisation of specific compounds contained in the fuel. The fuel feed mechanism affects the separation of emissions into bottom ash and fly ash. In general, the quantity of any given metal emitted depends on the physical and chemical properties of the element itself; concentration of the metal in the fuel; the combustion conditions; and the type of particulate control device used, and its collection efficiency as a function of particle size.

Some trace metals concentrate in certain waste particle streams from a combustor (bottom ash, collector ash, flue gas particulate), while others do not. Various classification schemes have been developed to describe this partitioning behavior. These classification schemes generally distinguish between:

- **Class 1:** Elements that are approximately equally concentrated in the fly ash and bottom ash or show little or no small particle enrichment. Examples include manganese, beryllium, cobalt, and chromium.
- **Class 2**: Elements that are enriched in fly ash relative to bottom ash or show increasing enrichment with decreasing particle size. Examples include arsenic, cadmium, lead, and antimony.
- **Class 3:** Elements which are emitted in the gas phase (primarily mercury and, in some cases, selenium).

By understanding trace metal partitioning and concentration in fine particulate, it is possible to postulate the effects of combustion controls on incremental trace metal emissions. For example, several NOx controls for boilers reduce peak flame temperatures. If combustion temperatures are reduced, fewer Class 2 metals will initially volatilise, and fewer will be available for subsequent condensation and enrichment on fine PM. Therefore, for combustors with particulate controls, lower volatile metal emissions should result due to improved particulate removal. Flue gas emissions of Class 1 metals (the non-segregating trace metals) should remain relatively unchanged.

Lower local O_2 concentrations is also expected to affect segregating metal emissions from boilers with particle controls. Lower O_2 availability decreases the possibility of volatile metal oxidation to fewer volatile oxides. Under these conditions, Class 2 metals should remain in the vapor phase as they enter the cooler sections of the boiler. More redistribution to small particles should occur and emissions should increase. Again, Class 1 metal emissions should remain unchanged.

Carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) emissions are all produced during fuel oil combustion. Nearly all of the fuel carbon (99%) in fuel oil is converted to CO_2 during the combustion process. This conversion is relatively independent of firing configuration. Although the formation of CO acts to reduce CO_2 emissions, the amount of CO produced is insignificant compared to the amount of CO_2 produced. The majority of the fuel carbon not converted to CO_2 is due to incomplete combustion in the fuel stream.

Formation of N_2O during the combustion process is governed by a complex series of reactions and its formation is dependent upon many factors.

Formation of N_2O is minimised when combustion temperatures are kept high (above 1475°F) and excess air is kept to a minimum (less than 1%). Emissions can vary widely from unit to unit, or even from the same unit at different operating conditions.

Methane emissions vary with the type of fuel and firing configuration but are highest during periods of incomplete combustion or low-temperature combustion, such as the start-up or shut-down cycle for oil-fired boilers. Typically, conditions that favour formation of N_2O also favour emissions of CH_4.

<u>Services – Steam Generation</u>

Emissions from coal combustion depend on the rank and composition of the fuel, the type and size of the boiler, firing conditions, load, type of control technologies, and the level of equipment maintenance. The major pollutants of concern from bituminous coal combustion are particulate matter (PM), sulfur oxides (SOx), and nitrogen oxides (NOx). Some unburned combustibles, including carbon monoxide (CO) and numerous organic compounds, are generally emitted even under proper boiler operating conditions.

PM composition and emission levels are a complex function of boiler firing configuration, boiler operation, pollution control equipment, and coal properties. Uncontrolled PM emissions from coal-fired boilers include the ash from combustion of the fuel as well as unburned carbon resulting from incomplete combustion.

Coal ash may either settle out in the boiler (bottom ash) or entrained in the flue gas (fly ash). The distribution of ash between the bottom ash and fly ash fractions directly affects the PM emission rate and depends on the boiler firing method and furnace type (wet or dry bottom). Boiler load also affects the PM emissions as decreasing load tends to reduce PM emissions. The magnitude of the reduction varies considerably depending on boiler type, fuel, and boiler operation.

Soot blowing is also a source of intermittent PM emissions in coal-fired boilers. Steam soot and air soot blowing is periodically used to dislodge ash from heat transfer surfaces in the furnace, convective section, economizer, and air preheater.

Gaseous SOx from coal combustion are primarily sulfur dioxide (SO_2), with a much lower quantity of sulfur trioxide (SO_3) and gaseous sulfates. These compounds form as the organic and pyretic sulfur in the coal are oxidized during the combustion process. On average, about 95% of the sulfur present in bituminous coal will be emitted as gaseous SOx. The more alkaline nature of the ash in some subbituminous coals causes some of the sulfur to react in the furnace to form various sulfate salts that are retained in the boiler or in the fly ash.

NOx emissions from coal combustion are primarily nitric oxide (NO), with only a few volume percent as nitrogen dioxide (NO_2). Nitrous oxide (N_2O) is also emitted at a few parts per million. NOx formation results from thermal fixation of atmospheric nitrogen in the combustion flame and from oxidation of nitrogen bound in the coal. Experimental measurements of thermal NOx formation have shown that the NOx concentration is exponentially dependent on temperature and is proportional to nitrogen concentration in the flame, the square root of oxygen concentration in the flame, and the gas residence time.

Bituminous coals usually contain from 0.5 to 2 weight percent nitrogen, mainly present in aromatic ring structures. Fuel nitrogen can account for up to 80% of total NOx from coal combustion.

The rate of CO emissions from combustion sources depends on the fuel oxidation efficiency of the source. By controlling the combustion process carefully, CO emissions can be minimized. Thus, if a unit is operated improperly or is not well-maintained, the resulting concentrations of CO (as well as organic compounds) may increase by several orders of magnitude. Smaller boilers, heaters, and furnaces typically emit more CO and organics than larger combustors. This is because smaller units usually have less high-temperature residence time and, therefore, less time to achieve complete combustion than larger combustors. Combustion modification techniques and equipment used to reduce NOx can increase CO emissions if the modification techniques are improperly implemented or if the equipment is improperly designed.

As with CO emissions, the rate at which organic compounds are emitted depends on the combustion efficiency of the boiler. Therefore, combustion modifications that change combustion residence time, temperature, or turbulence may increase or decrease concentrations of organic compounds in the flue gas. Organic emissions include volatile, semi volatile, and condensable organic compounds either present in the coal or formed as a product of incomplete combustion (PIC). Organic emissions are primarily characterized by the criteria pollutant class of unburned vapor-phase hydrocarbons. These emissions include alkanes, alkenes, aldehydes, alcohols, and substituted benzenes (e.g., benzene, toluene, xylene, and ethyl benzene).

Emissions of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/PCDF) also result from the combustion of coal. Of primary interest environmentally are tetrachloro- through octachloro- dioxins and furans. Dioxin and furan emissions are influenced by the extent of destruction of organics during combustion and through reactions in the air pollution control equipment. The formation of PCDD/PCDF in air pollution control equipment is primarily dependent on flue gas temperature, with maximum potential for formation occurring at flue gas temperatures of 230°C to 340°C.

The remaining organic emissions are composed largely of compounds emitted from combustion sources in a condensed phase. These compounds can almost exclusively be classed into a group known as polycyclic organic matter (POM), and a subset of compounds called polynuclear aromatic hydrocarbons (PNA or PAH). Polycyclic organic matter is more prevalent in the emissions from coal combustion because of the more complex structure of coal.

Trace metals are also emitted during coal combustion. The quantity of any given metal emitted, in general, depends on the:

- Physical and chemical properties of the metal itself.
- Concentration of the metal in the coal.
- Combustion conditions.
- Type of particulate control device used, and its collection efficiency as a function of particle size.

Some trace metals become concentrated in certain particle streams from a combustor (e.g. bottom ash, collector ash, and flue gas particulate) while others do not. Various classification schemes have been developed to describe this partitioning behavior. These classification schemes generally distinguish between:

- **Class 1:** Elements that are approximately equally concentrated in the fly ash and bottom ash or show little or no small particle enrichment. Examples include manganese, beryllium, cobalt, and chromium.
- **Class 2**: Elements that are enriched in fly ash relative to bottom ash or show increasing enrichment with decreasing particle size. Examples include arsenic, cadmium, lead, and antimony.
- **Class 3:** Elements which are emitted in the gas phase (primarily mercury and, in some cases, selenium).

Control of Class 1 metals is directly related to control of total particulate matter emissions, while control of Class 2 metals depends on collection of fine particulates. Because of variability in particulate control device efficiencies, emission rates of these metals can vary substantially. Because of the volatility of Class 3 metals, particulate controls have only a limited impact on emissions of these metals.

In addition to SO_2 and NOx emissions, combustion of coal also results in emissions of chlorine and fluorine, primarily in the form of hydrogen chloride (HCl) and hydrogen fluoride (HF). Lesser amounts of chlorine gas and fluorine gas are also emitted. A portion of the chlorine and fluorine in the fuel may be absorbed onto fly ash or bottom ash. Both HCl and HF are water soluble and are readily controlled by acid gas scrubbing systems.

Carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) emissions are all produced during coal combustion. Nearly all the fuel carbon (99%) in coal is converted to CO_2 during the combustion process. This conversion is relatively independent of firing configuration. Although the formation of CO acts to reduce CO_2 emissions, the amount of CO produced is insignificant compared to the amount of CO_2 produced. Most of the fuel carbon not converted to CO_2 is entrained in bottom ash. CO_2 emissions for coal vary with carbon content, and carbon content varies between the classes of bituminous and subbituminous coals. Further, carbon content also varies within each class of coal based on the geographical location of the mine.

Formation of N_2O during the combustion process is governed by a complex series of reactions and its formation is dependent upon many factors. Formation of N_2O is minimized when combustion temperatures are kept high (above 1575°F) and excess air is kept to a minimum (less than 1%). N_2O emissions for coal combustion are not significant.

Methane emissions vary with the type of coal being fired and firing configuration, but are highest during periods of incomplete combustion, such as the start-up or shut-down cycle for coal-fired boilers. Typically, conditions that favor formation of N_2O also favor emissions of CH_4.

<u>Material Handling and Stockpiling</u>

Inherent in operations that use minerals in aggregate form is the maintenance of outdoor storage piles. Storage piles are usually left uncovered, partially because of the need for frequent material transfer into or out of storage. Dust emissions occur at several points in the storage cycle, such as material loading onto the pile, disturbances by strong wind currents, and load-out from the pile. The movement of trucks and loading equipment in the storage pile area is also a substantial source of dust.

The quantity of dust emissions from aggregate storage operations varies with the volume of aggregate passing through the storage cycle. Emissions also depend on three parameters related to the condition of the storage pile: age of the pile, moisture content, and proportion of aggregate fines.

When freshly processed aggregate is loaded onto a storage pile, the potential for dust emissions is at a maximum. Fines are easily disaggregated and released to the atmosphere upon exposure to air currents, either from aggregate transfer itself or from high winds. As the aggregate pile weathers, however, potential for dust emissions is greatly reduced. Moisture causes aggregation and cementation of fines to the surfaces of larger particles. Any significant rainfall soaks the interior of the pile resulting in a slow drying process.

Total dust emissions from aggregate storage piles result from several distinct source activities within the storage cycle:

- Loading of aggregate onto storage piles (batch or continuous drop operations).
- Equipment traffic in storage area.
- Wind erosion of pile surfaces and ground areas around piles.
- Load-out of aggregate for shipment or for return to the process stream (batch or continuous drop operations).

Either adding aggregate material to a storage pile or removing it usually involves dropping the material onto a receiving surface. Truck dumping on the pile or loading out from the pile to a truck with a front-end loader are examples of batch drop operations. Adding material to the pile by a conveyor stacker is an example of a continuous drop operation.

Fugitive Dust Sources

Significant atmospheric dust arises from the mechanical disturbance of granular material exposed to the air. Dust generated from these open sources is termed 'fugitive' because it is not discharged to the atmosphere in a confined flow stream. Common sources of fugitive dust include unpaved roads, agricultural tilling operations, aggregate storage piles, and heavy construction operations.

For the above sources of fugitive dust, the dust-generation process is caused by two basic physical phenomena:

- Pulverisation and abrasion of surface materials by application of mechanical force through implements (wheels, blades, etc.).
- Entrainment of dust particles by the action of turbulent air currents, such as wind erosion of an exposed surface by wind speeds over 19km/h (5.3m/s).

The impact of a fugitive dust source on air pollution depends on the quantity and drift potential of the dust particles injected into the atmosphere. In addition to large dust particles that settle out near the source (often creating a local nuisance problem), considerable amounts of fine particles also are emitted and dispersed over much greater distances from the source. The potential drift distance of particles is governed by the initial injection height of the particle, the terminal settling velocity of the particle, and the degree of atmospheric turbulence. Theoretical drift distance, as a function of particle diameter and mean wind speed, has been computed for fugitive dust emissions.

Results indicate that, for a typical mean wind speed of 16km/h (4.4m/s), particles larger than about 100μm are likely to settle out within 6 to 9m from the edge of the road or other point of emission. Particles that are 30 to 100μm in diameter are likely to undergo impeded settling.

These particles, depending upon the extent of atmospheric turbulence, are likely to settle within a few hundred feet from the source. Smaller particles, particularly TSP and PM_{10}, have much slower gravitational settling velocities and are much more likely to have their settling rate retarded by atmospheric turbulence. Dust emissions may be generated by wind erosion of open aggregate storage piles and exposed areas within an industrial facility. These sources typically are characterised by non-homogeneous surfaces impregnated with non-erodible elements (particles larger than approximately 1cm in diameter).

Field testing of coal piles and other exposed materials using a portable wind tunnel has shown that:

- Threshold wind speeds exceed 5m/s at 15cm above the surface or 10m/s at 7m above the surface.
- Particulate emission rates tend to decay rapidly (half-life of a few minutes) during an erosion event.

In other words, these aggregate material surfaces are characterised by finite availability of erodible material (mass/area) referred to as the erosion potential. Any natural crusting of the surface binds the erodible material, thereby reducing the erosion potential.

<u>Vehicle Entrained Emissions</u>

When a vehicle travels an unpaved road, the force of the wheels on the road surface causes pulverisation of surface material. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong air currents in turbulent shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed. The quantity of dust emissions from a given segment of unpaved road varies linearly with the volume of traffic. Field investigations also have shown that emissions depend on source parameters that characterise the condition of a road and the associated vehicle traffic.

Characterisation of these source parameters allow for 'correction' of emission estimates to specific road and traffic conditions present on public and industrial roadways. Dust emissions from unpaved roads have been found to vary directly with the fraction of silt (particles smaller than 75µm in diameter) in the road surface materials. Other variables are important in addition to the silt content of the road surface material. For example, at industrial sites, where haul trucks and other heavy equipment are common, emissions are highly correlated with vehicle weight.

8.4.11.2. Emission Factors

Process emission rates were obtained from emission factors which associate the quantity of a pollutant to the activity associated with its release. Due to the absence of locally generated emission factors, use was made of the comprehensive set of emission factors published by the United States Environmental Protection Agency (US-EPA) in its AP-42 document *Compilation of Pollution Emission Factors* and the reference document on *Best Available Techniques for the Manufacture of Large Volume Inorganic Chemicals – Ammonia, Acids and Fertilisers Best* and *Available Techniques for the Management of Tailings and Waste Rock in Mining Activities* published by the European Integrated Pollution Prevention and Control Bureau.

Reference was made to routine emissions from the process. Table 8.4.11.2(a) to Table 8.4.11.2(c) summarises the emission factors for the current operations and the proposed Copper Flotation Plant and Magnetite Waste Site Disposal Facility of Bosveld Phosphates. Table 8.4.11.2(d) contains the most recent, emission rates for the current operations. Emission calculations were based on the parameters summarized in Table 8.4.11.2(e).

Table 8.4.11.2(a): Phosphoric Acid, Sulphuric Acid and Fertiliser Production – Emission Factors

Activity	Unit	Emission Factors											
		TSP	PM_{10}	$PM_{2.5}$	SO_2	SO_3	CO_2	CO	NO	NO_2	NH_3	H_2SO_4	F^-
A. Phosphoric Acid Production													
1. Reactor	kg/Mg	5.50E+00	4.40E+00	-	-	-	-	-	-	-	-	-	3.30E-01
2. Filtration	kg/Mg	1.00E-01	8.00E-02	-	-	-	-	-	-	-	-	-	6.00E-03
3. Concentration	kg/Mg	-	-	-	-	-	-	-	-	-	-	-	3.00E-03
4. Miscellaneous sources	kg/Mg	1.50E-02	1.20E-02	-	-	-	-	-	-	-	-	-	1.00E-03
B. Sulphuric Acid Production													
1. Production SA4	kg/Mg	-	-	-	1.03E+00	6.40E-02	-	4.05E+00	-	-	-	0.0640	-
2. Production SA5	kg/Mg	-	-	-	1.03E+00	6.40E-02	-	4.05E+00	-	-	-	0.0640	-
3. Miscellaneous sources SA4	kg/Mg	-	-	-	1.03E-01	6.00E-03	-	4.05E-01	-	-	-	0.0064	-
4. Miscellaneous sources SA5	kg/Mg	-	-	-	1.03E-01	6.00E-03	-	4.05E-01	-	-	-	0.0064	-
C. Fertiliser Production													
1. MAP reactor	kg/Mg	7.60E-01	6.10E-01	-	-	-	-	-	-	-	1.90E-01	-	2.00E-02
2. MAP granulation	kg/Mg	7.60E-01	6.10E-01	-	-	-	-	-	-	-	1.90E-01	-	2.00E-02
3. MAP drying and coating	kg/Mg	7.50E-01	6.00E-01	-	-	-	-	-	-	-	1.90E-01	-	2.00E-02
4. MAP product sizing & material transfer	kg/Mg	3.00E-02	2.00E-02	-	-	-	-	-	-	-	1.00E-02	-	1.00E-03
5. MAP miscellaneous sources	kg/Mg	3.40E-01	2.70E-01	-	-	-	-	-	-	-	7.00E-02	-	2.00E-02
6. SSP raw material handling	kg/Mg	1.10E-01	5.00E-02	-	-	-	-	-	-	-	-	-	-
7. SSP reaction process and	kg/Mg	2.60E-01	2.20E-01	-	-	-	-	-	-	-	-	-	1.00E-01
8. SSP curing and final product handling	kg/Mg	1.00E-01	8.00E-02	-	-	-	-	-	-	-	-	-	2.00E-02

Activity	Unit	Emission Factors											
		TSP	PM_{10}	$PM_{2.5}$	SO_2	SO_3	CO_2	CO	NO	NO_2	NH_3	H2SO4	F^-
9. GSP product sizing & material transfer	kg/Mg	3.00E-02	2.00E-02	-	-	-	-	-	-	-	-	-	0.001
10. GSP miscellaneous sources	kg/Mg	3.40E-01	2.70E-01	-	-	-	-	-	-	-	-	-	0.02
11. Blending plant miscellaneous sources	kg/Mg	3.40E-01	2.70E-01	-	-	-	-	-	-	-	-	-	0.02
D. Steam Generation													
1. Combustion	kg/Mg	3.30E+01	6.60E+00	6.60E+00	9.50E+00		3.09E+03	2.50E+00	-	2.75E-01	-	-	

Notes

kg/Mg : Kilogram per megagram.
Phosphoric acid production : US-EPA AP42, Volume 1, 5 Edition, Chapter 8.9 & EC LVIC-AAF.
Sulphuric acid production : US-EPA AP42, Volume 1, 5 Edition, Chapter 8.10 and EHRCON Process emission measurements.
Fertiliser production : US-EPA AP42, Volume 1, 5 Edition, Chapter 8.5, 8.9 & EC LVIC-AAF.
Steam generation : US-EPA AP42, Volume 1, 5 Edition, Chapter 1.1. Coal sulphur content of 0.5% and carbon content of 85%.

Table 8.4.11.2(b): Magnetite Beneficiation – Emission Factors

Activity	Unit	Emission Factors						
		TSP	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO_2	CO
A. SAOB Plant (MGB)								
1. Feed handling (MGB-F)								
1. FEL operation	g/VKT	2.62E+03	7.45E+02	7.45E+01	-	-	-	-
2. Material handling (3 operations)	kg/Mg	5.00E-03	2.00E-03	2.00E-04	-	-	-	-
3. Fugitive emissions from storage	kg/ha/h	7.20E+00	2.20E+00	2.20E-01	-	-	-	-
2. Beneficiation operations (MGB-2)								
1. Screening	kg/Mg	1.25E-02	4.30E-03	4.30E-04	-	-	-	-
2. DMS Beneficiation (8 operations)	kg/Mg	5.00E-03	2.00E-03	2.00E-04	-	-	-	-
3. Product handling (MGB-P1/P2)								
1. FEL operation	g/VKT	2.62E+03	7.45E+02	7.45E+01	-	-	-	-
2. Material handling (3 operations)	kg/Mg	5.00E-03	2.00E-03	2.00E-04	-	-	-	-
3. Fugitive emissions from storage	kg/ha/h	7.20E+00	2.20E+00	2.20E-01	-	-	-	-
B. MP2 Plant (MGD)								
1. Feed handling (MGD-F)								
1. FEL operation	g/VKT	2.62E+03	7.45E+02	7.45E+01	-	-	-	-
2. Material handling (3 operations)	kg/Mg	5.00E-03	2.00E-03	2.00E-04	-	-	-	-
3. Fugitive emissions from storage	kg/ha/h	7.20E+00	2.20E+00	2.20E-01	-	-	-	-
2. Drying operations (MGD-2)								
1. Drying circuit	kg/Mg	9.97E+00	5.93E+00	5.93E-01	-	-	-	-
2. Combustion	kg/Mg	3.30E+01	6.60E+00	6.60E+00	9.50E+00	2.75E-01	3.09E+03	2.50E+00

Activity	Unit	Emission Factors						
		TSP	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO_2	CO
3. Beneficiation operations (MGD-2)								
1. Magnetic separation (8 operations)	kg/Mg	6.00E-02	3.00E-02	3.00E-03	-	-	-	-
4. Product handling (MGB-P1/P2)								
1. FEL operation	g/VKT	2.62E+03	7.45E+02	7.45E+01	-	-	-	-
2. Material handling (3 operations)	kg/Mg	6.00E-02	3.00E-02	3.00E-03	-	-	-	-
3. Fugitive emissions from storage	kg/ha/h	7.20E+00	2.20E+00	2.20E-01	-	-	-	-
C. Magnetite Stockpiles								
1. Export stockpile 1 (Tengwa operations)(STN-1)								
1. FEL operation	g/VKT	2.62E+03	7.45E+02	7.45E+01	-	-	-	-
2. Material handling (3 operations)	kg/Mg	5.00E-03	2.00E-03	2.00E-04	-	-	-	-
3. Fugitive emissions from storage	kg/ha/h	7.20E+00	2.20E+00	2.20E-01	-	-	-	-
2. Export stockpile 2 (SAOB/MP2 operations)(STN-2)								
1. FEL operation	g/VKT	2.62E+03	7.45E+02	7.45E+01	-	-	-	-
2. Material handling (3 operations)	kg/Mg	5.00E-03	2.00E-03	2.00E-04	-	-	-	-
3. Fugitive emissions from storage	kg/ha/h	7.20E+00	2.20E+00	2.20E-01	-	-	-	-
3. Export stockpile 3 (SAOB/MP2 operations)(STN-3)								
1. FEL operation	g/VKT	2.62E+03	7.45E+02	7.45E+01	-	-	-	-
2. Material handling (3 operations)	kg/Mg	5.00E-03	2.00E-03	2.00E-04	-	-	-	-
3. Fugitive emissions from storage	kg/ha/h	7.20E+00	2.20E+00	2.20E-01	-	-	-	-

Activity	Unit	Emission Factors						
		TSP	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO_2	CO
4. MP2 P2 stockpile (MGD-P2 East)								
1. FEL operation	g/VKT	2.62E+03	7.45E+02	7.45E+01	-	-	-	-
2. Material handling (3 operations)	kg/Mg	5.00E-03	2.00E-03	2.00E-04	-	-	-	-
3. Fugitive emissions from storage	kg/ha/h	7.20E+00	2.20E+00	2.20E-01	-	-	-	-
5. SAOB P2 stockpile (MGD-P2 West)								
1. FEL operation	g/VKT	2.62E+03	7.45E+02	7.45E+01	-	-	-	-
2. Material handling (3 operations)	kg/Mg	5.00E-03	2.00E-03	2.00E-04	-	-	-	-
3. Fugitive emissions from storage	kg/ha/h	7.20E+00	2.20E+00	2.20E-01	-	-	-	-
D. Haul Roads								
1. Mag Ore to SAOB (unpaved)	g/VKT	3.37E+03	9.60E+02	9.60E+01	-	-	-	-
2. Mag Ore to MP2 (unpaved)	g/VKT	3.37E+03	9.60E+02	9.60E+01	-	-	-	-
3. Mag Ore to Tengwa (unpaved)	g/VKT	3.37E+03	9.60E+02	9.60E+01	-	-	-	-
4. SAOB P1 to export STN-2 (unpaved)	g/VKT	3.18E+03	9.05E+02	9.05E+01	-	-	-	-
5. SAOB P2 to MGD-P2 West (paved)	g/VKT	9.31E+02	1.79E+02	4.33E+01	-	-	-	-
6. SAOB P2 to export STN-3 (unpaved)	g/VKT	3.18E+03	9.05E+02	9.05E+01	-	-	-	-
7. MP2 P1 to export STN-2 (unpaved)	g/VKT	3.18E+03	9.05E+02	9.05E+01	-	-	-	-
8. MP2 P2 to MGD-P2 East (paved)	g/VKT	9.31E+02	1.79E+02	4.33E+01	-	-	-	-
9. MP2 P2 to export STN-3 (unpaved)	g/VKT	3.18E+03	9.05E+02	9.05E+01	-	-	-	-
10. Gypsum GS2 to export (unpaved)	g/VKT	3.37E+03	9.60E+02	9.60E+01	-	-	-	-
11. Mag Ore to SAOB/MP2 (paved)	g/VKT	1.06E+03	2.04E+02	4.94E+01	-	-	-	-
12. Mag Ore to Tengwa (paved)	g/VKT	1.06E+03	2.04E+02	4.94E+01	-	-	-	-
13. Gypsum GS2 to export (paved)	g/VKT	1.06E+03	2.04E+02	4.94E+01	-	-	-	-

Activity	Unit	Emission Factors						
		TSP	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO_2	CO
E. Tailings								
1. Gypsum A-Stack (GS1)								
1. Fugitive emissions from storage	mg/m²/day	1.57E+02	4.80E+01	4.80E+00	-	-	-	-
2. Gypsum B-Stack (Bosveld operations)(GS2)								
1. FEL operation	g/VKT	2.62E+03	7.45E+02	7.45E+01	-	-	-	-
2. Material handling (3 operations)	kg/Mg	5.00E-03	2.00E-03	2.00E-04	-	-	-	-
3. Fugitive emissions from storage	mg/m²/day	1.57E+02	4.80E+01	4.80E+00	-	-	-	-

Notes

g/VKT	:	Gram per vehicle kilometre travelled.
kg/Mg	:	Kilogram per megagram.
kg/ha/h	:	Kilogram per hectare per hour.
mg/m2/day	:	Milligram per square metre per day.
Mobile equipment operation	:	US EPA, AP42, Volume I, 5 Edition Chapter 13.2.
Material handling	:	US EPA, AP42, Volume I, 5 Edition Chapter 11.24. High moisture ore (>4%).
Fugitive emissions from magnetite storage	:	US EPA, AP42, Volume I, 5 Edition Chapter 11.9.
Screening	:	US EPA, AP42, Volume I, 5 Edition Chapter 11.19.
DMS beneficiation	:	US EPA, AP42, Volume I, 5 Edition Chapter 11.24. High moisture ore (>4%).
Magnetite drying	:	US EPA, AP42, Volume I, 5 Edition Chapter 11.19 and Chapter 11.24.
Coal combustion	:	US EPA, AP42, Volume I, 5 Edition Chapter 1.1. Coal sulphur content of 0.5% and carbon content of 85%.
Magnetic separation	:	US EPA, AP42, Volume I, 5 Edition Chapter 11.24. High moisture ore (<4%).
Fugitive emissions from gypsum storage	:	Bosveld ambient dust deposition monitoring for the period October 2019 to September 2021 .

Table 8.4.11.2(c): Copper Flotation Plant, Waste Disposal Facility and Pollution Control Dam – Emission Factors

Activity	Unit	Emission Factors						
		TSP	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO_2	CO
A. Copper Flotation Plant (CUF)								
1. Feed handling (CUF-F/CUF-1)								
1. FEL operation	g/VKT	2.62E+03	7.45E+02	7.45E+01	-	-	-	-
2. Material handling (3 operations)	kg/Mg	5.00E-03	2.00E-03	2.00E-04	-	-	-	-
3. Fugitive emissions from storage	kg/ha/h	7.20E+00	2.20E+00	2.20E-01	-	-	-	-
2. Beneficiation operations (CUF-2)								
1. Screening	kg/Mg	1.25E-02	4.30E-03	4.30E-04	-	-	-	-
2. DMS Beneficiation (8 operations)	kg/Mg	5.00E-03	2.00E-03	2.00E-04	-	-	-	-
3. Product handling (CUF-C)								
1. FEL operation	g/VKT	2.62E+03	7.45E+02	7.45E+01	-	-	-	-
2. Material handling (3 operations)	kg/Mg	5.00E-03	2.00E-03	2.00E-04	-	-	-	-
3. Fugitive emissions from storage	kg/ha/h	7.20E+00	2.20E+00	2.20E-01	-	-	-	-
B. Waste Disposal Facility (WDF) / Pollution Control Dam (PCD)								
1. Waste disposal facility (WDF)								
1. FEL operation	g/VKT	2.62E+03	7.45E+02	7.45E+01	-	-	-	-
2. Material handling (3 operations)	kg/Mg	5.00E-03	2.00E-03	2.00E-04	-	-	-	-
3. Fugitive emissions from storage	kg/ha/h	7.20E+00	2.20E+00	2.20E-01	-	-	-	-
C. Haul Roads								
1. CUF-C to export (unpaved)	g/VKT	3.18E+03	9.05E+02	9.05E+01	-	-	-	-
2. CUF-W to waste disposal facility (unpaved)	g/VKT	3.18E+03	9.05E+02	9.05E+01				

Notes

g/VKT	:	Gram per vehicle kilometre travelled.
kg/Mg	:	Kilogram per megagram.
kg/ha/h	:	Kilogram per hectare per hour.
Mobile equipment operation	:	US EPA, AP42, Volume I, 5 Edition Chapter 13.2.
Material handling	:	US EPA, AP42, Volume I, 5 Edition Chapter 11.24. High moisture ore (>4%).
Fugitive emissions from magnetite storage	:	US EPA, AP42, Volume I, 5 Edition Chapter 11.9.
Screening	:	US EPA, AP42, Volume I, 5 Edition Chapter 11.19.
DMS beneficiation	:	US EPA, AP42, Volume I, 5 Edition Chapter 11.24. High moisture ore (>4%).

Table 8.4.11.2(d): Magnetite Beneficiation – Emission Rates 2021 Reporting Period

Activity	Control Efficiency[b]	Emission Rate[a]							Totals	
		TSP	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO_2	CO		
A. SAOB Plant (MGB)									**5.610**	**7.69%**
1. Feed handling (MGB-F)										
1. FEL operation	25%	0.409	0.116	0.012	-	-	-	-	0.536	0.74%
2. Material handling (3 operations)	0%	0.306	0.122	0.012	-	-	-	-	0.440	0.60%
3. Fugitive emissions from storage	0%	1.280	0.392	0.039	-	-	-	-	1.711	2.35%
2. Beneficiation operations (MGB-2)										
1. Screening	0%	0.255	0.088	0.009	-	-	-	-	0.351	0.48%
2. DMS Beneficiation (8 operations)	0%	0.815	0.326	0.033	-	-	-	-	1.174	1.61%
3. Product handling (MGB-P1/P2)										
1. FEL operation	25%	0.406	0.115	0.012	-	-	-	-	0.533	0.73%
2. Material handling (3 operations)	0%	0.304	0.121	0.012	-	-	-	-	0.437	0.60%
3. Fugitive emissions from storage	0%	0.320	0.098	0.010	-	-	-	-	0.428	0.59%
B. MP2 Plant (MGD)									**29.020**	**39.79%**
1. Feed handling (MGD-F)										
1. FEL operation	25%	0.403	0.115	0.011	-	-	-	-	0.529	0.73%
2. Material handling (3 operations)	0%	0.301	0.121	0.012	-	-	-	-	0.434	0.60%
3. Fugitive emissions from storage	0%	0.360	0.110	0.011	-	-	-	-	0.481	0.66%
2. Drying operations (MGD-2)										
1. Drying circuit	99%	2.004	1.192	0.119	-	-	-	-	3.315	4.55%
2. Combustion	50%	0.188	0.038	0.038	0.054	0.002	17.611	0.014	17.945	24.61%

Activity	Control Efficiency[b]	Emission Rate[a]							Totals	
		TSP	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO_2	CO		
3. Beneficiation operations (MGD-2)										
1. Magnetic separation (8 operations)	50%	0.096	0.048	0.005	-	-	-	-	0.150	0.21%
4. Product handling (MGB-P1/P2)										
1. FEL operation	25%	0.150	0.043	0.004	-	-	-	-	0.197	0.27%
2. Material handling (3 operations)	0%	3.644	1.822	0.182	-	-	-	-	5.648	7.75%
3. Fugitive emissions from storage	0%	0.240	0.073	0.007	-	-	-	-	0.321	0.44%
C. Magnetite Stockpiles									**10.595**	**18.13%**
1. Export stockpile 1 (Tengwa operations)(STN-1)										
1. FEL operation	25%	0.992	0.282	0.028	-	-	-	-	1.303	1.79%
2. Material handling (3 operations)	0%	0.742	0.297	0.030	-	-	-	-	1.069	1.47%
3. Fugitive emissions from storage	0%	3.140	0.961	0.096	-	-	-	-	4.197	5.76%
2. Export stockpile 2 (SAOB/MP2 operations)(STN-2)										
1. FEL operation	25%	0.450	0.128	0.013	-	-	-	-	0.591	0.81%
2. Material handling (3 operations)	0%	0.337	0.135	0.013	-	-	-	-	0.485	0.66%
3. Fugitive emissions from storage	0%	1.780	0.545	0.054	-	-	-	-	2.379	3.26%
3. Export stockpile 3 (SAOB/MP2 operations)(STN-3)										
1. FEL operation	25%	0.106	0.030	0.003	-	-	-	-	0.139	0.19%
2. Material handling (3 operations)	0%	0.079	0.032	0.003	-	-	-	-	0.114	0.16%
3. Fugitive emissions from storage	0%	1.500	0.459	0.046	-	-	-	-	2.005	2.75%

Activity	Control Efficiency[b]	Emission Rate[a]							Totals	
		TSP	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO_2	CO		
4. MP2 P2 stockpile (MGD-P2 East)										
1. FEL operation	25%	0.000	0.000	0.000	-	-	-	-	0.000	0.00%
2. Material handling (3 operations)	0%	0.000	0.000	0.000	-	-	-	-	0.000	0.00%
3. Fugitive emissions from storage	0%	0.000	0.000	0.000	-	-	-	-	0.000	0.00%
5. SAOB P2 stockpile (MGD-P2 West)										
1. FEL operation	25%	0.000	0.000	0.000	-	-	-	-	0.000	0.00%
2. Material handling (3 operations)	0%	0.000	0.000	0.000	-	-	-	-	0.000	0.00%
3. Fugitive emissions from storage	0%	0.000	0.000	0.000	-	-	-	-	0.000	0.00%
D. Haul Roads									**13.034**	**22.31%**
1. Mag Ore to SAOB (unpaved)	25%	1.038	0.295	0.030	-	-	-	-	1.363	1.87%
2. Mag Ore to MP2 (unpaved)	25%	5.120	1.456	0.146	-	-	-	-	6.721	9.22%
3. Mag Ore to Tengwa (unpaved)	25%	3.943	1.121	0.112	-	-	-	-	5.177	7.10%
4. SAOB P1 to export STN-2 (unpaved)	25%	1.927	0.548	0.055	-	-	-	-	2.529	3.47%
5. SAOB P2 to MGD-P2 West (paved)	25%	0.000	0.000	0.000	-	-	-	-	0.000	0.00%
6. SAOB P2 to export STN-3 (unpaved)	25%	0.730	0.207	0.021	-	-	-	-	0.958	1.31%
7. MP2 P1 to export STN-2 (unpaved)	25%	0.638	0.181	0.018	-	-	-	-	0.837	1.15%
8. MP2 P2 to MGD-P2 East (paved)	25%	0.000	0.000	0.000	-	-	-	-	0.000	0.00%
9. MP2 P2 to export STN-3 (unpaved)	25%	0.047	0.013	0.001	-	-	-	-	0.061	0.08%
10. Gypsum GS2 to export (unpaved)	25%	0.348	0.099	0.010	-	-	-	-	0.457	0.63%
11. Mag Ore to SAOB/MP2 (paved)	25%	1.864	0.180	0.044	-	-	-	-	2.087	2.86%
12. Mag Ore to Tengwa (paved)	25%	2.039	0.391	0.095	-	-	-	-	2.526	3.46%
13. Gypsum GS2 to export (paved)	25%	0.083	0.016	0.004	-	-	-	-	0.103	0.14%

Activity	Control Efficiency[b]	Emission Rate[a]							Totals	
		TSP	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO_2	CO		
E. Tailings									**3.188**	**5.46%**
1. Gypsum A-Stack (GS1)										
1. Fugitive emissions from storage	0%	1.252	0.383	0.038	-	-	-	-	1.674	2.86%
2. Gypsum B-Stack (Bosveld operations)(GS2)										
1. FEL operation	25%	0.040	0.012	0.001	-	-	-	-	0.053	0.07%
2. Material handling (3 operations)	0%	0.030	0.012	0.001	-	-	-	-	0.044	0.06%
3. Fugitive emissions from storage	0%	1.067	0.326	0.033	-	-	-	-	1.426	1.95%
Totals		**40.773**	**13.050**	**1.422**	**0.054**	**0.002**	**17.611**	**0.014**	**72.926**	**100.00%**
		55.91%	**17.89%**	**1.95%**	**0.07%**	**0.00%**	**24.15%**	**0.02%**	**100.00%**	
Emissions Summary by Activity										
Mobile equipment operation		20.732	5.350	0.618	-	-	-	-	26.700	36.61%
Material handling		5.743	2.662	0.266	-	-	-	-	8.671	11.89%
Magnetite Beneficiation		3.358	1.691	0.203	0.054	0.002	17.611	0.014	22.934	31.45%
Fugitive emissions from magnetite storage		8.620	2.638	0.264	-	-	-	-	11.521	15.80%
Fugitive emissions from gypsum storage		2.319	0.710	0.071	-	-	-	-	3.099	4.25%

Notes

Emission rate : gram per second.

Control factor : Estimated control factors from various mining operations obtained from Holmes Air Sciences (1998).

Table 8.4.11.2(e): Magnetite Beneficiation – Emission Inventory Parameters

Parameter	Unit	Value
Annual production days	days/year	324.00
Monthly production days	days/month	27.00
Annual production hours	hours/year	7 776.00
Monthly production hours	hours/month	648.00
Daily production hours	hours/day	24.00
Coal used (Bosveld)(Air Emission Licence; AEL)	tonnes/year	20 000.00
Coal used (MP2)(AEL)	tonnes/year	18 000.00
HFO used (MP2)(AEL)	litres/year	200 000.00
Mag Ore raw material (SAOB)(2021)	tonnes	642 600.21
Mag Ore raw material (MP2) (2021)	tonnes	633 793.25
Mag Ore raw material (Tengwa) (2021)	tonnes	1 560 629.11
Gypsum raw material (Bosveld) (2021)	tonnes	63 666.78
Mag Ore P1 produced (SAOB) (2021)	tonnes	521 401.53
Mag Ore P2 produced (SAOB) (2021)	tonnes	117 054.69
Mag Ore P1 produced (MP2) (2021)	tonnes	186 063.00
Mag Ore P2 produced (MP2) (2021)	tonnes	49 793.00
Mag Ore produced (Tengwa) (2021)	tonnes	1 560 629.11
TSP Particle Size Multiplier for Paved Road Equation	g/VKT	3.23
PM10 Particle Size Multiplier for Paved Road Equation	g/VKT	0.62
PM2.5 Particle Size Multiplier for Paved Road Equation	g/VKT	0.15
Paved surfaces silt loading	g/m^2	9.70
Unpaved surfaces silt content	%	8.30
Constant k TSP Particle Size for Unpaved Road Equation	lb/VMT	4.90
Constant k PM10 Particle Size for Unpaved Road Equation	lb/VMT	1.50
Constant k PM2.5 Particle Size for Unpaved Road Equation	lb/VMT	0.15
Constant a TSP Particle Size for Unpaved Road Equation	lb/VMT	0.70
Constant a PM10/2.5 Particle Size for Unpaved Road Equation	lb/VMT	0.90
Constant b TSP/PM10/PM2.5 Particle Size for Unpaved Road Equation	lb/VMT	0.45
Bell 467ZX FEL weight	tonnes	22.08
Bell 467ZX FEL bucket capacity	m3	3.50
Bell 467ZX FEL bucket capacity	tonnes	4.90
Bell B30E 4x4 ADT average weight of 33.99t (Gross weight 47.99t & Tare weight 19.99t)	tonnes	33.99
Road transport average vehicle weight of 38.75t (Gross weight 56t & Tare weight 21.5t)	tonnes	38.75
Bosveld Phosphates average annual wind speed for 2021	m/s	4.00
Paved Road - Mag Ore to SAOB/MP2	kilometres	1.96
Unpaved Road - Mag Ore to SAOB	kilometres	0.78
Unpaved Road - Mag Ore to MP2	kilometres	3.90
Paved Road - Mag Ore to Tengwa and Gypsum export	kilometres	2.00
Unpaved Road - Mag Ore to Tengwa	kilometres	1.22

Parameter	Unit	Value
Unpaved Road - SAOB P1 to STN2	kilometres	1.66
Paved Road - SAOB P2 to MGD-P2 West	kilometres	1.58
Unpaved Road - SAOB P2 to STN3	kilometres	2.80
Unpaved Road - MP2 P1 to STN2	kilometres	1.54
Paved Road - MP2 P2 to MGD-P2 East	kilometres	1.12
Unpaved Road - MP2 P2 to STN3	kilometres	0.42
Unpaved Road - Gypsum export	kilometres	2.64
Stockpile Operations	kilometres	0.05
Surface Area - SAOB feed handling	ha	0.64
Surface Area - SAOB plant	ha	0.49
Surface Area - SAOB product handling	ha	0.16
Surface Area - MP2 feed handling	ha	0.18
Surface Area - MP2 plant	ha	0.10
Surface Area - MP2 product handling	ha	0.12
Surface Area - STN 1	ha	1.57
Surface Area - STN 2	ha	0.89
Surface Area - STN 3	ha	0.75
Surface Area - MGD-P2 East	ha	0.96
Surface Area - MGD-P2 West	ha	0.91
Surface Area - Gypsum A-Stack	ha	68.92
Surface Area - Gypsum B-Stack	ha	58.70
Surface Area - Gypsum Remining	ha	34.96
Material handling emission control factor	unitless	1.00
Magnetite stockpile emission control factor	unitless	1.00
Gypsum stockpile emission control factor	unitless	1.00
Roads and marshalling areas emission control factor	unitless	0.75
MP2 plant particulate gas emission control factor	unitless	0.01
MP2 plant scrubber gas emission control factor	unitless	0.01

8.4.11.3. Pollution Sources

The outdoor sources of air pollution resulting from human activities comprise three broad categories.

- **Stationary sources** can be subdivided into; rural area sources, e.g. agriculture, mining and quarrying and industrial point and area sources, e.g. manufacturing of chemicals, non-metallic mineral products, basic metal industries and power generation.
- **Community sources** i.e., heating of homes and buildings, municipal waste and sewage sludge incinerators, fireplaces, cooking facilities, laundry services and cleaning plants.
- **Mobile sources** include sources such as combustion-engine vehicles, e.g. light duty petrol-powered cars, light and heavy-duty diesel-powered vehicles, motorcycles, aircraft and line sources such as fugitive emissions from vehicle traffic.

Air pollutants are traditionally classified into suspended particulate matter (dusts, fumes, mists and smokes), gaseous pollutants (gases and vapours) and odours.

As evident from Figure 8.4.11.3(a), the source groups per District Municipality for the Limpopo Province include industry, domestic fuel burning and mining, with differences in contribution by each source across the Districts. Other sources within the Province contributing to air pollution include domestic fuel burning, vehicle tailpipe emissions, and biomass burning.

The main sources of SO_2 and NOx within the Limpopo Province are the power generation sources within the Waterberg District Municipality. Small boilers, followed by mining operations (both coal and metallurgical), are the main contributing sources to total suspended particulate matter (TSP) with boilers (assuming all TSP to be PM_{10}) the main source of PM_{10}. Wood processing is the second most significant source of PM_{10}. The main contributor within the Province to fine particulate matter ($PM_{2.5}$) and CO is biomass burning. Vehicle tailpipe emissions are the main source of hydrocarbons specifically within the Districts of Waterberg, Capricorn and Vhembe. VOCs show to be primarily from wood treatment works and these are mainly restricted to Mopani District Municipality. Small boilers, where quantified, also indicated to be potential significant sources of CO_2.

Four 'hot-spot' areas were selected for dispersion modelling (see Table 8.4.11.3(a)) based on the current understanding of the air quality within the Province, the location of significant sources as well as available emissions data. These are:

- **Polokwane region**: a region with a high number of sources and no up-to-date ambient air quality data to determine the current state of air.
- **Lephalale region**: the only region within the Province with power stations and large-scale coal mining activities.
- **Phalaborwa region**: the only area with fertiliser manufacturing, a copper smelter and large opencast mining operations.
- **Steelpoort Valley**: an area with significant number of mining activities.

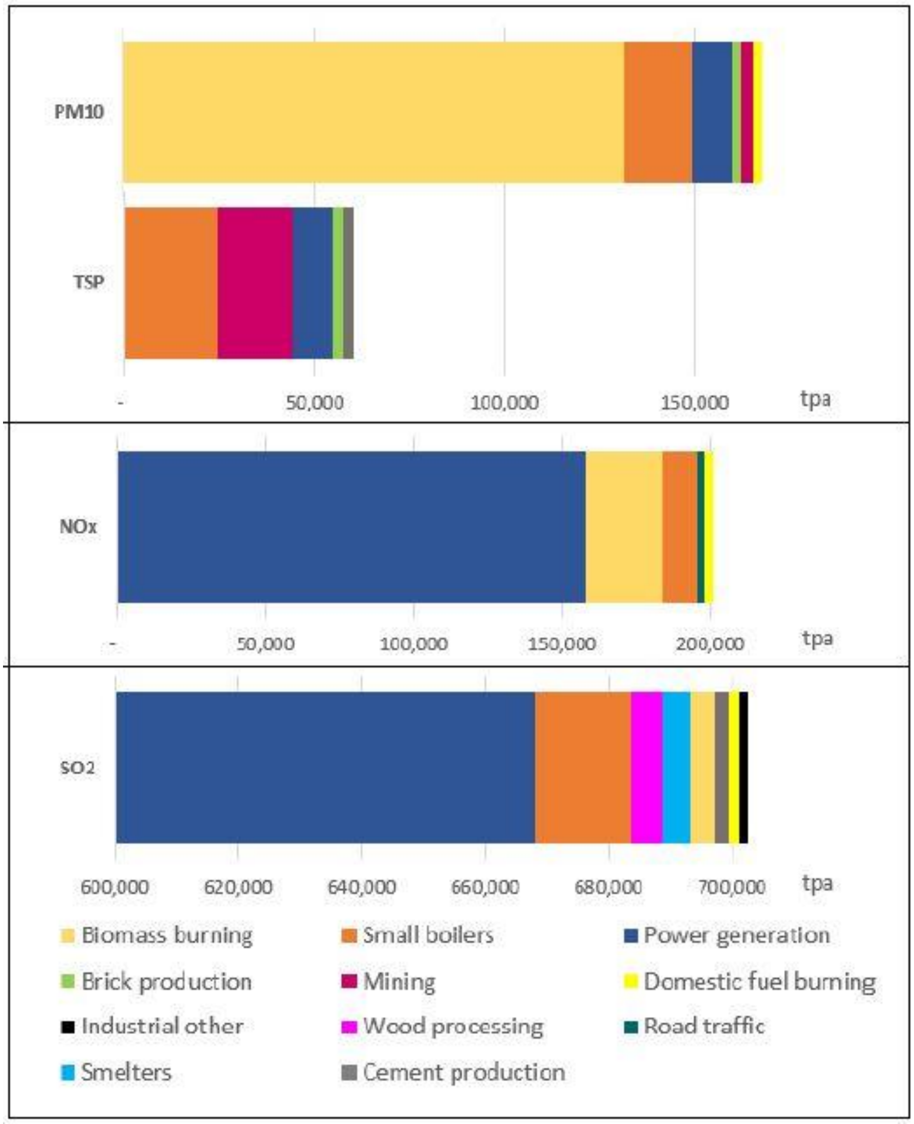

Figure 8.4.11.3(a): Limpopo Province Emission Per Source Group

Some of the concerns identified were:

- The predicted impacts within the Polokwane area are mainly localised.
- The area around Lephalale is of concern, due to the planned development rather than the current situation. Current Ground Level Concentrations (GLCs) PM_{10} are however a concern around the opencast mines in the area where it is predicted to exceed standards at nearby settlements.
- The main area of concern is around Phalaborwa due to very high SO_2 concentrations impacting on the town.
- The Steelpoort area due to the numerous mining operations within proximity to villages and homesteads resulting in high PM_{10} GLCs.

Table 8.4.11.3(a): Predicted Impact at the Four "Hot-spot" Areas Within the Limpopo Province

Identified Areas	Main Pollutant	Main Sources of Concern	Significance
Polokwane	PM_{10}	Brickworks and asphalt plants	Medium
	SO_2	Smelters	Medium
Lephalale	PM_{10}	Mining operations	High
	SO_2	Power plants	Medium
Phalaborwa	PM_{10}	Mining operations	Medium
	SO_2	Smelter and fertiliser production	High
Steelpoort	PM_{10}	Mining operations	High

All source groups were ranked in order of significance employing a typical Environmental Impact Assessment significance ranking methodology. The significance ranking for the areas of concern showed the following (see Table 8.4.11.3(b)):

- Wood processing, mainly based on the number of activities, was ranked first in Mopani and in Vhembe. There are, however, far more wood processing activities in Mopani than in Vhembe.
- The smelting and fertiliser operations at Phalaborwa, even though both ranked fourth, are significant impacting sources.
- Mining resulted in a significant source at Sekhukhune and Waterberg DMs. At Waterberg DM, the main concern is around the coal mining operations and at Sekhukhune it is around the numerous platinum mines within the Steelpoort Valley area.
- Brickworks and other industrial sources were flagged as significant contributing emission sources in the Capricorn DM.

Table 8.4.11.3(b): Ranked Significance of Source Groups in Each District Municipality

Source Group	Capricorn	Mopani	Sekhukhune	Vhembe	Waterberg
Brick production	1	3	-	3	2
Cement industry	3	-	-	-	5
Fertiliser	-	4	3	-	-
Fuel depot	-	7	5	-	-
Incinerators	-	-	-	-	-
Industrial stockpiles	7	-	-	-	-
Industrial other	1	6	4	4	3
Mining	3	2	1	2	1
Power generation	-	-	-	-	4
Small boilers	-	-	-	-	-
Smelter	5	4	2	-	-
Wood processing	6	1	-	1	-

Notes:
Ranking based on number of sources of each type and the total impact score.

The 2007 National Framework lists District and Metropolitan Municipalities where the ambient air is regarded as poor or potentially poor. For Limpopo Province, the ambient air in the Capricorn, Mopani and Waterberg District Municipalities are listed as 'potentially poor' with the definition as 'air quality poor at times or deteriorating'.

The National Framework describes, *inter alia*, the implementation of ambient air quality standards. In this discussion five zones of control are described, each summarised briefly below.

Green Zone: Class 1 Air Quality Area: The areas where ambient air quality remains within Target Levels and no substantive corrective air quality management interventions are required other than basic good air quality governance.

Target Levels – The ambient air quality targets for South Africa that provide an adequate 'development buffer' between air that is harmful and air that is not harmful to health and well-being. Target levels are likely to be set at 80% of the National ambient air quality standards.

Blue Zone: Class 2 Air Quality Area: The areas where ambient air quality remains within Alert Levels, but 'pre-emptive' air quality management interventions are required other than basic good air quality governance.

Alert Levels – will be the levels of ambient air quality where 'pre-emptive' governance interventions are triggered that provide an adequate 'intervention development buffer' between air that is harmful and air that is not harmful to health and well-being. Alert levels are likely to be set at 90% of the National ambient air quality standards.

Purple Zone: Class 3 Air Quality Area: The areas where ambient air quality remains within the standards, but sustained air quality management interventions are required to, at least, maintain or improve this situation.

The Ambient Air Quality Standards will be the levels of ambient air quality where immediate governance interventions are triggered with the aim of, at least, bringing the area into compliance with the standard. This standard is the boundary between air that is potentially harmful and air that is not harmful to health and well-being.

Orange Zone: Class 4 Air Quality Area: The areas where ambient air quality represents a possible threat to health and well-being and requires immediate and sustained air quality management interventions to, at least, bring the area into compliance with the standards within agreed time frames.

In order for Government to prioritise efficient and effective air quality interventions, although immediate interventions are required, Class 4 Air Quality Areas need not necessarily be declared as priority areas in terms of the AQA.

Red Zone: Class 5 Air Quality Area: The areas where ambient air quality represents a possible threat to health and well-being and requires immediate and sustained air quality management interventions to, at least, bring the area into compliance with the standards within agreed time frames. Class 5 Air Quality Areas must immediately be declared National or Provincial priority areas in terms of the AQA.

Dispersion modelling carried out as part of the baseline assessment indicated that ambient air quality standards of PM_{10} and SO_2 may be exceeded from time-to-time near Lephalale, Phalaborwa and in the Steelpoort Valley. This implies a potential of Zones 3 or 4 being approached, requiring action by Air Quality Officers.

However, as no substantive air quality measurements have been conducted in these areas, other than SO_2 by Palaborwa Copper, it is suggested that insufficient information exists to indicate which of the two air quality control zones is applicable. It was recommended, therefore, that current monitoring requirements are aimed at a Zone 3 (purple zone) level in those regions. Until better information becomes available, it was recommended that a Zone 2 classification be given to the other areas in the Province.

8.4.11.4. Bosveld Phosphates Air Quality

Ambient dust deposition monitoring commenced in October 2019 at Bosveld Phosphates. The program provided for 11 dust deposition monitoring stations indicated in Figure 8.4.11.4(a).

A summary of the dust deposition rates for the period October 2020 to September 2021 is presented in Table 8.4.11.4(a) and Figure 8.4.11.4(b) to Figure 8.4.11.4(m).

Figure 8.4.11.4(a): Bosveld Phosphates Dust Deposition Monitoring Matrix (Yellow markers – Non-residential receptor, Red marker – Source)

Table 8.4.11.4(a): Summary of Dust Deposition Rates – September 2020 to August 2021

Monitoring Station		Average Dust Deposition Rate ($mg/m^2/day$)[1]	Comments[2]
Non-Residential Monitoring Stations			
BOS6	Loading Station #1 lat 23.975214° lon 31.100977°	**4 823.03**	- Dust deposition rate above the **1 200 mg/m^2/day non-residential NEM: AQA** dust deposition standard. - Contraventions: **11** - Last three contraventions: **06/2021, 07/2021 & 08/2021** - Current Classification: **Excessive!**
BOS7	Northern Boundary lat 23.974907° lon 31.093576°	**924.63**	- Dust deposition rate above the **1 200 mg/m^2/day non-residential NEM: AQA** dust deposition standard. - Contraventions: 3 - Last two contraventions: **10/2020, 11/2020 & 08/2021** - Current Classification: **Excessive!**
BOS8	North Western Boundary lat 23.973683° lon 31.079200°	**281.04**	- Dust deposition rate below the **1 200 mg/m^2/day non-residential NEM: AQA** dust deposition standard. - Contraventions: **0** - Last contravention: **None** - Current Classification: **Acceptable**
BOS9	Eastern Boundary, Opposite Dry Magnetite Beneficiation Plant lat 23.979487° lon 31.104985°	**4 132.60**	- Dust deposition rate above the **1 200 mg/m^2/day non-residential NEM: AQA** dust deposition standard. - Contraventions: **11** - Last three contraventions: **06/2021, 07/2021 & 08/2021** - Current Classification: **Excessive!**
BOS10	Eastern Boundary, Opposite Loading Station #2 lat 23.981442° lon 31.104088°	**3 509.32**	- Dust deposition rate above the **1 200 mg/m^2/day non-residential NEM: AQA** dust deposition standard. - Contraventions: **10** - Last three contraventions: **06/2021, 07/2021 & 08/2021** - Current Classification: **Excessive!**
BOS11	Eastern Boundary, Opposite Loading Station #3 lat 23.984432° lon 31.102827°	**5 091.88**	- Dust deposition rate above the **1 200 mg/m^2/day non-residential NEM: AQA** dust deposition standard. - Contraventions: **10** - Last three contraventions: **06/2021, 07/2021 & 08/2021** - Current Classification: **Excessive!**

Monitoring Station		Average Dust Deposition Rate ($mg/m^2/day$)[1]	Comments[2]
Source Monitoring Stations			
BOS1	Dry Magnetite Beneficiation lat 23.978356° lon 31.103937°	**3 014.84**	- Standard for reference purposes only when evaluating source monitoring results within the plant boundary. - Source monitoring data is used to maintain the emissions inventory, for calibration of dispersion models, for prioritisation of management
BOS2	Loading Station #2 lat 23.980833° lon 31.102825°	**4 929.72**	
BOS3	Loading Station #3 lat 23.981953° lon 31.100642°	**4 014.73**	

Monitoring Station		Average Dust Deposition Rate (mg/m²/day)[1]	Comments[2]
BOS4	Wet Magnetite Beneficiation lat 23.977674° lon 31.099586°	6 208.55	actions and evaluation of the effectiveness of control measures.
BOS5	Gypsum Stack A lat 23.976481° lon 31.090588°	272.31	
BOS12	Fedex Plant Administration Building lat 23.979347° lon 31.101392°	3 989.34	

Notes:

mg/m²/day: milligram dust deposited on a horizontal area of one square meter in a period of 24-hours

1: Dust deposition for the monitoring period measured in accordance with ASTM D1739: 1998. Colours correspond to the coding used below, i.e. dust deposition rates indicated in blue indicate conformance to the national standard and red indicates that the national standard has been contravened.

2: Comments NEM: AQA dust deposition standard promulgated under the National Dust Control Regulations, National Environmental Management: Air Quality Act (Act No. 39 of 2004) Standard for reference purposes only when evaluating source monitoring results within the plant boundary.

Standard: Dust deposition rate below 1 200mg/m²/day in non-residential areas and below 600mg/m²/day in residential areas. These standards are aimed at avoiding, preventing, or reducing harmful effects on human health or the environment.

Contravention: Requires investigation and remediation if two sequential months exceed the standard or if the level is exceeded more than twice per annum.

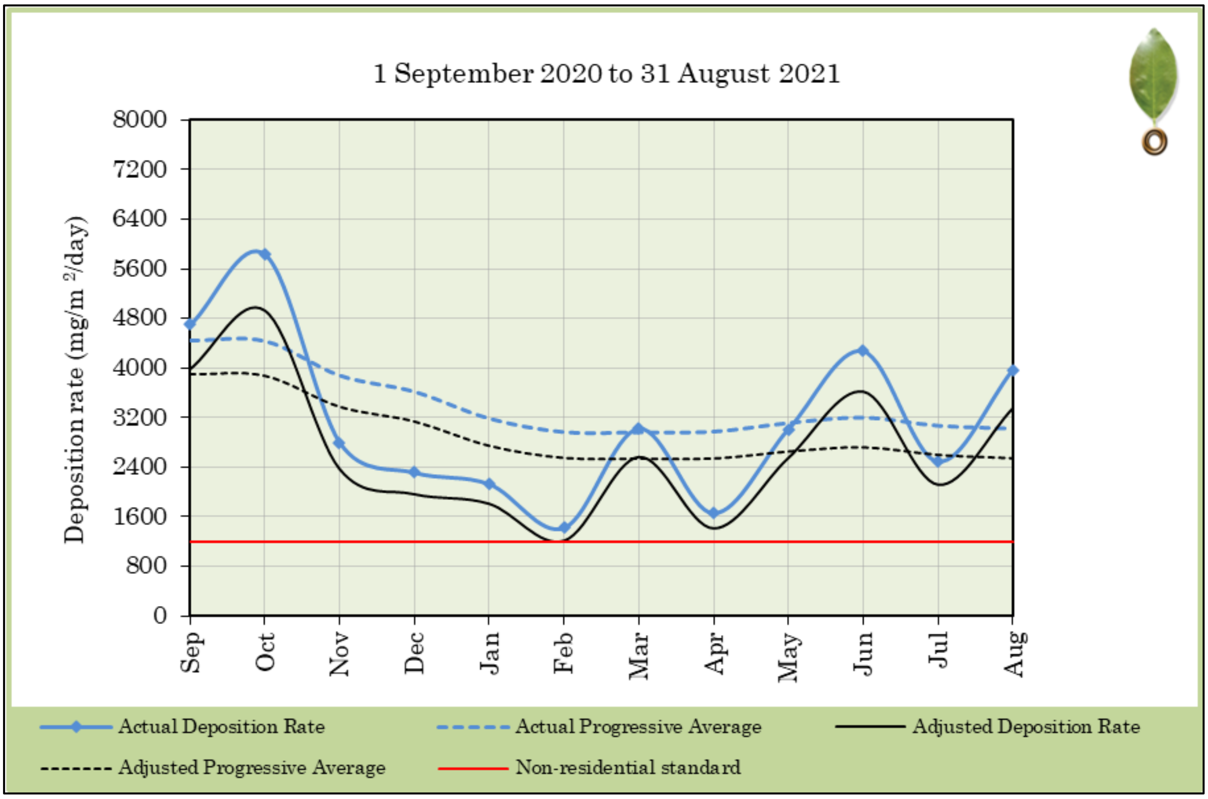

Figure 8.4.11.4(b): BOS#1 – Dry Magnetite Beneficiation

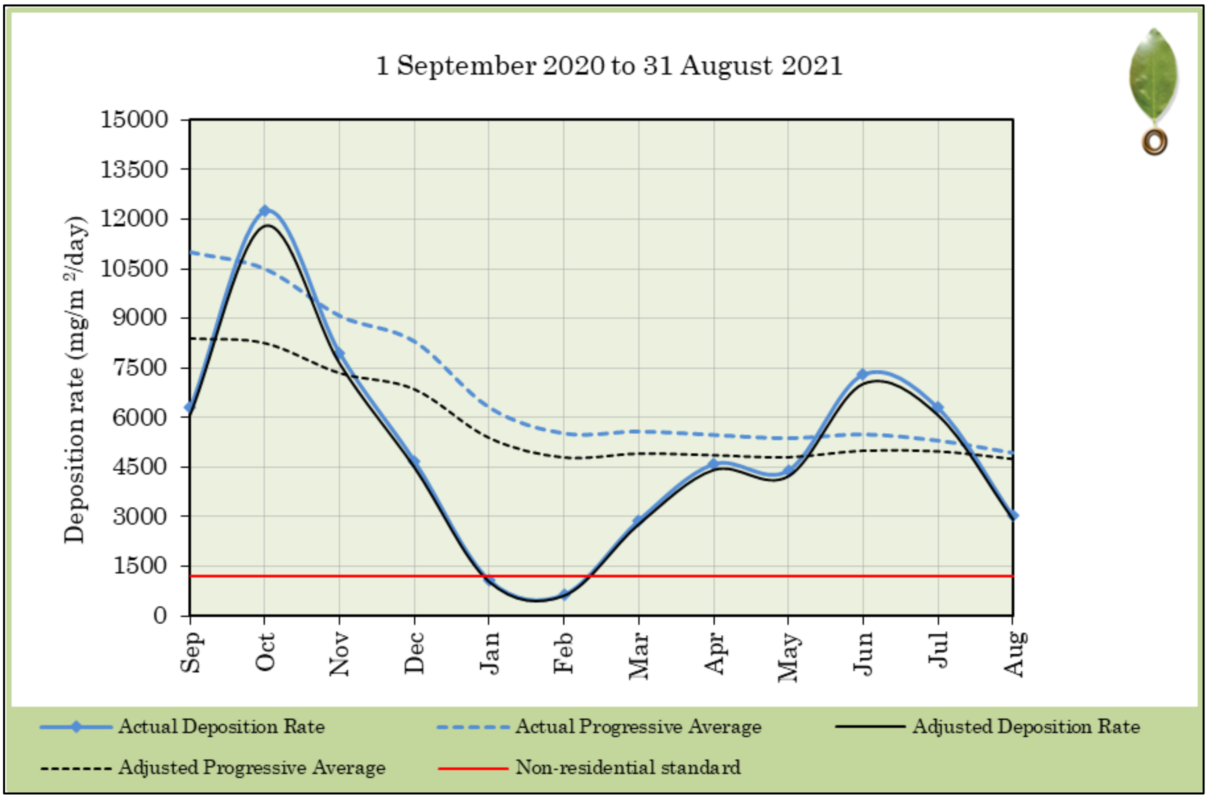

Figure 8.4.11.4(c): BOS#2 – Loading Station #2

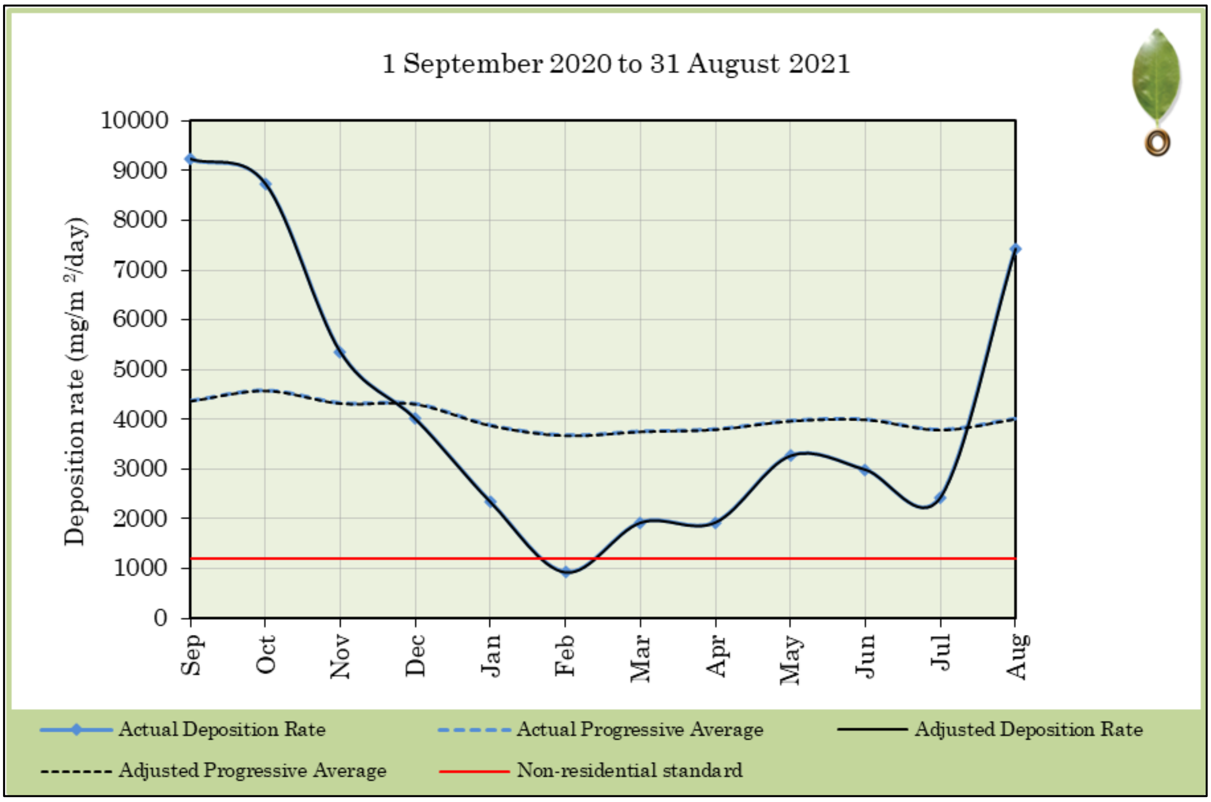

Figure 8.4.11.4(d): BOS #3 – Loading Station #3

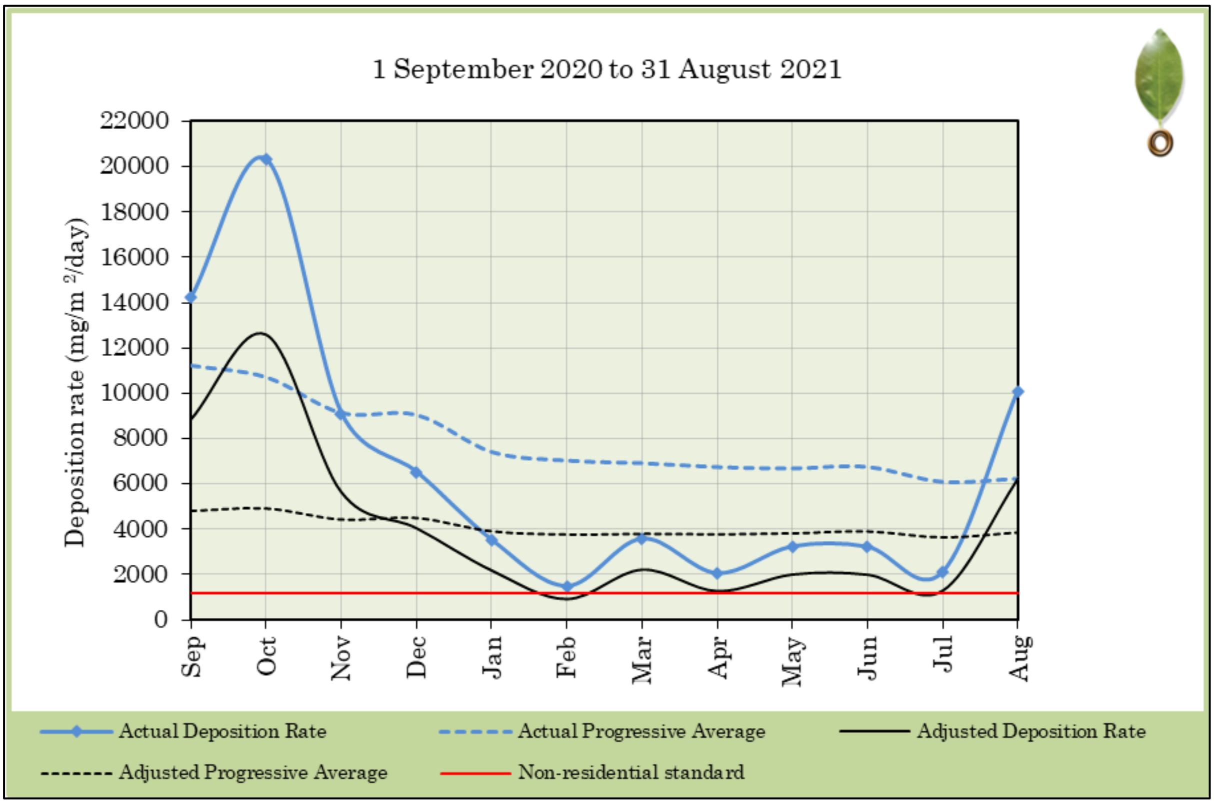

Figure 8.4.11.4(e): BOS #4 – Wet Magnetite Beneficiation

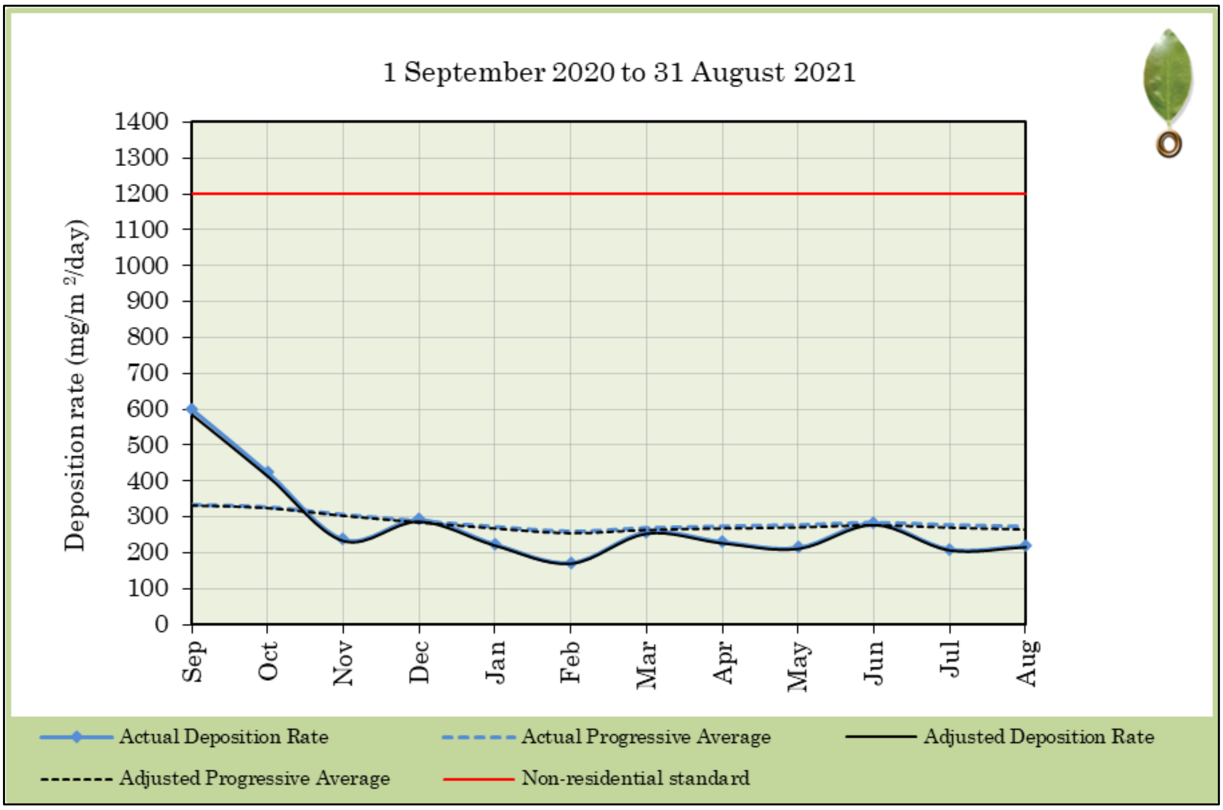

Figure 8.4.11.4(f): BOS #5 – Gypsum Stack A

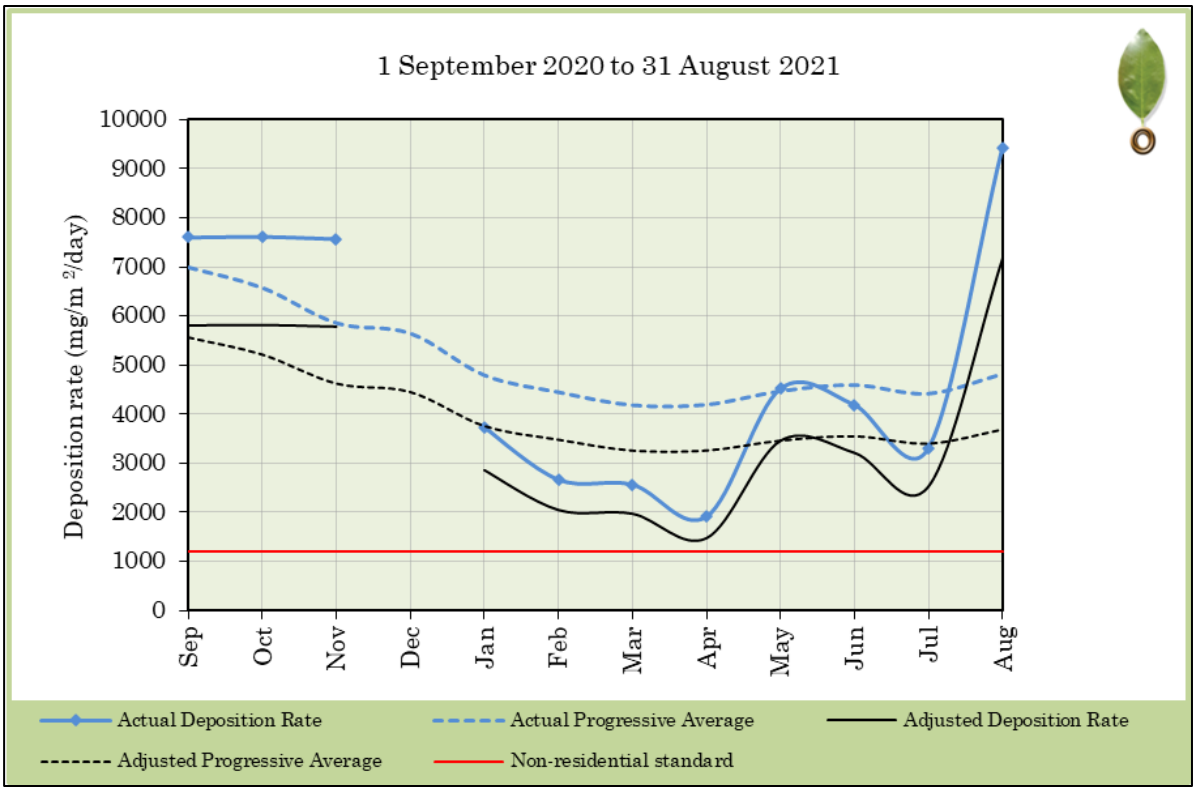

Figure 8.4.11.4(g): BOS #6 – Loading Station #1

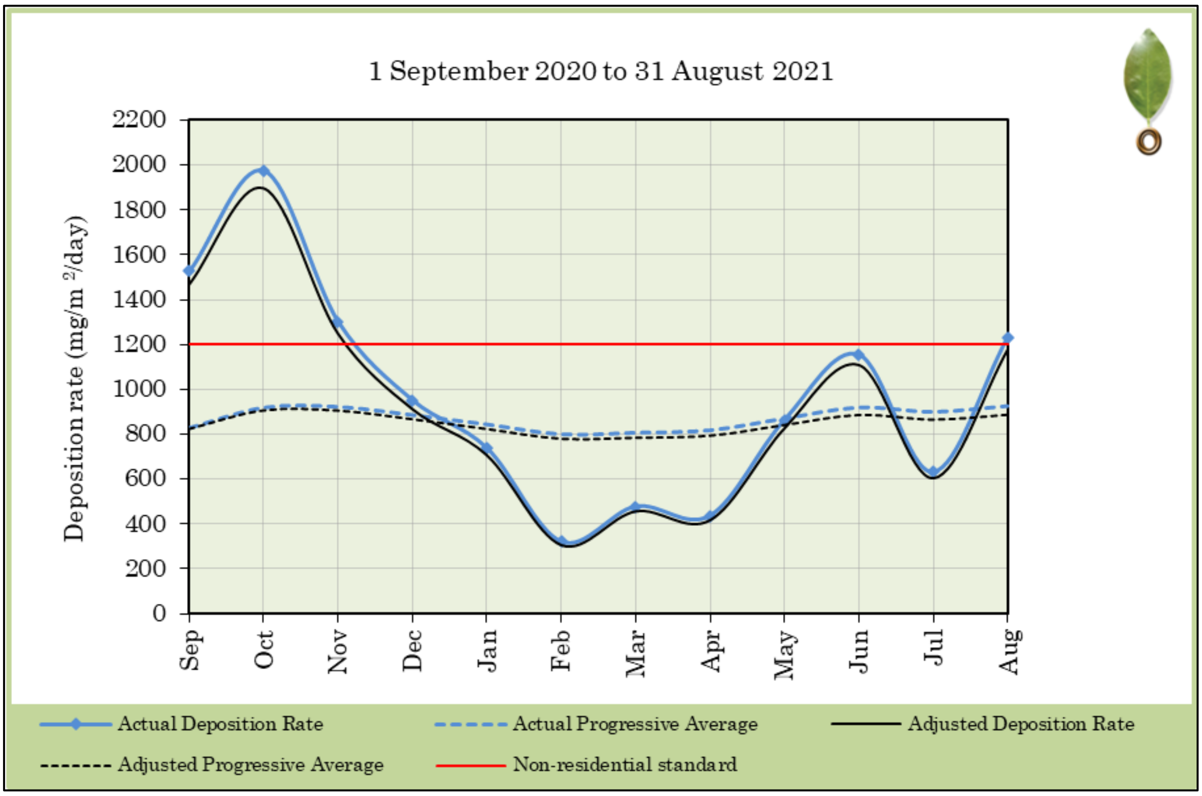

Figure 8.4.11.4(h): BOS #7 – Northern Boundary

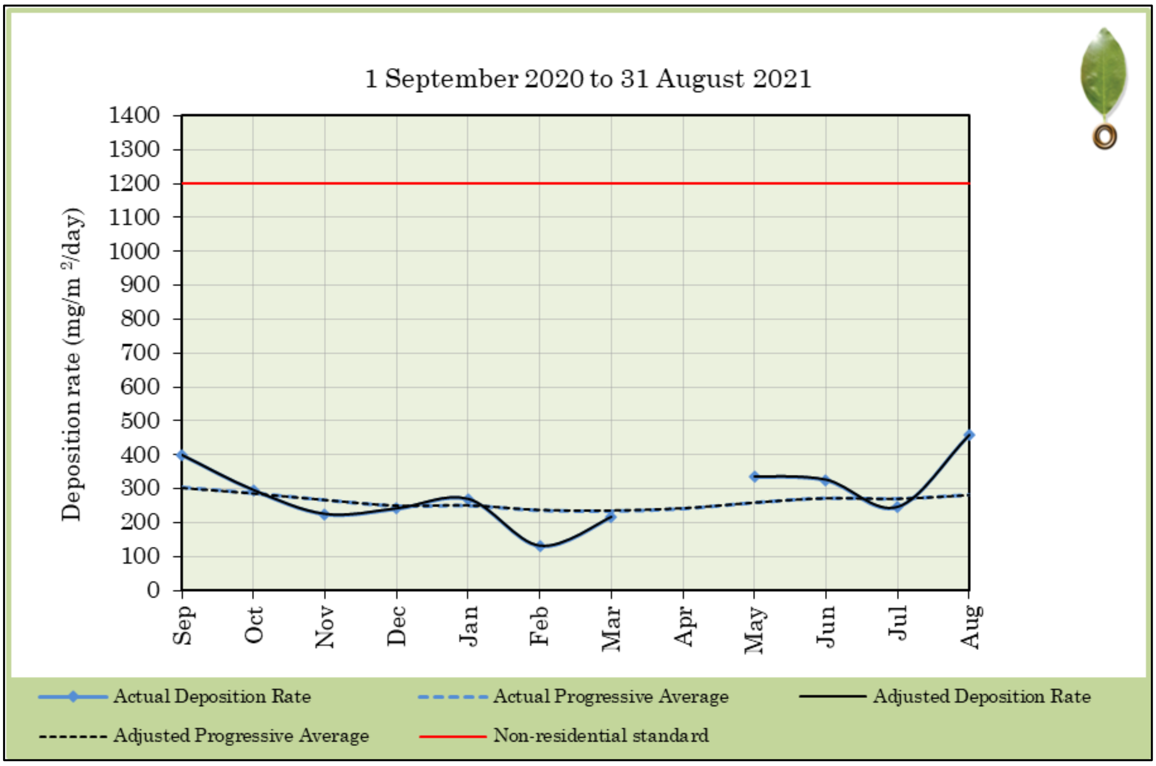

Figure 8.4.11.4(i): BOS #8 – North Western Boundary

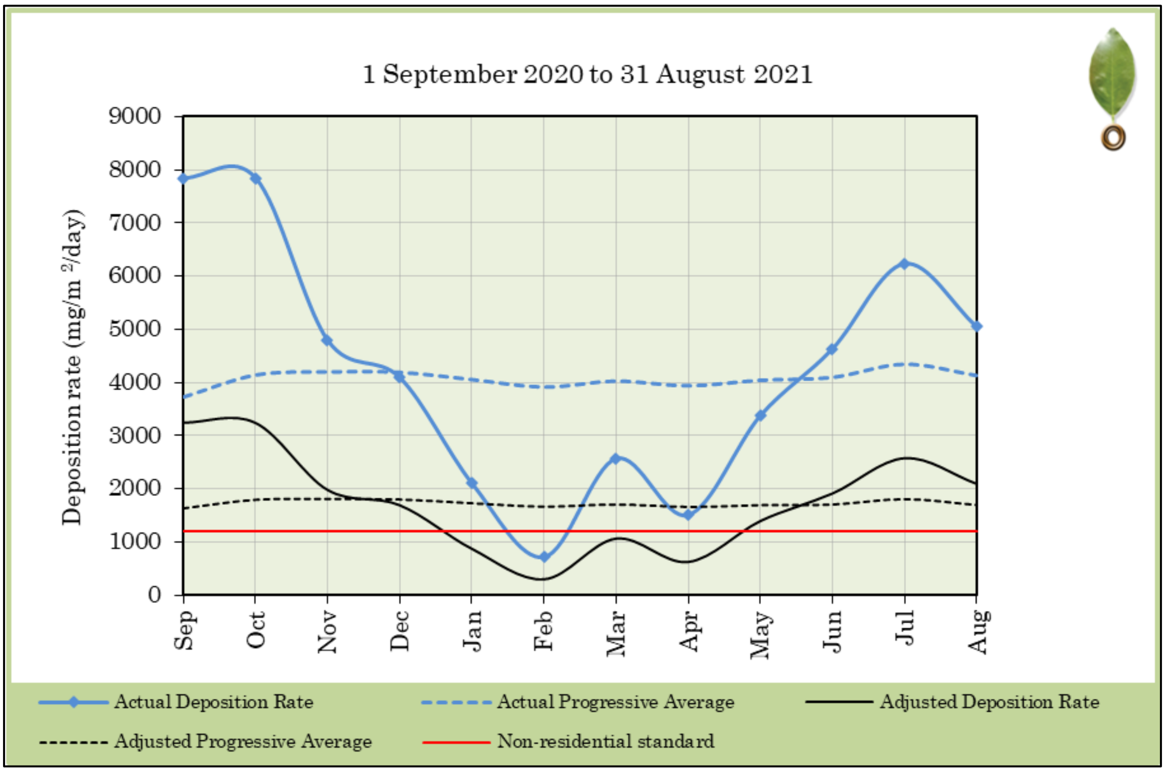

Figure 8.4.11.4(j): BOS #9 – Eastern Boundary Opposite Dry Magnetite Beneficiation

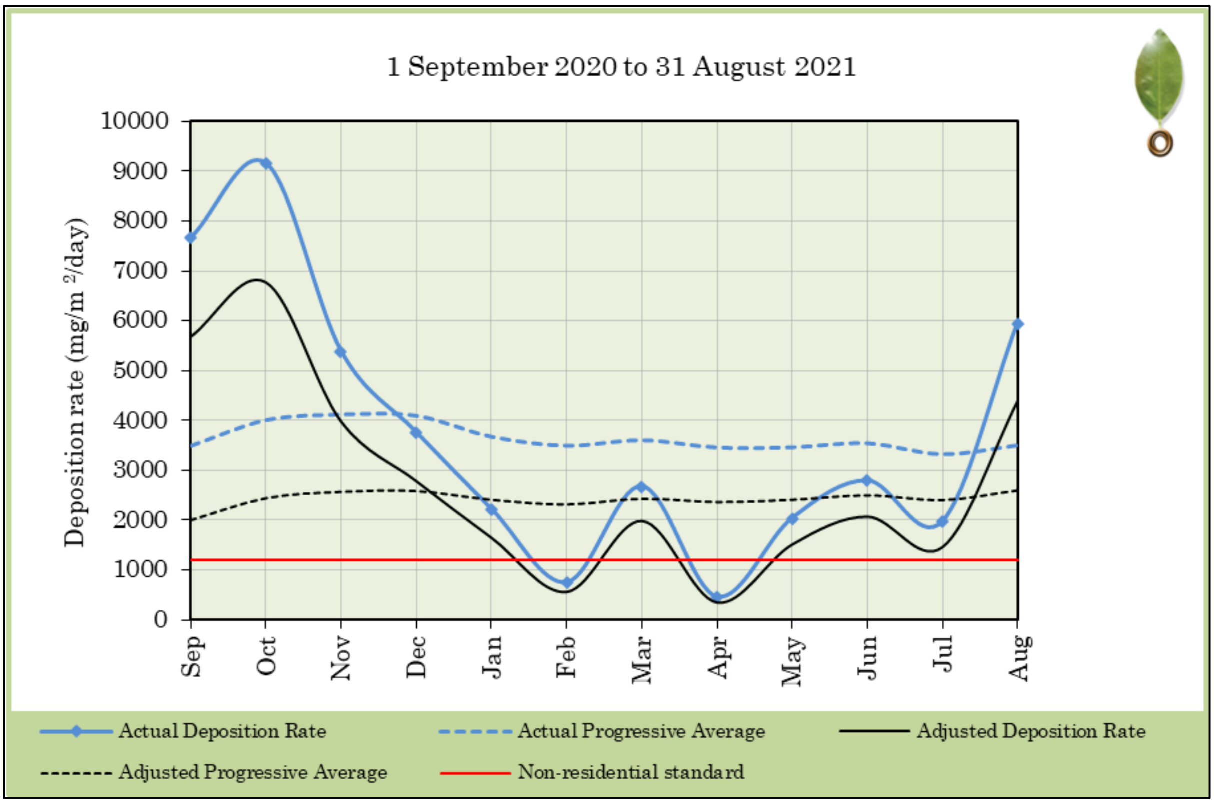

Figure 8.4.11.4(k): BOS #10 – Eastern Boundary Opposite Loading Station #1

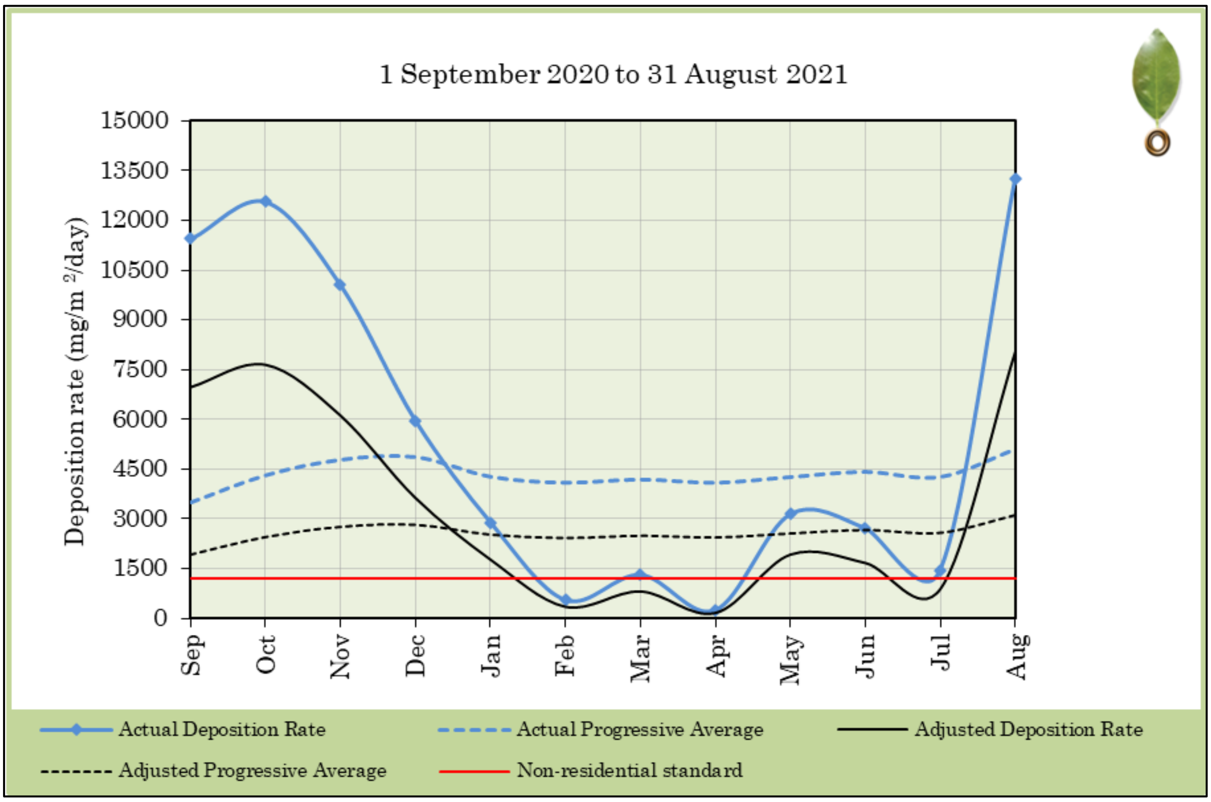

Figure 8.4.11.4(l): BOS #11 – Eastern Boundary Opposite Loading Station #3

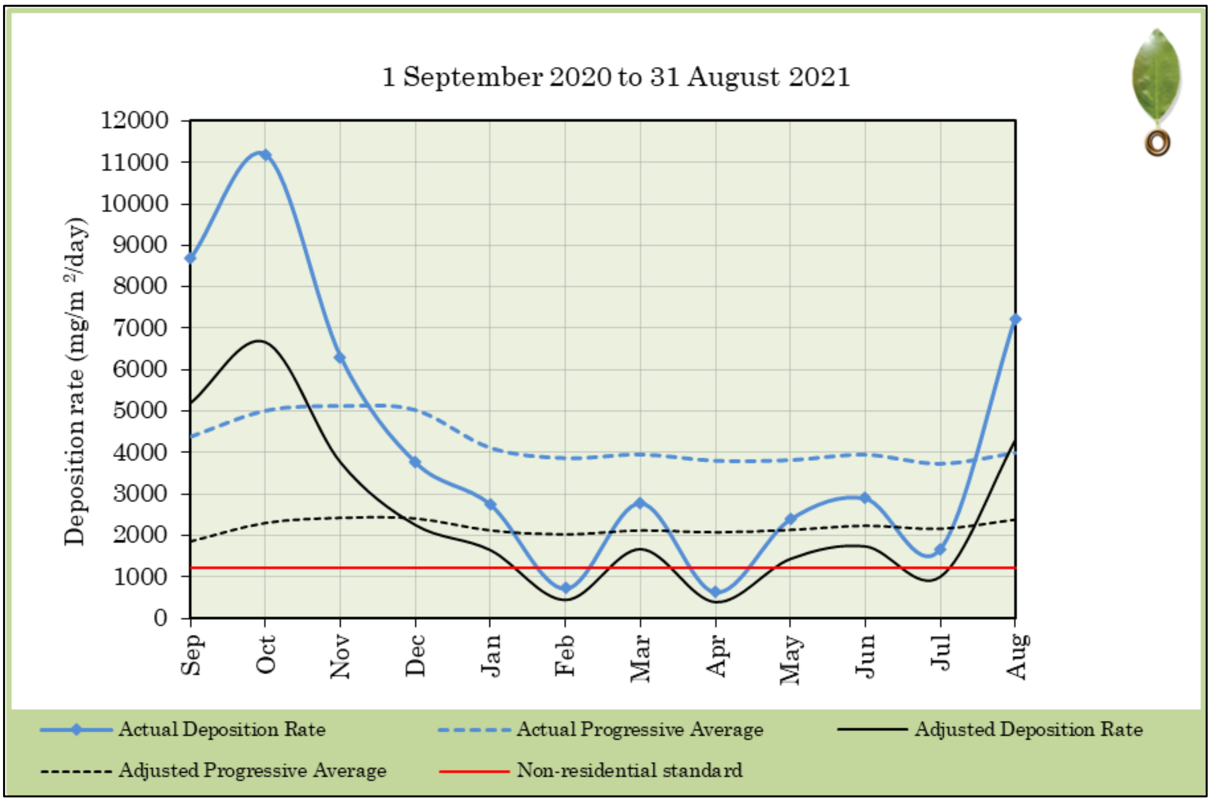

Figure 8.4.11.4(m): BOS #12 – Fedex Plant Administration Building

A number of exceedances were reported during the reporting period:

- BOS #6 – Loading Station #1 reported 11 consecutive exceedances of the non-residential standard.
- BOS #7 – Northern Boundary reported two consecutive exceedances in October and November 2020 and during August and September 2021 of the non-residential standard.
- BOS #9 – Eastern Boundary Opposite Dry Magnetite Beneficiation registered four consecutive exceedances from October 2020 to January 2021 and seven consecutive exceedances from March to September 2021.
- BOS #10 – Eastern Boundary Opposite Loading Station #1 registered four consecutive exceedances from October 2020 to January 2021 and five consecutive exceedances from May to September 2021.
- BOS #11 – Eastern Boundary Opposite Loading Station #3 reported four consecutive exceedances from October 2020 to January 2021 and five consecutive exceedances from May to September 2021.

<u>Process Emission Testing</u>

Process emission testing was performed on 19 August 2020. Key finding from emission testing include:

- The average of three particulate matter samples, collected was 2 390.77 mg/Nm^3. All samples contravened the minimum emission standard of 50mg/Nm^3 stipulated in the AEL.
- Sulphur dioxide (average 1.48 mg/Nm^3) concentrations remained below the minimum emission standard of 1000 mg/Nm^3, while nitrogen oxide (expressed as nitrogen dioxide) (average 45.95 mg/Nm^3) concentrations remained below the minimum emission standard of 500 mg/Nm^3.

- The average carbon monoxide concentration was 1590.70 mg/Nm^3, carbon dioxide concentration 1.52%v/v. and the average oxygen concentration 18.38 %v/v.

8.4.11.5. Mopani District Municipality

Criteria pollutants are pollutants commonly found from various sources and for which health-based criteria (science-based guidelines) have been established as the basis for setting permissible levels. Typical pollutants include particulates (including soot, fly ash and aerosols), sulphur oxides (SO_x), oxides of nitrogen (NO_x), carbon monoxide (CO), carbon dioxide (CO_2), volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), methane (CH_4), ammonia (NH_3), hydrogen chloride (HCl), hydrogen sulphide (H_2S), ozone (O_3) and other photochemical oxidants (as secondary pollutants) and various trace elements. Organic compounds released include formaldehyde, benzene, poly-aromatic hydrocarbons, PCBs and dioxins and furans.

Air pollution is a major environmental problem affecting most areas in the Mopani District. Vehicles, mines and industries, as well as burnings of refuse dumping sites and onsite incineration by households pollute the air by releasing harmful gasses, especially in urban areas. In the rural areas, air pollution is caused by the burning of wood and coal. Another source of air pollution is leakage of sewage and companies burning waste.

Based on an assessment of the Department of Environment Forestry and Fisheries, Mopani District Municipality was rated as having potentially poor air quality or deteriorating air quality. The major contributors to this rating are the mining activities in Ba-Phalaborwa municipality and wood-drying activities concentrated in Greater Tzaneen municipality.

Ambient air quality monitoring in the Limpopo Province, conducted by the Department of Economic Development, Environment and Tourism (LEDET) includes a station in Phalaborwa and two Eskom owned station at Marapong and Medupi. Waterberg District Municipality, as part of the monitoring of the Waterberg-Bojanala Priority Area (WBPA) has three monitoring stations. The stations are located in Thabazimbi, Lephalale and Mokopane. Ambient monitoring data from the Phalaborwa station has been included in the study.

Particulate Matter

Particulate matter (PM) is a broad term used to describe the fine particles found in the atmosphere, including soil dust, dirt, soot, smoke, pollen, ash, aerosols and liquid droplets. The most distinguishing characteristic of PM is the particle size and the chemical composition. Particle size has the greatest influence on the behaviour of PM in the atmosphere with smaller particles tending to have longer residence times than larger ones. PM is categorised, according to particle size, into TSP, PM_{10} and $PM_{2.5}$.

Figure 8.4.11.5(a) shows the 24-hour average PM_{10} concentrations for the Phalaborwa monitoring station.

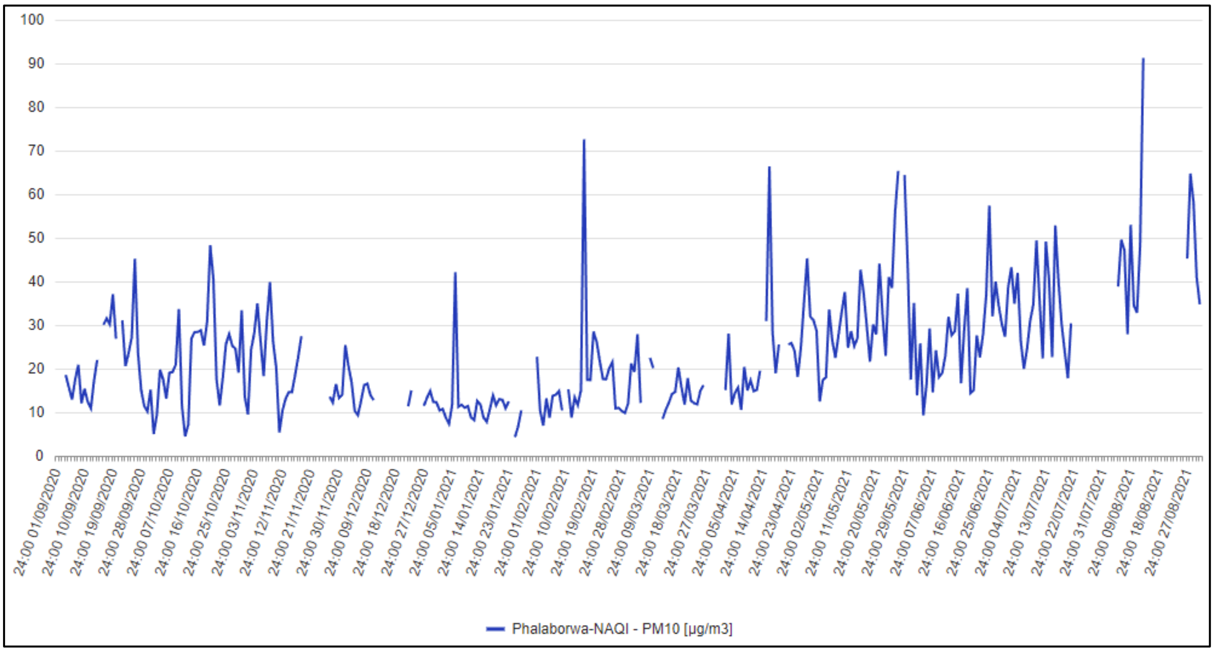

Figure 8.4.11.5(a): Phalaborwa Daily Average PM_{10} Concentration (SAAQIS, 2021)

Total suspended particulates (TSP) consist of all sizes of particles suspended within the air smaller than 100 micrometres (µm). TSP is useful for understanding nuisance effects of PM, e.g. settling on houses, deposition on and discoloration of buildings, and reduction in visibility.

PM_{10} describes all particulate matter in the atmosphere with a diameter equal to or less than 10µm. Sometimes referred to simply as coarse particles, they are generally emitted from motor vehicles (primarily those using diesel engines), factory and utility smokestacks, construction sites, tilled fields, unpaved roads, stone crushing, and burning of wood. Natural sources include sea spray, windblown dust and volcanoes.

Coarse particles tend to have relatively short residence times as they settle out rapidly and PM_{10} is generally found relatively close to the source except in strong winds.

$PM_{2.5}$ describes all particulate matter in the atmosphere with a diameter equal or less than 2.5µm. They are often called fine particles, and are mostly related to combustion (motor vehicles, smelting, incinerators), rather than mechanical processes as is the case with PM_{10}.

$PM_{2.5}$ may be suspended in the atmosphere for long periods and can be transported over large distances.

Fine particles can form in the atmosphere in three ways: when particles form from the gas phase, when gas molecules aggregate or cluster together without the aid of an existing surface to form a new particle, or from reactions of gases to form vapours that nucleate to form particles.

Particulate matter may contain both organic and inorganic pollutants. The extent to which particulates are considered harmful depends on their chemical composition and size, e.g. particulates emitted from diesel vehicle exhausts mainly contain unburned fuel oil and hydrocarbons that are known to be carcinogenic. Very fine particulates pose the greatest health risk as they can penetrate deep into the lung, as opposed to larger particles that may be filtered out through the airways' natural mechanisms.

Figure 8.4.11.5(b) shows the 24-hour average $PM_{2.5}$ concentrations for the Phalaborwa monitoring station.

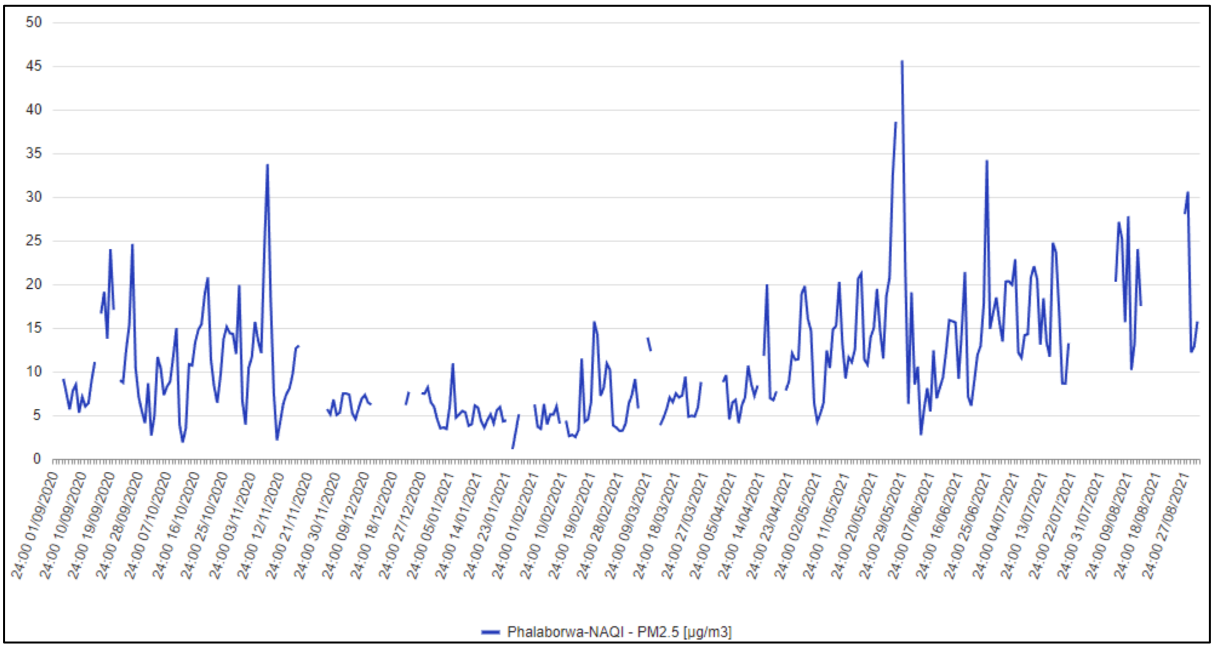

Figure 8.4.11.5(b): Phalaborwa Daily Average $PM_{2.5}$ Concentration (SAAQIS, 2021)

In normal nasal breathing, particles larger than 10µm are typically removed from the air stream as it passes through the nose and upper respiratory airways, and particles between 3µm and 10µm are deposited on the mucociliary escalator in the upper airways. Only particles in the range of 1µm to 2µm penetrate deeper where deposition in the alveoli of the lung can occur (WHO, 2003).

Coarse particles (PM_{10} to $PM_{2.5}$) can accumulate in the respiratory system and aggravate health problems such as asthma. $PM_{2.5}$ which can penetrate deeply into the lungs, are more likely to contribute to the health effects (e.g. premature mortality and hospital admissions) than coarse.

People with existing health conditions such as cardiovascular disease and asthmatics, as well as the elderly and children, are more at risk to the inhalation of particulates than normal healthy people.

Mortality outcomes calculated for South African urban areas estimate that outdoor air pollution caused 3.7% of total mortality from cardiopulmonary disease in adults aged 30 years and older, 5.1% of mortality attributable to cancers of the trachea, bronchus, and lung in adults, and 1.1% of mortality from acute respiratory infections in children under 5 years of age.

<u>Sulphur Dioxide</u>

SO_2 is a colourless pungent, irritating, water-soluble and reactive gas. The major source of SO_2 is the combustion fossil fuels such coal, oil and diesel which contain sulphur.

Figure 8.4.11.5(c) shows the 24-hour average SO_2 concentrations for the Phalaborwa monitoring station.

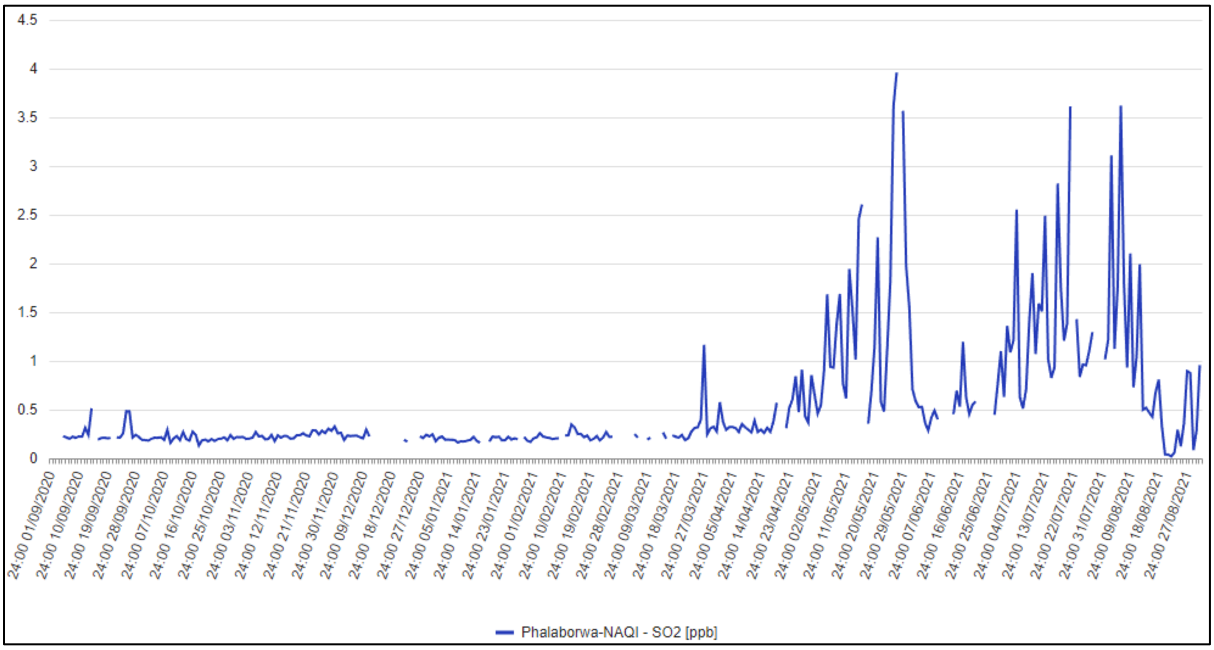

Figure 8.4.11.5(c): Phalaborwa Daily Average SO_2 Concentration (SAAQIS, 2021)

On inhalation, most SO_2 only penetrates as far as the nose and throat as it is readily soluble in the moist lining of the upper respiratory system, with minimal amounts reaching the lungs, unless the person is breathing heavily, breathing only through the mouth, or if the concentration of SO_2 is high. The acute response to SO_2 is rapid, within 10 minutes in people suffering from asthma (WHO, 2005). SO_2 reacts with cell moisture in the respiratory system to form sulphuric acid. This can lead to impaired cell function and effects such as coughing, broncho-constriction, exacerbation of asthma and reduced lung function.

Effects such as a reduction in lung function, an increase in airway resistance, wheezing and shortness of breath, are enhanced by exercise that increases the volume of air inspired, as it allows SO_2 to penetrate further into the respiratory tract (WHO, 1999).

Due to its reactivity, SO_2 has a highly non-uniform dose distribution along the conductive airways of the respiratory tract. For low to moderate tidal volumes and nasal breathing, the penetration into the lungs is negligible. For larger tidal volumes and oral inhalation, doses of interest may extend into the segmental bronchi. SO_2 can only reach the gas-exchange region of the lungs after adsorption onto particulate matter.

Another special consideration for SO_2 is that there is great variation in susceptibility to bronchoconstrictive responses. Persons having asthma or atopy can be about ten times more responsive than healthy subjects.

<u>Nitrogen Oxides</u>

Ambient concentrations of NO_2 in air are highly variable. Natural background concentrations can range from less than 0.4 µg/m^3 to more than 9 µg/m^3. In cities, ambient annual mean concentrations can range from 20 to 90 µg/m^3 with hourly maximum concentrations from 75 to 1 000µg/m^3. NO_2 is formed in combustion processes and other high temperature operations such as metallurgical furnaces, blast furnaces, and internal combustion engines.

In the atmosphere, NO_2 reacts with water vapour to produce nitric acid.

This acidic pollution can be transported over long distances by wind and deposited as acid rain, causing the acidification of soils, lakes, and streams, accelerated corrosion of buildings and monuments and damages paintwork. NO_2 is also a major source of secondary fine particulate pollution, which decreases visibility, and contributes to surface ozone formation through its reaction with VOCs in the presence of sunlight. Figure 8.4.11.5(d) shows the 24-hour average NO_2 concentrations for the Phalaborwa monitoring station.

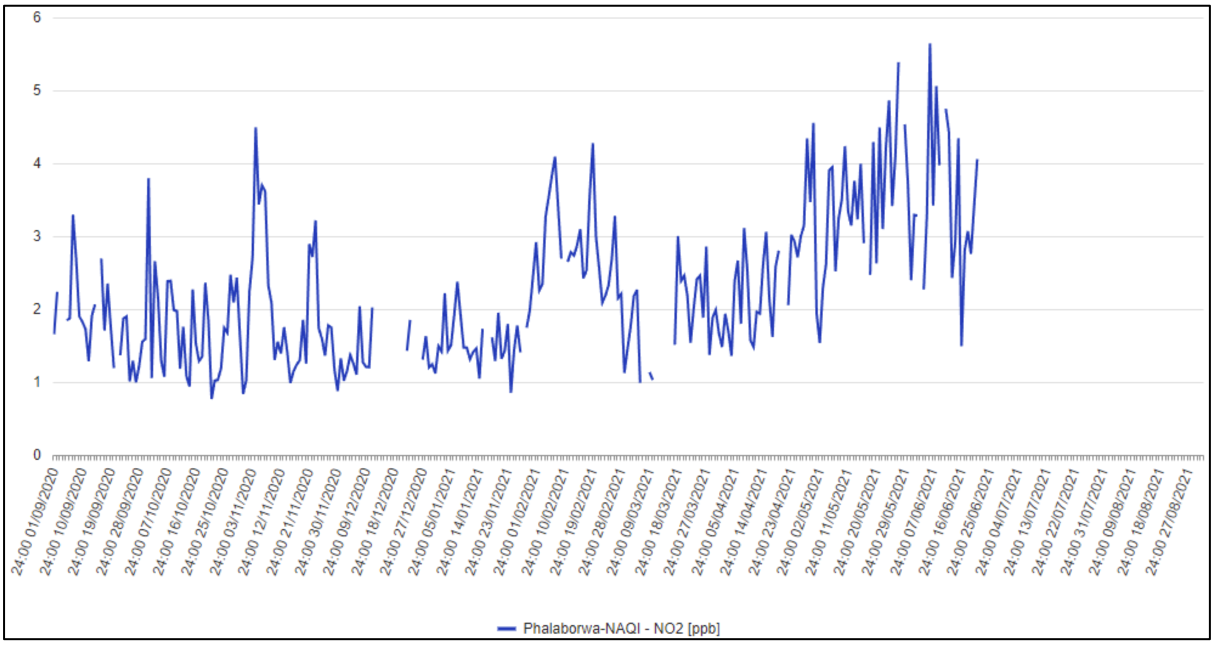

Figure 8.4.11.5(d): Phalaborwa Daily Average NO_2 Concentrations (SAAQIS, 2021)

The route of exposure to NO_2 is inhalation and the seriousness of the effects depends more on the concentration, than the length of exposure. The site of deposition for NO_2 is the distal lung as NO_2 does not readily dissolve in the moist upper respiratory system where it reacts with moisture in the fluids of the lower respiratory tract to form nitrous and nitric acids (WHO, 1997). About 80 to 90% of inhaled nitrogen dioxide is absorbed through the lungs (CCINFO, 1998). NO_2 present in the blood as the nitrite ion oxidises unsaturated membrane lipids and proteins, which result in the loss of cell permeability control. NO_2 causes decrements in lung function, particularly increased airway resistance. People with chronic respiratory problems and people who work, or exercise outside will be more at risk to NO_2 exposure.

Carbon Monoxide

CO is a product of incomplete combustion of fossil fuels. It is predominantly formed in internal combustion engines of motor vehicles, but the combustion of any carbon-based material can release CO. Chemical reactions in the atmosphere may also lead to the formation of CO by the oxidation of other carbon-based gases such as methane. Decomposition of organic material within soils can also result in the release of CO. When inhaled, CO enters the blood stream by crossing the alveolar, capillary and placental membranes. In the bloodstream approximately 80-90% of absorbed CO binds with heamoglobin to form carboxyhaemoglobin. The haemoglobin affinity for CO is approximately 200-250 times higher than that of oxygen. Carboxyhaemoglobin reduces the oxygen carrying capacity of the blood and reduces the release of oxygen from haemoglobin, which leads to tissue hypoxia. This may lead to neurological effects and sometimes delayed severe neurological effects that may include impaired coordination, vision problems, reduced vigilance and cognitive ability, reduced manual dexterity, and difficulty in performing complex tasks (WHO, 1999).

Ozone

Ozone is a colourless gas which carries a harsh odour. It occurs naturally in the lower stratosphere as the ozone layer. This layer protects the earth from shortwave ultraviolet radiation. Near the earth's surface, ozone is a secondary pollutant and a major constituent of photochemical smog. The formation of ozone is dependent on the availability of NOx, VOCs and sunlight. Thus, ozone may not be related directly to any source. Rather it may be associated with the sources of its precursor gases (NOx and VOCs). Ozone may also reach the lower troposphere from the stratosphere, mostly associated with deep frontal systems or with deep convective storms.

Background one-hour average concentrations of O_3 in remote and relatively unpolluted parts of the world are often in the range of 40 to 70 µg/m^3. In cities maximum mean hourly concentrations can be as high as 300 to 400µg/m^3. High O_3 concentrations can persist for 8 to 12 hours per day for several days, when atmospheric conditions favour O_3 formation and poor dispersion conditions exists. Figure 8.4.11.5(e) shows the 24-hour average O_3 concentrations for the Phalaborwa monitoring station.

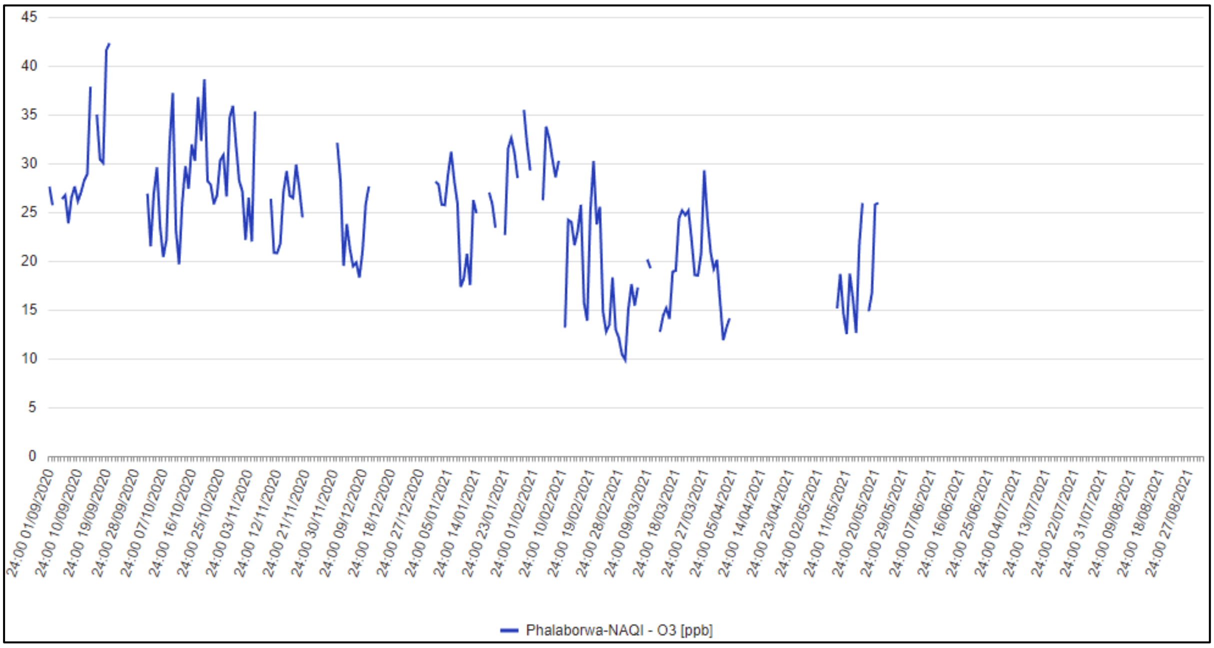

Figure 8.4.11.5(e): Phalaborwa Daily Average O_3 Concentrations (SAAQIS, 2021)

Ozone is a very reactive gas and a strong oxidant, associated with a number of health effects. Ozone toxicity occurs in a continuum in which higher concentrations, longer exposure duration and greater activity levels during exposure cause greater effects. These include respiratory system effects such as coughing, aggravation of asthma and reduced lung function.

Lead

Lead is a metal that occurs naturally in small amounts in the earth's crust. It is used in the production of some types of batteries, ammunition, metal products (such as solder and pipes) ceramic glazes and paint. Chemicals containing lead, such as tetraethyl lead and tetramethyl lead are used as gasoline additives. In the atmosphere, lead exists primarily in the particulate form and is removed from air by wet and dry deposition. Nearly all environmental exposure to lead is attributed to inorganic compounds.

Levels of lead found in air, food, water and soil/dust vary widely throughout the world and depend on the degree of industrial development, urbanisation and other lifestyle factors. In cities of developing countries traffic-related lead levels range between 0.3 and 1 µg/m^3 with extreme annual mean values between 1.5 and 2 µg/m^3.

Exposure to Pb may be through inhalation of contaminated air and ingestion of contaminated food, water and soil. Lead can accumulate in plants and animals. The half-life of lead in human blood (it affects haemoglobin synthesis in the blood) is 28 to 36 days, but lead accumulates in the bones and teeth where it can stay for decades and be released again. Children absorb more and excrete less of the absorbed lead than adults.

<u>Volatile Organic Compounds</u>

VOCs are compounds that have a high vapour pressure at ordinary, room-temperature conditions. It is noted that some organic compounds have little or no known direct human health effects, while others are extremely toxic and/or carcinogenic. The US-EPA has classified benzene as a Group A known human carcinogen. Increased incidence of leukaemia (cancer of the tissues that form white blood cells) has been observed in humans occupationally exposed to benzene. The US-EPA has derived a range of inhalation cancer unit risk estimates for benzene.

Chronic (long-term) inhalation exposure has caused various disorders in the blood, including reduced numbers of red blood cells and aplastic anaemia, in occupationally exposed humans. Reproductive effects have been reported in women exposed by inhalation to high levels of benzene, and adverse effects on the developing foetus have been observed in animal tests (US-EPA, 2001).

The US-EPA calculated a range of 2.2×10^{-5} to 7.8×10^{-6} as the increase in the lifetime cancer risk to an individual who is continuously exposed to 1 µg/m^3 of benzene in the air over his or her lifetime. EPA estimates that, if an individual were to continuously breathe air containing benzene at an average of 0.13 to 0.45 µg/m^3 over his or her entire lifetime, that person would have no more than a 1 in a million increased chance of developing cancer as a direct result (US-EPA, 2001).

Chronic inhalation of certain levels of benzene causes disorders in the blood of humans. Benzene specifically affects bone marrow (the tissues that produce blood cells). Aplastic anaemia, excessive bleeding, and damage to the immune system (by changes in blood levels of antibodies and loss of white blood cells) may develop. In animals, chronic inhalation and oral exposure to benzene produce the same effects as seen in humans. Reproductive effects have been reported for women exposed by inhalation to high levels, and adverse effects on the developing foetus have been observed in animal tests (US-EPA, 2001).

<u>Magnetite</u>

Magnetite is an iron-oxide mineral that occurs naturally on Earth. Because it is also an important component of many anthropogenic materials (i.e. coal fly ash) and synthetic products (i.e. black toner powders), magnetite can be released to the environment through human activities.

Magnetite belongs to the spinel group. It crystallises in the cubic crystal system and can be described by the general formula $Fe^{2+}Fe^{3+}{}_2O_4$. Magnetite is a common natural phase, occurring in various geological environments, ranging from igneous (i.e. layered ultra-basic rocks, basalts) to sedimentary (i.e. banded iron formations, beach sands) rocks and to high-grade meta-morphic rocks (i.e. schists, skarns), where it can be produced through a multitude of chemical reactions.

Due to its tendency to react with oxygen to form hematite (Fe_2O_3) and various iron oxyhydroxides (i.e. ferrihydrite, goethite), magnetite can be used as a powerful tool to explore oxygen concentrations in rocks during geological processes, changes in the oxygen content of the atmosphere and redox conditions in near surface environments (i.e. oxic-anoxic transition zone).

Because magnetite is ferrimagnetic, it represents a phase that is essential for paleomagnetic investigations, which help in reconstructing plate tectonics through Earth's history.

Biogenic, chemically pure magnetite crystals occur in the bodies of a wide range of organisms within the kingdoms of the Monera, Protista, and Animalia (i.e. magnetotactic microbes, insects, molluscs, fish, birds, mammals). In these organisms, magnetite forms the basis for one type of biophysical mechanism of magnetic field detection, which facilitates orientation and navigation. In the human brain, magnetite is also believed to precipitate biologically as part of the iron metabolism. Maher et al., 2016*,* suggest that it can originate from an external source.

Air pollution comprises not only gases (i.e. nitrogen oxides, ozone, sulphur dioxide) but also solid particles, which range in size from a few nanometres to several micrometres. These particles, known as particulate matter (PM), are generated through both natural processes and human activity and are emitted directly into, or formed within, the atmosphere. As a result of atmospheric circulation, the airborne particles in a given environment can be derived from both local and distant sources, such as dry lakes, deserts, fires, smokestacks, traffic, or mining operations. Magnetite is an abundant constituent of atmospheric PM pollution, especially in the urban environment, where it has been identified in diesel exhaust, as brake-abrasion particles, in the air of underground stations, along railway lines, at welding workplaces, and in the emissions from industrial combustion processes.

In addition to having major atmospheric, environmental, and ecological impacts, airborne PM may have adverse health effects, both acute and chronic, because with each breath, millions of solid particles, including magnetite, can enter our respiratory system. Once inhaled, coarse particles (>2.5 μm) may be deposited on the surfaces of the conducting airways of the upper respiratory system, whereas smaller particles (<2.5 μm) can migrate to the deepest parts of the lung where the gas exchange takes place. Ultrafine particles (<100 nm), or nanoparticles, may penetrate through the cell tissue that lines the respiratory tract and translocate into the blood circulation and into extrapulmonary organs, but also, via the olfactory nerve, into the central nervous system.

Maher et al., 2016 invoke this latter mechanism for the transfer of air pollution-derived magnetite nanoparticles to the brains of the studied individuals. These authors use the mostly spherical shapes of the magnetite as one of the main arguments for their hypothesis: Spherical shapes are typical of combustion-derived particles (i.e. in diesel exhaust) in contrast to abrasion-derived particles (e.g., brake-wear particles), which are typically irregularly shaped and angular, or to endogenous particles, which tend to be euhedral because they grew in situ (i.e. within the brain). Maher et al. (2) document that two types of magnetite, spherical and euhedral, are present in the studied brains, suggesting that they were derived from two different sources, one external (from air pollution) and one internal (i.e. biogenic). This conclusion is further supported by the presence of other transition-metal nanoparticles, which are common in air borne PM from polluted areas.

One of the questions that arises from the discovery of externally derived magnetite in brain tissue is whether or not the abundant additional magnetite adversely affects human health. It is well known from epidemiological and toxicological studies that exposure to $PM_{2.5}$ is linked to increases in mortality and hospital admissions due to respiratory and cardiovascular diseases. There is increasing evidence that coarser particles may also produce deleterious health effects.

In addition to being dependent on size, however, the interactions are influenced by other particle characteristics, including structure, chemical composition, shape, surface area and reactivity, absorptive properties and solubility. The adverse health effects include chronic bronchitis, exacerbation of asthma, fibrosis, and lung cancer. The mechanisms behind these diseases, as well as their dependence on particle properties, are still poorly known. The most likely mechanisms involve the excessive production of free radicals [i.e. reactive oxygen species (ROS)], which can lead to oxidative damage to cell membranes, proteins, and DNA, as well as to the release of chemical substances that trigger and perpetuate inflammation.

In regard to the human health effects of magnetite, published data exist for both the brain and the respiratory system. For example, the presence in the brain of magnetite may be linked to several neurodegenerative diseases, including Alzheimer's disease and oxidative stress appears to play a key role in the pathogenesis.

In vitro experiments with human lung cells, which were exposed for 24-hours to different magnetite size fractions (including nanoparticles) and doses, revealed that the studied particles, although being only slightly cytotoxic, led to increased ROS formation, mitochondrial damage, and genotoxic effects. The results allowed for the conclusion that ROS formation plays an important role in the genotoxicity of magnetite in lung cells. On the other hand, magnetite nanoparticles might be considerably less toxic when surface-modified (i.e. coated).

The presence of magnetite in humans, however, also has other potential implications, including possible biological disorders linked to the weak magnetic fields generated by cellular phones, electric power lines, and appliances, or high-field saturation effects from exposure to strong magnetic fields during MRI procedures. At the same time, nanoparticles of magnetite are of special interest in the biomedical sciences, because they can be used as carriers for targeted drug delivery. Moreover, magnetite nanoparticles can be exploited for hyperthermia-based cancer therapy, where the heat induced by application of an alternating magnetic field causes necrosis of cancer cells but does not damage the surrounding normal tissue. Various researchers have further proposed that endogenous magnetite might play a key role in perception, transduction, and long-term storage of information in the human brain and in other organisms.

The occurrence of magnetite in cell tissues therefore represents an intriguing dichotomy: On the one hand, the mineral can play a key role in magnetoreception and navigation, and thus survival, of various types of organisms, and on the other hand, it can impart deleterious effects in humans, especially when they are exposed to high PM concentrations in polluted urban environments.

Currently, the Occupational Safety and Health Administration (OSHA) has a permissible exposure limit of 10 mg/m^3 for fine iron oxide over the course of an 8-hour workday. The National Institute for Occupational Safety and Health (NIOSH) set a recommended exposure limit (REL) of 5 mg/m^3 for iron (in iron oxide) over a 10-hour workday, while the American Conference of Governmental Industrial Hygienists (ACGIH) recommended 5 mg/m^3 limit for the respirable fraction of iron oxide over an 8-hour workday. However, there is currently no separate REL for iron oxide nanoparticles (IONPs).

8.5. POTENTIAL IMPACTS/RISKS

This section is not the main/comprehensive impact assessment for the project, but relates specifically to the impact and risk assessment conducted in support of the consideration of alternatives for the proposed Magnetite Waste Site Disposal Facility (MWSDF) and associated infrastructure during the Scoping Phase of the project.

The potential impacts and risks identified informed and supported the alternatives selection process which determined the preferred alternative site (see section 8.1) during the Scoping Phase of the project.

The potential impacts listed in Table 8.5(a) below, therefore represent impacts that if not acceptable after mitigation, would require an alteration in:

- the proposed site locality
- the type of activity
- the design or layout
- the technology used
- any operational aspects
- invoking the no-go option

It should be noted that the impact assessment was conducted from the premise that all the design features aimed at environmental protection would be implemented during development. This would include aspects related to the minimisation of development footprints, the appropriate lining of facilities to protect the groundwater resources, a suitable design of required storage capacity to cater for rainfall storm events and operational aspects aimed at ensuring stability and the prevention of spillages, leakages or failures.

The environmental attributes selected and included in the impact assessment, were determined by the EAP and were based on the baseline descriptions provided in section 8.4 of this report.

With reference to the outcome of the potential impact assessment as reflected in Table 8.5(a), the following conclusions are relevant:

- All four site options for the proposed Magnetite Waste Site Disposal Facility (MWSDF) and associated infrastructure had very similar Environmental Impact and Risk Assessment outcomes. The receiving environment and the ecological importance at all four sites options considered, are similar in nature.
- Two Late Iron Age and historical settlements (kopjes Serotwe and Mabadika) are located within close proximity of site options 3 and 4. No Heritage resources were identified for site option 1 (preferred alternative).
- Mitigation measures could however be proposed and implemented in terms of the potential risk associated with the heritage aspects at site options 3 and 4.
- The site selection for the proposed Magnetite Waste Site Disposal Facility (MWSDF) could therefore continue from the same Environmental Impact and Risk base and could be done subject to practical, engineering and operational considerations.

Table 8.5(a): Potential Impacts Identified and Assessed for Alternatives Considered during the Scoping Phase of the project

Development Activity	Environmental Aspect	Potential Impact	Magnitude	Duration	Spatial Scale	Consequence	Probability	Significance
Magnetite Waste Site Disposal Facility (MWSDF) and associated infrastructure Site 1 (Preferred Alternative)	Heritage	**No potential impact.** None of the types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act within footprint area.	-	-	-	-	-	-
	Soils & Land Capability	Loss of wilderness and grazing (poor) potential at footprint.	**Moderate**	**Long term**	**Site**	**Medium**	**Definite**	**Medium**
	Groundwater	Seepage of leachate through the baseliner resulting in groundwater pollution.	**Moderate**	**Long Term**	**Local**	**Medium**	**Unlikely**	**Low**
	Surface Water	Spillage of process and storm water runoff resulting in surface water pollution.	**Moderate**	**Short Term**	**Regional**	**Medium**	**Unlikely**	**Low**
	Plant Life	Habitat loss and modification due to vegetation clearance.	**Moderate**	**Medium Term**	**Local**	**Medium**	**Definite**	**Medium**
	Animal Life	Disturbance and mortality of fauna species during construction activities.	**Major**	**Short Term**	**Site**	**Medium**	**Unlikely**	**Low**
	Aquatic Ecosystems	Spillage of process and storm water runoff resulting in surface water pollution.	**Moderate**	**Short Term**	**Regional**	**Medium**	**Unlikely**	**Low**
	Wetlands	**No potential impact.** No natural wetland habitat was identified within the project study area or the 500m buffer.	-	-	-	-	-	-
	Air Quality	Impact on air quality due to dust generation from MWSDF.	**Moderate**	**Medium Term**	**Local**	**Medium**	**Possible**	**Medium**
Magnetite Waste Site Disposal Facility (MWSDF) and associated infrastructure Site 2	Heritage	Negative impact on heritage resources if present within footprint area.	**Major**	**Short Term**	**Site**	**Medium**	**Possible**	**Medium**
	Soils & Land Capability	Loss of land capability potential at footprint.	**Moderate**	**Long term**	**Site**	**Medium**	**Definite**	**Medium**
	Groundwater	Seepage of leachate through the baseliner resulting in groundwater pollution.	**Moderate**	**Long Term**	**Local**	**Medium**	**Unlikely**	**Low**
	Surface Water	Spillage of process and storm water runoff resulting in surface water pollution.	**Moderate**	**Short Term**	**Regional**	**Medium**	**Unlikely**	**Low**
	Plant Life	Habitat loss and modification due to vegetation clearance.	**Moderate**	**Medium Term**	**Local**	**Medium**	**Definite**	**Medium**
	Animal Life	Disturbance and mortality of fauna species during construction activities.	**Major**	**Short Term**	**Site**	**Medium**	**Unlikely**	**Low**
	Aquatic Ecosystems	Spillage of process and storm water runoff resulting in surface water pollution.	**Moderate**	**Short Term**	**Regional**	**Medium**	**Unlikely**	**Low**
	Wetlands	Negative impact on wetland resources if present within footprint area.	**Moderate**	**Long Term**	**Site**	**Medium**	**Possible**	**Medium**
	Air Quality	Impact on air quality due to dust generation from MWSDF.	**Moderate**	**Medium Term**	**Local**	**Medium**	**Possible**	**Medium**

Development Activity	Environmental Aspect	Potential Impact	Magnitude	Duration	Spatial Scale	Consequence	Probability	Significance
Magnetite Waste Site Disposal Facility (MWSDF) and associated infrastructure **Site 3**	Heritage	Potential negative impact on two Late Iron Age and historical settlements (kopjes Serotwe and Mabadika).	**Major**	**Medium Term**	**Site**	**Medium**	**Possible**	**Medium**
	Soils & Land Capability	Loss of wilderness and grazing (poor) potential at footprint.	**Moderate**	**Long term**	**Site**	**Medium**	**Definite**	**Medium**
	Groundwater	Seepage of leachate through the baseliner resulting in groundwater pollution.	**Moderate**	**Long Term**	**Local**	**Medium**	**Unlikely**	**Low**
	Surface Water	Spillage of process and storm water runoff resulting in surface water pollution.	**Moderate**	**Short Term**	**Regional**	**Medium**	**Unlikely**	**Low**
	Plant Life	Habitat loss and modification due to vegetation clearance.	**Moderate**	**Medium Term**	**Local**	**Medium**	**Definite**	**Medium**
	Animal Life	Disturbance and mortality of fauna species during construction activities.	**Major**	**Short Term**	**Site**	**Medium**	**Unlikely**	**Low**
	Aquatic Ecosystems	Spillage of process and storm water runoff resulting in surface water pollution.	**Moderate**	**Short Term**	**Regional**	**Medium**	**Unlikely**	**Low**
	Wetlands	**No potential impact.** No natural wetland habitat was identified within the project study area.	**-**	**-**	**-**	**-**	**-**	**-**
	Air Quality	Impact on air quality due to dust generation from MWSDF.	**Moderate**	**Medium Term**	**Local**	**Medium**	**Possible**	**Medium**
Magnetite Waste Site Disposal Facility (MWSDF) and associated infrastructure **Site 4**	Heritage	Negative impact on heritage resources if present within footprint area.	**Major**	**Short Term**	**Site**	**Medium**	**Possible**	**Medium**
	Groundwater	Seepage of leachate through the baseliner resulting in groundwater pollution	**Moderate**	**Long Term**	**Local**	**Medium**	**Unlikely**	**Low**
	Soils & Land Capability	Loss of land capability potential at footprint.	**Moderate**	**Long term**	**Site**	**Medium**	**Definite**	**Medium**
	Surface Water	Spillage of process and storm water runoff resulting in surface water pollution.	**Moderate**	**Short Term**	**Regional**	**Medium**	**Unlikely**	**Low**
	Plant Life	Habitat loss and modification due to vegetation clearance.	**Moderate**	**Medium Term**	**Local**	**Medium**	**Definite**	**Medium**
	Animal Life	Disturbance and mortality of fauna species during construction activities.	**Major**	**Short Term**	**Site**	**Medium**	**Unlikely**	**Low**
	Aquatic Ecosystems	Spillage of process and storm water runoff resulting in surface water pollution.	**Moderate**	**Short Term**	**Regional**	**Medium**	**Unlikely**	**Low**
	Wetlands	Negative impact on wetland resources if present within footprint area.	**Moderate**	**Long Term**	**Site**	**Medium**	**Possible**	**Medium**
	Air Quality	Impact on air quality due to dust generation from MWSDF.	**Moderate**	**Medium Term**	**Local**	**Medium**	**Possible**	**Medium**

8.6. IMPACT ASSESSMENT METHODOLOGY

The basic elements used in the evaluation of impact significance are described in the table below (Table 8.6(a)) and the characteristics used to describe the consequence of an impact are outlined in Table 8.6(b). The impact significance rating system is presented in Table 8.6(c) and involves three parts:

- **Part A**: Define impact consequence using the three primary impact characteristics of magnitude, duration and spatial scale (extent);
- **Part B**: Use the matrix to determine a rating for impact consequence based on the definition identified in Part A;
- **Part C**: Use the matrix to determine the impact significance rating, which is a function of the impact consequence rating and the probability of occurrence;

Table 8.6(a): Key Elements in the evaluation of Impact Significance

Element	Description	Questions applied?
Consequence	An impact or effect can be described as the change in an environmental parameter, which results from a particular project activity or intervention. Here the term consequence refers to: ➢ The sensitivity of the receiving environment, including its capacity to accommodate the kinds of changes the project may bring about ➢ The type of change and the key characteristics of the change (these are magnitude, extent and duration) ➢ The importance of the change (the level of public concern/ value attached to environment by the stakeholders and the change effected by the project) The following should be considered in the determination of impact consequence: ➢ Standards and Guidelines (e.g. pollution and emissions thresholds) ➢ Scientific evidence and professional judgement ➢ Points of reference from comparable cases ➢ Levels of stakeholder concern	Will there be a change in the biophysical environment? Is the change of consequence (of any importance)?
Probability	Likelihood/ Chances of an impact occurring	Is the change likely to occur?
Effectiveness of the Management Measures	Significance of the impact needs to be determined both without management measures and with management measures. The significance of the unmanaged impact needs to be determined so there is an appreciation of what could occur in the absence of management measures and of the effectiveness of the proposed management measures.	Will the management measures reduce impact to an acceptable level?

Table 8.6(b): Characteristics to be used in Impact Description

Characteristics used to describe Consequence	Sub-Components	Terms used to describe the Characteristics
Phase of Project		During the Pre-Construction (if applicable), Construction, Operational, Decommissioning/ Post Closure
Nature		Direct or Indirect or Cumulative
Magnitude	**Sensitivity of the Receiving environment/ receptors**	High, Medium or Low Sensitivity Low capacity to accommodate the change (impact)/ tolerant of the proposed change
	Severity/ Intensity (degree of change measured against thresholds and/ or professional judgment)	Gravity/ seriousness of the impact Intensity / Influence/ Power/ Strength
Spatial Extent The area affected by the impact.		Area/ Volume covered , Distribution, Population Site/ Local, Regional, National or International
Duration (and Reversibility) Length of time over which an impact occurs and potential for recovery of the endpoint from the impact		Short term. Long term Intermittent, Continuous Reversible, Irreversibility Temporary, Permanent

Table 8.6(c): Method for rating the Significance of Impacts

PART A: DEFINING CONSEQUENCES OF MAGNITUDE, DURATION AND SPATIAL SCALE (Use these definitions to define the consequence in Part B) + *denotes a positive impact*		
Impact Characteristics	**Definition**	**Criteria**
MAGNITUDE	**Major**	Substantial deterioration or harm to receptors; receiving environment has an inherent value to stakeholders; receptors of impact are of conservation importance; or identified threshold often exceeded
	Moderate	Moderate/ measurable deterioration of harm to receptors; receiving environment moderately sensitive; or identified threshold occasionally exceeded
	Minor	Minor deterioration (nuisance or minor deterioration) or harm to receptors; change to receiving environment not measurable; or identified threshold never exceeded
	Minor +	Minor improvement; change not measurable; or threshold never exceeded
	Moderate +	Moderate improvement; within or better than the threshold; or no observed reaction
	Major +	Substantial improvement; within or better than the threshold; or favourable publicity
DURATION	**Short term**	Quickly reversible. Less than two years
	Medium term	Reversible over time. Life of the project
	Long term	Permanent. Beyond closure
SPATIAL SCALE	**Site or Local**	Site specific or confined to the immediate project area
	Regional	May be defined in various ways e.g. cadastral, catchment, topographic
	National/ International	Nationally or beyond

PART B: DETERMINING CONSEQUENCE RATING (Rate consequence based on definition of magnitude, duration and spatial extent)					
			SPATIAL SCALE		
			Site or Local	**Regional**	**National/ International**
MAGNITUDE					
Minor	**DURATION**	**Long term**	**Medium**	**Medium**	**High**
		Medium term	**Low**	**Low**	**Medium**
		Short term	**Low**	**Low**	**Medium**
Moderate	**DURATION**	**Long term**	**Medium**	**High**	**High**
		Medium term	**Medium**	**Medium**	**High**
		Short term	**Low**	**Medium**	**Medium**
Major	**DURATION**	**Long term**	**High**	**High**	**High**
		Medium term	**Medium**	**Medium**	**High**
		Short term	**Medium**	**Medium**	**High**

PART C: DETERMINING SIGNIFICANCE RATING (Rate significance based on consequence and probability)				
		CONSEQUENCE		
		Low	**Medium**	**High**
PROBABILITY (of exposure to impacts)	**Definite**	**Medium**	**Medium**	**High**
	Possible	**Low**	**Medium**	**High**
	Unlikely	**Low**	**Low**	**Medium**

8.7. POSITIVE AND NEGATIVE IMPACTS

The impact and risk assessment conducted during the Scoping Phase of the project and discussed in section 8.5, indicated that the proposed development activities associated with this project, will have some degree of environmental impact and risk for all site options/alternatives considered. Table 8.7(a) below summarises the potential positive and negative impacts anticipated with the different site options/ alternatives considered during the Scoping Phase of the project.

Table 8.7(a): Summary of Positive and Negative Impacts

Activity	Positive Impacts	Negative Impacts
Magnetite Waste Site Disposal Facility (MWSDF) and associated infrastructure **Site 1 (Preferred Alternative)**	Tailings is removed from the adjacent Foskor site through the beneficiation process. The life of the operations will be extended thereby contributing to sustainable development and a positive socio-economic impact. The Phase I HIA study for the Bosveld Phosphates' proposed Magnetite Waste Site Disposal Facility footprint revealed none of the types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act (Act No. 25 of 1999) for the Project Area. No natural wetland habitat was identified within the project study area or the 500m buffer.	The development of the MWSDF will lead to a loss of wilderness and grazing (poor) potential and habitat loss and modification due to vegetation clearance. Disturbance and mortality of fauna species can occur during construction activities. Seepage of leachate through the baseliner of the facility resulting in groundwater pollution is unlikely since the design and layout of the proposed MWSDF is governed by legal requirements as per the NEMWA and NWA Regulations. Spillage of process and storm water runoff resulting in surface water pollution is unlikely as the required storage capacity to cater for rainfall storm events and operational aspects aimed at ensuring stability and the prevention of spillages. Impact on air quality due to dust generation from MWSDF is possible if the impact is not mitigated. All potential impacts identified will not have unacceptable adverse effects as management measures can be proposed to mitigate adequately.
Magnetite Waste Site Disposal Facility (MWSDF) and associated infrastructure **Site 2**	Tailings is removed from the adjacent Foskor site through the beneficiation process. The life of the operations will be extended thereby contributing to sustainable development and a positive socio-economic impact.	The development of the MWSDF will lead to a loss of land capability potential and habitat loss and modification due to vegetation clearance. Disturbance and mortality of fauna species can occur during construction activities. Negative impact on heritage resources if present within footprint area. Seepage of leachate through the baseliner of the facility resulting in groundwater pollution is unlikely since the design and layout of the proposed MWSDF is governed by legal requirements as per the NEMWA and NWA Regulations. Spillage of process and storm water runoff resulting in surface water pollution is unlikely as the required storage capacity to cater for rainfall storm events and operational aspects aimed at ensuring stability and the prevention of spillages. Impact on air quality due to dust generation from MWSDF is possible if the impact is not mitigated. All potential impacts identified will not have unacceptable adverse effects as management measures can be proposed to mitigate adequately.

Activity	Positive Impacts	Negative Impacts
Magnetite Waste Site Disposal Facility (MWSDF) and associated infrastructure **Site 3**	Tailings is removed from the adjacent Foskor site through the beneficiation process. The life of the operations will be extended thereby contributing to sustainable development and a positive socio-economic impact. No natural wetland habitat was identified within the project study area.	The development of the MWSDF will lead to a loss of wilderness and grazing (low intensity) potential and habitat loss and modification due to vegetation clearance. Disturbance and mortality of fauna species can occur during construction activities. Potential negative impact on two Late Iron Age and historical settlements (kopjes Serotwe and Mabadika). Seepage of leachate through the baseliner of the facility resulting in groundwater pollution is unlikely since the design and layout of the proposed MWSDF is governed by legal requirements as per the NEMWA and NWA Regulations. Spillage of process and storm water runoff resulting in surface water pollution is unlikely as the required storage capacity to cater for rainfall storm events and operational aspects aimed at ensuring stability and the prevention of spillages. Impact on air quality due to dust generation from MWSDF is possible if the impact is not mitigated. All potential impacts identified will not have unacceptable adverse effects as management measures can be proposed to mitigate adequately.
Magnetite Waste Site Disposal Facility (MWSDF) and associated infrastructure **Site 4**	Tailings is removed from the adjacent Foskor site through the beneficiation process. The life of the operations will be extended thereby contributing to sustainable development and a positive socio-economic impact.	The development of the MWSDF will lead to a loss of land capability potential and habitat loss and modification due to vegetation clearance. Disturbance and mortality of fauna species can occur during construction activities. Potential negative impact on two Late Iron Age and historical settlements (kopjes Serotwe and Mabadika). Seepage of leachate through the baseliner of the facility resulting in groundwater pollution is unlikely since the design and layout of the proposed MWSDF is governed by legal requirements as per the NEMWA and NWA Regulations. Spillage of process and storm water runoff resulting in surface water pollution is unlikely as the required storage capacity to cater for rainfall storm events and operational aspects aimed at ensuring stability and the prevention of spillages. Impact on air quality due to dust generation from MWSDF is possible if the impact is not mitigated. All potential impacts identified will not have unacceptable adverse effects as management measures can be proposed to mitigate adequately.

A comprehensive and detailed impact and risk assessment was performed by a team of competent and qualified natural scientists for the preferred alternative site during the EIA Phase of this project. Refer to section 9 and 10 of this report for the details pertaining this assessment.

8.8. POSSIBLE MITIGATION MEASURES

Possible mitigation measures identified during the Scoping Phase of the project, for all the site alternatives considered to manage the negative environmental impacts anticipated for the proposed project activities, can be summarised as follows:

- The footprint sites have been selected to not encroach on sensitive environmental features as far as possible.
- The footprint sizes of all the new proposed facilities are minimised through detailed design according to site specific surface water runoff characteristics and precipitation event return intervals.
- All facilities conveying or containing "dirty water"/ waste are designed with appropriate liner systems to prevent seepage of contaminated water into the sub-surface.
- Furthermore the capacities of these facilities are designed to prevent spillages during storm rainfall events as specified by legislation.

Table 8.8(a) summarises the potential impacts identified for the preferred alternative site, the possible mitigation measures that could/should be implemented and the level of residual risk anticipated.

8.9. NO ALTERNATIVE SITE MOTIVATION

Four site options/alternatives were considered and assessed for the development of the Magnetite Waste Site disposal Facility (MWSDF) and associated infrastructure. Refer to section 8.1 of this report for a comprehensive alternative assessment performed as per regulations. A potential impact/risk assessment considering a host of environmental components was furthermore performed for these four sites identified; refer to section 8.5 of this report.

Taken the above into account, no other site option/alternative is as feasible and favourable as the preferred alternative site, **site option 1**. Refer to Figure 8.1(a) where the locality of the preferred alternative site is provided in context of the greater Bosveld Phosphates site.

Table 8.8(a):Potential Impacts Identified, Possible Mitigation Measures and Level of Residual Risk for Preferred Alternative Site

Development Element/Activity	Environmental Aspect	Potential Impact	Possible Mitigation Measures	Long Term Residual Risk Significance
Magnetite Waste Site Disposal Facility (MWSDF) and associated infrastructure **Site 1 (Preferred Alternative)**	Soils & Land Capability	Loss of wilderness and grazing (poor) potential at footprint.	Minimise the development/ facility footprints. Optimise the post closure land capability to achieve the post closure land use objectives.	**Low**
	Groundwater	Seepage of leachate through the baseliner resulting in groundwater pollution.	Design and install an appropriate liner and under drain system in compliance with regulatory requirements and relevant guidelines.	**Low**
	Surface Water	Spillage of process and storm water runoff resulting in surface water pollution.	Design for adequate operational, storage and free board capacities in compliance with regulatory requirements and relevant guidelines.	**Low**
	Plant Life	Habitat loss and modification due to vegetation clearance.	Prior to any vegetation clearing, permits must be obtained from the relevant national and/or provincial authority to clear protected trees that occur within the development footprint. Vegetation clearing should be restricted to the proposed development footprints only, with no clearing permitted outside of these areas. The areas to be cleared should be clearly demarcated to prevent any unnecessary clearing outside of these areas.	**Low**
	Animal Life	Disturbance and mortality of fauna species.	Diligent monitoring during vegetation clearing to manage any wildlife-human interactions. Training and awareness raising (induction training and on-site signage) in terms of fauna species identification and snake handling. Appropriate barriers to prevent fauna gaining access to construction trenches and voids where they may become trapped. Enforce low-speed limit (recommended 20-40 km/h) to reduce wildlife-collisions. The handling, poisoning and killing of on-site fauna must be strictly prohibited. Consider noise abatement equipment fitment to machinery and vehicles. Regular dust suppression on roads and other sites where dust entrainment occurs.	**Low**
	Aquatic Ecosystems	Spillage of process and storm water runoff resulting in surface water pollution.	Design for adequate operational, storage and free board capacities in compliance with regulatory requirements and relevant guidelines to minimise any potential spills/seeping of waste material and other pollutants into on-site drainage lines and the surrounding aquatic ecosystems. Implement additional safety measures, such as storm water infrastructure and silt/pollution traps, to further prevent any contamination/pollution entering the downstream environment.	**Low**
	Air Quality	Impact on air quality due to dust generation from MWSDF.	Effective operational procedures to manage the dry and wet sections on top of the MWSDF as well as regular on-site dust suppression.	**Low**

8.10. MOTIVATED PREFERRED ALTERNATIVE

The preferred alternative site for the development of the Magnetite Waste Site Disposal Facility (MWSDF) and associated infrastructure is **site option 1.**

All four site options/alternatives for the proposed MWSDF and associated infrastructure had very similar Environmental Impact and Risk Assessment outcomes (section 8.5). The receiving environment and the ecological importance at all four sites options considered, are similar in nature.

Evident from Table 8.1(a) is that Bosveld Phosphates currently does not have surface rights to all this site options/alternatives available. Furthermore, as can also be seen on Figure 8.1(a), not all sites can ensure sustainable development as limited space is available for future operations and associated expansion considerations.

The site selection for the proposed MWSDF could therefore continue from the same Environmental Impact and Risk base and could be done subject to legal and sustainable operational considerations.

Geotechnical and stability assessments were performed at the preferred alternative site as part of the civil design and engineering component of this project which informed the design specifications and parameters to ensure that development at this site does not pose a safety risk. Refer to **APPENDIX 4(A)** for the Detailed Design Report.

The proposed position of the MWSDF and the PCD is such to maintain only a contaminated catchment surrounding these facilities and to maintain the clean natural drainage paths of the area towards the Selati River.

The proposed Site Layout Plan presented to I&AP's for consideration during the Scoping Phase of this project, is depicted in Figure 4.3(a). A large scale version of the proposed Site Layout Plan at the preferred alternative site is attached as **APPENDIX 8(A)** to this report.

9. IMPACT AND RISK ASSESSMENT PROCESS

9.1. ENVIRONMENTAL IMPACTS AND RISKS IDENTIFIED

The impact and risk assessment methodology utilised for the alternative impact assessment (section 8.5) during the Scoping Phase of the project, is the same methodology employed during the EIA Phase of the project. This methodology/process comprise of the identification of the following:

- Project activity
- Aspect of activity that could potentially cause an impact
- Environmental component that could potentially be impacted upon
- Potential impact description
- Potential impact/risk evaluation

These steps are systematically described in the sections below. The activity is determined in order to identify the relevant aspects of the activity that could potentially cause an impact. Thereafter the environmental components that could potentially be impacted upon is identified. The potential environmental impact associated with this aspect is then defined/described and finally, evaluated with reference to the impact assessment methodology relayed in the section below.

9.1.1. Relevant Project Activity/ies

The development of the Magnetite Waste Site Disposal Facility (MWSDF) and associated infrastructure (Access Road and Pollution Control Dam) and the Copper Flotation Plant were considered the project activities. The details pertaining to the development and operation of these activities is relayed in section 4.3 of this report.

9.1.2. Identification of Activity Aspects

The details pertaining to the development and operation of these activities is relayed in section 4.3 of this report and were perused to determine what particular aspect/action associated with the activity could potentially cause an impact.

9.1.3. Identification of Environmental Components

The relevant environmental components deemed to be impacted upon when conducting this activity and associated aspects/ actions were identified by the EAP subject to consideration of the environment encountered.

9.1.4. Impact Description/Definition

The potential impact anticipated is described/defined for each environmental component assessed and considered.

9.1.5. Evaluation of Environmental Impacts

The potential impacts are ranked by means of the impact assessment methodology relayed in section 8.6 of this report.

9.1.6. Evaluation of Environmental Impacts

The basic elements used in the evaluation of impact significance are described in Table 8.6(a) and the characteristics used to describe the consequence of an impact are outlined in Table 8.6(b). The impact significance rating system is presented in Table 8.6(c).

9.2. SIGNIFICANCE ASSESSMENT & EXTENT TO WHICH IMPACTS AND RISKS COULD BE AVOIDED

For each potential environmental impact or risk identified and described following the steps outlined above, a management objective/ outcome was proposed. The ultimate purpose of a management objective/ outcome is to mitigate the potential impact.

Subsequently, mitigation measures are proposed which aim to achieve the management objective. Mitigation measures can either avoid, modify, remedy, control or stop impacts, consistent with best practice.

The potential environmental impact or risk is then re-assessed supposing mitigation was implemented, with the same impact assessment methodology as before, to determine the effectiveness of these objectives/ outcomes in terms of their ability to avoid, modify, remedy, control or stop an impact entirely, render it insignificant or reduce its magnitude.

10. IMPACT AND RISK SIGNIFICANCE ASSESSMENT

Sections provided below describe the cumulative impact and risk assessment as well the comprehensive impact and risk assessments performed by the relevant specialists when considering the project as a whole, i.e. inclusive of all the life-cycle phases of the project.

10.1. CUMULATIVE IMPACT AND RISK ASSESSMENT

A cumulative impact is defined in the EIA Regulations of 2014 (as amended), as:

"'cumulative impact' in relation to an activity, means the past, current and reasonably foreseeable impact of an activity, considered with the impact of activities associated with that activity, that in itself may not be significant, but may become significant when added to the existing and reasonable foreseeable impacts eventuating from similar or diverse activities"

A description of the cumulative impacts associated with this project is relayed in Table 10.1(a).

Table 10.1(a): Cumulative impact description for each environmental component assessed

Environmental Component	Description of Cumulative Impact	Cumulative Impact Risk Rating
Socio-Cultural/ Economic Aspects	Additional industrial and mining activities could increase nuisance factors (air quality and noise) in the area.	**Medium**
	The project could contribute to the local economic instability related to over-reliance on the mining sector.	**Medium**
	Additional economic activities (especially mining) in the area could lead to a population influx (in-migration).	**Low**
	Additional industrial and mining activities could increase the intensity of water and energy consumption in the area.	**Medium**
Archaeological, Heritage & Palaeontology Aspects	None of the types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act (No 25 of 1999) were found in the project area. In addition, the proposed activities associated with this project, will not affect palaeontological heritage as the entire study area is underlain by Archaean igneous and metamorphic rocks of the Makhutswi Gneiss and syenites of the Phalaborwa Complex. There is an unlikely possibility that the superficial Quaternary alluvial deposits could host fossils.	**None**
Soils, Land Capability and Land Use	The activities associated with the project could potentially increase the amount of dust generated from the operational area of Bosveld Phosphates to the surrounding area.	**Low to Medium**
	The activities associated with the project could potentially lead to an increase in contaminated storm water runoff and ingress.	**Very Low**
Geology & Groundwater Aspects	The groundwater impact assessment for the proposed developments was simulated through utilisation of a groundwater model. When including contamination from the existing sources at Bosveld Phosphates, it is evident that the expected impact of the proposed facilities is low in comparison to that of the existing activities. The contaminant plume originating from the existing activities has a much greater impact on the groundwater system as it has a larger extent and higher concentrations compared to that of the proposed activities. Therefore, the simulation suggests that the potential impact of the proposed activity will be a relatively minor contributing factor to the overall potential groundwater contamination status of the study area.	**Low**
Surface Water Aspects	Topsoil stripping associated with the proposed project will add to sediment loads generated by erosion from upstream agricultural activities.	**Low**
	Potential sources of hydrocarbon pollutants in the project area as a result of increased traffic of vehicles during construction period and operating period of the facility.	**Low**

Environmental Component	Description of Cumulative Impact	Cumulative Impact Risk Rating
Surface Water Aspects	Overflowing of PCD during storms with return period greater than 1:50 year will contribute to contaminated water discharges in accordance with Government Notice 704 of the South African National Water Act, Act 36 of 1998	**Very Low**
Surface Water Aspects	Reduction of catchment runoff yield	**Very Low**
Terrestrial Ecology (Plant and Animal Life)	The progressive loss and modification of supporting natural habitat patches adjacent to the Ga-Selati River may disrupt the ability of the riparian corridor to maintain the ecological supporting role that contributes to the ecosystem dynamics of the broader landscape.	**Low to Medium**
Aquatic Ecosystems Aspects	During the aquatic baseline and impact assessment survey, anthropogenic impacts were identified in and around the study area. They primarily included industrial activities, wastewater treatment works, erosion, alien vegetation colonisation and sand mining. Bosveld Phosphates (current and proposed activities) places a level of stress on the aquatic environment.	**Medium**
Wetland Aspects	The proposed site for the MWSDF is located the industrial footprint. Although the land has not been significantly disturbed by any existing activities, it does fall within the secured management footprint of Bosveld Phosphates and can thus be considered earmarked for development. Extensive existing tailings storage facilities, mining areas and dirty water dams occur within the immediate adjacent areas to the south and east, which dwarf the proposed footprint of the MWSDF. These existing activities have impacted on a number of small watercourses, resulting in loss and degradation of habitat. Both the Ga-Selati River and the Olifants River are also impacted by these activities. The proposed MWSDF therefore will not impact on pristine or unimpacted habitats but represent a further expansion of industrial and mining activities. The consequences are further loss of habitat and creation of a further potential source of contaminants to the watercourses of the area that will require management into the future to prevent/minimise contamination of watercourses.	**Low to Medium**
Air Quality Aspects	Ambient dust deposition rates	**Medium**
Air Quality Aspects	Ambient particulate matter concentrations	**Very High**
Air Quality Aspects	Ambient gaseous and hazardous air pollutant concentrations	**Low**

10.2. PROJECT LIFE CYCLE IMPACT AND RISK ASSESSMENT

The outcome of the process described in section 9 of this report is documented in the Impact and Risk Assessment Tables presented for all the life cycle phases applicable to this project.

Impact and Risk Assessment Tables consist of the following columns:

- Column 1: Project Activity
- Column 2: Activity Aspect
- Column 3: Environmental Aspect (Component) Affected
- Column 4: Potential Impact Description

These columns are followed by **the actual impact and risk assessment** which comprises the following columns:

- Column 5: Impact Characteristics before Mitigation/Management (magnitude, duration, spatial scale, consequence, probability)
- Column 6: Impact Characteristic Rating before Mitigation/Management
- Column 7: Impact Significance before Mitigation/Management
- Column 8: Management Objective/Outcome (avoid, modify, remedy, control, stop)
- Column 9: Impact Characteristics after Mitigation/Management (magnitude, duration, spatial scale, consequence, probability)
- Column 10: Impact Characteristic Rating after Mitigation/Management
- Column 11: Impact Significance after Mitigation/Management

Table 10.2.1(a) – (h) represent the Impact and Risk Assessment performed for each Environmental Component separately for the Construction Phase.

Table 10.2.2(a) – (h) represent the Impact and Risk Assessment performed for each Environmental Component separately for the Operational Phase.

Table 10.2.3(a) – (h) represent the Impact and Risk Assessment performed for each Environmental Component separately for the Decommissioning Phase.

Table 10.2.4(a) – (h) represent the Impact and Risk Assessment performed for each Environmental Component separately for the Post Closure Phase.

10.2.1. Construction Phase Impact and Risk Assessment

Table 10.2.1(a): Construction Phase Impact Significance Rating Table – Socio-Economic/Cultural

CONSTRUCTION PHASE IMPACT SIGNIFICANCE RATING TABLE – SOCIO-ECONOMIC/CULTURAL										
Activity	**Construction Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Proposed Activities	Construction of proposed activities	Socio-Economic	Potential increase in employment and income opportunities.	**Magnitude**	Minor	**LOW + (positive)**	Optimise recruitment of unskilled labour from local communities.	**Magnitude**	Moderate	**MEDIUM + (positive)**
				Duration	Short term			**Duration**	Short term	
				Scale	Local			**Scale**	Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Definite	
Proposed Activities	Construction of proposed activities	Socio-Economic	Potential deterioration of safety and security aspects.	**Magnitude**	Moderate	**Low**	Follow a transparent and fair local recruitment process.	**Magnitude**	Moderate	**Low**
				Duration	Short term			**Duration**	Short term	
				Scale	Local			**Scale**	Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	
Proposed Activities	Construction of proposed activities	Socio-Economic	Potential increase in nuisance factors (dust and noise).	**Magnitude**	Minor	**Low**	Minimize nuisance factors (dust and noise) for local communities.	**Magnitude**	Minor	**Low**
				Duration	Short term			**Duration**	Short term	
				Scale	Local			**Scale**	Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	
Proposed Activities	Construction of proposed activities	Socio-Economic	Informal and formal population influx as a result of job-seekers.	**Magnitude**	Moderate	**Low**	Optimise recruitment of unskilled labour from local communities.	**Magnitude**	Moderate	**Low**
				Duration	Short term			**Duration**	Short term	
				Scale	Local			**Scale**	Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	

Table 10.2.1(b): Construction Phase Impact Significance Rating Table – Soils, Land Use and Land Capability

CONSTRUCTION PHASE IMPACT SIGNIFICANCE RATING TABLE – SOILS, LAND USE AND LAND CAPABILITY										
Activity	**Construction Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Magnetite Waste Site Disposal Facility (MWSDF)	Clearance of Vegetation	Soil Fertility and change in Land Use Capability.	Change in land use, loss of vegetative cover and the possible loss of the resource, sterilisation of the footprint and increased potential for erosion and impact of sedimentary load on downstream receptors.	**Magnitude**	Major	**High**	Manage and control size of footprint of disturbance. Avoid excessive vehicle movement over unprotected soils. Control and manage storm water runoff and erosion. Manage contamination from hydrocarbon spillage.	**Magnitude**	Major	**High**
				Duration	Long term			**Duration**	Long term	
				Scale	Regional			**Scale**	Site	
				Consequence	High			**Consequence**	High	
				Probability	Definite			**Probability**	Possible	
	Topsoil Stripping and Stockpiling	Change in Ecosystem Services and the potential Land Capability.	Loss of ecosystem service and resource, de-nutrification and reduction in nutrient status and potential for compaction and erosion of unprotected materials.	**Magnitude**	Moderate	**Medium**	Delineate area for storage of utilisable soils, protect from dirty water and dust ingress from wind blown and storm water runoff from dirty areas. Control and manage erosion by wind and/or water. Avoid excessive vehicle movement over unprotected soils. Manage contamination from hydrocarbon spillage.	**Magnitude**	Moderate	**Medium**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Site			**Scale**	Site	
				Consequence	Medium			**Consequence**	Medium	
				Probability	Definite			**Probability**	Possible	
	Construction of Facility	Loss of Ecosystem Services and Resource.	Permanent loss and sterilisation of resource, potential for salinisation and contamination by dirty water runoff, reagent and hydrocarbon spills and the consequences for downstream receptors.	**Magnitude**	Major	**High**	Manage and control size of footprint of disturbance. Avoid excessive vehicle movement over unprotected soils. Control and manage storm water runoff and erosion. Manage contamination from hydrocarbon spillage.	**Magnitude**	Major	**High**
				Duration	Long term			**Duration**	Long term	
				Scale	Site			**Scale**	Site	
				Consequence	High			**Consequence**	High	
				Probability	Definite			**Probability**	Definite	
Access Road to MWSDF	Clearance of Vegetation	Soil Fertility and change in Land Use Capability.	Change in land use, loss of vegetative cover and the possible loss of the resource, sterilisation of the footprint and increased potential for erosion and impact of sedimentary load on downstream receptors.	**Magnitude**	Moderate	**Medium**	Manage and control size of footprint of disturbance. Minimise erosion and compaction. Avoid excessive vehicle movement over unprotected soils. Control and manage storm water runoff and erosion. Manage contamination from hydrocarbon spillage.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Site			**Scale**	Site	
				Consequence	Medium			**Consequence**	Low	
				Probability	Definite			**Probability**	Possible	

CONSTRUCTION PHASE IMPACT SIGNIFICANCE RATING TABLE – SOILS, LAND USE AND LAND CAPABILITY										
Activity	**Construction Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Access Road to MWSDF	Topsoil Stripping and Stockpiling	Change in Ecosystem Services and the potential Land Capability.	Loss of ecosystem service and resource, de-nutrification and reduction in nutrient status and potential for compaction and erosion of unprotected materials.	**Magnitude**	Moderate	**Medium**	Delineate area for storage of utilisable soils, protect from dirty water and dust ingress from wind blown and storm water runoff from dirty areas. Control and manage erosion by wind and/or water. Avoid excessive vehicle movement over unprotected soils. Manage contamination from hydrocarbon spillage.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Site			**Scale**	Site	
				Consequence	Medium			**Consequence**	Low	
				Probability	Definite			**Probability**	Possible	
Pollution Control Dam (PCD) and associated infrastructure (including the silt trap)	Clearance of Vegetation	Soil Fertility and change in Land Use Capability.	Change in land use, loss of vegetative cover and the possible loss of the resource, sterilisation of the footprint and increased potential for erosion and impact of sedimentary load on downstream receptors.	**Magnitude**	Major	**High**	Manage and control size of footprint of disturbance. Avoid excessive vehicle movement over unprotected soils. Control and manage storm water runoff and erosion. Manage contamination from hydrocarbon spillage.	**Magnitude**	Major	**High**
				Duration	Long term			**Duration**	Long term	
				Scale	Regional			**Scale**	Site	
				Consequence	High			**Consequence**	High	
				Probability	Definite			**Probability**	Possible	
	Topsoil Stripping and Stockpiling	Change in Ecosystem Services and the potential Land Capability.	Loss of ecosystem service and resource, de-nutrification and reduction in nutrient status and potential for compaction and erosion of unprotected materials.	**Magnitude**	Moderate	**Medium**	Delineate area for storage of utilisable soils, protect from dirty water and dust ingress from wind blown and storm water runoff from dirty areas. Control and manage erosion by wind and/or water. Avoid excessive vehicle movement over unprotected soils. Manage contamination from hydrocarbon spillage.	**Magnitude**	Moderate	**Medium**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Site			**Scale**	Site	
				Consequence	Medium			**Consequence**	Medium	
				Probability	Definite			**Probability**	Possible	
	Construction of Facility	Loss of Ecosystem Services and Resource.	Permanent loss and sterilisation of resource, potential for salinisation and contamination by dirty water runoff, reagent and hydrocarbon spills and the consequences for downstream receptors.	**Magnitude**	Major	**High**	Manage and control size of footprint of disturbance. Avoid excessive vehicle movement over unprotected soils. Control and manage storm water runoff and erosion. Manage contamination from hydrocarbon spillage.	**Magnitude**	Major	**High**
				Duration	Long term			**Duration**	Long term	
				Scale	Site			**Scale**	Site	
				Consequence	High			**Consequence**	High	
				Probability	Definite			**Probability**	Definite	

CONSTRUCTION PHASE IMPACT SIGNIFICANCE RATING TABLE – SOILS, LAND USE AND LAND CAPABILITY											
Activity	**Construction Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Copper Flotation Plant	Construction of Facility	Loss of Ecosystem Services and Resource.	Loss and sterilisation of resource, potential for salinisation and contamination by dirty water runoff, reagent and hydrocarbon spills and the consequences for downstream receptors.	**Magnitude**	Major	**Medium**	Manage and control size of footprint of disturbance. Avoid excessive vehicle movement over unprotected soils. Control and manage storm water runoff and erosion. Manage contamination from hydrocarbon spillage.	**Magnitude**	Major	**Medium**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Site			**Scale**	Site	
				Consequence	Medium			**Consequence**	Medium	
				Probability	Definite			**Probability**	Definite	

Table 10.2.1(c): Construction Phase Impact Significance Rating Table – Groundwater

CONSTRUCTION PHASE IMPACT SIGNIFICANCE RATING TABLE – GROUNDWATER										
Activity	**Construction Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/ Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Magnetite Waste Site Disposal Facility (MWSDF)	Construction of Facility	Groundwater: Quality	Deterioration of the groundwater resource quality due to spillages and infiltration of fuel (hydrocarbons) from the fuel tanks of construction vehicles.	**Magnitude**	Minor	**Low**	Control and manage hydrocarbon spillage and contamination of resource (source control measure).	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Local			**Scale**	Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	
Access Road to MWSDF	Construction of Facility	Groundwater: Quality	Deterioration of the groundwater resource quality due to spillages and infiltration of fuel (hydrocarbons) from the fuel tanks of construction vehicles.	**Magnitude**	Minor	**Low**	Control and manage hydrocarbon spillage and contamination of resource (source control measure).	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Local			**Scale**	Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	
Pollution Control Dam (PCD) and associated infrastructure	Construction of Facility	Groundwater: Quality	Deterioration of the groundwater resource quality due to spillages and infiltration of fuel (hydrocarbons) from the fuel tanks of construction vehicles.	**Magnitude**	Minor	**Low**	Control and manage hydrocarbon spillage and contamination of resource (source control measure).	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Local			**Scale**	Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	
Copper Flotation Plant	Construction of Facility	Groundwater: Quality	Deterioration of the groundwater resource quality due to spillages and infiltration of fuel (hydrocarbons) from the fuel tanks of construction vehicles.	**Magnitude**	Minor	**Low**	Control and manage hydrocarbon spillage and contamination of resource (source control measure).	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Local			**Scale**	Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	

Table 10.2.1(d): Construction Phase Impact Significance Rating Table – Surface Water

CONSTRUCTION PHASE IMPACT SIGNIFICANCE RATING TABLE – SURFACE WATER										
Activity	**Construction Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Magnetite Waste Site Disposal Facility (MWSDF)	Clearance of Vegetation	Surface Water: Quality	Contamination of the surface water resource due to increased sediment load from cleared area directly into the surface water resource.	**Magnitude**	Minor	**Low**	Control by maintaining suitable bufferzones (temporary berms) around activity footprint.	**Magnitude**	Minor	**Low**
				Duration	Short term			**Duration**	Short term	
				Scale	Site			**Scale**	Site	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	
	Topsoil Stripping and Stockpiling	Surface Water: Quality	Contamination of the surface water resource due to increased sediment load from cleared area directly into the surface water resource.	**Magnitude**	Minor	**Low**	Control by maintaining suitable bufferzones (temporary berms) around activity footprint.	**Magnitude**	Minor	**Low**
				Duration	Short term			**Duration**	Short term	
				Scale	Site			**Scale**	Site	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	
	Construction of Facility	Surface Water: Quality	Contamination of the surface water resource due to contamination from construction activities/ material/ vehicles.	**Magnitude**	Moderate	**Low**	Control potential migration of construction activities (diesel and oil) into the surface runoff through a spillages control and clean-up procedure.	**Magnitude**	Minor	**Low**
				Duration	Short term			**Duration**	Short term	
				Scale	Site			**Scale**	Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	
Access Road to MWSDF	Topsoil Stripping and Stockpiling	Surface Water: Quality	Contamination of the surface water resource due to contaminated runoff from "dirty areas" directly into the surface water resources.	**Magnitude**	Minor	**Low**	Control by maintaining suitable bufferzones around watercourses.	**Magnitude**	Minor	**Low**
				Duration	Short term			**Duration**	Short term	
				Scale	Site			**Scale**	Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	Clearance of Vegetation	Surface Water: Quality	Contamination of the surface water resource due to increased sediment load from cleared area directly into the surface water resource.	**Magnitude**	Minor	**Low**	Control by maintaining suitable bufferzones (temporary berms) around activity footprint.	**Magnitude**	Minor	**Low**
				Duration	Short term			**Duration**	Short term	
				Scale	Site			**Scale**	Site	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	

CONSTRUCTION PHASE IMPACT SIGNIFICANCE RATING TABLE – SURFACE WATER										
Activity	**Construction Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	Topsoil Stripping and Stockpiling	Surface Water: Quality	Contamination of the surface water resource due to increased sediment load from cleared area directly into the surface water resource.	**Magnitude**	Minor	**Low**	Control by maintaining suitable bufferzones (temporary berms) around activity footprint.	**Magnitude**	Minor	**Low**
				Duration	Short term			**Duration**	Short term	
				Scale	Site			**Scale**	Site	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	
	Construction of Facility	Surface Water: Quality	Contamination of the surface water resource due to contamination from construction activities/ material/ vehicles.	**Magnitude**	Minor	**Low**	Control potential migration of construction activities (diesel and oil) into the surface runoff through a spillages control and clean-up procedure.	**Magnitude**	Minor	**Low**
				Duration	Short term			**Duration**	Short term	
				Scale	Site			**Scale**	Site	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	
Copper Flotation Plant	Construction of Facility	Surface Water: Quality	Contamination of the surface water resource due to contamination from construction activities/ material/ vehicles.	**Magnitude**	Minor	**Low**	Control potential migration of construction activities (diesel and oil) into the surface runoff through a spillages control and clean-up procedure.	**Magnitude**	Minor	**Low**
				Duration	Short term			**Duration**	Short term	
				Scale	Site			**Scale**	Site	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	

Table 10.2.1(e): Construction Phase Impact Significance Rating Table – Terrestrial Ecology

CONSTRUCTION PHASE IMPACT SIGNIFICANCE RATING TABLE – TERRESTRIAL ECOLOGY										
Activity	**Construction Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Magnetite Waste Site Disposal Facility (MWSDF)	Clearance of Vegetation	Flora & Fauna: Habitat and Diversity	Loss and disturbance of habitat due to site clearance. Approximate extent of habitat loss/ disturbance is 16.7 ha of *C. mopane – C. apiculatum* Bushveld & 0.8 ha of *D. cinerea* Secondary Bushveld.	**Magnitude**	Major	**High**	Control through restriction of vegetation clearance to development footprint area. Control by re-establishing indigenous vegetation on rehabilitated areas.	**Magnitude**	Moderate	**Medium**
				Duration	Long term			**Duration**	Medium term	
				Scale	Local			**Scale**	Site	
				Consequence	High			**Consequence**	Medium	
				Probability	Definite			**Probability**	Possible	
	Clearance of Vegetation	Fauna: Habitat and Diversity	Fragmentation of habitat causing disruption of fauna movement/dispersal corridors.	**Magnitude**	Moderate	**Medium**	Control through restriction of vegetation clearance to development footprint area Control by re-establishing indigenous vegetation on rehabilitated areas.	**Magnitude**	Minor	**Low**
				Duration	Long term			**Duration**	Medium term	
				Scale	Local			**Scale**	Local	
				Consequence	Medium			**Consequence**	Low	
				Probability	Definite			**Probability**	Possible	
	Clearance of Vegetation & Topsoil Stripping	Flora: Habitat and Diversity	Establishment and spread of alien invasive species resulting from the removal of indigenous vegetation and soil disturbances.	**Magnitude**	Moderate	**Medium**	Modify, control and stop potential impacts by implementing an invasive species programme. Remedy by rehabilitating disturbed areas.	**Magnitude**	Minor	**Low**
				Duration	Long term			**Duration**	Short term	
				Scale	Local			**Scale**	Site	
				Consequence	Medium			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	
	Clearance of Vegetation	Flora: Species of conservation concern (Protected Trees)	Loss of protected tree species located in construction footprints.	**Magnitude**	Major	**High**	Modify, control and stop potential impacts by limiting the number of protected trees that require clearing to a minimum, applying for the correct clearing permits and implementing a conservation plan that includes the planting of juvenile protected trees during rehabilitation.	**Magnitude**	Minor	**Low**
				Duration	Long term			**Duration**	Medium term	
				Scale	Local			**Scale**	Site	
				Consequence	High			**Consequence**	Low	
				Probability	Definite			**Probability**	Possible	
	Clearance of Vegetation Topsoil Stripping & Construction of Facility	Fauna: Diversity	Direct mortality and disturbance of fauna as a consequence of construction activities, including vehicle collisions, trapping in excavations, hunting/snaring and sensory disturbance.	**Magnitude**	Major	**High**	Control and stop potential impacts by actively managing fauna-human interactions, and implementing minimisation measures and awareness training for all on-site workers.	**Magnitude**	Minor	**Low**
				Duration	Long term			**Duration**	Short term	
				Scale	Local			**Scale**	Site	
				Consequence	High			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	

CONSTRUCTION PHASE IMPACT SIGNIFICANCE RATING TABLE – TERRESTRIAL ECOLOGY										
Activity	**Construction Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Magnetite Waste Site Disposal Facility (MWSDF)	Construction of Facility	Flora & Fauna: Habitat and Diversity	Contamination of downstream riparian habitat resulting from pollution spills or leaks from construction equipment and waste containers.	**Magnitude**	Moderate	**High**	Stop and control impact by ensuring all built facilities are correctly designed, and minimise and remedy impacts through effective emergency response planning and implementation.	**Magnitude**	Minor	**Low**
				Duration	Long term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Local	
				Consequence	High			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	
Access Road to MWSDF	Clearance of Vegetation	Flora & Fauna: Habitat and Diversity	Loss and disturbance of habitat due to site clearance. Approximate extent of habitat loss/ disturbance is 0.5 ha of C. mopane – *C. apiculatum* Bushveld.	**Magnitude**	Minor	**Medium**	Control through restriction of vegetation clearance to development footprint area. Remedy by fully re-establishing indigenous vegetation on rehabilitated areas during decommissioning and closure.	**Magnitude**	Minor	**Low**
				Duration	Long term			**Duration**	Medium term	
				Scale	Site			**Scale**	Site	
				Consequence	Medium			**Consequence**	Medium	
				Probability	Possible			**Probability**	Unlikely	
	Clearance of Vegetation & Topsoil Stripping	Flora: Habitat and Diversity	Establishment and spread of alien invasive species resulting from the removal of indigenous vegetation and soil disturbances.	**Magnitude**	Moderate	**Medium**	Modify, control and stop potential impacts by implementing an invasive species programme Remedy by rehabilitating disturbed areas.	**Magnitude**	Minor	**Low**
				Duration	Long term			**Duration**	Short term	
				Scale	Local			**Scale**	Site	
				Consequence	Medium			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	
	Clearance of Vegetation	Flora: Species of conservation concern (Protected Trees)	Loss of protected tree species located in construction footprints.	**Magnitude**	Major	**High**	Modify, control and stop potential impacts by limiting the number of protected trees that require clearing to a minimum, applying for the correct clearing permits and implementing a conservation plan that includes the planting of juvenile protected trees during rehabilitation.	**Magnitude**	Minor	**Low**
				Duration	Long term			**Duration**	Medium term	
				Scale	Local			**Scale**	Site	
				Consequence	High			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	
	Clearance of Vegetation Topsoil Stripping & Construction of Facility	Fauna: Diversity	Direct mortality and disturbance of fauna as a consequence of construction activities, including vehicle collisions, trapping in excavations, hunting/ snaring and sensory disturbance.	**Magnitude**	Moderate	**Medium**	Control and stop potential impacts by actively managing fauna-human interactions, and implementing minimisation measures and awareness training for all on-site workers.	**Magnitude**	Minor	**Low**
				Duration	Long term			**Duration**	Short term	
				Scale	Local			**Scale**	Site	
				Consequence	Medium			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	

CONSTRUCTION PHASE IMPACT SIGNIFICANCE RATING TABLE – TERRESTRIAL ECOLOGY										
Activity	**Construction Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	Clearance of Vegetation	Flora & Fauna: Habitat and Diversity	Loss and disturbance of habitat due to site clearance. Approximate extent of habitat loss/disturbance is 3.9 ha of C. mopane – *C. apiculatum* Bushveld.	**Magnitude**	Major	**High**	Control through restriction of vegetation clearance to development footprint area. Remedy by fully re-establishing indigenous vegetation on rehabilitated areas during decommissioning and closure.	**Magnitude**	Minor	**Low**
				Duration	Long term			**Duration**	Medium term	
				Scale	Local			**Scale**	Site	
				Consequence	High			**Consequence**	Medium	
				Probability	Definite			**Probability**	Unlikely	
	Clearance of Vegetation	Fauna: Habitat and Diversity	Fragmentation of habitat causing disruption of fauna movement/dispersal corridors.	**Magnitude**	Moderate	**Medium**	Control through restriction of vegetation clearance to development footprint area. Remedy by re-establishing indigenous vegetation on rehabilitated areas.	**Magnitude**	Minor	**Low**
				Duration	Long term			**Duration**	Medium term	
				Scale	Local			**Scale**	Local	
				Consequence	Medium			**Consequence**	Low	
				Probability	Definite			**Probability**	Unlikely	
	Clearance of Vegetation & Topsoil Stripping	Flora: Habitat and Diversity	Establishment and spread of alien invasive species resulting from the removal of indigenous vegetation and soil disturbances.	**Magnitude**	Moderate	**Medium**	Modify, control and stop potential impacts by implementing an invasive species programme. Remedy by rehabilitating disturbed areas.	**Magnitude**	Minor	**Low**
				Duration	Long term			**Duration**	Short term	
				Scale	Local			**Scale**	Site	
				Consequence	Medium			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	
	Clearance of Vegetation	Flora: Species of conservation concern (Protected Trees)	Loss of protected tree species located in construction footprints.	**Magnitude**	Major	**High**	Modify, control and stop potential impacts by limiting the number of protected trees that require clearing to a minimum, applying for the correct clearing permits and implementing a conservation plan that includes the planting of juvenile protected trees during rehabilitation.	**Magnitude**	Minor	**Low**
				Duration	Long term			**Duration**	Medium term	
				Scale	Local			**Scale**	Site	
				Consequence	High			**Consequence**	Low	
				Probability	Definite			**Probability**	Possible	
	Clearance of Vegetation Topsoil Stripping & Construction of Facility	Fauna: Diversity	Direct mortality and disturbance of fauna as a consequence of construction activities, including vehicle collisions, trapping in excavations, hunting/snaring and sensory disturbance.	**Magnitude**	Major	**High**	Control and stop potential impacts by actively managing fauna-human interactions, and implementing minimisation measures and awareness training for all on-site workers.	**Magnitude**	Minor	**Low**
				Duration	Long term			**Duration**	Short term	
				Scale	Local			**Scale**	Site	
				Consequence	High			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	

CONSTRUCTION PHASE IMPACT SIGNIFICANCE RATING TABLE – TERRESTRIAL ECOLOGY										
Activity	**Construction Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	Construction of Facility	Flora & Fauna: Habitat and Diversity	Contamination of downstream riparian habitat resulting from pollution spills or leaks from construction equipment and waste containers.	**Magnitude**	Moderate	**High**	Stop and control impact by ensuring all built facilities are correctly designed, and minimise and remedy impacts through effective emergency response planning and implementation.	**Magnitude**	Minor	**Low**
				Duration	Long term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Local	
				Consequence	High			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	

Table 10.2.1(f): Construction Phase Impact Significance Rating Table – Aquatic Ecosystems

CONSTRUCTION PHASE IMPACT SIGNIFICANCE RATING TABLE – AQUATIC ECOSYSTEMS										
Activity	**Construction Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Magnetite Waste Site Disposal Facility (MWSDF)	Clearance of Vegetation	Surface Water: Quality	Degradation of aquatic ecosystems due to sediment mobilisation, runoff from site and potential erosion.	**Magnitude**	Moderate	**Medium**	Minimise footprint of vegetation clearing and ensure limited sediment mobilisation and runoff towards the Ga-Selati.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Regional	
				Consequence	Medium			**Consequence**	Low	
				Probability	Definite			**Probability**	Possible	
	Topsoil Stripping and Stockpiling	Surface Water: Quality	Degradation of aquatic ecosystems due to sediment mobilisation, runoff from site and potential erosion. Changes/ deterioration of water quality (within the Ga-Selati River).	**Magnitude**	Moderate	**Medium**	Ensure suitable bufferzone around watercourses. No stockpiling within bufferzone or within the riparian zone of the Ga-Selati (36m from the watercourse). Minimise footprint and residence time of topsoil stockpiles.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Regional	
				Consequence	Medium			**Consequence**	Low	
				Probability	Definite			**Probability**	Possible	
		Aquatic habitats	Loss / alteration of habitat: mainly in-stream channel habitat - limited riparian habitat. Increase in erosion within riparian zone. Increased sedimentation smothering in-stream habitats and reducing availability of biotopes.	**Magnitude**	Minor	**Low**	Ensure suitable bufferzone around watercourses. No stockpiling within bufferzone or within the riparian zone of the Ga-Selati (36m from the watercourse). Minimise footprint and residence time of topsoil stockpiles.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Regional	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	
		Aquatic biota	Loss of ecological communities.	**Magnitude**	Minor	**Low**	Ensure suitable bufferzone around watercourses. No stockpiling within bufferzone or within the riparian zone of the Ga-Selati (36m from the watercourse). Minimise footprint and residence time of topsoil stockpiles.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Regional	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	
	Construction of Facility	Surface Water: Quality	Alteration of drainage patterns of the cleared area and the area immediate adjacent to it.	**Magnitude**	Moderate	**Medium**	Ensure suitable bufferzone around watercourses. No construction activities or storage of infrastructure within bufferzone or within riparian zone of the Ga-Selati (36m from the watercourse). Implement dust control measures on all dirt roads.	**Magnitude**	Moderate	**Medium**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Regional	
				Consequence	Medium			**Consequence**	Medium	
				Probability	Definite			**Probability**	Possible	

CONSTRUCTION PHASE IMPACT SIGNIFICANCE RATING TABLE – AQUATIC ECOSYSTEMS										
Activity	**Construction Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Magnetite Waste Site Disposal Facility (MWSDF)	Construction of Facility	Aquatic habitats	Loss / alteration of habitat: mainly in-stream channel habitat - limited riparian habitat. Increase in erosion within riparian zone. Increased sedimentation smothering in-stream habitats and reducing availability of biotopes.	**Magnitude**	Moderate	**Medium**	Minimise sediment mobilisation and runoff towards the Ga-Selati.	**Magnitude**	Moderate	**Medium**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Regional	
				Consequence	Medium			**Consequence**	Medium	
				Probability	Definite			**Probability**	Possible	
		Aquatic biota	Loss of ecological communities.	**Magnitude**	Moderate	**Medium**	Ensure a suitable bufferzone around watercourses and minimise sediment mobilisation and runoff towards the Ga-Selati.	**Magnitude**	Moderate	**Medium**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Regional	
				Consequence	Medium			**Consequence**	Medium	
				Probability	Definite			**Probability**	Possible	
Access Road to MWSDF	Clearance of Vegetation	Surface Water: Quality	Degradation of aquatic ecosystems due to sediment mobilisation, runoff from site and potential erosion.	**Magnitude**	Minor	**Low**	Minimise footprint of vegetation clearing and ensure limited sediment mobilisation and runoff towards the Ga-Selati.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Regional	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	
	Topsoil Stripping and Stockpiling	Surface Water: Quality	Degradation of aquatic ecosystems due to sediment mobilisation, runoff from site and potential erosion. Changes/ deterioration of water quality (within the Ga-Selati River).	**Magnitude**	Moderate	**Medium**	Minimise footprint and residence time of topsoil stockpiles.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Regional	
				Consequence	Medium			**Consequence**	Low	
				Probability	Definite			**Probability**	Possible	
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	Clearance of Vegetation	Surface Water: Quality	Degradation of aquatic ecosystems due to sediment mobilisation, runoff from site and potential erosion.	**Magnitude**	Moderate	**Medium**	Minimise footprint of vegetation clearing.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Regional	
				Consequence	Medium			**Consequence**	Low	
				Probability	Definite			**Probability**	Possible	

CONSTRUCTION PHASE IMPACT SIGNIFICANCE RATING TABLE – AQUATIC ECOSYSTEMS										
Activity	**Construction Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Pollution Control Dam (PCD) and associated infrastructure (including the silt trap)	Topsoil Stripping and Stockpiling	Surface Water: Quality	Degradation of aquatic ecosystems due to sediment mobilisation, runoff from site and potential erosion.	**Magnitude**	Moderate	**Medium**	Maintain suitable bufferzones around watercourses. Minimise footprint and residence time of topsoil stockpiles.	**Magnitude**	Moderate	**Medium**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Regional	
				Consequence	Medium			**Consequence**	Medium	
				Probability	Definite			**Probability**	Possible	
		Aquatic habitats	Loss / alteration of habitat: mainly in-stream channel habitat - limited riparian habitat. Increase in erosion within riparian zone. Increased sedimentation smothering in-stream habitats and reducing availability of biotopes.	**Magnitude**	Moderate	**Medium**	Maintain suitable bufferzones around watercourses.	**Magnitude**	Moderate	**Medium**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Regional	
				Consequence	Medium			**Consequence**	Medium	
				Probability	Definite			**Probability**	Possible	
		Aquatic biota	Loss of ecological communities.	**Magnitude**	Moderate	**Medium**	Maintain suitable bufferzones around watercourses. Minimise footprint and residence time of topsoil stockpiles.	**Magnitude**	Moderate	**Medium**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Regional	
				Consequence	Medium			**Consequence**	Medium	
				Probability	Definite			**Probability**	Possible	
	Construction of Facility	Surface Water: Quality	Alteration of drainage patterns of the cleared area and the area immediate adjacent to it.	**Magnitude**	Moderate	**Medium**	Ensure suitable bufferzone around watercourses, including drainage lines on site. No construction activities or storage of infrastructure within bufferzone or within the riparian zone of the Ga-Selati (36m from the watercourse). Implement dust control measures on all dirt roads.	**Magnitude**	Moderate	**Medium**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Regional	
				Consequence	Medium			**Consequence**	Medium	
				Probability	Definite			**Probability**	Possible	
		Aquatic habitats	Loss / alteration of habitat: mainly in-stream channel habitat - limited riparian habitat. Increase in erosion within riparian zone. Increased sedimentation smothering in-stream habitats and reducing availability of biotopes.	**Magnitude**	Moderate	**Medium**	Minimise sediment mobilisation and runoff towards the Ga-Selati.	**Magnitude**	Moderate	**Medium**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Regional	
				Consequence	Medium			**Consequence**	Medium	
				Probability	Definite			**Probability**	Possible	

CONSTRUCTION PHASE IMPACT SIGNIFICANCE RATING TABLE – AQUATIC ECOSYSTEMS

Activity	Construction Activity Aspect	Environmental Component Affected	Potential Impact Description	Impact Assessment BEFORE Mitigation		Significance if NOT Managed	Management Objective/Outcome	Impact Assessment AFTER Management		Significance if Managed
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	Construction of Facility	Aquatic biota	Loss of ecological communities.	**Magnitude**	Moderate	**Medium**	Ensure a suitable bufferzone around watercourses and minimise sediment mobilisation and runoff towards the Ga-Selati.	**Magnitude**	Moderate	**Medium**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Regional	
				Consequence	Medium			**Consequence**	Medium	
				Probability	Definite			**Probability**	Possible	
Copper Flotation Plant	Construction of Facility	Surface Water: Quality	Degradation of the aquatic ecosystems due to sediment mobilisation, runoff from the site and potential erosion.	**Magnitude**	Moderate	**Medium**	Ensure suitable bufferzone around watercourses, including drainage lines on site. No construction activities or storage of infrastructure within bufferzone or within the riparian zone of the Ga-Selati (36m from the watercourse). Implement dust control measures on all dirt roads.	**Magnitude**	Moderate	**Medium**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Regional	
				Consequence	Medium			**Consequence**	Medium	
				Probability	Definite			**Probability**	Possible	
		Aquatic habitats	Loss / alteration of habitat: mainly in-stream channel habitat - limited riparian habitat. Increase in erosion within riparian zone. Increased sedimentation smothering in-stream habitats and reducing availability of biotopes.	**Magnitude**	Moderate	**Medium**	Minimise sediment mobilisation and runoff towards the Ga-Selati.	**Magnitude**	Moderate	**Medium**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Regional	
				Consequence	Medium			**Consequence**	Medium	
				Probability	Definite			**Probability**	Possible	
		Aquatic biota	Loss of ecological communities.	**Magnitude**	Moderate	**Medium**	Ensure suitable bufferzone around watercourses and minimise sediment mobilisation and runoff towards the Ga-Selati.	**Magnitude**	Moderate	**Medium**
				Duration	Medium term			**Duration**	Medium	
				Scale	Regional			**Scale**	Regional	
				Consequence	Medium			**Consequence**	Medium	
				Probability	Definite			**Probability**	Possible	

Table 10.2.1(g): Construction Phase Impact Significance Rating Table – Wetlands

CONSTRUCTION PHASE IMPACT SIGNIFICANCE RATING TABLE – WETLANDS										
Activity	**Construction Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Magnetite Waste Site Disposal Facility (MWSDF)	Clearance of Vegetation. Topsoil stripping and stockpiling. Construction of MWSDF.	Wetlands, riparian habitats and watercourses	Loss of watercourse habitat due to clearance of vegetation. Disturbance of adjacent watercourse habitat.	**Magnitude**	Moderate	**Medium**	Limit disturbance to direct development footprint.	**Magnitude**	Moderate	**Medium**
				Duration	Long term			**Duration**	Long term	
				Scale	Site			**Scale**	Site	
				Consequence	Medium			**Consequence**	Medium	
				Probability	Definite			**Probability**	Definite	
		Wetlands, riparian habitats and watercourses	Increased sedimentation in adjacent watercourses resulting in habitat degradation.	**Magnitude**	Moderate	**Medium**	Limit extent of vegetation clearance and limit sediment transport off the development site.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Short term	
				Scale	Regional			**Scale**	Local	
				Consequence	Medium			**Consequence**	Low	
				Probability	Definite			**Probability**	Possible	
		Wetlands, riparian habitats and watercourses	Fragmentation of habitat.	**Magnitude**	Minor	**Medium**	Minimise fragmentation of riparian and watercourse habitat.	**Magnitude**	Minor	**Low**
				Duration	Long term			**Duration**	Long term	
				Scale	Site			**Scale**	Site	
				Consequence	Medium			**Consequence**	Medium	
				Probability	Possible			**Probability**	Unlikely	
		Wetlands, riparian habitats and watercourses	Establishment and spread of alien invasive species.	**Magnitude**	Moderate	**Medium**	Prevent spread of alien invasive plant species.	**Magnitude**	Minor	**Low**
				Duration	Long term			**Duration**	Medium term	
				Scale	Site			**Scale**	Site	
				Consequence	Medium			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	
		Wetlands, riparian habitats and watercourses	Contamination of downstream watercourses.	**Magnitude**	Moderate	**Medium**	Prevent degradation of habitat due to water quality contamination.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Short term	
				Scale	Regional			**Scale**	Local	
				Consequence	Medium			**Consequence**	Low	
				Probability	Definite			**Probability**	Possible	

CONSTRUCTION PHASE IMPACT SIGNIFICANCE RATING TABLE – WETLANDS

Activity	Construction Activity Aspect	Environmental Component Affected	Potential Impact Description	Impact Assessment BEFORE Mitigation		Significance if NOT Managed	Management Objective/Outcome	Impact Assessment AFTER Management		Significance if Managed
Access Road to MWSDF	Clearance of Vegetation. Topsoil stripping and stockpiling. Construction of Access Road.	Wetlands, riparian habitats and watercourses	Disturbance of adjacent watercourse habitat.	**Magnitude**	Minor	**Low**	Limit disturbance to direct development footprint.	**Magnitude**	Minor	**Low**
				Duration	Short term			**Duration**	Short term	
				Scale	Site			**Scale**	Site	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	
		Wetlands, riparian habitats and watercourses	Increased sedimentation in adjacent watercourses resulting in habitat degradation.	**Magnitude**	Moderate	**Medium**	Limit extent of vegetation clearance and limit sediment transport off the development site.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Short term	
				Scale	Regional			**Scale**	Local	
				Consequence	Medium			**Consequence**	Low	
				Probability	Definite			**Probability**	Possible	
		Wetlands, riparian habitats and watercourses	Establishment and spread of alien invasive species.	**Magnitude**	Moderate	**Medium**	Prevent spread of alien invasive plant species.	**Magnitude**	Minor	**Low**
				Duration	Long term			**Duration**	Medium term	
				Scale	Site			**Scale**	Site	
				Consequence	Medium			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	
		Wetlands, riparian habitats and watercourses	Contamination of downstream watercourses.	**Magnitude**	Minor	**Low**	Prevent degradation of habitat due to water quality contamination.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Local			**Scale**	Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	
Pollution Control Dam (PCD) and associated infrastructure (including the silt trap)	Clearance of Vegetation. Topsoil stripping and stockpiling. Construction of PCD and associated infrastructures.	Wetlands, riparian habitats and watercourses	Loss of watercourse habitat due to clearance of vegetation. Disturbance of adjacent watercourse habitat.	**Magnitude**	Moderate	**Medium**	Limit disturbance to direct development footprint.	**Magnitude**	Moderate	**Medium**
				Duration	Long term			**Duration**	Long term	
				Scale	Site			**Scale**	Site	
				Consequence	Medium			**Consequence**	Medium	
				Probability	Definite			**Probability**	Definite	
		Wetlands, riparian habitats and watercourses	Increased sedimentation in adjacent watercourses resulting in habitat degradation.	**Magnitude**	Moderate	**Medium**	Limit extent of vegetation clearance and limit sediment transport off the development site.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Short term	
				Scale	Regional			**Scale**	Local	
				Consequence	Medium			**Consequence**	Low	
				Probability	Definite			**Probability**	Possible	

CONSTRUCTION PHASE IMPACT SIGNIFICANCE RATING TABLE – WETLANDS											
Activity	**Construction Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
		Wetlands, riparian habitats and watercourses	Fragmentation of habitat.	**Magnitude**	Minor	**Medium**	Minimise fragmentation of riparian and watercourse habitat	**Magnitude**	Minor	**Low**
				Duration	Long term			**Duration**	Long term	
				Scale	Site			**Scale**	Site	
				Consequence	Medium			**Consequence**	Medium	
				Probability	Possible			**Probability**	Unlikely	
		Wetlands, riparian habitats and watercourses	Establishment and spread of alien invasive species.	**Magnitude**	Moderate	**Medium**	Prevent spread of alien invasive plant species.	**Magnitude**	Minor	**Low**
				Duration	Long term			**Duration**	Medium term	
				Scale	Site			**Scale**	Site	
				Consequence	Medium			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	
		Wetlands, riparian habitats and watercourses	Contamination of downstream watercourses.	**Magnitude**	Moderate	**Medium**	Prevent degradation of habitat due to water quality contamination.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Short term	
				Scale	Regional			**Scale**	Local	
				Consequence	Medium			**Consequence**	Low	
				Probability	Definite			**Probability**	Possible	

Table 10.2.1(h): Construction Phase Impact Significance Rating Table – Air Quality

CONSTRUCTION PHASE IMPACT SIGNIFICANCE RATING TABLE – AIR QUALITY											
Activity	**Construction Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Magnetite Waste Site Disposal Facility (MWSDF); Access Road to MWSDF; Pollution Control Dam (PCD) and associated infrastructure (including the silt trap); Copper Flotation Plant	Land clearing, excavation, earth moving & engineering	Air Quality: Dust Fallout	Increased dust deposition rate at Foskor Mine, at Phalaborwa Town, at PMC Mine, at Schalk Small Holdings, at Namakgale/ Makhushane and at Phalaborwa Industrial Area.	**Magnitude**	Minor	**Low**	Control through implementing appropriate dust suppression methods and administrative measures.	**Magnitude**	Minor	**Low**
				Duration	Short			**Duration**	Short	
				Scale	Site/Local			**Scale**	Site/Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	
		Air Quality: Particulate Matter	Increased particulate concentration at Foskor Mine, at Phalaborwa Town, at PMC Mine, at Schalk Small Holdings, at Namakgale/ Makhushane and at Phalaborwa Industrial Area.	**Magnitude**	Minor	**Low**	Control through implementing appropriate dust suppression methods and administrative measures.	**Magnitude**	Minor	**Low**
				Duration	Short			**Duration**	Short	
				Scale	Site/Local			**Scale**	Site/Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	
		Air Quality: Gaseous Emissions	Increased gaseous concentration at Foskor Mine, at Phalaborwa Town, at PMC Mine, at Schalk Small Holdings, at Namakgale/ Makhushane and at Phalaborwa Industrial Area.	**Magnitude**	Minor	**Low**	Control through ensuring mobile and stationary internal combustion equipment is properly serviced and operated.	**Magnitude**	Minor	**Low**
				Duration	Short			**Duration**	Short	
				Scale	Site/Local			**Scale**	Site/Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	

10.2.2. Operational Phase Impact and Risk Assessment

Table 10.2.2(a): Operational Phase Impact Significance Rating Table – Socio-Economic/Cultural

OPERATIONAL PHASE IMPACT SIGNIFICANCE RATING TABLE – SOCIO-ECONOMIC/CULTURAL										
Activity	**Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Management**		**Significance if NOT Managed**	**Management Objective/ Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Proposed Activities	Operation of proposed activities	Socio-Economic	Potential increase in employment and income opportunities.	**Magnitude**	Low	**LOW + (positive)**	Optimise recruitment of labour and inputs from local area.	**Magnitude**	Low	**MEDIUM + (positive)**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Local			**Scale**	Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Definite	
Proposed Activities	Operation of proposed activities	Socio-Economic	Support of local economic development objectives.	**Magnitude**	Moderate	**MEDIUM + (positive)**	Support local economic development objectives.	**Magnitude**	Moderate	**MEDIUM + (positive)**
				Duration	Short term			**Duration**	Short term	
				Scale	Local			**Scale**	Short term	
				Consequence	Low			**Consequence**	Low	
				Probability	Definite			**Probability**	Definite	
Proposed Activities	Operation of proposed activities	Socio-Economic	Potential increase in nuisance factors (dust and noise).	**Magnitude**	Moderate	**Medium**	Minimise nuisance factors (dust and noise) for local communities.	**Magnitude**	Moderate	**Medium**
				Duration	Short term			**Duration**	Short term	
				Scale	Local			**Scale**	Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	
Proposed Activities	Operation of proposed activities	Socio-Economic	Increased economic concentration.	**Magnitude**	Low	**Medium**	Contribute to diversification of the local economy.	**Magnitude**	Low	**Low**
				Duration	Short term			**Duration**	Short term	
				Scale	Local			**Scale**	Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Definite			**Probability**	Possible	
Proposed Activities	Operation of proposed activities	Socio-Economic	Increased local water use.	**Magnitude**	Low	**Medium**	Minimise water consumption.	**Magnitude**	Low	**Low**
				Duration	Short term			**Duration**	Short term	
				Scale	Local			**Scale**	Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Definite			**Probability**	Possible	

Table 10.2.2(b): Operational Phase Impact Significance Rating Table – Soils, Land Use and Land Capability

OPERATIONAL PHASE IMPACT SIGNIFICANCE RATING TABLE – SOILS, LAND USE AND LAND CAPABILITY											
Activity	**Operational Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Magnetite Waste Site Disposal Facility (MWSDF)	Disposal of Magnetite Waste on top of facility	Continued loss of in-situ soil utilisation potential/ sterilisation of resource, possible contamination of in-situ and stored soils. Change of Land Capability and Land Use.	On-going sterilisation of in-situ and stripped/stored (berms) soil, loss of ecosystem services and potential for salinisation and/or contamination of in-situ and stored soils due to product ingress and/or storm water runoff.	**Magnitude**	Major	**High**	Manage and control footprint area, storm water controls (berms, channels) and potential for contamination from dirty water runoff and spillage of material.	**Magnitude**	Major	**High**
				Duration	Long term			**Duration**	Long term	
				Scale	Regional			**Scale**	Site	
				Consequence	High			**Consequence**	High	
				Probability	Definite			**Probability**	Definite	
	Reticulation of Return Water from MWSDF	Sterilisation, loss of in-situ soil utilisation potential along reticulation line, de-nutrification and loss of fertility on stored materials. Possible contamination on stored and in-situ soils along linear infrastructure.	On-going sterilisation of in-situ and stripped/stored (berms) soil over footprint servitude of pipeline and associated infrastructure. Possible erosion (wind and water) and compaction of unprotected (de-vegetated) sites.	**Magnitude**	Moderate	**Medium**	Manage and control of footprint area, storm water controls (berms, channels), erosion (water) and compaction along water servitudes (pipeline and service road).	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Site			**Scale**	Site	
				Consequence	Medium			**Consequence**	Low	
				Probability	Definite			**Probability**	Possible	
Access Road to MWSDF	Transport of Material	Sterilisation and loss of soils utilisation potential on disturbed footprint, de-nutrification (loss of fertility), change of Land Capability and possible contamination.	Continued loss of soil (ecosystem services) land capability due to uncontrolled erosion, compaction and the potential for salinisation and/or contamination by vehicle movement.	**Magnitude**	Moderate	**Medium**	Manage and control/prevent further loss and contamination of resource. Minimise and maintain footprint of impact and monitor and audit soil stockpiles and berms as part of management plan.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Site			**Scale**	Site	
				Consequence	Medium			**Consequence**	Low	
				Probability	Definite			**Probability**	Possible	
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	Reticulation of contaminated Storm Water Runoff	Sterilisation and loss of in-situ soil utilisation potential, de-nutrification and possible contamination of stored and in-situ soils. Permanent change of Land Use.	On-going sterilisation of in-situ and stored (berms) soil associated with PCD footprint and surrounds. Ingress and erosion (water leakage) of unprotected (de-vegetated) soils.	**Magnitude**	Moderate	**High**	Manage and control footprint area, storm water controls (berms, channels) and potential for contamination from spillage and dirty water runoff and overflow.	**Magnitude**	Minor	**Low**
				Duration	Long term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Site	
				Consequence	High			**Consequence**	Low	
				Probability	Definite			**Probability**	Possible	

OPERATIONAL PHASE IMPACT SIGNIFICANCE RATING TABLE – SOILS, LAND USE AND LAND CAPABILITY											
Activity	**Operational Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	Storage of contaminated Storm Water Runoff	Sterilisation and loss of in-situ soil utilisation potential, de-nutrification and contamination of in-situ soils. Permanent change in Land Use.	On-going sterilisation of in-situ and stored materials associated with PCD footprint and surrounds. Ingress and erosion (water leakage) of unprotected soils.	**Magnitude**	Moderate	**High**	Manage and control of footprint area, storm water controls (berms, channels), erosion (water) and compaction associated with PCD.	**Magnitude**	Moderate	**Medium**
				Duration	Long term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Site	
				Consequence	High			**Consequence**	Medium	
				Probability	Definite			**Probability**	Possible	
Copper Flotation Plant	Extraction of Copper	Sterilisation and loss of in-situ soil utilisation potential, de-nutrification/loss of stored soil fertility and contamination. Change of Land Capability and Land Use.	Continued loss of soil resource and utilisation potential, contamination of footprint soils by operational activities.	**Magnitude**	Major	**Medium**	Manage and control footprint area, storm water controls (berms, dams and channels) and potential for contamination (hydrocarbon/ reagents).	**Magnitude**	Moderate	**Medium**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Site	
				Consequence	Medium			**Consequence**	Medium	
				Probability	Definite			**Probability**	Definite	

Table 10.2.2(c): Operational Phase Impact Significance Rating Table – Groundwater

OPERATIONAL PHASE IMPACT SIGNIFICANCE RATING TABLE – GROUNDWATER										
Activity	**Operational Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Magnetite Waste Site Disposal Facility (MWSDF)	Disposal of magnetite waste on top of facility	Groundwater: Quality	Deterioration of the groundwater resource quality due to the infiltration of soluble contaminants into the subsurface through the footprints of the facility.	**Magnitude**	Minor	**Medium**	Control by monitoring groundwater quality adjacent to facility.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Local			**Scale**	Local	
				Consequence	Medium			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	
	Reticulation of contaminated Storm Water Runoff	Groundwater: Quality	Deterioration of the groundwater resource quality due to the infiltration of contaminated storm water runoff.	**Magnitude**	Minor	**Medium**	Avoid by diverting and capturing contaminated storm water runoff in the PCD.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Local			**Scale**	Local	
				Consequence	Medium			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	
Access Road to MWSDF	Transport of Material	Groundwater: Quality	Deterioration of the groundwater resource quality due to seepage or leaching of material spillages during transport.	**Magnitude**	Minor	**Low**	Control potential infiltration into the sub-surface through a spillages control and clean-up procedure.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Local			**Scale**	Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	
Internal Roads	Dust Suppression	Groundwater: Quality	Deterioration of the groundwater resource quality due to the infiltration of contaminated water used for dust suppression on internal road surface.	**Magnitude**	Minor	**Low**	Avoid by not using contaminated water for dust suppression.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Local			**Scale**	Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	
Pollution Control Dam (PCD) and associated infrastructure	Reticulation of contaminated Storm Water Runoff	Groundwater: Quality	Deterioration of the groundwater resource quality due to the infiltration of spilled contaminated water or seepage from cracks or breaks of canals.	**Magnitude**	Minor	**Medium**	Avoid by capturing contaminated storm water runoff to be diverted to the PCD.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Local			**Scale**	Local	
				Consequence	Medium			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	

OPERATIONAL PHASE IMPACT SIGNIFICANCE RATING TABLE – GROUNDWATER										
Activity	**Operational Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
	Reticulation of PCD water from PCD to Plant	Groundwater: Quality	Deterioration of the groundwater resource quality due to the infiltration of spilled contaminated water from cracks or breaks in the pipeline.	**Magnitude**	Moderate	**Medium**	Avoid by preventing spills from pipeline.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Local			**Scale**	Local	
				Consequence	Medium			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	
	Storage of contaminated Storm Water Runoff	Groundwater: Quality	Deterioration of the groundwater resource quality due to spillages and infiltration of contaminated water from and/or the infiltration of soluble contaminants into the subsurface through the footprint of the dam.	**Magnitude**	Moderate	**Medium**	Avoid by lining the PCD to prevent any seepage of contaminated water.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Local			**Scale**	Local	
				Consequence	Medium			**Consequence**	Medium	
				Probability	Possible			**Probability**	Unlikely	
Copper Flotation Plant	Extraction of Copper	Groundwater: Quality	Contamination of groundwater due to seepage of spillages of chemicals used in the plant.	**Magnitude**	Moderate	**Medium**	Avoid by preventing spills in the plant.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Local			**Scale**	Local	
				Consequence	Medium			**Consequence**	Medium	
				Probability	Possible			**Probability**	Unlikely	

Table 10.2.2(d): Operational Phase Impact Significance Rating Table – Surface Water

OPERATIONAL PHASE IMPACT SIGNIFICANCE RATING TABLE – SURFACE WATER										
Activity	**Operational Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/ Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Magnetite Waste Site Disposal Facility (MWSDF)	Disposal of magnetite waste on top of facility	Surface Water: Quality	Deterioration in surface water resource quality due to spillages and subsequent runoff containing soluble contaminants from the MWSDF across the surface into the receiving surface drainage features.	**Magnitude**	Moderate	**Medium**	Prevent spillages from the MWSDF by implementing approved design and sound operational plan.	**Consequence**	Moderate	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Regional	
				Consequence	Medium			**Consequence**	Medium	
				Probability	Definite			**Probability**	Unlikely	
	Collection of Contaminated runoff water from MWSDF	Surface Water: Quantity	Reduction in the quantity of the surface water resource due to the capturing of rainfall on the MWSDF.	**Magnitude**	Moderate	**Medium**	Avoid by minimising the footprint of facility.	**Magnitude**	Moderate	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Regional	
				Consequence	Medium			**Consequence**	Medium	
				Probability	Definite			**Probability**	Unlikely	
Access Road to MWSDF	Transport of Material	Surface Water: Quality	Deterioration in surface water resource quality due to spillages and subsequent runoff containing soluble contaminants from the access road across the surface into the receiving surface drainage features.	**Magnitude**	Minor	**Low**	Prevent spillages onto soil through a spillages control and clean-up procedure.	**Magnitude**	Minor	**Low**
				Duration	Short term			**Duration**	Short term	
				Scale	Site			**Scale**	Site	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	Reticulation of contaminated Storm Water Runoff	Surface Water: Quality	Deterioration in surface water resource quality due to spillages from the PCD and subsequent runoff of PCD return water containing soluble contaminants across the surface into the receiving surface drainage features.	**Magnitude**	Moderate	**Medium**	Prevent spillages from the PCD by implementing approved design and sound operational plan.	**Magnitude**	Minor	**Low**
				Duration	Short term			**Duration**	Short term	
				Scale	Regional			**Scale**	Site	
				Consequence	Medium			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	
	Storage of contaminated Storm Water Runoff	Surface Water: Quality	Contamination of the surface water resource due to spillages of contaminated water from dam.	**Magnitude**	Minor	**Low**	Prevent by maintaining PCD water level at an elevation below peak storage volume.	**Magnitude**	Minor	**Low**
				Duration	Short term			**Duration**	Short term	
				Scale	Site			**Scale**	Site	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	possible	

OPERATIONAL PHASE IMPACT SIGNIFICANCE RATING TABLE – SURFACE WATER											
Activity	**Operational Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/ Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Copper Flotation Plant	Extraction of Copper	Surface Water: Quality	Contamination of the surface water resource due to spillages of contaminated water from dirty water systems.	**Magnitude**	Minor	**Low**	Prevent by maintaining clearance of vegetation and obstructions from conveyance systems.	**Magnitude**	Minor	**Low**
				Duration	Short term			**Duration**	Short term	
				Scale	Site			**Scale**	Site	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	

Table 10.2.2(e): Operational Phase Impact Significance Rating Table – Terrestrial Ecology

OPERATIONAL PHASE IMPACT SIGNIFICANCE RATING TABLE – TERRESTRIAL ECOLOGY										
Activity	**Operational Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Magnetite Waste Site Disposal Facility (MWSDF)	Disposal of magnetite waste on top of facility & Reticulation of Return Water from MWSDF	Flora & Fauna: Habitat and Diversity	Contamination of downstream riparian habitats resulting from spills or seepage of waste and/ or contaminated water from MWSDF and/ or water infrastructure.	**Magnitude**	Major	**High**	Control impact through continuing facility maintenance. Minimise and remedy impacts through effective response planning and implementation.	**Magnitude**	Moderate	**Low**
				Duration	Long term			**Duration**	Medium term	
				Scale	Local			**Scale**	Local	
				Consequence	High			**Consequence**	Medium	
				Probability	Possible			**Probability**	Unlikely	
	General disturbances	Flora: Habitat and Diversity	Establishment and spread of alien invasive species resulting from general disturbances associated with MWSDF.	**Magnitude**	Moderate	**Medium**	Control potential impacts by implementing an invasive species programme.	**Magnitude**	Minor	**Low**
				Duration	Long term			**Duration**	Short term	
				Scale	Local			**Scale**	Site	
				Consequence	Medium			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	
Access Road to MWSDF	Transport of Material	Fauna: Diversity	Direct mortality and disturbance of fauna as a consequence of vehicle collisions.	**Magnitude**	Minor	**Medium**	Control potential impacts by actively managing fauna-human interactions, and implementing minimisation measures and awareness training for all on-site workers.	**Magnitude**	Minor	**Low**
				Duration	Long term			**Duration**	Short term	
				Scale	Local			**Scale**	Site	
				Consequence	Medium			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	
Pollution Control Dam (PCD) and associated infrastructure (including the silt trap)	Reticulation of contaminated Storm Water Runoff & Storage of contaminated Storm Water Runoff	Flora & Fauna: Habitat and Diversity	Contamination of downstream riparian habitats resulting from spills or seepage of waste and/or contaminated water from PCD and/ or water infrastructure.	**Magnitude**	Major	**High**	Control impact through continuing facility maintenance. Minimise and remedy impacts through effective response planning and implementation.	**Magnitude**	Moderate	**Low**
				Duration	Long term			**Duration**	Medium term	
				Scale	Local			**Scale**	Local	
				Consequence	High			**Consequence**	Medium	
				Probability	Possible			**Probability**	Unlikely	
	Storage of contaminated Storm Water Runoff	Flora: Habitat and Diversity	Establishment and spread of alien invasive species resulting from general disturbances associated with PCD and associated infrastructure.	**Magnitude**	Moderate	**Medium**	Control potential impacts by implementing an invasive species programme.	**Magnitude**	Minor	**Low**
				Duration	Long term			**Duration**	Short term	
				Scale	Local			**Scale**	Site	
				Consequence	Medium			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	

Table 10.2.2(f): Operational Phase Impact Significance Rating Table – Aquatic Ecosystems

OPERATIONAL PHASE IMPACT SIGNIFICANCE RATING TABLE – AQUATIC ECOSYSTEMS										
Activity	**Operational Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Magnetite Waste Site Disposal Facility (MWSDF)	Disposal of magnetite waste on top of facility	Surface Water: Quality	Changes/ deterioration of water quality (within the Ga-Selati River).	**Magnitude**	Major	**Medium**	Remedy by monitoring restored surface runoff patterns and erosion gulleys. Maintain suitable bufferzones around watercourses.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Regional	
				Consequence	Medium			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	
		Aquatic biota	Loss of ecological communities.	**Magnitude**	Major	**High**	Maintain suitable bufferzones around watercourses.	**Magnitude**	Major	**Medium**
				Duration	Long term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Regional	
				Consequence	High			**Consequence**	Medium	
				Probability	Possible			**Probability**	Possible	
	Reticulation of Return Water from MWSDF	Surface Water: Quality	Potential spillage/leakage of contaminated water from reticulation/pipes and subsequently contamination directly into the adjacent surface water resources.	**Magnitude**	Major	**Medium**	Remedy by monitoring restored surface runoff patterns and erosion gulleys. Maintain suitable bufferzones around watercourses.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Regional	
				Consequence	Medium			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	
		Aquatic biota	Loss of ecological communities.	**Magnitude**	Major	**High**	Maintain suitable bufferzones around watercourses.	**Magnitude**	Major	**Medium**
				Duration	Long term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Regional	
				Consequence	High			**Consequence**	Medium	
				Probability	Possible			**Probability**	Possible	
Access Road to MWSDF	Transport of Material	Surface Water: Quality	Degradation of the aquatic ecosystems due to sediment mobilisation, runoff from site and potential erosion.	**Magnitude**	Moderate	**Medium**	Maintain suitable bufferzones around watercourses. Control by cleaning spillage from haulage ways and vehicles regularly. Control and prevent potential impacts by implementing dust control measures on all dirt roads.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Regional	
				Consequence	Medium			**Consequence**	Low	
				Probability	Definite			**Probability**	Possible	

OPERATIONAL PHASE IMPACT SIGNIFICANCE RATING TABLE – AQUATIC ECOSYSTEMS										
Activity	**Operational Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Pollution Control Dam (PCD) and associated infrastructure (including the silt trap)	Reticulation of contaminated Storm Water Runoff	Surface Water: Quality	Changes/ deterioration of water quality (within the Ga-Selati River).	**Magnitude**	Major	**High**	Remedy by monitoring restored surface runoff patterns and erosion gulleys. Control by maintaining suitable bufferzones around watercourses.	**Magnitude**	Major	**Medium**
				Duration	Long term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Regional	
				Consequence	High			**Consequence**	Medium	
				Probability	Possible			**Probability**	Possible	
		Aquatic biota	Loss of ecological communities.	**Magnitude**	Major	**High**	Maintain suitable bufferzones around watercourses.	**Magnitude**	Major	**Medium**
				Duration	Long term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Regional	
				Consequence	High			**Consequence**	Medium	
				Probability	Possible			**Probability**	Possible	
	Storage of contaminated Storm Water Runoff	Surface Water: Quality	Potential spillage/leakage from storage and subsequently contamination directly into the adjacent surface water resources.	**Magnitude**	Major	**High**	Remedy by monitoring restored surface runoff patterns and erosion gulleys. Control by maintaining suitable bufferzones around watercourses. Prevent by maintaining PCD water levels as to avoid overflow during high rainfall events.	**Magnitude**	Major	**Medium**
				Duration	Long term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Regional	
				Consequence	High			**Consequence**	Medium	
				Probability	Possible			**Probability**	Possible	
		Aquatic biota	Loss of ecological communities.	**Magnitude**	Major	**High**	Maintain suitable bufferzones around watercourses.	**Magnitude**	Major	**Medium**
				Duration	Long term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Regional	
				Consequence	High			**Consequence**	Medium	
				Probability	Possible			**Probability**	Possible	

Table 10.2.2(g): Operational Phase Impact Significance Rating Table – Wetlands

OPERATIONAL PHASE IMPACT SIGNIFICANCE RATING TABLE – WETLANDS											
Activity	**Operational Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Magnetite Waste Site Disposal Facility (MWSDF)	Disposal of magnetite waste on top of facility	Wetlands, riparian habitats and watercourses	Water quality deterioration in adjacent watercourses.	**Magnitude**	Major	**High**	Limit water quality impact by isolating contaminants from water resources and controlling contaminants at source.	**Magnitude**	Moderate	**Medium**
				Duration	Long term			**Duration**	Long term	
				Scale	Regional			**Scale**	Local	
				Consequence	High			**Consequence**	Medium	
				Probability	Possible			**Probability**	Possible	
	Reticulation of Return Water from MWSDF	Wetlands, riparian habitats and watercourses	Water quality deterioration in adjacent watercourses.	**Magnitude**	Major	**High**	Limit water quality impact by isolating contaminants from water resources and controlling contaminants at source.	**Magnitude**	Moderate	**Medium**
				Duration	Long term			**Duration**	Long term	
				Scale	Regional			**Scale**	Local	
				Consequence	High			**Consequence**	Medium	
				Probability	Possible			**Probability**	Possible	
Access Road to MWSDF	Transport of Material	Wetlands, riparian habitats and watercourses	Water quality deterioration in adjacent watercourses.	**Magnitude**	Moderate	**Medium**	Limit water quality impact by isolating contaminants from water resources and controlling contaminants at source.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Local			**Scale**	Local	
				Consequence	Medium			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	Reticulation of contaminated Storm Water Runoff	Wetlands, riparian habitats and watercourses	Water quality deterioration in adjacent watercourses.	**Magnitude**	Major	**High**	Limit water quality impact by isolating contaminants from water resources and controlling contaminants at source.	**Magnitude**	Moderate	**Medium**
				Duration	Long term			**Duration**	Long term	
				Scale	Regional			**Scale**	Local	
				Consequence	High			**Consequence**	Medium	
				Probability	Possible			**Probability**	Possible	
	Storage of contaminated Storm Water Runoff	Wetlands, riparian habitats and watercourses	Water quality deterioration in adjacent watercourses.	**Magnitude**	Major	**High**	Limit water quality impact by isolating contaminants from water resources and controlling contaminants at source.	**Magnitude**	Moderate	**Medium**
				Duration	Long term			**Duration**	Long term	
				Scale	Regional			**Scale**	Local	
				Consequence	High			**Consequence**	Medium	
				Probability	Possible			**Probability**	Possible	

OPERATIONAL PHASE IMPACT SIGNIFICANCE RATING TABLE – WETLANDS											
Activity	**Operational Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Copper Flotation Plant	Extraction of Copper	Wetlands, riparian habitats and watercourses	Water quality deterioration in adjacent watercourses.	**Magnitude**	Major	**High**	Limit water quality impact by isolating contaminants from water resources and controlling contaminants at source.	**Magnitude**	Moderate	**Medium**
				Duration	Long term			**Duration**	Long term	
				Scale	Regional			**Scale**	Local	
				Consequence	High			**Consequence**	Medium	
				Probability	Possible			**Probability**	Possible	

Table 10.2.2(h): Operational Phase Impact Significance Rating Table – Air Quality

OPERATIONAL PHASE IMPACT SIGNIFICANCE RATING TABLE – AIR QUALITY											
Activity	Operational Activity Aspect	Environmental Component Affected	Potential Impact Description	Impact Assessment BEFORE Mitigation		Significance if NOT Managed	Management Objective/Outcome	Impact Assessment AFTER Management		Significance if Managed
Magnetite Waste Site Disposal Facility (MWSDF); Access Road to MWSDF; Pollution Control Dam (PCD) and associated infrastructure (including the silt trap); Copper Flotation Plant	Extraction of copper; transport and disposal of magnetite waste	Air Quality: Dust Fallout	Increased dust deposition rate at Foskor Mine	**Magnitude**	Moderate	**Medium**	Control through implementing appropriate dust suppression methods and administrative measures.	**Magnitude**	Possible	**Medium**
				Duration	Medium			**Duration**	Medium	
				Scale	Site/Local			**Scale**	Site/Local	
				Consequence	Medium			**Consequence**	Medium	
				Probability	Possible			**Probability**	Medium	
			Increased dust deposition rate at Phalaborwa Town	**Magnitude**	Minor	**Low**		**Magnitude**	Minor	**Low**
				Duration	Medium			**Duration**	Medium	
				Scale	Site/Local			**Scale**	Site/Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Low	
			Increased dust deposition rate at PMC Mine	**Magnitude**	Minor	**Low**		**Magnitude**	Minor	**Low**
				Duration	Medium			**Duration**	Medium	
				Scale	Site/Local			**Scale**	Site/Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Low	
			Increased dust deposition rate at Schalk Small Holdings	**Magnitude**	Minor	**Low**		**Magnitude**	Minor	**Low**
				Duration	Medium			**Duration**	Medium	
				Scale	Site/Local			**Scale**	Site/Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Low	
			Increased dust deposition rate at Namakgale/Makhushane	**Magnitude**	Minor	**Low**		**Magnitude**	Minor	**Low**
				Duration	Medium			**Duration**	Medium	
				Scale	Site/Local			**Scale**	Site/Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Low	

OPERATIONAL PHASE IMPACT SIGNIFICANCE RATING TABLE – AIR QUALITY										
Activity	**Operational Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Magnetite Waste Site Disposal Facility (MWSDF); Access Road to MWSDF; Pollution Control Dam (PCD) and associated infrastructure (including the silt trap); Copper Flotation Plant	Extraction of copper; transport and disposal of magnetite waste	Air Quality: Dust Fallout	Increased dust deposition rate at Phalaborwa Industrial Area	**Magnitude**	Moderate	**Medium**	Control through implementing appropriate dust suppression methods and administrative measures.	**Magnitude**	Moderate	**Medium**
				Duration	Medium			**Duration**	Medium	
				Scale	Site/Local			**Scale**	Site/Local	
				Consequence	Medium			**Consequence**	Medium	
				Probability	Possible			**Probability**	Medium	
Magnetite Waste Site Disposal Facility (MWSDF); Access Road to MWSDF; Pollution Control Dam (PCD) and associated infrastructure (including the silt trap); Copper Flotation Plant	Extraction of copper; transport and disposal of magnetite waste	Air Quality: Particulate Matter	Increased particulate concentration at Foskor Mine	**Magnitude**	Major	**Medium**	Control through implementing appropriate dust suppression methods and administrative measures.	**Magnitude**	Moderate	**Medium**
				Duration	Medium			**Duration**	Medium	
				Scale	Regional			**Scale**	Regional	
				Consequence	Medium			**Consequence**	Medium	
				Probability	Definite			**Probability**	Definite	
			Increased particulate concentration at Phalaborwa Town	**Magnitude**	Minor	**Low**		**Magnitude**	Minor	**Low**
				Duration	Medium			**Duration**	Medium	
				Scale	Regional			**Scale**	Regional	
				Consequence	Low			**Consequence**	Low	
				Probability	Definite			**Probability**	Definite	
			Increased particulate concentration at PMC Mine	**Magnitude**	Minor	**Low**		**Magnitude**	Minor	**Low**
				Duration	Medium			**Duration**	Medium	
				Scale	Regional			**Scale**	Regional	
				Consequence	Low			**Consequence**	Low	
				Probability	Definite			**Probability**	Definite	
			Increased particulate concentration at Schalk Small Holdings	**Magnitude**	Major	**Medium**		**Magnitude**	Moderate	**Medium**
				Duration	Medium			**Duration**	Medium	
				Scale	Regional			**Scale**	Regional	
				Consequence	Medium			**Consequence**	Medium	
				Probability	Definite			**Probability**	Definite	

OPERATIONAL PHASE IMPACT SIGNIFICANCE RATING TABLE – AIR QUALITY										
Activity	**Operational Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Magnetite Waste Site Disposal Facility (MWSDF); Access Road to MWSDF; Pollution Control Dam (PCD) and associated infrastructure (including the silt trap); Copper Flotation Plant	Extraction of copper; transport and disposal of magnetite waste	Air Quality: Particulate Matter	Increased particulate concentration at Namakgale/Makhushane	**Magnitude**	Major	**Medium**	Control through implementing appropriate dust suppression methods and administrative measures.	**Magnitude**	Moderate	**Medium**
				Duration	Medium			**Duration**	Medium	
				Scale	Regional			**Scale**	Regional	
				Consequence	Medium			**Consequence**	Medium	
				Probability	Definite			**Probability**	Definite	
			Increased particulate concentration at Phalaborwa Industrial Area	**Magnitude**	Major	**Medium**		**Magnitude**	Moderate	**Medium**
				Duration	Medium			**Duration**	Medium	
				Scale	Regional			**Scale**	Regional	
				Consequence	Medium			**Consequence**	Medium	
				Probability	Definite			**Probability**	Definite	
Magnetite Waste Site Disposal Facility (MWSDF); Access Road to MWSDF; Pollution Control Dam (PCD) and associated infrastructure (including the silt trap); Copper Flotation Plant	Extraction of copper; transport and disposal of magnetite waste	Air Quality: Gaseous Emissions	Increased gaseous concentration at Foskor Mine	**Magnitude**	Minor	**Low**	Control through ensuring mobile and stationary internal combustion equipment is properly serviced and operated.	**Magnitude**	Minor	**Low**
				Duration	Short			**Duration**	Short	
				Scale	Site/Local			**Scale**	Site/Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	
			Increased gaseous concentration at Phalaborwa Town	**Magnitude**	Minor	**Low**		**Magnitude**	Minor	**Low**
				Duration	Short			**Duration**	Short	
				Scale	Site/Local			**Scale**	Site/Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	
			Increased gaseous concentration at PMC Mine	**Magnitude**	Minor	**Low**		**Magnitude**	Minor	**Low**
				Duration	Short			**Duration**	Short	
				Scale	Site/Local			**Scale**	Site/Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	

OPERATIONAL PHASE IMPACT SIGNIFICANCE RATING TABLE – AIR QUALITY											
Activity	**Operational Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Magnetite Waste Site Disposal Facility (MWSDF); Access Road to MWSDF; Pollution Control Dam (PCD) and associated infrastructure (including the silt trap); Copper Flotation Plant	Extraction of copper; transport and disposal of magnetite waste	Air Quality: Gaseous Emissions	Increased gaseous concentration at Schalk Small Holdings	**Magnitude**	Minor	**Low**	Control through ensuring mobile and stationary internal combustion equipment is properly serviced and operated.	**Magnitude**	Minor	**Low**
				Duration	Short			**Duration**	Short	
				Scale	Site/Local			**Scale**	Site/Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	
			Increased gaseous concentration at Namakgale/Makhushane	**Magnitude**	Minor	**Low**		**Magnitude**	Minor	**Low**
				Duration	Short			**Duration**	Short	
				Scale	Site/Local			**Scale**	Site/Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	
			Increased gaseous concentration at Phalaborwa Industrial Area	**Magnitude**	Minor	**Low**		**Magnitude**	Minor	**Low**
				Duration	Short			**Duration**	Short	
				Scale	Site/Local			**Scale**	Site/Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	

10.2.3. Decommissioning Phase Impact and Risk Assessment

Table 10.2.3(a): Decommissioning Phase Impact Significance Rating Table – Socio-Economic/Cultural

DECOMMISSIONING PHASE IMPACT SIGNIFICANCE RATING TABLE – SOCIO-ECONOMIC/CULTURAL											
Activity	**Activity Aspect**	**Environ-mental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Management**		**Significance if NOT Managed**	**Management Objective/ Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Proposed Activities	Decommissioning and Closure of proposed activities	Socio-Economic	Job and income losses.	**Magnitude**	Low	**Medium**	Minimise local job losses.	**Magnitude**	Low	**Low**
				Duration	Long term			**Duration**	Long term	
				Scale	Local			**Scale**	Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Definite			**Probability**	Possible	
Proposed Activities	Decommissioning and Closure of proposed activities	Socio-Economic	Potential increase in nuisance factors (dust and noise).	**Magnitude**	Low	**Low**	Minimise nuisance factors (dust and noise) for local communities.	**Magnitude**	Low	**Low**
				Duration	Short term			**Duration**	Short term	
				Scale	Local			**Scale**	Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	
Proposed Activities	Decommissioning and Closure of proposed activities	Socio-Economic	Permanent loss of land use.	**Magnitude**	Low	**Medium**	Minimise loss of local land use.	**Magnitude**	Low	**Medium**
				Duration	Long term			**Duration**	Long term	
				Scale	Local			**Scale**	Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Definite			**Probability**	Definite	

Table 10.2.3(b): Decommissioning Phase Impact Significance Rating Table – Soils, Land Use and Land Capability

DECOMMISSIONING PHASE IMPACT SIGNIFICANCE RATING TABLE – SOILS, LAND USE AND LAND CAPABILITY											
Activity	**Decommissioning Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Magnetite Waste Site Disposal Facility (MWSDF)	Decommissioning of Facility (Flatten and Shape Side Slopes, Install Suitable Capping Liner, Resoil, Re-Vegetate)	Land Capability and Land Use	Loss of soil nutrients while in storage, contamination by dirty water used for rehabilitated/ re-vegetation, possible hydrocarbon spills from vehicles, compaction and dust.	**Magnitude**	Major	**High**	Cap and close facility as per approved closure and rehabilitation plan.	**Magnitude**	Major	**High**
				Duration	Long term			**Duration**	Long term	
				Scale	Regional			**Scale**	Site	
				Consequence	High			**Consequence**	High	
				Probability	Definite			**Probability**	Definite	
Access Road to MWSDF	Decommissioning of Road (Flatten and Shape, Resoil, Re-Vegetate)	Land Capability and Land Use	Loss of soil nutrients while in storage, contamination by dirty water used for watering of rehabilitated/ re-vegetated areas, possible hydrocarbon spills from vehicles, compaction and dust.	**Magnitude**	Moderate	**Medium**	Replacement of soils, morphology, soil fertility and rectification of residual contamination. Monitor and manage erosion.	**Magnitude**	Minor	**Low**
				Duration	Long term			**Duration**	Medium term	
				Scale	Site			**Scale**	Site	
				Consequence	Medium			**Consequence**	Low	
				Probability	Definite			**Probability**	Possible	
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	Decommissioning of Dam (Dewatering of the dam, Removal of contaminated sediment on basin, Removal of liner, contaminated sediment and underlaying layers, Flatten and Shape Dam Walls, Resoil, Re-Vegetate)	Land Capability and Land Use	Loss of soil nutrients while soils in storage, contamination by dirty water used for watering of rehabilitated/re-vegetated areas, possible hydrocarbon spills from vehicles and decommissioned infrastructure, compaction and dust.	**Magnitude**	Major	**High**	Decommission and close facility per approved closure and rehabilitation plan.	**Magnitude**	Moderate	**Medium**
				Duration	Long term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Site	
				Consequence	High			**Consequence**	Medium	
				Probability	Definite			**Probability**	Definite	
Copper Flotation Plant	Decommissioning of Plant (Demolish and remove infrastructure, Flatten and Shape, Resoil, Re-Vegetate)	Land Capability and Land Use	Loss of soil nutrients while in storage, contamination by dirty water used for watering of rehabilitated/re-vegetated areas, possible hydrocarbon spills from vehicles and decommissioned infrastructure, compaction and dust.	**Magnitude**	Major	**High**	Decommission and close facility per approved closure and rehabilitation plan.	**Magnitude**	Moderate	**Medium**
				Duration	Long term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Site	
				Consequence	High			**Consequence**	Medium	
				Probability	Definite			**Probability**	Definite	

Table 10.2.3(c): Decommissioning Phase Impact Significance Rating Table – Groundwater

DECOMMISSIONING PHASE IMPACT SIGNIFICANCE RATING TABLE – GROUNDWATER										
Activity	**Decommissioning Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/ Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Magnetite Waste Site Disposal Facility (MWSDF)	Decommissioning of Facility (Flatten and Shape Side Slopes, Install Suitable Capping Liner, Resoil, Re-Vegetate)	Groundwater: Quality	Deterioration of the groundwater resource quality due to the leaching of residual materials during decommissioning.	**Magnitude**	Minor	**Low**	Control by monitoring groundwater quality adjacent to facility.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Local			**Scale**	Local	
				Consequence	Medium			**Consequence**	Medium	
				Probability	Possible			**Probability**	Possible	
Access Road to MWSDF	Decommissioning of Road (Flatten and Shape, Resoil, Re-Vegetate)	Groundwater: Quality	Deterioration of the groundwater resource quality due to spillages and infiltration of fuel (hydrocarbons) from the fuel tanks of construction vehicles.	**Magnitude**	Minor	**Low**	Stop and control by inspecting construction vehicles regularly and also cleaning spillage from vehicles regularly.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Local			**Scale**	Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	
Internal Roads	Dust Suppression	Groundwater: Quality	Deterioration of the groundwater resource quality due to the infiltration of contaminated water used for dust suppression on internal road surface.	**Magnitude**	Minor	**Low**	Avoid by not using contaminated water for dust suppression.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Local			**Scale**	Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	
Pollution Control Dam (PCD) and associated infrastructure	Decommissioning of Dam (Dewatering of the dam, Removal of contaminated sediment on basin, Removal of liner, contaminated sediment and underlaying layers, Flatten and Shape Dam Walls, Resoil, Re-Vegetate)	Groundwater: Quality	Deterioration of the groundwater resource quality due to the leaching of residual materials during decommissioning.	**Magnitude**	Minor	**Low**	Control by monitoring groundwater quality adjacent to facility.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Local			**Scale**	Local	
				Consequence	Low			**Consequence**	Medium	
				Probability	Possible			**Probability**	Possible	
Copper Flotation Plant	Decommissioning of Plant (Demolish and remove infrastructure, Flatten and Shape, Resoil, Re-Vegetate)	Groundwater: Quality	Deterioration of the groundwater resource quality due to the leaching of residual materials during decommissioning.	**Magnitude**	Minor	**Low**	Control by monitoring groundwater quality adjacent to facility.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Local			**Scale**	Local	
				Consequence	Low			**Consequence**	Medium	
				Probability	Possible			**Probability**	Possible	

Table 10.2.3(d): Decommissioning Phase Impact Significance Rating Table – Surface Water

DECOMMISSIONING PHASE IMPACT SIGNIFICANCE RATING TABLE – SURFACE WATER											
Activity	**Decommissioning Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/ Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Magnetite Waste Site Disposal Facility (MWSDF)	Decommissioning of Facility (Flatten and Shape Side Slopes, Install Suitable Capping Liner, Resoil, Re-Vegetate)	Surface Water: Quality	Contamination of the surface water resource due to increased sediment load from MWSDF covered slopes directly into the surface water resource.	**Magnitude** **Duration** **Scale** **Consequence** **Probability**	Moderate Short term Regional Medium Possible	**Medium**	Control impact on surface water resource quality through sediment load control plan.	**Magnitude** **Duration** **Scale** **Consequence** **Probability**	Minor Short term Local Low Unlikely	**Low**
Access Road to MWSDF	Decommissioning of Road (Flatten and Shape, Resoil, Re-Vegetate)	Surface Water: Quality	Deterioration of the surface water resource quality as a result of increased erosion introducing elevated sediment load into the surface drainage features and as a result of diesel and oil spillages into storm water flowing into the surface drainage features.	**Magnitude** **Duration** **Scale** **Consequence** **Probability**	Minor Short term Site Low Possible	**Low**	Control impact on surface water resource quality through sediment load control plan as well as a spillages control and clean-up procedure.	**Magnitude** **Duration** **Scale** **Consequence** **Probability**	Minor Short term Local Low Unlikely	**Low**
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	Decommissioning of Dam (Dewatering of the dam, Removal of contaminated sediment on basin, Removal of liner, contaminated sediment and underlaying layers, Flatten and Shape Dam Walls, Resoil, Re-Vegetate)	Surface Water: Quality	Deterioration of the surface water resource quality as a result of increased erosion introducing elevated sediment load into the surface drainage features.	**Magnitude** **Duration** **Scale** **Consequence** **Probability**	Minor Short term Site Low Possible	**Low**	Control impact on surface water resource quality through sediment load control plan.	**Magnitude** **Duration** **Scale** **Consequence** **Probability**	Minor Short term Local Low Unlikely	**Low**
Copper Flotation Plant	Decommissioning of Plant (Demolish and remove infrastructure, Flatten and Shape, Resoil, Re-Vegetate)	Surface Water: Quality	Deterioration of the surface water resource quality as a result of increased erosion introducing elevated sediment load into the surface drainage features.	**Magnitude** **Duration** **Scale** **Consequence** **Probability**	Minor Short term Site Low Possible	**Low**	Control impact on surface water resource quality through sediment load control plan.	**Magnitude** **Duration** **Scale** **Consequence** **Probability**	Minor Short term Local Low Unlikely	**Low**

Table 10.2.3(e): Decommissioning Phase Impact Significance Rating Table – Terrestrial Ecology

DECOMMISSIONING PHASE IMPACT SIGNIFICANCE RATING TABLE – TERRESTRIAL ECOLOGY									
Decommissioning Activity Aspect	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Decommissioning of Facility (Flatten and Shape Side Slopes, Install Suitable Capping Liner, Resoil, Re-Vegetate)	Flora & Fauna: Habitat and Diversity	Contamination of downstream riparian habitats resulting from seepage of waste and/or contaminated water from MWSDF.	**Magnitude**	Major	**High**	Stop and control impact through continuing facility maintenance, and minimise and remedy impacts through effective response planning and implementation.	**Magnitude**	Moderate	**Low**
			Duration	Long term			**Duration**	Medium term	
			Scale	Local			**Scale**	Local	
			Consequence	High			**Consequence**	Medium	
			Probability	Possible			**Probability**	Unlikely	
	Flora: Habitat and Diversity	Establishment and spread of alien invasive species resulting from disturbances caused by decommissioning activities.	**Magnitude**	Moderate	**Medium**	Modify, control and stop potential impacts by implementing an invasive species programme.	**Magnitude**	Minor	**Low**
			Duration	Long term			**Duration**	Short term	
			Scale	Local			**Scale**	Site	
			Consequence	Medium			**Consequence**	Low	
			Probability	Possible			**Probability**	Unlikely	
Decommissioning of Road (Flatten and Shape, Resoil, Re-Vegetate)	Flora: Habitat and Diversity	Establishment and spread of alien invasive species resulting from disturbances caused by decommissioning activities.	**Magnitude**	Moderate	**Medium**	Modify, control and stop potential impacts by implementing an invasive species programme.	**Magnitude**	Minor	**Low**
			Duration	Long term			**Duration**	Short term	
			Scale	Local			**Scale**	Site	
			Consequence	Medium			**Consequence**	Low	
			Probability	Possible			**Probability**	Unlikely	
Decommissioning of Dam (Dewatering of the dam, Removal of contaminated sediment on basin, Removal of liner, contaminated sediment and underlaying layers, Flatten and Shape Dam Walls, Resoil, Re-Vegetate)	Flora & Fauna: Habitat and Diversity	Contamination of downstream riparian habitats resulting from seepage of waste and/or contaminated water from PCD and associated water infrastructure.	**Magnitude**	Major	**High**	Stop and control impact through continuing facility maintenance, and minimise and remedy impacts through effective response planning and implementation.	**Magnitude**	Moderate	**Low**
			Duration	Long term			**Duration**	Medium term	
			Scale	Local			**Scale**	Local	
			Consequence	High			**Consequence**	Medium	
			Probability	Possible			**Probability**	Unlikely	
	Flora: Habitat and Diversity	Establishment and spread of alien invasive species resulting from disturbances caused by decommissioning activities.	**Magnitude**	Moderate	**Medium**	Modify, control and stop potential impacts by implementing an invasive species programme.	**Magnitude**	Minor	**Low**
			Duration	Long term			**Duration**	Short term	
			Scale	Local			**Scale**	Site	
			Consequence	Medium			**Consequence**	Low	
			Probability	Possible			**Probability**	Unlikely	

DECOMMISSIONING PHASE IMPACT SIGNIFICANCE RATING TABLE – TERRESTRIAL ECOLOGY									
Decommissioning Activity Aspect	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Decommissioning of Plant (Demolish and remove infrastructure, Flatten and Shape, Resoil, Re-Vegetate)	Flora: Habitat and Diversity	Establishment and spread of alien invasive species resulting from disturbances caused by decommissioning activities.	**Magnitude**	Moderate	**Medium**	Modify, control and stop potential impacts by implementing an invasive species programme.	**Magnitude**	Minor	**Low**
			Duration	Long term			**Duration**	Short term	
			Scale	Local			**Scale**	Site	
			Consequence	Medium			**Consequence**	Low	
			Probability	Possible			**Probability**	Unlikely	

Table 10.2.3(f): Decommissioning Phase Impact Significance Rating Table – Aquatic Ecosystems

DECOMMISSIONING PHASE IMPACT SIGNIFICANCE RATING TABLE – AQUATIC ECOSYSTEMS											
Activity	**Decommissioning Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Magnetite Waste Site Disposal Facility (MWSDF)	Decommissioning of Facility (Flatten and Shape Side Slopes, Install Suitable Capping Liner, Resoil, Re-Vegetate)	Surface Water: Quality	Potential spillage/ leakage from demolished facility.	**Magnitude**	Major	**Medium**	Control by maintaining suitable bufferzones around watercourses.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Regional	
				Consequence	Medium			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	
Access Road to MWSDF	Decommissioning of Road (Flatten and Shape, Resoil, Re-Vegetate)	Surface Water: Quality	Degradation of the aquatic ecosystems due to sediment mobilisation, runoff from the site and potential erosion.	**Magnitude**	Major	**Medium**	Control by maintaining suitable bufferzones around watercourses. Avoid by minimizing the footprint.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Consequence	Medium			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	
		Aquatic habitat	Loss/ alteration of habitat: mainly in-stream channel habitat - limited riparian habitat. Increase in erosion within the riparian zone. Increased sedimentation smothering in-stream habitats and reducing availability of biotopes.	**Magnitude**	Minor	**Low**	Control by maintaining suitable bufferzones around watercourses.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Site/local	
				Consequence	Low			**Consequence**	Low	
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	Decommissioning of Dam (Dewatering of the dam, Removal of contaminated sediment on basin, Removal of liner, contaminated sediment and underlaying layers, Flatten and Shape Dam Walls, Resoil, Re-Vegetate)	Surface Water: Quality	Potential spillage/leakage from decommissioning of dam, dewatering, leakage of contained sediments in adjacent Ga-Selati.	**Magnitude**	Major	**High**	Remedy by monitoring any surface runoff patterns and erosion gulleys. Control by maintaining suitable bufferzones around watercourses.	**Magnitude**	Major	**Medium**
				Duration	Long term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Regional	
				Consequence	High			**Consequence**	Medium	
				Probability	Possible			**Probability**	Possible	
		Aquatic biota	Loss of ecological communities.	**Magnitude**	Major	**High**	Control by maintaining suitable bufferzones around watercourses.	**Magnitude**	Major	**Medium**
				Duration	Long term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Regional	
				Consequence	High			**Consequence**	Medium	
				Probability	Possible			**Probability**	Possible	

DECOMMISSIONING PHASE IMPACT SIGNIFICANCE RATING TABLE – AQUATIC ECOSYSTEMS											
Activity	**Decommissioning Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Copper Flotation Plant	Decommissioning of Plant (Demolish and remove infrastructure, Flatten and Shape, Resoil, Re-Vegetate)	Surface Water: Quality	Potential spillage/ leakage from demolished facility.	**Magnitude**	Major	**Medium**	Control by maintaining suitable bufferzones around watercourses.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Regional	
				Consequence	Medium			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	

Table 10.2.3(g): Decommissioning Phase Impact Significance Rating Table – Wetlands

DECOMMISSIONING PHASE IMPACT SIGNIFICANCE RATING TABLE – WETLANDS										
Activity	**Decommissioning Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Magnetite Waste Site Disposal Facility (MWSDF)	Decommissioning of Facility (Flatten and Shape Side Slopes, Install Suitable Capping Liner, Resoil, Re-Vegetate)	Wetlands, riparian habitats and watercourses	Destruction and disturbance of watercourse habitat. Increased sedimentation within watercourses. Water quality deterioration. Increase in alien vegetation.	**Magnitude**	Moderate	**Medium**	Prevent further disturbance and degradation of watercourse habitats on site.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Short term	
				Scale	Local			**Scale**	Site	
				Consequence	Medium			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	
Access Road to MWSDF	Decommissioning of Road (Flatten and Shape, Resoil, Re-Vegetate)	Wetlands, riparian habitats and watercourses	Destruction and disturbance of watercourse habitat. Increased sedimentation within watercourses. Water quality deterioration. Increase in alien vegetation.	**Magnitude**	Moderate	**Medium**	Prevent further disturbance and degradation of watercourse habitats on site.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Short term	
				Scale	Site			**Scale**	Site	
				Consequence	Medium			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	Decommissioning of Dam (Dewatering of the dam, Removal of contaminated sediment on basin, Removal of liner, contaminated sediment and underlaying layers, Flatten and Shape Dam Walls, Resoil, Re-Vegetate)	Wetlands, riparian habitats and watercourses	Destruction and disturbance of watercourse habitat. Increased sedimentation within watercourses. Water quality deterioration. Increase in alien vegetation.	**Magnitude**	Moderate	**Medium**	Prevent further disturbance and degradation of watercourse habitats on site.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Short term	
				Scale	Site			**Scale**	Site	
				Consequence	Medium			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	
Copper Flotation Plant	Decommissioning of Plant (Demolish and remove infrastructure, Flatten and Shape, Resoil, Re-Vegetate)	Wetlands, riparian habitats and watercourses	Destruction and disturbance of watercourse habitat. Increased sedimentation within watercourses. Water quality deterioration. Increase in alien vegetation.	**Magnitude**	Moderate	**Medium**	Prevent further disturbance and degradation of watercourse habitats on site.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Short term	
				Scale	Site			**Scale**	Site	
				Consequence	Medium			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	

Table 10.2.3(h): Decommissioning Phase Impact Significance Rating Table – Air Quality

DECOMMISSIONING PHASE IMPACT SIGNIFICANCE RATING TABLE – AIR QUALITY										
Activity	**Decommissioning Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/ Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Magnetite Waste Site Disposal Facility (MWSDF); Access Road to MWSDF; Pollution Control Dam (PCD) and associated infrastructure (including the silt trap); Copper Flotation Plant	Decommissioning of Facility (Flatten and Shape Side Slopes, Install Suitable Capping Liner, Resoil, Re-Vegetate); Decommissioning of Road (Flatten and Shape, Resoil, Re-Vegetate); Decommissioning of Dam (Dewatering of the dam, Removal of contaminated sediment on basin, Removal of liner, contaminated sediment and underlaying layers, Flatten and Shape Dam Walls, Resoil, Re-Vegetate); Decommissioning of Plant (Demolish and remove infrastructure, Flatten and Shape, Resoil, Re-Vegetate)	Air Quality: Dust Fallout	Increased dust deposition rate at Foskor Mine, at Phalaborwa Town, at PMC Mine, at Schalk Small Holdings, at Namakgale/ Makhushane and at Phalaborwa Industrial Area	**Magnitude**	Minor	**Low**	Control through implementing appropriate dust suppression methods and administrative measures	**Magnitude**	Minor	**Low**
				Duration	Short			**Duration**	Short	
				Scale	Site/ Local			**Scale**	Site/ Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	
Magnetite Waste Site Disposal Facility (MWSDF); Access Road to MWSDF; Pollution Control Dam (PCD) and associated infrastructure (including the silt trap); Copper Flotation Plant	Decommissioning of Facility (Flatten and Shape Side Slopes, Install Suitable Capping Liner, Resoil, Re-Vegetate); Decommissioning of Road (Flatten and Shape, Resoil, Re-Vegetate); Decommissioning of Dam (Dewatering of the dam, Removal of contaminated sediment on basin, Removal of liner, contaminated sediment and underlaying layers, Flatten and Shape Dam Walls, Resoil, Re-Vegetate); Decommissioning of Plant (Demolish and remove infrastructure, Flatten and Shape, Resoil, Re-Vegetate)	Air Quality: Particulate Matter	Increased particulate concentration at Foskor Mine, at Phalaborwa Town, at PMC Mine, at Schalk Small Holdings, at Namakgale/ Makhushane and at Phalaborwa Industrial Area	**Magnitude**	Minor	**Low**	Control through implementing appropriate dust suppression methods and administrative measures	**Magnitude**	Minor	**Low**
				Duration	Short			**Duration**	Short	
				Scale	Site/ Local			**Scale**	Site/ Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	

DECOMMISSIONING PHASE IMPACT SIGNIFICANCE RATING TABLE – AIR QUALITY											
Activity	**Decommissioning Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/ Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Magnetite Waste Site Disposal Facility (MWSDF); Access Road to MWSDF; Pollution Control Dam (PCD) and associated infrastructure (including the silt trap); Copper Flotation Plant	Decommissioning of Facility (Flatten and Shape Side Slopes, Install Suitable Capping Liner, Resoil, Re-Vegetate); Decommissioning of Road (Flatten and Shape, Resoil, Re-Vegetate); Decommissioning of Dam (Dewatering of the dam, Removal of contaminated sediment on basin, Removal of liner, contaminated sediment and underlaying layers, Flatten and Shape Dam Walls, Resoil, Re-Vegetate); Decommissioning of Plant (Demolish and remove infrastructure, Flatten and Shape, Resoil, Re-Vegetate)	Air Quality: Gaseous Emissions	Increased gaseous concentration at Foskor Mine, at Phalaborwa Town, at PMC Mine, at Schalk Small Holdings, at Namakgale/ Makhushane and at Phalaborwa Industrial Area	**Magnitude**	Minor	**Low**	Control through ensuring mobile and stationary internal combustion equipment is properly serviced and operated	**Magnitude**	Minor	**Low**
				Duration	Short			**Duration**	Short	
				Scale	Site/ Local			**Scale**	Site/ Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	

10.2.4. Post Closure Phase Impact and Risk Assessment

Table 10.2.4(a): Post Closure Phase Impact Significance Rating Table – Socio-Economic/Cultural

Refer to Table 10.2.3(a) - Decommissioning Phase Impact Significance Rating Table – Socio-Economic/Cultural.

Table 10.2.4(b): Post Closure Phase Impact Significance Rating Table – Soils, Land Use and Land Capability

POST CLOSURE PHASE IMPACT SIGNIFICANCE RATING TABLE – SOILS, LAND USE AND LAND CAPABILITY										
Activity	**Post Closure Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Magnetite Waste Site Disposal Facility (MWSDF)	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner	Soil fertility and vegetative cover.	Addition of fertilizers is a possible contaminant in excessive quantities. Vehicle, animal and human movement impact on soil compaction, erosion, generation of dust, storm water runoff and sedimentary load on receiving environment.	**Magnitude**	Moderate +	**MEDIUM + (positive)**	Facilitate end Land Use. Monitor and remediate where necessary.	**Magnitude**	Moderate +	**MEDIUM + (positive)**
				Duration	Long term			**Duration**	Long term	
				Scale	Site			**Scale**	Site	
				Consequence	Medium +			**Consequence**	Medium +	
				Probability	Definite			**Probability**	Definite	
Access Road to MWSDF	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner	Soil fertility and vegetative cover.	Addition of fertilizers is a possible contaminant in excessive quantities. Vehicle, animal and human movement impact on soil compaction, erosion, generation of dust and possible contamination (hydrocarbons).	**Magnitude**	Moderate +	**MEDIUM + (positive)**	Facilitate end Land Use. Monitor and remediate where necessary.	**Magnitude**	Minor +	**LOW + (positive)**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Regional			**Scale**	Site	
				Consequence	Medium +			**Consequence**	Low +	
				Probability	Possible			**Probability**	Possible	
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner	Soil fertility and vegetative cover.	Addition of fertilizers is a possible contaminant in excessive quantities. Vehicle, animal and human movement impact on soil compaction, erosion, generation of dust, storm water runoff and sedimentary load on receiving environment.	**Magnitude**	Moderate +	**MEDIUM + (positive)**	Facilitate end Land Use. Monitor and remediate where necessary.	**Magnitude**	Moderate +	**MEDIUM + (positive)**
				Duration	Long term			**Duration**	Long term	
				Scale	Site			**Scale**	Site	
				Consequence	Medium +			**Consequence**	Medium +	
				Probability	Definite			**Probability**	Definite	
Copper Flotation Plant	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner	Soil fertility and vegetative cover.	Addition of fertilizers is a possible contaminant in excessive quantities. Vehicle, animal and human movement impact on soil compaction, erosion, generation of dust, storm water runoff and sedimentary load on receiving environment.	**Magnitude**	Moderate +	**MEDIUM + (positive)**	Facilitate end Land Use. Monitor and remediate where necessary.	**Magnitude**	Moderate +	**MEDIUM + (positive)**
				Duration	Long term			**Duration**	Medium term	
				Scale	Site			**Scale**	Site	
				Consequence	Medium +			**Consequence**	Medium +	
				Probability	Definite			**Probability**	Definite	

Table 10.2.4(c): Post Closure Phase Impact Significance Rating Table – Groundwater

POST CLOSURE PHASE IMPACT SIGNIFICANCE RATING TABLE – GROUNDWATER											
Activity	**Post Closure Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/ Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Magnetite Waste Site Disposal Facility (MWSDF)	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner.	Groundwater Quality	Residual impact on the groundwater resource quality due to the previous infiltration of soluble contaminants into the subsurface through the footprints of the facility.	**Magnitude**	Minor	**Medium**	Control by monitoring groundwater quality adjacent to facility.	**Magnitude**	Minor	**Low**
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)				**Duration**	Medium term			**Duration**	Medium term	
				Scale	Local			**Scale**	Local	
Copper Flotation Plant				**Consequence**	Medium			**Consequence**	Medium	
				Probability	Possible			**Probability**	Unlikely	

Table 10.2.4(d): Post Closure Phase Impact Significance Rating Table – Surface Water

POST CLOSURE PHASE IMPACT SIGNIFICANCE RATING TABLE – SURFACE WATER										
Activity	**Post Closure Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Magnetite Waste Site Disposal Facility (MWSDF)	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner	Surface Water: Quality	Impact on surface water resource quality if erosion occurs due to runoff from poorly rehabilitated and re-vegetated surface areas.	**Magnitude**	Minor	**Medium**	Maintain rehabilitated surfaces in good condition (no erosion with stable vegetative cover).	**Magnitude**	Minor	**Low**
Access Road to MWSDF				**Duration**	Long term			**Duration**	Short term	
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)				**Scale**	Regional			**Scale**	Local	
Copper Flotation Plant				**Consequence**	High			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	

Table 10.2.4(e): Post Closure Phase Impact Significance Rating Table – Terrestrial Ecology

POST CLOSURE PHASE IMPACT SIGNIFICANCE RATING TABLE – TERRESTRIAL ECOLOGY										
Activity	**Post Closure Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Magnetite Waste Site Disposal Facility (MWSDF)	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner.	Flora: Habitat and Diversity	Contamination of downstream riparian habitats resulting from seepage of waste and/or contaminated water from MWSDF.	**Magnitude**	Major	**Medium**	Stop and control impact through continuing facility maintenance, and minimise and remedy impacts through effective response planning and implementation.	**Magnitude**	Moderate	**Low**
				Duration	Long term			**Duration**	Medium term	
				Scale	Local			**Scale**	Local	
				Consequence	High			**Consequence**	Medium	
				Probability	Unlikely			**Probability**	Unlikely	
	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner.	Flora & Fauna: Habitat and Diversity	Establishment and spread of alien invasive species resulting from any disturbances caused by maintenance and aftercare.	**Magnitude**	Minor	**Medium**	Modify, control and stop potential impacts by implementing an invasive species programme.	**Magnitude**	Minor	**Low**
				Duration	Long term			**Duration**	Short term	
				Scale	Local			**Scale**	Site	
				Consequence	Medium			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	
Access Road to MWSDF	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner.	Flora: Habitat and Diversity	Establishment and spread of alien invasive species resulting from any disturbances caused by maintenance and aftercare.	**Magnitude**	Minor	**Medium**	Modify, control and stop potential impacts by implementing an invasive species programme.	**Magnitude**	Minor	**Low**
				Duration	Long term			**Duration**	Short term	
				Scale	Local			**Scale**	Site	
				Consequence	Medium			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner.	Flora: Habitat and Diversity	Establishment and spread of alien invasive species resulting from any disturbances caused by maintenance and aftercare.	**Magnitude**	Minor	**Medium**	Modify, control and stop potential impacts by implementing an invasive species programme.	**Magnitude**	Minor	**Low**
				Duration	Long term			**Duration**	Short term	
				Scale	Local			**Scale**	Site	
				Consequence	Medium			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	
Copper Flotation Plant	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner.	Flora: Habitat and Diversity	Establishment and spread of alien invasive species resulting from any disturbances caused by maintenance and aftercare.	**Magnitude**	Minor	**Medium**	Modify, control and stop potential impacts by implementing an invasive species programme.	**Magnitude**	Minor	**Low**
				Duration	Long term			**Duration**	Short term	
				Scale	Local			**Scale**	Site	
				Consequence	Medium			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	

Table 10.2.4(f): Post Closure Phase Impact Significance Rating Table – Aquatic Ecosystems

POST CLOSURE PHASE IMPACT SIGNIFICANCE RATING TABLE – AQUATIC ECOSYSTEMS										
Activity	**Post Closure Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Magnetite Waste Site Disposal Facility (MWSDF)	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner.	Surface Water: Quality, habitats, biota.	Further degradation of the aquatic ecosystem health should on-going maintenance, aftercare and monitoring not be undertaken.	**Magnitude**	Major	**Medium**	Continued maintenance and monitoring to ensure closure objectives have been met.	**Magnitude**	Minor	**Low**
Access Road to MWSDF				**Duration**	Medium term			**Duration**	Medium term	
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)				**Scale**	Regional			**Scale**	Local/site	
Copper Flotation Plant				**Consequence**	Medium			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	

Table 10.2.4(g): Post Closure Phase Impact Significance Rating Table – Wetlands

POST CLOSURE PHASE IMPACT SIGNIFICANCE RATING TABLE – WETLANDS										
Activity	**Post Closure Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Magnetite Waste Site Disposal Facility (MWSDF)	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner	Wetlands, riparian habitats and watercourses	Contamination of downstream watercourses. Establishment and spread of alien invasive species.	**Magnitude**	Moderate	**High**	Maintain PES of the Ga-Selati riparian zone and other affected watercourses.	**Magnitude**	Minor	**Medium**
				Duration	Long term			**Duration**	Long term	
				Scale	Regional			**Scale**	Regional	
				Consequence	High			**Consequence**	Medium	
				Probability	Possible			**Probability**	Possible	
Access Road to MWSDF	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner	Wetlands, riparian habitats and watercourses	Contamination of downstream watercourses. Establishment and spread of alien invasive species.	**Magnitude**	Minor	**Low**	Maintain PES of the Ga-Selati riparian zone and other affected watercourses.	**Magnitude**	Minor	**Low**
				Duration	Medium term			**Duration**	Medium term	
				Scale	Site			**Scale**	Site	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Unlikely	
Pollution Control Dam (PCD) and associated infrastructure (including silt trap)	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner	Wetlands, riparian habitats and watercourses	Contamination of downstream watercourses. Establishment and spread of alien invasive species.	**Magnitude**	Moderate	**Medium**	Maintain PES of the Ga-Selati riparian zone and other affected watercourses.	**Magnitude**	Minor	**Low**
				Duration	Long term			**Duration**	Long term	
				Scale	Local			**Scale**	Local	
				Consequence	Medium			**Consequence**	Medium	
				Probability	Unlikely			**Probability**	Unlikely	
Copper Flotation Plant	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner	Wetlands, riparian habitats and watercourses	Contamination of downstream watercourses. Establishment and spread of alien invasive species.	**Magnitude**	Moderate	**Medium**	Maintain PES of the Ga-Selati riparian zone and other affected watercourses.	**Magnitude**	Minor	**Low**
				Duration	Long term			**Duration**	Long term	
				Scale	Local			**Scale**	Local	
				Consequence	Moderate			**Consequence**	Medium	
				Probability	Possible			**Probability**	Unlikely	

Table 10.2.4(h): Post Closure Phase Impact Significance Rating Table – Air Quality

POST CLOSURE PHASE IMPACT SIGNIFICANCE RATING TABLE – AIR QUALITY											
Activity	**Post Closure Activity Aspect**	**Environmental Component Affected**	**Potential Impact Description**	**Impact Assessment BEFORE Mitigation**		**Significance if NOT Managed**	**Management Objective/Outcome**	**Impact Assessment AFTER Management**		**Significance if Managed**
Magnetite Waste Site Disposal Facility (MWSDF); Access Road to MWSDF; Pollution Control Dam (PCD) and associated infrastructure (including the silt trap); Copper Flotation Plant	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner	Air Quality: Dust Fallout	Increased dust deposition rate at Foskor Mine, at Phalaborwa Town, at PMC Mine, at Schalk Small Holdings, at Namakgale/ Makhushane and at Phalaborwa Industrial Area.	**Magnitude**	Minor	**Low**	Control through implementing appropriate dust suppression methods and administrative measures.	**Magnitude**	Minor	**Low**
				Duration	Short			**Duration**	Short	
				Scale	Site/Local			**Scale**	Site/Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	
Magnetite Waste Site Disposal Facility (MWSDF); Access Road to MWSDF; Pollution Control Dam (PCD) and associated infrastructure (including the silt trap); Copper Flotation Plant	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner	Air Quality: Particulate Matter	Increased dust deposition rate at Foskor Mine, at Phalaborwa Town, at PMC Mine, at Schalk Small Holdings, at Namakgale/ Makhushane and at Phalaborwa Industrial Area.	**Magnitude**	Minor	**Low**	Control through implementing appropriate dust suppression methods and administrative measures.	**Magnitude**	Minor	**Low**
				Duration	Short			**Duration**	Short	
				Scale	Site/Local			**Scale**	Site/Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	
Magnetite Waste Site Disposal Facility (MWSDF); Access Road to MWSDF; Pollution Control Dam (PCD) and associated infrastructure (including the silt trap); Copper Flotation Plant	On-going maintenance, aftercare and monitoring to confirm that all the closure objectives have been met in a sustainable manner	Air Quality: Gaseous Emissions	Increased dust deposition rate at Foskor Mine, at Phalaborwa Town, at PMC Mine, at Schalk Small Holdings, at Namakgale/ Makhushane and at Phalaborwa Industrial Area.	**Magnitude**	Minor	**Low**	Control through ensuring mobile and stationary internal combustion equipment is properly serviced and operated.	**Magnitude**	Minor	**Low**
				Duration	Short			**Duration**	Short	
				Scale	Site/Local			**Scale**	Site/Local	
				Consequence	Low			**Consequence**	Low	
				Probability	Possible			**Probability**	Possible	

11. SPECIALIST REPORT FINDINGS AND RECOMMENDATIONS

Specialist reports were compiled for the following environmental components considered:

- Socio-Cultural and Socio-Economic
- Archaeology, Heritage and Palaeontology
- Soils, Land Capability and Land Use
- Geology and Groundwater
- Surface Water
- Terrestrial Ecology (Plant Life and Animal Life)
- Aquatic Ecosystems
- Wetlands
- Air Quality

Each specialist report was compiled in strict accordance with the EIA Regulations of December 2014 (as amended), Appendix 6. Specialist reports are provided as Appendices to this EIAR– see Chapter 8.4 for details pertaining to each specialist report.

The specialist reports contain information pertaining to the baseline and impact assessments conducted as well as the management and monitoring plans proposed for the particular environmental component considered.

A summary of the findings and recommendations provided in each specialist report and an indication as to where these findings and recommendations have been included in the EIAR is provided in Table 11(a).

Table 11(a): Summary of the Specialist Reports Findings and Recommendations

Specialist Study / Environmental Component	Specialist Report Findings and Recommendations	Section in EIAR where Findings and Recommendations have been Included
Socio-Cultural/ Economic Aspects	The proposed project is in line with development priorities identified by the local municipality, which is to enhance the reclamation of mine waste and also in general, to support the mining sector in the district and province. The project is consistent with existing land use practices in the surrounding area and facilitates the continuation of beneficiation activities that supports local job opportunities. Consequently, the project is expected to have a positive socio-economic impact of medium significance on the local environment over the lifetime of the project in this regard. Potential negative impacts associated with the proposed project relate to nuisance factors anticipated such as dust generated from the MWSDF as well as the permanent change in land use. The change in land use rated as a negative impact of medium significance albeit the actual value of land lost was considered low from an economic perspective since the current land use is split between wilderness area (not eco-tourism related) and land with a poor grazing potential.	Chapter 5, 6, 7, 8, 10, 11, 12, 13, 15, 16, 17 and 21 of EIAR & EMPr
Archaeological, Heritage & Palaeontology Aspects	The Phase I Heritage Impact Assessment (HIA) revealed none of the types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act (Act No. 25 of 1999) within the proposed project area. The proposed activities associated with this project, will not affect palaeontological heritage as the entire study area is underlain by Archaean igneous and metamorphic rocks of the Makhutswi Gneiss and syenites of the Phalaborwa Complex. There is an unlikely possibility that the superficial Quaternary alluvial deposits could host fossils. Chance-find procedures are proposed if any heritage resources of significance, graves or fossils are uncovered during any life-cycle phase of the proposed project. In such an event, a qualified archaeologist and/or palaeontologist must assess the situation and, if necessary, provide advise about the applicable mitigation measures.	Chapter 5, 6, 7, 8, 10, 11, 12, 13, 15, 16, 17 and 21 of EIAR & EMPr
Soils, Land Capability and Land Use	A significant proportion of the area being considered for development returned soils with a land capability of poor to very poor grazing land potential and wilderness status, with shallow to average soil depths, moderate to poor nutrient status and poor water holding capabilities. The relatively homogeneous nature of the soils across the site makes for ease of management when working with or on the footprint considered for the Magnetite Waste Disposal Site. The sandy nature of the soils mapped renders them more easily worked and stored, albeit that erosion will be a sensitivity that will need to be well managed. Small but significant areas of wet based soils were mapped associated with the narrow drainage ways. These soils do not classify as wetlands based on the depth to wetness indicators. The impact on the soils will be high to very high and permanent for the MWSDF footprint (inclusive of the PCD), and moderate to low for the other proposed activities. If the well-engineered designs are implemented, and if cognisance is taken of the soil management plan provided in the EMPs, mitigation can be adequately instituted to acceptable levels of risk.	Chapter 5, 6, 7, 8, 10, 11, 12, 13, 15, 16 and 17 of EIAR & EMPr
Geology & Groundwater Aspects	The groundwater impact assessment for the proposed project was simulated through utilisation of a groundwater model. Simulations indicate that provided that the impermeable liner/barrier systems as designed for the MWSDF (Class C), and its associated PCD (Class C), are installed during the Construction Phase pf the project, the resulting impacts on the groundwater resource quality and quantity will be at an acceptable level. Levels of acceptable groundwater quality change was defined as the achievement of compliance with the current Bosveld Phosphates surface water and groundwater resource quality objectives (RQO's) as prescribed in the Bosveld Phosphates Amendment WUL of 2017. The modelling outcomes were superimposed on (added to) the current background groundwater quality and then assessed for compliance with the WUL RQO's. The groundwater impact assessment was conducted for all four of the life cycle phases of the proposed project. The impact assessment was done with reference to both Prior to Mitigation, as well as After Mitigation. The impact assessment confirmed that all potential groundwater impacts identified for the proposed Bosveld Phosphates project, could be mitigated/managed to have a low significance.	Chapter 5, 6, 7, 8, 10, 11, 12, 13, 15, 16 and 17 of EIAR & EMPr

Specialist Study / Environmental Component	Specialist Report Findings and Recommendations	Section in EIAR where Findings and Recommendations have been Included
Surface Water Aspects	An impact assessment was conducted, and potential surface water/hydrological impacts that could emanate from the proposed project and its associated activities were identified. The potential significant impacts included siltation of surface water resources leading to a poor water quality as a result of eroded material reporting into the streams, contamination of surface water resources when dirty water runoff or contamination with hydrocarbons reports into the nearby streams directly, seepage of contaminated water from the MWSDF and PCD into the groundwater; and reduction in runoff to the natural streams when all the dirty water runoff is contained within the proposed pollution control dams. Appropriate mitigation/management measures to prevent, and/or minimise the identified potential surface water impacts were identified and provided in the EMPr. With all the proposed mitigation and management measures in place, this project and the associated activities are unlikely to pose a significant threat to the natural watercourses and the hydrological features within and around the project area.	Chapter 5, 6, 7, 8, 10, 11, 12, 13, 15, 16 and 17 of EIAR & EMPr
Terrestrial Ecology (Plant and Animal Life)	The project area is located within a broader network of undeveloped natural habitat, that flanks the Ga-Selati River and extends west- and southward toward the Olifants River and the Greater Kruger National Park. The project area is dominated by savanna habitat that is consistent with the regional Phalaborwa-Timbavati-Mopaneveld vegetation type, as described by Musina & Rutherford (2011). Phalaborwa-Timbavati-Mopaneveld is considered 'well protected' and not threatened. The site is located within the 10 km buffer of the Kruger National Park and in close proximity to other smaller local protected areas. A small portion of land along the northern boundary of the project area has been disturbed by historic borrow pit operations and is currently characterised by a secondary vegetation, termed *Dichrostachys cinerea* Secondary Bushveld. The remainder comprises relatively undisturbed *Colophospermum mopane – Combretum apiculatum* Bushveld. Excluding the area of modified *Dichrostachys cinerea* Secondary Bushveld, these findings are consistent with the designation of the project area and its encompassing habitat network as CBA 2 by the Limpopo Conservation Plan (V2). The presence of nearby protected areas and the relatively high-level of landscape-scale habitat connectivity has resulted in the project area and the broader Bosveld Phosphates site having a rich assemblage of terrestrial fauna that includes inter alia, large and free-roaming taxa, such as the African Elephant. A number of mobile fauna species of conservation concern were recorded during the field programme, and several more may potentially be present in the immediate landscape, albeit probably only on a transient basis. The flora of the project area is dominated by indigenous species, typical of Phalaborwa-Timbavati-Mopaneveld. Several nationally protected tree species, as listed under the National Forests Act, (1998), were recorded including *Boscia albitrunca, Combretum imberbe, Diospyros mespiliformis, Philenoptera violacea, and Sclerocarya birrea* subsp. *caffra* and one species (viz. *Spirostachys africana*) listed as protected at a provincial level, under the Limpopo Environmental Management Act (2003). No nationally threatened (Red List) flora species were recorded on-site. It is anticipated that the proposed project will have a direct negative impact on the biodiversity and ecology of the project area and it will be important to appropriately avoid, minimise and address identified impacts during project implementation. Important identified impacts include habitat loss and disturbance, and habitat fragmentation. It is anticipated that approximately 21.1 ha of *Colophospermum mopane – Combretum apiculatum* Bushveld and 0.8 ha of *Dichrostachys cinerea* Secondary Bushveld will be cleared or disturbed during the construction phase. Other identified negative impacts include mortality and disturbance of fauna, alien invasive species colonisation and contamination of downstream riparian habitat. These impacts can be restricted to the proposed development footprints and/or successfully mitigated, through the correct application of the management and mitigation measures outlined in the EMPr, which include *inter alia*, the careful management of on-site flora and fauna, coupled with the active rehabilitation and revegetation using indigenous flora species of all disturbed areas.	Chapter 5, 6, 7, 8, 10, 11, 12, 13, 15, 16 and 17 of EIAR & EMPr

Specialist Study / Environmental Component	Specialist Report Findings and Recommendations	Section in EIAR where Findings and Recommendations have been Included
Aquatic Ecosystems Aspects	Confirmed by historical data of the study area, the Ga-Selati River continues to be under pressure and consequently its health and integrity is deteriorating temporally, owing to an increase in mining, industrial, agriculture and domestic practices within the catchment. These continue to elevate the TDS concentrations and salinity, particularly within the Ga-Selati, which is of concern to the aquatic biota (fish and aquatic macroinvertebrates). The Ga-Selati River is a major tributary for the Olifants River, and thus where it meets at the confluence of the Olifants River, it is known to be supplying impaired water quality into the main stem, as seen by the historical results. Furthermore, the Olifants River System has been described as degraded and under threat, owing to cumulative upstream catchment impacts contributing to the heavy metal and chemical loads. Based on the ecoclassification process conducted for the baseline study, and the integrated ecological state calculated at four assessments sites, the following conclusions were reached. Overall, the EcoStatus for site Sel_US (upstream from the project area) remains in a Class E (similar to PES identified during DWS (2014) study). There have been some changes to the upstream catchment in recent years with flow regime changes (lower runoff and increased abstraction), poor land-use practices, erosion and increased pollution from the catchment due to both increased mining and industrial activities. Consequently, owing to these continued threats, this site continues to be seriously modified. Further downstream at site Sel_DS (downstream of the project area), the integrated ecological state improved compared to DWS (2014) to a Class C/D. However, this may have been attributed to better habitat diversity (large pools, downstream riffles and small rapids flowing through channels) with an abundance of overhanging habitat created by marginal reeds, providing adequate habitat for the aquatic biota. The integrated ecological status within the Olifants River, both upstream and downstream, have both improved compared to DWS (2014). Both sites indicated moderately modified (Class C) conditions, primarily influenced by the moderately modified (Class B/C) instream and riparian habitat integrity, including deep river runs, side channel pools, although limited marginal or overhanging vegetation. Unlike the Ga-Selati River, the rapids and deeper riffles within the Olifants River, particular at the downstream site, were however favourable habitat for all the rheophilic (flow-dependent) fish species, including *C. pretoriae, Labeobarbus* and *Labeo* species, and aquatic macroinvertebrate taxa with specific velocity preferences namely Heptageniidae, Leptophlebiidae and Tricorythidae. Overall, the Ga-Selati River is in a more impaired state from both an aquatic biota and instream/riparian integrity, compared to the Olifants River, owing to this resource consistently and continually being under great threat from cumulative catchment impacts. However, as ecosystems respond in a knock-on effect, it will be vital to manage the Ga-Selati River, with the aim to improve its current ecological state towards the gazetted RQOs for quaternary catchment B72K. The project area on the Bosveld Phosphates site will likely contribute to the current and existing Ga-Selati catchment activities and pressures experienced on these associated water resources, thus further compromising the ecological state both Ga-Selati and the Olifants river. The primary impacts identified and potentially related to the associated activities for this project during the construction, operational and decommissioning phases will include the degradation of aquatic ecosystems due to increased sedimentation and bank erosion, changes in surface water quality, loss or alteration of habitat: both riparian and in-stream channel habitat (owing to potential sediment loads) and the loss of ecological communities (due to potential loss of habitats being smothered or impaired water quality). However, as the closest point of this proposed project is 250m from the river and the fact that these impacts were identified to be medium to low significance, they can certainly be mitigated and managed appropriately with measures provided in the EMPr and WUL. This will warrant overall low impact significance throughout the project life-cycle, improvement, or at least sustaining the ecological integrity and functionality of the current aquatic resource conditions. To enhance the Ga-Selati River and downstream to the confluence of the Olifants River's instream and riparian habitat integrity, biotic integrity, water quality and flow dynamics, this would need wider catchment management and overall environmental responsibility, not only from this proposed project, but from the surrounding mining, industry and agricultural practices within the catchment.	Chapter 5, 6, 7, 8, 10, 11, 12, 13, 15, 16 and 17 of EIAR & EMPr

Specialist Study / Environmental Component	Specialist Report Findings and Recommendations	Section in EIAR where Findings and Recommendations have been Included
Wetland Aspects	No natural wetland habitat was identified within the project area or the 500m buffer. However, several watercourses and related features were identified within the project area and its immediate surroundings. Identified features include the following: ▪ Ga-Selati river and associated riparian habitat ▪ Riparian habitat associated with a small, non-perennial tributary of the Ga-Selati river in the north-western corner of the project area ▪ Several small, ephemeral (lasting for a very short time) drainage lines on and adjacent to the project area ▪ A large Dirty Water Dam area to the south of the proposed development site associated with the existing gypsum stacks of Bosveld Phosphates The most significant aquatic ecosystem within the greater project study area is considered to be the Ga-Selati River and associated riparian habitat. Adjacent to the project area and approximately 200m to the west of the proposed development site is the Ga-Selati River which flows roughly from north to south – the Regulated Area (defined in GN509 of 2016 as *(a) The outer edge of the 1 in 100 year floodline and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of the river, spring, natural channel, lake or dam. (b) In the absence of a determined 1 in 100 year floodline or riparian area the area within 100m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench*) surrounding the Ga-Selati river does therefore not extend into the proposed development site. A small unnamed tributary with associated riparian habitat extends into the extreme north-western corner of the project area. The riparian habitat identified on site and associated with the Ga-Selati river adjacent to the site are considered to be moderately modified and largely modified respectively. In contrast, the small watercourses within the northwest of the study area are currently largely unaffected by industrial or mining activity and presumably still clean water systems. It is therefore recommended that the proposed MWSDF be located within the catchment of the existing Dirty Water Dam. This would limit potential contamination impacts to an already compromised watercourse system, rather than impacting on currently unimpacted systems. The proposed project will result in potentially negative impacts on riparian and watercourse habitat through direct destruction of these areas falling within the footprint of the proposed developments, as well more indirectly through impacts on water quality in the Ga-Selati river. Predicated on the findings of the impact assessment and the character of on-site riparian and watercourse habitats and assuming the full implementation of mitigation and management measures proposed and provided in the EMPr, the proposed MWSDF could be considered for authorisation from a wetland and riparian habitat perspective.	Chapter 5, 6, 7, 8, 10, 11, 12, 13, 15, 16 and 17 of EIAR & EMPr
Air Quality Aspects	The objectives of the air quality impact study were to describe the ambient emissions from the proposed project and to assess the impact on the health of the receiving community. The assessment considered a review of the relevant health legislation, ambient air quality guidelines and standards. Sources and emissions were identified and process emission factors were proposed. Considering possible pollutants of concern, possible impacts and impact areas, an evaluation of the potential impact on human health and the environmental, centred on comparisons of modelled pollutant concentrations compared to relevant guidelines and standards. An assessment of the contribution and outcome of the process on the current air quality, was conducted. During construction and normal operations, dust deposition rates will increase by about 4.3% provided that a minimum control efficiency of 75% is constantly maintained. Under this ideal scenario, deposition rates could increase by between 150 - and 300 mg/m2/day downwind of the MWSDF, up to the R40/ Makhushani Drive intersection. Uncontrolled deposition rates will probably exceed the residential standard over large portions of the industrial area and up to the R40/ Makhushani Drive intersection. Dust deposition rates could range from 150 - to 300 mg/m2/day in the northern sections of the Schalk Small Holdings. Controlled PM10 emission during the operational phase could result in up to five additional daily contraventions up to a distance of 500m downwind of the MWSDF.	Chapter 5, 6, 8, 10, 11, 12, 13, 15, 16 and 17 of EIAR & EMPr

Specialist Study / Environmental Component	Specialist Report Findings and Recommendations	Section in EIAR where Findings and Recommendations have been Included
Air Quality Aspects	Additional contraventions are also expected over the entire industrial area. Annual PM10 concentrations are expected to increase by about 3.5% over the entire study area. The area of significance will increase slightly over the industrial area and up to 100m beyond the western boundary, towards the R40/ Makhushani Drive intersection. The incremental contribution of PM2.5 during normal operations will be insignificant for the daily reference period and below 25% of the standard onsite for the annual reference period. Annual PM2.5 concentrations are expected to increase on average by about 4.2% throughout the study area. The area of significance will increase to just beyond the western boundary. Emissions from mobile equipment operations and material handling will most likely be the largest source of ambient pollution for the proposed Copper Flotation Plant, Waste Disposal Facility and Pollution Control Dam. This will be followed by beneficiation process emissions and fugitive emissions from material storage. Particulate matter will most likely contribute the most to the pollution load of the proposed development, with PM10 being the criteria pollutant of concern. The negative impact of particulate emissions for the proposed development will most likely be medium at the closest receivers identified during the operational phase of the project and low during all other phases. Best industry practice should be supplemented with engineering and administrative measures, where required, to reduce the impact at all receivers to current levels. The negative impact of gaseous emissions for the proposed development will most likely be low at the closest receivers identified during all phases of the project. Best industry practice should be supplemented with administrative measures to maintain the impact at all receivers to current levels. Strict monitoring of ambient particulate deposition rates and concentrations throughout the operational life of the project, in addition to an annual inventory and modelling regime, will assist effective air quality management and open communication to all stakeholders. Develop and implement an Air Quality Management Plan in support of the next AEL Amendment Application and Process.	

12. ENVIRONMENTAL IMPACT STATEMENT

Based on the findings of the Environmental Impact Assessment documented in Chapter 10 of the EIAR, a summary of the key findings of the environmental impact assessment is provided in the section below for each life cycle phase associated with this project.

12.1. SUMMARY OF KEY FINDINGS OF ENVIRONMENTAL IMPACT ASSESSMENT

A comprehensive Environmental Impact and Risk Assessment was conducted for each proposed activity associated with this project. These activities are described in detail in section 4.3 of the EIAR. The outcome of this assessment is provided for every environmental component considered and for all the life cycle phases associated with the proposed project - refer to section 10.2 of this report.

The Environmental Impact and Risk Assessment was of high integrity with a high degree of confidence, mainly due to:

- Comprehensive baseline descriptions for the following environmental components:
  - Socio-Economic Aspects
  - Archaeology, Heritage and Palaeontology
  - Topography and Land Use
  - Climate and Meteorology
  - Soils and Land Capability
  - Geology and Groundwater
  - Surface Water
  - Terrestrial Ecology (Plant Life & Animal Life)
  - Aquatic Ecosystems
  - Wetlands
  - Air Quality
- The baseline studies provided detailed, site specific quantitative descriptions of the current conditions associated with the project area.
- Detailed project and process descriptions for the current and proposed activities at Bosveld Phosphates were provided by the Applicant which could be used to identify aspects and related impacts.
- In addition, specialist reports were compiled by suitable qualified specialists addressing aspects related to inter alia water management and air quality management.
- The same specialists that conducted the baseline studies, performed detailed empirical, analytical and numerical modelling to support the impact assessments for various critical environmental components including groundwater and air quality.
- Formal Impact and Risk Significance Assessments were compiled, when assessing the impacts and risks associated with all the identified activities, for all the life cycle phases of the project.
- The impact and risk significance assessments considered the following criteria: Magnitude, Duration, Spatial Scale, Consequence and Significance.
- The key findings of the Impact and Risk Assessment will be discussed with reference to the Impact and Risk Significance categories listed above, for each of the project life cycle phases.

12.1.1. Construction Phase

The key findings of the Construction Phase Impact and Risk Assessment have been summarised from the comprehensive Impact and Risk Significance Tables (10.2.1(a) – (h)) and are now given for each Environmental Component in Table 12.1.1(a) below. This summary relates to the construction of the proposed activities. The table reflects the Impact and Risk Significance for both, **before mitigation**, as well as for **after mitigation** and concisely details the potential impact anticipated as well as the mitigation type/outcome proposed.

Table 12.1.1(a): Key Findings - Construction Phase Impact and Risk

Environmental Component	Impact and Risk before Mitigation	Impact and Risk after Mitigation	Comment
Socio-Economic	Low (+)	Medium (+)	The potential increase in employment and income opportunities during the construction of the proposed activities can be optimised by recruiting unskilled labour from local communities.
	Low	Low	The potential population influx as a result of job-seekers and the potential deterioration of safety and security can be mitigated by optimising recruitment from local communities.
Soils, Land Use and Land Capability	High	High	The construction of the proposed MWSDF will lead to the permanent loss and sterilisation of the resource. Areas for storage of utilisable soils should be clearly delineated. Activities associated with the clearance of vegetation and construction of the proposed facilities could potentially lead to salinisation and contamination by dirty water runoff, reagent and hydrocarbon spills. This could potentially have a negative impact on downstream receptors. The size of the disturbance footprint should be manged and excessive vehicle movement over unprotected soils should be avoided. Storm water runoff, erosion and contamination from hydrocarbon spillages should be controlled and manged.
Groundwater	Low	Low	Construction activities could potentially have a negative impact on the groundwater quality as a result of spillages and infiltration of fuel associated with construction vehicles and machinery. This impact can be mitigated if spillages are controlled and managed with a formalised spillages control and clean-up procedure.
Surface Water	Low	Low	Construction activities could result in the contamination of the surface water resource due to increased sediment load from cleared areas, spillages from construction activities, materials and vehicles and runoff from the dirty areas. Impacts can be mitigated by maintaining suitable bufferzones (temporary berms) around the activity footprint as well as the watercourses and by developing and implementing a formalised spillages control and clean-up procedure.
Terrestrial Ecology	High	Medium/Low	Clearance of the areas associated with the proposed facilities will lead to the loss and disturbance of floral habitat and also the loss of protected tree species located in the construction footprints. The removal of indigenous vegetation and soil disturbances could result in the establishment and spread of alien invasive species. Construction activities could furthermore result in the contamination of the downstream riparian habitat as a result of pollution spills/leaks from equipment, vehicles and containers. These impacts can be mitigated by restricting the vegetation clearance to the development footprint. An application for a licence regarding protected trees should be obtained from the DFFE and the number of protected trees that require clearing should be restricted to a minimum. The restoration and rehabilitation plan that will be developed and implemented should include planting of juvenile protected trees and re-establishing indigenous vegetation on disturbed/ rehabilitated areas. The alien invasive species control programme that will developed should include a combined approach using both chemical and mechanical control methods, and periodic follow-up treatments that are informed by regular monitoring. By constructing the proposed facilities as per the approved civil designs (appropriate liners) and operating it as per the approved designs and environmental authorisations should prevent/control contamination of the downstream riparian habitat. Development and implementation of an effective emergency response procedure will control/manage potential contamination of the downstream riparian habitat.
		Low	Construction of proposed facilities will lead to the fragmentation of habitat causing disruption of fauna movement/ dispersal corridors.

Environmental Component	Impact and Risk before Mitigation	Impact and Risk after Mitigation	Comment
Terrestrial Ecology	**High**	**Low**	These impacts can be mitigated by restricting the vegetation clearance to the development footprint. The restoration and rehabilitation plan that will be developed and implemented will also mitigate this impact. Direct mortality and disturbance of fauna as a consequence of construction activities, including vehicle collisions, trapping in excavations, hunting/snaring and sensory disturbance can be controlled by actively managing fauna-human interactions and by providing awareness raising/ training for all onsite workers.
Aquatic Ecosystems	**Medium**	**Medium/Low**	Construction activities could lead to a degradation of aquatic ecosystems due to sediment mobilisation, runoff from site and potential erosion as well as the alteration of drainage patterns of the cleared area and the area immediate adjacent to it. These impacts can be mitigated by restricting the vegetation clearance to the development footprint and by ensuring suitable bufferzone are maintained around watercourses. Effective dust control measures should be implemented and no construction activities or storage of infrastructure should occur within the bufferzone or within the riparian zone of the Ga-Selati.
Wetlands	**Medium**	**Medium/Low**	Clearance of vegetation could lead to a loss of watercourse habitat, disturbance of adjacent watercourse habitat, increased sedimentation in adjacent watercourses and contamination of downstream watercourses. Construction activities could also result in the establishment and spread of alien invasive species. These impacts can be mitigated by restricting the vegetation clearance to the development footprint and by maintaining suitable bufferzones (temporary berms) around the activity footprint as well as the watercourses. The alien invasive species control programme that will developed should include a combined approach using both chemical and mechanical control methods, and periodic follow-up treatments that are informed by regular monitoring.
Air Quality	**Low**	**Low**	Construction of the proposed facilities will lead to an increase in dust deposition, particulate concentration and gaseous concentration at Foskor Mine, Phalaborwa Town, PMC Mine, Schalk Small Holdings, Namakgale/ Makhushane and at Phalaborwa Industrial Area. The impacts can be controlled by implementing appropriate dust suppression methods and by administrative measures.

12.1.2. Operational Phase

The key findings of the Operational Phase Impact and Risk Assessment have been summarised from the Impact and Risk Significance Tables (10.2.2(a) – (h)) and are now given for each Environmental Component in Table 12.1.2(a) below. This summary relates to the operation of the proposed activities. The table reflects the Impact and Risk Significance for both, **before mitigation**, as well as for **after mitigation** and concisely details the potential impact anticipated as well as the mitigation type/outcome proposed.

Table 12.1.2(a): Key Findings - Operational Phase Impact and Risk

Environmental Component	Impact and Risk before Mitigation	Impact and Risk after Mitigation	Comment
Socio-Economic	**Low (+)**	**Medium (+)**	The potential increase in employment and income opportunities during the operations of the proposed activities can be optimised by recruiting/ input from local communities.
	Medium	**Low**	A potential increase in nuisance factors (dust) should be mitigated as per Air Quality Management Plan.
Soils, Land Use and Land Capability	**High**	**High/Medium**	On-going sterilisation of in-situ and stripped soil, loss of ecosystem service, potential for salinisation and/or contamination and compaction of in-situ and stored soils due to uncontrolled erosion, ingress and stormwater runoff associated with operational activities. These impacts can be mitigated by managing and controlling the footprint area in terms of stormwater runoff, spillages and vehicle movement. Condition of soil stockpiles should be monitored as part of the management plan.

Environmental Component	Impact and Risk before Mitigation	Impact and Risk after Mitigation	Comment
Groundwater	**Medium**	**Low**	Deterioration of the groundwater resource quality could occur during the operation of the proposed activities as a result of infiltration of soluble contaminants into the subsurface through the footprint of the facility, stormwater runoff, seepage/leaching of material during transport or spillages of chemicals/ hydrocarbons in the plant. Impacts on the groundwater resource can be controlled by monitoring groundwater quality as per proposed monitoring plan. Impacts can be mitigated by diverting and capturing contaminated stormwater runoff in the PCD, avoiding spillages of any material and implementing prompt clean-up procedures.
Surface Water	**Medium**	**Low**	Deterioration in surface water resource quality could occur during the operation of the proposed activities due to spillages and subsequent runoff containing soluble contaminants into the receiving surface drainage features. A reduction in the quantity of the surface water resource can also occur as a result of the MWSDF capturing rainfall. These impacts can be mitigated by constructing and operating facilities as per approved civil design (optimal footprint size and capacity) and implementing prompt clean-up procedures.
Terrestrial Ecology	**High**	**Low**	Potential contamination of the downstream riparian habitats can occur during the operational phase of the project as a result of spills or seepage of material of contaminated water. These impacts can ne controlled by ensuring continued maintenance of proposed facilities as well as the development and implementation of an effective emergency response procedure to control/manage potential contamination of the downstream riparian habitat.
		Low	During the operations of the proposed activities (transport of material), direct mortality and disturbance of fauna could occur as a consequence of vehicle collisions. These potential impacts can be controlled by actively managing fauna-human interactions, and implementing minimisation measures (appropriate barriers) and speed limits. Awareness raising/training of onsite workers will be very important.
Aquatic Ecosystems	**High**	**Medium**	Operation of the proposed facilities could lead to changes/ deterioration of water quality within the Ga-Selati River, degradation of aquatic ecosystems due to sediment mobilisation, runoff from site and potential erosion as well as the loss of ecological communities. These impacts can be mitigated by ensuring suitable bufferzone are maintained around watercourses. Surface runoff and erosion gulleys should be monitored and remedied, spillages should be cleaned up and effective dust control measures should be implemented.
Wetlands	**High**	**Medium**	The impact associated with the operational phase pertains to the potential deterioration of the water quality in adjacent watercourses. These impacts can be limited by isolating contaminants from water resources and controlling the contaminants at source.
Air Quality	**Medium**	**Medium**	Potential impacts anticipated during the operational phase relate to an increased dust deposition rate at Foskor Mine and at Phalaborwa Industrial Area, increased particulate concentration at Foskor Mine, Schalk Small Holdings, Namakgale/ Makhushane and at Phalaborwa Industrial Area. The impacts can be controlled by implementing appropriate dust suppression methods and by administrative measures.

12.1.3. Decommissioning and Closure Phase

The key findings of the Decommissioning and Closure Phase Impact and Risk Assessment have been summarised from the Impact and Risk Significance Tables (10.2.3(a) – (h)) and are now given for each Environmental Component in Table 12.1.3(a) below. This summary relates to the decommissioning and closure of the proposed activities.

The table reflects the Impact and Risk Significance for both, **before mitigation**, as well as for **after mitigation** and concisely details the potential impact anticipated as well as the mitigation type/outcome proposed.

Table 12.1.3(a): Key Findings – Decommissioning and Closure Phase Impact and Risk

Environmental Component	Impact and Risk before Mitigation	Impact and Risk after Mitigation	Comment
Socio-Economic	**Medium**	**Medium**	The potential impacts anticipated during the decommissioning and closure of the proposed facilities relate to the job and income losses and permanent loss of land use. The impacts can be mitigated by ensuring that the impact is limited to the minimum.
Soils, Land Use and Land Capability	**High**	**High/Medium**	The potential impacts anticipated during the decommissioning and closure of the proposed facilities relate to the loss of soil nutrients while in storage, contamination by dirty water and possible hydrocarbon (diesel/fuel) spills from decommissioning vehicles and machinery, compaction and dust. The impacts can be mitigated by remedying the soil fertility (adding fertilisers), rectification of the residual contamination, limiting vehicle movement over soils and monitoring and managing erosion.
Groundwater	**Low**	**Low**	Potential impacts associated with the decommissioning phase of the proposed activities relate to the deterioration of the groundwater resource quality due leaching of residual materials, spillages and infiltration of hydrocarbon (diesel/fuel) and/or contaminated water. Impacts on the groundwater resource can be controlled by monitoring groundwater quality as per proposed monitoring plan and if spillages are controlled and managed with a formalised spillages control and clean-up procedure.
Surface Water	**Medium**	**Low**	Potential impacts associated with the decommissioning phase of the proposed activities relate to the deterioration of the surface water resource quality as a result of increased sediment load or from hydrocarbon spillages (diesel/fuel) into surface water drainage features. Impacts can be mitigated by maintaining suitable bufferzones (temporary berms) around the decommissioning activity footprint as well as the watercourses and by developing and implementing a formalised spillages control and clean-up procedure.
Terrestrial Ecology	**High**	**Low**	Decommissioning activities could result in the contamination of the downstream riparian habitat as a result of seepage of waste or pollution spills/leaks from equipment, vehicles and containers. These impacts can be mitigated by ensuring facilities are decommissioned and closed as per approved closure plan and implementing a formalised spillages control and clean-up procedure. Decommissioning activities/ soil disturbances could result in the establishment and spread of alien invasive species. The alien invasive species control programme that will developed should include a combined approach using both chemical and mechanical control methods, and periodic follow-up treatments that are informed by regular monitoring.
Aquatic Ecosystems	**High**	**Medium/Low**	Potential impacts associated with the decommissioning phase of the proposed activities relate to the degradation of the aquatic ecosystems as a result of sediment mobilisation (runoff from site or potential erosion) or from spillages/leakages into adjacent watercourses. Impacts can be mitigated by maintaining suitable bufferzones (temporary berms) around the decommissioning activity footprint as well as the watercourses and by developing and implementing a formalised spillages control and clean-up procedure.
Wetlands	**Medium**	**Low**	Potential impacts associated with the decommissioning phase of the proposed activities relate to possible destruction and disturbance of watercourse habitat, increased sediments within watercourses, water quality deterioration and an increase in alien invasive species. These impacts can be mitigated by implementing the above-mentioned management measures proposed by the all the other relevant specialists.
Air Quality	**Low**	**Low**	Potential impacts anticipated during the decommissioning phase relate to an increased dust deposition rate, increased particulate concentration and increased gaseous concentration at Foskor Mine, Phalaborwa Town, PMC Mine, Schalk Small Holdings, Namakgale/ Makhushane and at Phalaborwa Industrial Area. The impacts can be controlled by implementing appropriate dust suppression methods and by administrative measures.

12.1.4. Post Closure Phase

The key findings of the Post Closure Phase Impact and Risk Assessment have been summarised from the Impact and Risk Significance Tables (10.2.4(a) – (h)) and are now given for each Environmental Component in Table 12.1.4(a) below. This summary relates to the phase after closure (post closure) associated with the proposed activities.

The table reflects the Impact and Risk Significance for both, **before mitigation**, as well as for **after mitigation** and concisely details the potential impact anticipated as well as the mitigation type/outcome proposed.

Table 12.1.4(a): Key Findings – Post Closure Phase Impact and Risk

Environmental Component	Impact and Risk before Mitigation	Impact and Risk after Mitigation	Comment
Socio-Economic	Refer to Decommissioning and Closure Phase description.		
Soils, Land Use and Land Capability	**Medium (+)**	**Medium (+)**	During the post closure phase the end land use will be facilitated by the addition of nutrients/fertilisers to the soil.
Groundwater	**Medium**	**Low**	A residual impact on the groundwater resource quality could be present as a result of previous infiltration of soluble contaminants into the subsurface through the footprints of the facilities. This impact can be controlled by maintaining the groundwater monitoring programme.
Surface Water	**Medium**	**Low**	During the post closure phase, an impact on the surface water resource quality can become evident if erosion occurs due to runoff from poorly rehabilitated and revegetated surface areas. This impact can be mitigated if the rehabilitated surfaces are maintained in good condition.
Terrestrial Ecology	**Medium**	**Low**	During the post closure phase, contamination of the downstream riparian habitat can occur as a result of seepage of waste from the MWSDF. These impacts can be mitigated by ensuring facilities are decommissioned and closed as per approved closure plan and implementing an effective response plan if and when necessary. Disturbances caused by maintenance and aftercare could result in the establishment and spread of alien invasive species. The alien invasive species control programme that will developed should include a combined approach using both chemical and mechanical control methods, and periodic follow-up treatments that are informed by regular monitoring.
Aquatic Ecosystems	**Medium**	**Low**	Further degradation of the aquatic ecosystem health can be a consequence if on-going maintenance, aftercare and monitoring is not being undertaken.
Wetlands	**High**	**Medium/Low**	During the post closure phase contamination of the downstream watercourses and establishment and spread of alien invasive species can occur if all the closure objectives have not been met in a sustainable manner. The PES of the Ga-Selati riparian zone and other affected watercourses should be maintained.
Air Quality	**Low**	**Low**	Potential impacts anticipated during the post closure phase relate to an increased dust deposition rate, increased particulate concentration and increased gaseous concentration at Foskor Mine, Phalaborwa Town, PMC Mine, Schalk Small Holdings, Namakgale/ Makhushane and at Phalaborwa Industrial Area. The impacts can be controlled by implementing appropriate dust suppression methods and by administrative measures.

12.2. ENVIRONMENTAL SENSITIVITIES AND BUFFER ZONE MAP

Figure 12.2(a) delineates the proposed activities (and its associated structures and infrastructure) related to the proposed project, superimposed on the environmental sensitivities of the preferred development footprint as contemplated in the accepted Scoping Report.

Evident from this map is that no natural wetland habitat was identified within the local study area or the 500m buffer around the local study area.

The nearest point of the proposed development footprint to the Ga-Selati River is approximately 230-250m away and thus far beyond the 32m riparian buffer of the Ga-Selati River.

The proposed development footprints are not located within the 32m/100m buffer of the Ga-Selati River.

A large-scale version of the site map with all the environmental sensitivities and buffer zones is attached as **APPENDIX 12(A).**

Figure 12.2(b) provides a layout plan of the proposed development detailing the positioning of the protected tree species within the local study area.

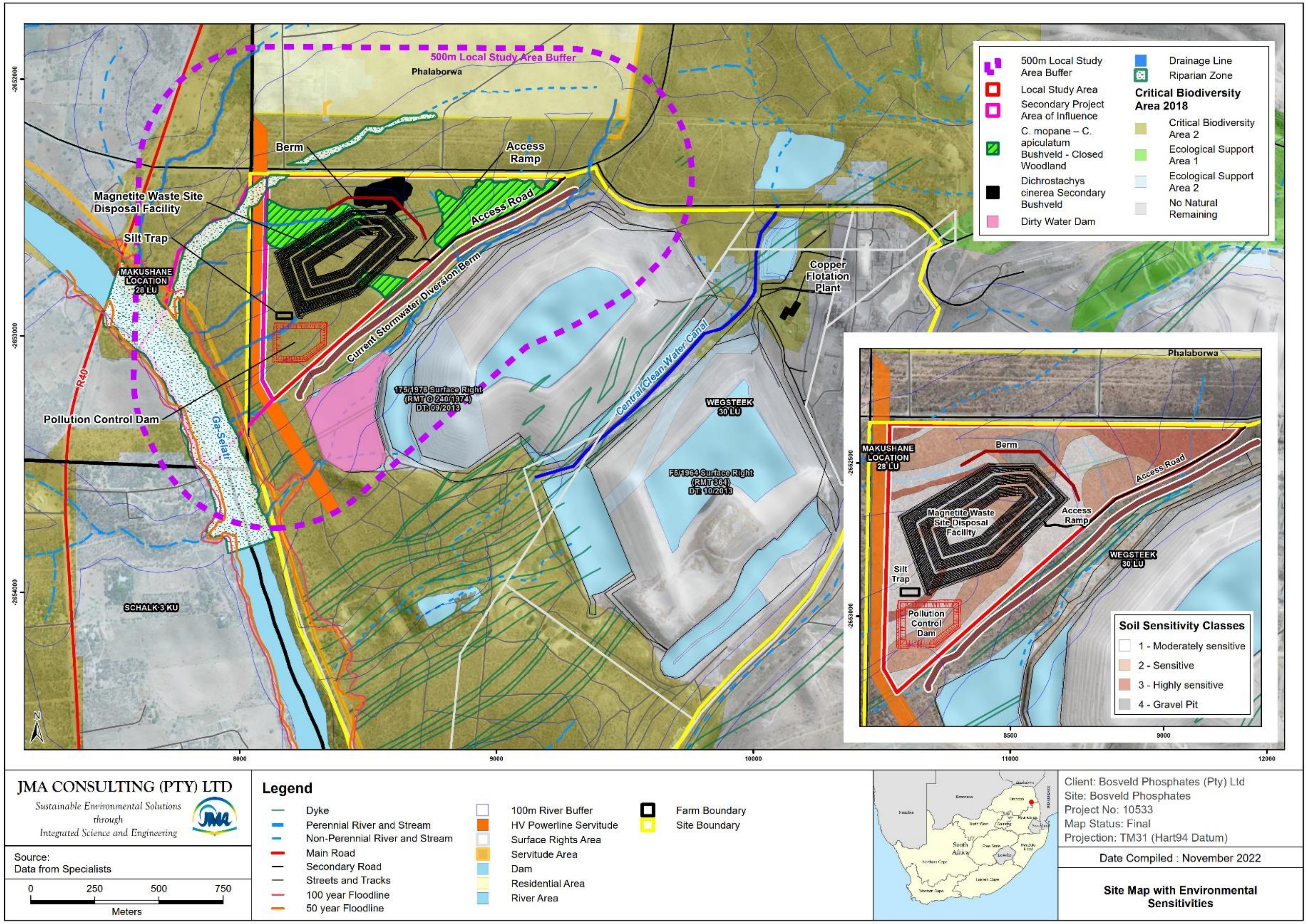

Figure 12.2(a): Environmental Sensitivities and Buffer Zone Map

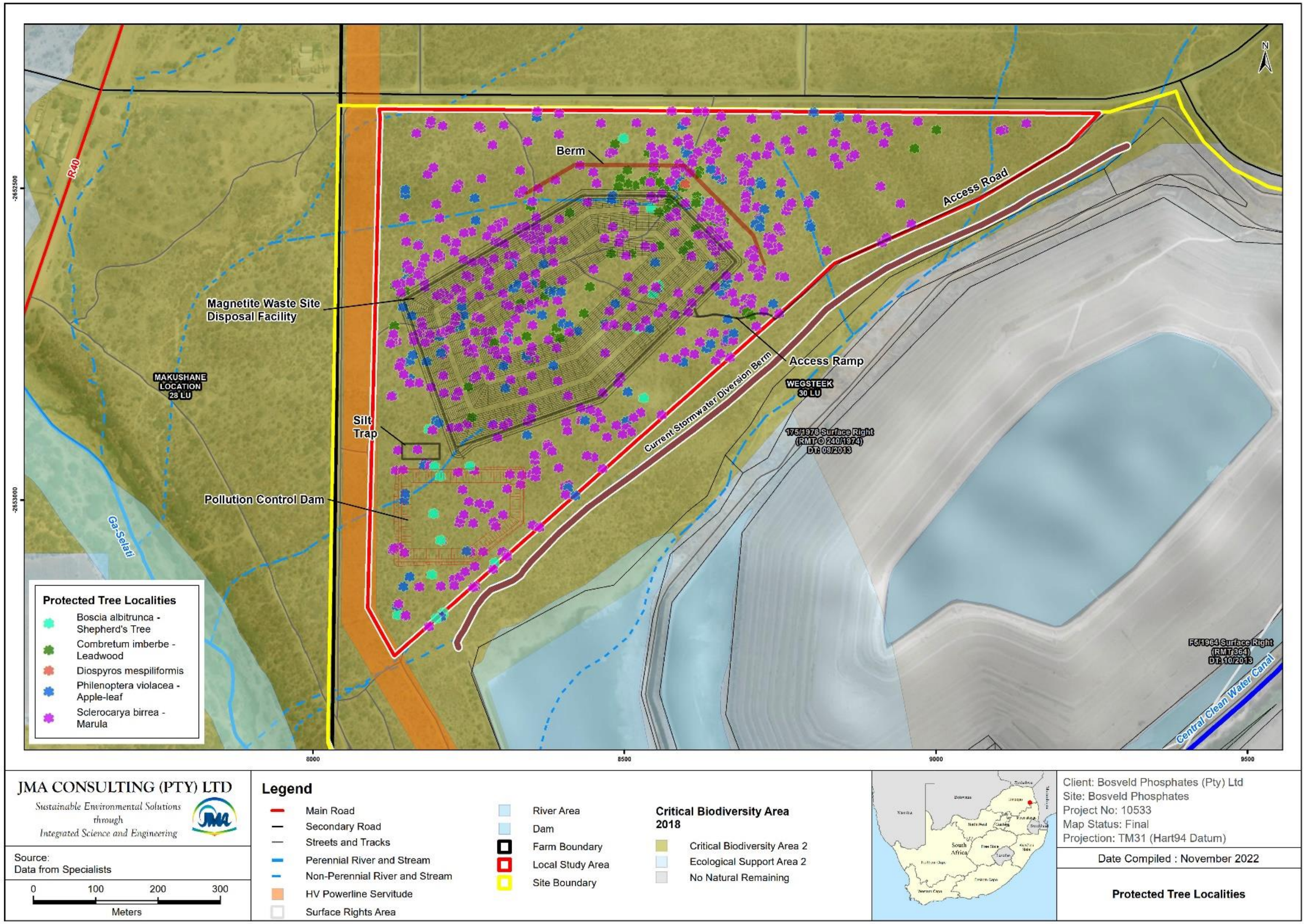

Figure 12.2(b): Protected Tree Species associated with the Proposed Development Area

12.3. SUMMARY OF POSITIVE AND NEGATIVE IMPACTS AND RISKS

The proposed project not only entails the beneficiation/ upgrading of magnetite from the adjacent Foskor site, but also the further extraction of copper from the non-magnetite tailings originating from this beneficiation process through the proposed copper flotation plant (i.e. reduce waste) which is aligned with the general duty in respect of waste management as per NEMWA. The primary positive impact associated with this project relates to the positive socio-economic impact, i.e. economic benefit that will be achieved by this project. By authorising this project, beneficiation activities will be able to continue for more or less 20 years, which is the estimated lifespan of the MWSDF. This project will therefore be able to sustain current and future employment and income opportunities for this amount of time.

The potential negative environmental impacts were assessed by a team of competent and qualified natural scientists during the EIA Phase of this project. The detailed outcome of these assessments is presented in Chapter 10 of this report and a summary of these assessments are provided in the preceding section 12.1.

The MWSDF and PCD were designed with the appropriate liner (Class C) as per legislative requirements. The proposed position of the MWSDF and the PCD is such to maintain only a contaminated catchment surrounding these facilities and to maintain the clean natural drainage paths of the area towards the Selati River.

All management measures/actions proposed in the Draft EMPr is according to latest and best practise guidelines in order to avoid, modify, remedy and/or control the negative impacts associated with the proposed activities.

All monitoring plans and actions proposed are also in line with legislative requirements to ensure compliance with the Draft EMPr and relevant legislation. The Applicant will ensure efficient and suitable training for all employees to ensure compliance with legislation and all environmental authorisations applicable.

13. PROPOSED IMPACT MANAGEMENT OBJECTIVES/OUTCOMES

This section provides the proposed impact management objectives, and the impact management outcomes identified during the Scoping Phase of the project that was now further developed for inclusion in the EMPr as well as for inclusion as conditions of authorisation.

Table 13(a) summarises the information.

Table 13(a): Summary of the Proposed Management Objectives/Outcomes as per Environmental Component

Environmental Component	Management Objective	Construction Phase Management Outcomes	Operational Phase Management Outcomes	Decommissioning and Closure Phase Management Outcomes	Post Closure Phase Management Outcomes
Socio-Cultural/ Socio-Economic Environment	Positive community liaisons.	Optimise transparent and fair local recruitment processes. Minimise nuisance factors (dust and noise) of local communities.	Support local economic development objectives. Minimise nuisance factors (dust and noise) of local communities.	Mitigate local job losses. Minimise impact on land use.	Positive community liaisons.
Archaeological and Heritage Environment	Mitigate impact on the heritage resources.	Implement chance find procedures if any heritage resources are uncovered during construction activities.	Implement chance find procedures if any heritage resources are uncovered during operational activities.	Implement chance find procedures if any heritage resources are uncovered during decommissioning activities.	None.
Palaeontological Environment	Mitigate impact on the palaeontological resources (fossils).	Implement chance find procedures if any fossils are uncovered during construction activities.	Implement chance find procedures if any fossils are uncovered during operational activities.	Implement chance find procedures if any fossils are uncovered during decommissioning activities.	None.
Soils, Land Capability & Land Use	Soil fertility that allows for stable, self-sustaining vegetation cover.	Optimise stripping and storage of soils to ensure future utilisation.	Manage and control of footprint area to prevent further loss and contamination of the resource.	Replacement of utilisable soils and morphology, soil fertility and residual contamination.	Soil fertility that supports end land use.
Groundwater Environment	Prevent contamination of the groundwater resource.	Control and manage contamination of the resource (source control measure).	Groundwater quality to be compliant with the background groundwater quality profile / WUL conditions.	Groundwater quality to be compliant with the background groundwater quality profile / WUL conditions.	Groundwater quality to be compliant with the background groundwater quality profile / WUL conditions.
Surface Water Environment	Prevent contamination of receiving environment. Prevent erosion.	Prevent contamination of receiving environment. Ensure that clean storm water runoff is free-draining.	Dirty water to be contained in PCD's. Clean water to be diverted past contaminated areas. Water contained must comply with WUL conditions.	Prevent contamination of receiving environment. Ensure that clean storm water runoff is free-draining.	Surface water quality to be compliant with resource quality objectives / WUL conditions.
Terrestrial Ecology (Plant and Animal Life)	Ensure facilities are operated /rehabilitated as per approved designs and closure plans. Survivorship of replaced protected trees. Absence of invasive alien species.	Apply for protected trees licence (clearing permits). Restrict vegetation clearance to development footprint area. Develop and implement a suitable and approved rehabilitation programme. Actively manage fauna-human interactions.	Ensure optimal operation and maintenance of facilities. Implement an invasive species programme. Implement a suitable and approved rehabilitation programme. Actively manage fauna-human interactions.	Ensure optimal operation and maintenance of facilities. Implement an invasive species programme. Implement a suitable and approved rehabilitation programme. Actively manage fauna-human interactions.	Ensure facilities are rehabilitated as per approved closure plan. Ensure survivorship of replaced protected trees. Absence of invasive alien species.

Environmental Component	Management Objective	Construction Phase Management Outcomes	Operational Phase Management Outcomes	Decommissioning and Closure Phase Management Outcomes	Post Closure Phase Management Outcomes
Aquatic Ecosystems Environment	Prevent further degradation of the aquatic ecosystem health.	Minimise footprint of vegetation clearing. Ensure suitable bufferzone around watercourses. Minimise sediment mobilisation and runoff towards the Ga-Selati.	Maintain suitable bufferzone around watercourses. Prevent potential impacts on surface water quality. Monitor water quality and remedy appropriately.	Maintain suitable bufferzone around watercourses. Prevent potential impacts on surface water quality. Monitor water quality and remedy appropriately.	Ensure no further degradation of the aquatic ecosystem health by implementing on-going maintenance, aftercare and monitoring.
Wetland Environment	Maintain PES of the Ga-Selati riparian zone and other affected watercourses.	Minimise footprint of disturbance and vegetation clearing. Limit sediment transport from the project area. Prevent degradation of habitat due to water quality contamination. Minimise fragmentation of riparian and watercourse habitat. Prevent spread of alien invasive plant species.	Limit water quality impact by isolating contaminants from water resources and controlling contaminants at source.	Prevent further disturbance and degradation of watercourse habitats on site.	Maintain PES of the Ga-Selati riparian zone and other affected watercourses.
Air Quality Environment	Conditions and targets as per Bosveld Phosphates Air Quality Management Plan, the Atmospheric Emission License and National Standards.	Control through implementing appropriate dust suppression methods and administrative measures. Control through ensuring mobile and stationary internal combustion equipment is properly serviced and operated.	Control through implementing appropriate dust suppression methods and administrative measures. Control through ensuring mobile and stationary internal combustion equipment is properly serviced and operated.	Control through implementing appropriate dust suppression methods and administrative measures. Control through ensuring mobile and stationary internal combustion equipment is properly serviced and operated.	Control through implementing appropriate dust suppression methods and administrative measures. Control through ensuring mobile and stationary internal combustion equipment is properly serviced and operated.

14. FINAL PROPOSED ALTERNATIVES

An alternative identification and motivation table (Table 8.1(a)) was compiled which provides a summary of the outcome of the alternative's assessment. Refer to Figure 8.1(a) for the alternative positions considered in terms of the proposed activities associated with this project and to Figure 8.1(b) for the site layout plan of the preferred alternative.

A large-scale version of the proposed site layout plan, indicating the preferred alternative is attached as **APPENDIX 8(A)** to this report.

This represents the final proposed alternative which respond to the impact management measures, avoidance and mitigation measure identified through the assessment.

Table 14(a): Final Proposed Alternatives

Activity	Alternative Property	Alternative Site	Alternative Type of Activity	Alternative Design/ Layout	Alternative Technology	Alternative Operational Aspects	No-Go Alternative
Magnetite Waste Site Disposal Facility (MWSDF)	Four sites were identified as alternatives. All four sites are located on the Farm Wegsteek 30, Registration Division L.U. **Site 1:** 175/1976 Surface Right belonging to Bosveld Phosphates **Site 2:** 175/1976 Surface Right belonging to Bosveld Phosphates **Site 3:** Unknown Surface Right **Site 4:** Partially located on175/1976 Surface Right belonging to Bosveld Phosphates & partially located on Base mineral claim (RMT M 45/83) DT: 03/2004 Diagram with re-registration 18/11/2005	**Site 1:** North West of Gypsum Dam A; North of Impounding Dam 2 **Site 2:** South-West of Gypsum Dam A; East of Impounding Dam 2 **Site 3:** South of the Emergency Dam Management Area; Northern corner of Southern Open Veld Management Area **Site 4:** South of the Emergency Dam Management Area; Southern corner of Southern Open Veld Management Area	A Waste Disposal Facility (disposal to landfill) is a primary requirement to cater for the disposal of tailings/ slimes generated from a beneficiation plant. The non-magnetite tailings will be stored temporarily on site until it is processed through a copper flotation plant where copper mineral will be extracted. The waste produced from this copper extraction process needs to be disposed onto an authorised waste disposal facility.	The design and layout of the proposed MWSDF is governed by the legal requirements as per the NEMWA and NWA Regulations, whilst the actual layout is a function of the site attributes where the facility will be located.	The development of the MWSDF will be done in compliance with current legal requirements and through standard best practice civil construction technologies which will be determined by the approved civil designs as well as site conditions.	The development of the MWSDF will be done in strict compliance with the DWS approved designs and the operation will be done in accordance with standard best practices and the operational plan/manual for the MWSDF.	Waste produced by a beneficiation process needs to be disposed onto an authorised waste disposal facility.
Preferred Alternative	**Sites 1, 2 and 4 are the preferred alternative sites –** Surface Rights belong to Bosveld Phosphates.	**Site 1 is the preferred alternative site –** Limited footprint available at Site 2 & 4.	**No Type of Activity Alternative.**	**No Design/ Layout Alternative**	**No Technology Alternative.**	**No Operational Aspects Alternative.**	**The no-go option will deter sustainable development.**
Access Road to the Magnetite Waste Site Disposal Facility	The Access Road is required to the new Magnetite Waste Site Disposal Facility which will be located on Bosveld Phosphates property.	There is no site alternative for the Access Road to the new Magnetite Waste Site Disposal Facility.	An Access Road for vehicular traffic is required.	The Access Road will be designed in accordance with standard best practice civil engineering requirements.	An Access Road for vehicular traffic is required.	The Access Road will be operated in compliance with the design, safety and environmental procedures as prescribed in the design report and the site EMPr.	The access road is an operational requirement.
Preferred Alternative	**Access Road to Magnetite Waste Site Disposal Facility located at the preferred alternative Site 1 – Bosveld Phosphates property.**	**The locality of the new access road is dictated by the current infrastructure and the preferred alternative site for the new Magnetite Waste Site Disposal Facility - Site 1.**	**No Type of Activity Alternative.**	**No Design/Layout Alternative.**	**No Technology Alternative.**	**No Operational Aspects Alternative.**	**The no-go option is not feasible.**
Pollution Control Dam (PCD)	Property dictated by location of the actual Magnetite Waste Site Disposal Facility – Preferred Alternative Site 1.	Dam to be downslope of the new Magnetite Waste Site Disposal Facility.	A PCD is a basic requirement for process water recovery and reticulation during tailings/ slimes storage.	The layout for the new PCD is dictated by its functional requirements, the available footprint and the liner type design as legally prescribed.	The use of PCD's for the containment of affected storm water and contaminated leachate is current best practice in South Africa.	The new PCD will be operated in strict compliance with the operational procedures as specified in the design report which is prescribed by the DWS.	The new Magnetite Waste Site Disposal Facility cannot operate without a PCD.
Preferred Alternative	**Facility located at the preferred alternative Site 1 – Bosveld Phosphates property.**	**No Alternative Site. Facility at the preferred alternative Site 1.**	**No Activity Type Alternative.**	**No Design/ Layout Alternative.**	**No Technology Alternative.**	**No Operational Aspects Alternative.**	**The no-go option is not feasible.**

Activity	Alternative Property	Alternative Site	Alternative Type of Activity	Alternative Design/ Layout	Alternative Technology	Alternative Operational Aspects	No-Go Alternative
Copper Flotation Plant	Existing Operations on Properties where the Surface Rights belong to Bosveld Phosphates.	Optimal proximity to stockpile areas, favourable transport routes, ample footprint area and will not inhibit existing or future plant activities.	Optimisation of beneficial material on or close to the Bosveld Phosphates site which contribute to the economic/ value adding potential of the site.	The design and layout of the plant are dictated by spatial attributes and functional requirements related to the extraction of copper from the non-magnetite tailings. The new Plant design and layout was therefore optimized to fit into the existing materials flow of the Bosveld Phosphates site.	The technology used for Copper extraction is determined by the nature of the feed materials.	Plant will operate in accordance with approved design specifications.	Optimisation of beneficial material on or close to the Bosveld Phosphates site which contribute to the economic/ value adding potential of the site.
Preferred Alternative	**No Alternative Property.**	**No Alternative Site.**	**No Activity Type Alternative.**	**No Design/ Layout Alternative.**	**No Technology Alternative.**	**No Operational Aspects Alternative.**	**The no-go option will deter sustainable development.**

15. ASPECTS FOR INCLUSION AS CONDITIONS OF AUTHORISATION

Table 15(a) relays aspects, as identified by each specialist and the EAP, to be included as conditions in the Environmental Authorisation.

Aspects provided in this section do not relay/ duplicate the management measures proposed in the EMPr, but provides aspects that were conditional to the findings of the assessment either by a specialist or the EAP or from comments received and considered from competent authorities and/or I&AP's.

Table 15(a): Aspects for Inclusion as Conditions of Environmental Authorisation

Environmental Component	Aspects for Inclusion as Conditions of Environmental Authorisation (as per Specialist or EAP)
Socio-Cultural/ Economic Aspects	• No additional aspects identified/ listed as conditions to be included in the Environmental Authorisation which are not proposed as management measures in the EMPr.
Archaeological, Heritage & Palaeontology Aspects	• If any heritage resources/ fossils are exposed during the proposed project, the South African Heritage Resources Authority (SAHRA) should be notified immediately, all development activities must be stopped, and an archaeologist/ palaeontologist accredited with the Association for Southern African Professional Archaeologist (ASAPA) should be notified to determine appropriate mitigation measures for the discovered finds.
Soils, Land Capability and Land Use	• The Soil Utilisation Plan developed and provided in the Soil Specialist Report (APPENDIX 8(G)) for all the life-cycle phases of the project should be implemented. This plan relates to the correct stripping and stockpiling of the soils as well as the management of the soils prior to rehabilitation.
Geology & Groundwater Aspects	• The MWSDF should be provided with a Class C liner/barrier system. • The MWSDF PCD should be provided with a Class C liner/barrier system. • During the operational phase the MWSDF PCD must be operated not to spill. • Any spillages of waste material or contaminated water must be cleaned up immediately as per a formal Spill Clean-Up Protocol. • Groundwater monitoring must be conducted as per the proposed groundwater monitoring plan detailed in the Groundwater Specialist Report (APPENDIX 8(H)). • In the unlikely event that groundwater pollution is detected by the monitoring system, groundwater remediation measures must be designed and implemented without delay to mitigate the groundwater quality impact.
Surface Water Aspects	• Refine (if necessary) and implement the Storm Water Management Plan provided in the Surface Water Specialist Report (APPENDIX 8(I)) once proposed project commences. Storm water management measures/actions are provided for each life-cycle phase of the project.
Terrestrial Ecology (Plant and Animal Life)	• Develop and implement an Alien Invasive Species Control Programme before clearance of vegetation commences. • Develop and implement a Restoration and Rehabilitation Plan in terms of the protected tree species located within the development footprint before clearance of vegetation commences.
Aquatic Ecosystems Aspects	• Bi-annual Aquatic Biomonitoring must be undertaken throughout the life of the project. Monitoring of the health and integrity of the Ga-Selati and Olifants Rivers, and monitoring of any deviations from the baseline conditions.
Wetland Aspects	• Development of a detailed Water Management Strategy /Storm Water Management Plan to prevent further contamination of the adjacent Ga-Selati River originating from activities related to this project. • The Ga-Selati River, associated riparian habitat, and 32m buffer zone must also be excluded from all disturbances.
Air Quality Aspects	• Develop and implement an Air Quality Management Plan in support of the next AEL Amendment Application and Process.
Waste Aspects	• Domestic waste or any waste generated on site should be handled, transported, and disposed off at designated landfill facilities. Hazardous waste shall be disposed off at a waste disposal facility permitted to handle such materials. Copies of the signed service agreements with the service providers or local municipality regarding the disposal of the waste should be kept on record. • Training on waste handling and other waste aspects should be provided to all contractors and employees.
Environmental Awareness/ Training	• The Environmental Awareness Plan of Bosveld Phosphates and other third parties operating on site, should be updated to ensure that awareness raising topics include/ reflect the recommendations and findings of all the environmental components assessed during this project. • All contractors and employees operating on site must receive training on relevant and applicable management measures authorised in the EMPr(s) and environmental authorisation(s) applicable to the site.

16. ASSUMPTIONS, UNCERTAINTIES AND GAPS IN KNOWLEDGE

The table below (Table 16(a)) presents Assumptions, Uncertainties and Gaps in Knowledge in terms of each Environmental Component assessed by the team of specialists, which relate to the assessment, predictive methods/models (if applied) as well as the mitigation measures proposed.

Table 16(a): Assumptions, Uncertainties and Gaps in Knowledge per Environmental Component Assessed

Environmental Component	Assumptions	Uncertainties	Gaps in Knowledge
Socio-Cultural/ Economic Aspects	Municipal and provincial trends were used as substitution for trends in the local area where up to date site specific /ward level socio-economic data were missing, Local community development priorities are expressed through public processes and public documents such as municipal integrated development plans.	The impact assessment included consultations with key stakeholders and potentially affected parties. These consultations did not form part of the formal PPP required for the overall S&EIR process, except where it was specifically specified as such during the consultation session.	Recent local ward level data (after the 2011 census) are limited and provincial and municipal trends were used where available to update certain ward level indicators.
Archaeological, Heritage & Palaeontology Aspects	The findings, observations, conclusions, and recommendations reached during the assessment are based on the specialist's author's scientific and professional knowledge/ experience and information that could be collected from spokespersons.	The study area comprised a triangular piece of land which varies from disturbed pieces of land to patches where no development has occurred. It was not possible to survey the total surface area on foot because of areas with thick impenetrable vegetation cover.	It is possible that not all heritage resources were recorded in the project area. Heritage resources, particularly graves, may occur in tall grass or thick clumps of vegetation whilst others may be located below the surface and may only be exposed once development commences. Heritage resources may also simply have been missed because of human failure to observe or to recognise them as such.
Soils, Land Capability and Land Use	The project description included the total area of possible disturbance and that the development plan provided caters for all activities (existing and cumulative) that could potentially have an impact on the soils and land capability. Recommendations made from the baseline study and impact significance ratings will need to be re-assessed if the development plan changes. The project area has been mapped on a detailed grid base of which the degree and intensity of mapping and geochemical sampling being considered and measured based on the complexity of the soils noted in field during the field mapping, the interplay of geomorphological aspects (ground roughness, slope, aspect and geology etc.) and the development being considered.	Limitations to the accuracy of the pedological mapping (as recognised within the pedological industry) are accepted at between 50% (reconnaissance mapping) and 80% (detailed mapping), while the degree of certainty for the soils physical and chemical (analytical data) results has been based on "composite" samples taken from the dominant soil types mapped in the project area. The uncertainties are limited to the finalisation of the MWSDF design and a detailed description of the development/ construction methods to be used. It has been assumed that the project description is final, and that surface disturbance will be limited to the development footprint as delineated.	No knowledge gaps identified.

Environmental Component	Assumptions	Uncertainties	Gaps in Knowledge
Geology & Groundwater Aspects	The predictive methods used throughout the groundwater specialist assessment adhered to the relevant regulating requirements. The assumption is, however, made that the parameters used in the model domain(s) are representative of that specific material across the entire area of investigation. The groundwater modelling was performed subject to the source-pathway-receptor hierarchy, and investigated the mobilisation of soluble/mobile contaminants through the material and into the subsurface, the mixing of these contaminants within the saturated zone, as well as the subsequent lateral migration of these contaminants away from the potential points of infiltration within the saturated zone, assuming that all the contaminants are mobile and conservative, i.e. they won't break down or chemically react within the groundwater system. It is important to note here that a model is a simplification of a real-world system and is only used as a simulation of the real-world situation. The models will be used as indicative tools and are only as accurate as the data that is defined and inserted into the model.	Except for the laboratory test results, all the information used during the groundwater specialist assessment was quantitatively obtained from and verified during the various investigations undertaken on site. All water samples analysed over the years for the site, were conducted by reputable and, where relevant, accredited laboratories. Sampling frequencies furthermore support the potential variability in groundwater levels and qualities and do represent a time series over several hydrological years.	The groundwater specialist assessment was specifically undertaken with reference to the activities which are proposed to be developed at Bosveld Phosphates. All the information used was quantitatively obtained from and verified during the various investigations undertaken on site or from the proposed designs and corresponding design reports to ensure that all knowledge gaps are adequately addressed.
Surface Water Aspects	The surface water specialist study was limited to the north-western open veld management area only and assumes that the proposed surface footprint of the project will stay within the confines as depicted in the layout maps provided for this project. It was assumed that the layout will consist of components stipulated in the final project layout and descriptions that were approved by the applicant. Furthermore, that the pumped abstraction from the PCD will always be available to be received within the plant processes and that the project proponent will always strive to avoid, mitigate and/or offset potentially negative project related impacts on the environment, with impact avoidance being considered the most successful approach, followed by mitigation and offset. In addition, that the project proponent will seek to enhance potential positive impacts on the environment.	Hydrological assessments are based on a selection of available techniques that have been developed through the Department of Water and Sanitation (DWS) as well as the Water Research Council (WRC) based on site conditions and applicability. These techniques are however largely qualitative in nature with associated limitations due to the range of interdisciplinary aspects that have to be taken into consideration.	Historical evaporation records for the site were not available, an average evaporation dataset was applied to the water balance model. The PCD water balance has been developed which quantified volumes of water abstractions however these volumes will be updated during the operation of the extension of the mine workings;

Environmental Component	Assumptions	Uncertainties	Gaps in Knowledge
Surface Water Aspects	Finally, that project proponent will commission additional studies to assess the impact(s) if there is a change in the size, location and/or extent of the study area that is likely to have a potentially highly significant and/ or unavoidable impact on the natural environment.		
Terrestrial Ecology (Plant and Animal Life)	The delineation of vegetation communities for the vegetation map was conducted based on a subjective interpretation of available Google Earth imagery supported by field observations, and is therefore limited to the spatial and resolution accuracy of the imagery.	Flora field work focusing on the project area was conducted over one survey period in mid-April. It is thus possible that small, short-lived annuals, geophytes or cryptic species that are only visible when in flower and/or at specific times of the year may be overlooked during the field visit. The absence or non-recording of a specific fauna species, at a particular time, does not necessarily indicate that 1) the species does not occur there; 2) the species does not utilise resources in that area; or 3) the area does not play an ecological support role in the ecology of that species. Given the difficulty in fully sampling and characterising the abundance and distribution of fauna species during the short period of time allocated to field work, the baseline description was qualitative.	Field work was conducted at the end of April, which constitutes the late wet-season. Field data for the local study area was therefore not collected during the peak wet-season when both flora and fauna productivity/ activity/ presence is generally highest, nor during the dry season.
Aquatic Ecosystems Aspects	There are no assumptions, uncertainties and/or knowledge gaps for the study area relating to the aquatic ecosystem. Much historical and reference data is available for the study area, and subsequently included within this aquatic specialist report.		
Wetland Aspects	Wetland boundaries reflect the ecological boundary where the interaction between water and plants influences the soils, but more importantly the plant communities. The depth to the water table where this begins to influence plant communities is approximately 50 centimetres. This boundary, based on plant species composition, can vary depending on antecedent rainfall conditions, and can introduce a degree of variability in the wetland boundary between years and/or sampling period. A two-day site visit was undertaken on the 28 - 29 March 2022. All suspected wetland and riparian habitat identified off aerial imagery and/or observed on site was visited in the field and delineated.	No uncertainties identified.	Reference conditions of the wetland and riparian habitats are unknown. This limits the confidence with which the present ecological category (PES) is assigned.

Environmental Component	Assumptions	Uncertainties	Gaps in Knowledge
Wetland Aspects	Due to the scale of the remote imagery used (1:10 000 orthophotos and Google Earth Imagery), as well as the accuracy of the handheld GPS unit used to delineate wetland and riparian areas in the field, the delineated boundaries cannot be guaranteed beyond an accuracy of about 15m on the ground. Should greater mapping accuracy be required, the wetlands and/or riparian areas would need to be pegged in the field and surveyed using conventional survey techniques. In addition, it is recognised that the passage of time may affect the information and assessment provided. Opinions are therefore based upon the information that was made available and which existed at the time of this assessment.		
Air Quality Aspects	The impact assessment was limited to routine emissions from the process, including criteria process emissions and particulate emissions from mobile equipment operation, material handling and fugitive emissions. Vehicle tailpipe emissions were not quantified due to the relatively low expected risk. Routine emissions for the proposed operations were simulated. Atmospheric releases occurring due to non-routine conditions were not accounted for. All sources were digitised from site layout diagrams provided by JMA Consulting and Bosveld Phosphates. The amount of surface area available to wind erosion for all stockpiles was conservatively assumed to be 85%. Copper Flotation Plant raw material rate of 38.5 tonnes per hour, 24 hours per day, 27 days per month and 325 days per year. Magnetite Waste Site Disposal waste rate of 38.1 tonnes per hours, 24 hours per day, 27 days per month and 325 day per year. Construction, operational and rehabilitation activities to occur concurrently. The report was compiled with due consideration of all process information and specific conditions outlined by JMA Consulting and Bosveld Phosphates.	No uncertainties identified.	Unified model meteorological data for the period 1 September 2020 to 31 August 2021, supplied by Meteoblue was used to determine dispersion potential for the baseline assessment. Unified model meteorological data for the period 1 September 2021 to 31 August 2022, supplied by Meteoblue was used to determine dispersion potential for the impact study. Ambient monitoring data from the Phalaborwa station was included in the study.

17. REASONED OPINION FOR AUTHORISATION

17.1. REASONS FOR AUTHORISATION

The proposed project not only entails the beneficiation/ upgrading of magnetite from the adjacent Foskor site, but also the further extraction of copper from the non-magnetite tailings originating from this beneficiation process through the proposed copper flotation plant (i.e. reduce waste) which is aligned with the general duty in respect of waste management as per NEMWA. The primary positive impact associated with this project relates to the positive socio-economic impact, i.e. economic benefit that will be achieved by this project. By authorising this project, beneficiation activities will be able to continue for more or less 20 years, which is the estimated lifespan of the MWSDF. This project will therefore be able to sustain current and future employment and income opportunities for this amount of time.

The potential negative environmental impacts were assessed by a team of competent and qualified natural scientists during the EIA Phase of this project. The detailed outcome of these assessments is presented in Chapter 10 of this report and a summary of these assessments are provided in the preceding section 12.1.

The MWSDF and PCD were designed with the appropriate liner (Class C) as per legislative requirements. The proposed position of the MWSDF and the PCD is such to maintain only a contaminated catchment surrounding these facilities and to maintain the clean natural drainage paths of the area towards the Selati River.

All management measures/actions proposed in the Draft EMPr is according to latest and best practise guidelines in order to avoid, modify, remedy and/or control the negative impacts associated with the proposed activities.

All monitoring plans and actions proposed are also in line with legislative requirements to ensure compliance with the Draft EMPr and relevant legislation. The Applicant will ensure efficient and suitable training for all employees to ensure compliance with legislation and all environmental authorisations applicable.

17.2. CONDITIONS TO BE INCLUDED IN AUTHORISATION

Conditions for approval remain the prerogative and responsibility of the relevant regulating authority(ies). However, the recommendations for approval by the team of specialists is relayed in section 15 of this report and that of the EAP is made subject to the following conditions:

- That all aspects listed for inclusion as conditions in Table 15(a) of this EIAR be considered for inclusion as conditions for approval.
- That upon approval, the Draft EMPr, be implemented as proposed (technical details of management measures proposed contained in each specialist report compiled in support of this project), or alternatively with motivated alterations.
- That environmental management measures be adapted, or continued, based on the outcome of the monitoring and auditing programmes as well as best practice technologies.
- That on-going monitoring and auditing, also as proposed in the EMPr be conducted during the life span of the project, or alternatively with motivated alterations.

18. PERIOD OF ENVIRONMENTAL AUTHORISATION

Proposed activities associated with this project relate to beneficiation operations to be undertaken at Bosveld Phosphates.

Most of the designs for operational facilities are done for time periods varying between 20 and 30 years. The life span of the MWSDF will be constrained by its depositional capacity which is estimated at **20 years**, it would therefore seem realistic to request that the environmental authorisations to be granted, be granted for a time period of **at least 20 -30 years**.

19. UNDERTAKING BY THE EAP

19.1. CORRECTNESS OF INFORMATION IN REPORTS

I, **René van Greunen**, duly appointed by Bosveld Phosphates (Pty) Ltd, in terms of the provisions of the National Environmental Management Act, Act No.107 of 1998, and the EIA Regulations, GNR 982 of 4 December 2014 (as amended), as the EAP managing this application, hereby confirms that as far as my knowledge goes, the information provided in the EIAR, the EMP, as well as the supporting Specialist Reports are correct.

19.2. INCLUSION OF COMMENTS AND INPUTS FROM I&AP'S

I, **René van Greunen**, duly appointed by Bosveld Phosphates (Pty) Ltd, in terms of the provisions of the National Environmental Management Act, Act No.107 of 1998, and the EIA Regulations, GNR 982 of 4 December 2014 (as amended), as the EAP managing this application, hereby confirms that all comments and inputs from Stakeholders and I&AP's were included in the Issues and Comments Register of this project and were duly considered throughout the S&EIR process.

19.3. INCLUSION OF INPUTS AND RECOMMENDATIONS FROM SPECIALIST REPORTS

I, **René van Greunen**, duly appointed by Bosveld Phosphates (Pty) Ltd, in terms of the provisions of the National Environmental Management Act, Act No.107 of 1998, and the EIA Regulations, GNR 982 of 4 December 2014 (as amended), as the EAP managing this application, hereby confirms that all inputs and recommendations from Specialist Reports, including but not restricted to baseline descriptions, impact significance ratings, proposed impact management measures, as well as monitoring proposals, were duly, where practicable, included in the EIAR and EMP.

19.4. INFORMATION PROVIDED AND RESPONSES TO I&AP'S

I, **René van Greunen**, duly appointed by Bosveld Phosphates (Pty) Ltd, in terms of the provisions of the National Environmental Management Act, Act No.107 of 1998, and the EIA Regulations, GNR 982 of 4 December 2014 (as amended), as the EAP managing this application, hereby confirms the correctness of all information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested and affected parties, and as duly recorded in the formal Public Participation Programme Report and also in the Issues and Comments Register of this project presented in section 8.3 of this EIAR.

Respectfully submitted

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René van Greunen (EAP; Pr.Sci.Nat.)

on behalf of

JMA Consulting (Pty) Ltd

20. DEVIATIONS FROM SCOPING REPORT AND PLAN OF STUDY

20.1. DEVIATIONS FROM IMPACT ASSESSMENT METHODOLOGY

No deviations were made in terms of the methodology used in determining the significance of the potential environmental impacts and risks as contemplated in the accepted Scoping Report.

20.2. MOTIVATION FOR DEVIATION

There is no motivation for deviation required as far as the methodology used in determining the significance of the potential environmental impacts and risks is concerned, as no deviations occurred in this regard.

21. OTHER INFORMATION REQUIRED BY THE COMPETENT AUTHORITY

21.1. IMPACT ON SOCIO-ECONOMIC CONDITIONS OF DIRECTLY AFFECTED PERSONS

Table 21.(a) shows the expected potential impacts associated with the proposed project from a Socio-Economic perspective. The proposed project is expected to have positive impacts (rated medium) in terms of local job creation and income generating opportunities as well as supporting the local development objectives to reclaim and beneficiate mine waste.

The majority of the potential negative impacts identified related to the proposed project is expected to be low. Nuisance factors associated with dust from the MWSDF rated as medium during the operational phase. The long-term loss of land use is also rated as a medium negative impact although the actual value of the land lost is rated low from an economic perspective.

Table 21(a): Potential Socio-Economic Impacts associated with the project

Phase	Potential Impact Description	Significance if NOT Managed	Significance if Managed
Construction	Employment and income	**LOW +**	**MEDIUM +**
	Safety and security	**Low -**	**Low -**
	Nuisance factors	**Low -**	**Low -**
	Informal and formal population influx	**Low -**	**Low -**
Operations	Employment and income	**LOW +**	**MEDIUM +**
	Support of local economic development objectives	**MEDIUM +**	**MEDIUM +**
	Nuisance factors	**Medium -**	**Medium -**
	Increased economic concentration	**Medium -**	**Low -**
	Increased local water consumption	**Medium -**	**Low -**
Decommissioning and Closure	Job and income losses	**Medium -**	**Low -**
	Nuisance factors	**Low -**	**Low -**
	Permanent loss of land use	**Medium -**	**Medium -**

Table 21(b) summarizes the proposed socio-economic management plan for the proposed project.

Table 21(b): Socio-Economic Management Plan

Phase	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)
Construction	Employment and income	Optimise recruitment of unskilled labour from local communities	1) Local recruitment
	Safety and security	Follow a transparent and fair local recruitment process	1) Work with local leaders in the procurement of local labour
			2) Develop and implement a clear communication strategy

Phase	Potential Impact Description	Management Objective/Outcome	Management Measures (Actions)
Construction	Nuisance factors	Minimise nuisance factors (dust and noise) for local communities	1) Establish communication channels with local landowners
			2) Implement management of air quality reports
	Informal and formal population influx	Optimise recruitment of unskilled labour from local communities	1) Recruit unskilled labour from local area
			2) Verify local status of applicants
Operational	Employment and income	Optimise recruitment of labour and inputs from local area	1) Recruit workers of MWSDF from the local area
			2) Maximise local procurement
	Support of local economic development objectives	Support local economic development objectives	1) Facilitate the further beneficiation of waste
	Nuisance factors	Minimise nuisance factors (dust and noise) for local communities	1) Adherence air quality management plan
			2) Establish local forum
			3) Register local community complaints through register
	Increased economic concentrations	Contribute to diversification of the local economy	1) Focus local procurement programme on non-core inputs
	Increased local water resource consumption	Minimise water consumption	1) Develop a plan to ensure optimal water use on the MWSDF
Decommissioning and Closure	Job and income losses	Minimise local job losses	1) Prepare workforce a year in advance
			2) Make use of local labour force in dismantling of structure
			3) Develop mechanisms to assist employees, prior to retrenchment date in the transition phase after closure
	Nuisance factors (noise and dust)	Minimise nuisance factors (dust and noise) for local communities	1) Liaise on a regular basis with the relevant community forum
			2) Maintain the grievances register
	Permanent loss of land use	Minimise loss of local land use	1) Formulate and implement an alternative land-use and rehabilitation plan

21.2. IMPACT ON THE NATIONAL ESTATE (SECTION 3(2) OF THE NHRA)

South Africa's heritage resources ('national estate') are protected by international, national and regional legislation which provides regulations, policies and guidelines for the protection, management, promotion and utilisation of heritage resources. South Africa's 'national estate' includes a wide range of various types of heritage resources as outlined in Section 3 of the National Heritage Resources Act (NHRA, Act No. 25 of 1999) and comprises of the following:

- Archaeological artefacts, structures and sites older than 100 years
- Ethnographic art objects (e.g. prehistoric rock art) and ethnography
- Objects of decorative and visual arts
- Military objects, structures and sites older than 75 years
- Historical objects, structures and sites older than 60 years
- Proclaimed heritage sites
- Graveyards, burial grounds and graves older than 60 years
- Meteorites and fossils
- Objects, structures and sites or scientific or technological value.

Elaborating on the above the 'national estate' also includes:

- Places, buildings, structures and equipment of cultural significance
- Places to which oral traditions are attached or which are associated with living heritage
- Historical settlements and townscapes
- Landscapes and features of cultural significance
- Geological sites of scientific or cultural importance
- Archaeological and paleontological sites of importance
- Sites of significance relating to the history of slavery
- Movable objects (e.g. archaeological, paleontological, meteorites, geological specimens, military and ethnographic objects, books etc.)

21.2.1. Legislation Relevant to Heritage Resources

The identification, evaluation and assessment of heritage resources in South Africa are regulated by the following legislation:

- National Environmental Management Act (NEMA); Act No.107 of 1998
- National Heritage Resources Act (NHRA); Act No. 25 of 1999
- National Heritage Council Act; Act No. 11 of 1999

At a national level, heritage resources are dealt with by the National Heritage Council Act and the National Heritage Resources Act.

At the provincial level, heritage legislation is implemented by Provincial Heritage Resources Agencies (PHRAs) which apply the NHRA together with provincial government guidelines and strategic frameworks. Metropolitan or Municipal (local) policy regarding the protection of cultural heritage resources is also linked to national acts and is implemented by the South African Heritage Resources Agency (SAHRA) and the Provincial Heritage Resources Agencies.

21.2.2. Heritage Impact Assessment (HIA) Studies

According to Section 38 of the NHRA a Heritage Impact Assessment (HIA) process must be followed under the following circumstances:

- The construction of a linear development (road, wall, power line, canal etc.) exceeding 300 *m* in length
- The construction of a bridge or similar structure exceeding 50 *m* in length
- Any development or activity that will change the character of a site and which exceeds 5 000 m^2 or which involve three or more existing erven or subdivisions thereof
- Re-zoning of a site exceeding 10 000 m^2
- Any other category provided for in the regulations of SAHRA or a provincial heritage authority

21.2.3. HIA for Bosveld Phosphates

A Phase I Heritage Impact Assessment (HIA) study as required in terms of Section 38 of the National Heritage Resources Act (Act 25 of 1999) was done for the proposed project area on the Farm Wegsteek 31LU in the Limpopo Province.

The aims of the Phase I HIA were the following:

- To establish whether any of the types and ranges of heritage resources ('national estate') as outlined in Section 3 of the National Heritage Resources Act (Act 25 of 1999) (except paleontological) remains do occur in the project area.
- To determine the significance of these heritage resources and whether they will be affected by the proposed project.
- To propose mitigation measures for those heritage resources that may be affected by the proposed project.

The Phase I HIA study for the proposed project revealed none of the types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act (No 25 of 1999) were found in the project area.

21.2.4. Chance Find Procedure

Due to the nature of the assessment, it is possible that not all heritage resources were recorded in the project area because the total surface area could not be covered on foot. Excluding the size of the project area other reasons included the fact that heritage resources, particularly graves, may occur in tall grass or thick clumps of vegetation whilst others may be located below the surface and may only be exposed once development commences. Heritage resources may also simply have been missed because of human failure to observe or to recognise them as such. Therefore chance-find procedures must be implemented during the implementation of the proposed project, which are applicable during the construction, operation, or closure phases of the project.

The chance-find procedures apply to all contractors, subcontractors, subsidiaries, or service providers. If any of these institutions' employees find any heritage resources during any developmental activity all work at the site must be stopped and kept on hold. Chance-finds must be reported to supervisors and through supervisors to the senior manager on site. Chance-find procedures are summarised for heritage resources and graveyards.

21.2.4.1. Chance-find procedures for heritage resources

The initial procedure to follow whenever heritage resources are uncovered during development is aimed at avoiding any further possible damage to the heritage resources, namely:

- The person or group (identifier) who identified or exposed the heritage resource or graves must cease all activity in the immediate vicinity of the site.
- The identifier must immediately inform the senior on-site manager of the discovery.
- The senior on-site manager must make an initial assessment of the extent of the find and confirm that further work has stopped and ensure that the site is secured, and that controlled access is implemented.
- The senior on-site manager should inform the Environmental Officer and Health and Safety officers of the chance-find and its immediate impact on the proposed project. The Environmental Officer will then contact the project archaeologist.
- The project archaeologist will do a site inspection and confirm the significance of the discovery, recommend appropriate mitigation measures to the industry and notify the relevant authorities.
- Based on the comments received from the authorities the project archaeologist will provide the site with a terms of reference report and associated costs if mitigation measures must be implemented.

21.2.4.2. Chance-find procedures for graves

If previously unidentified graves are uncovered and/or exposed during any of the developmental phases of the proposed project, the following steps must be implemented after those outlined above:

- The project archaeologist must confirm the presence of graveyards and graves and follow the following procedures;
- Inform the local South African Police Service (SAPS) and traditional authority.
- The project archaeologist in conjunction with the SAPS and traditional authority will inspect the possible graves and make an informed decision whether the remains are of forensic, recent, cultural-historical or of archaeological significance.
- Should it be concluded that the find is of heritage significance and therefore protected in terms of heritage legislation the project archaeologist will notify the relevant authorities.
- The project archaeologist will provide advice about mitigation measures for the graveyards and graves.

21.2.4.3. Chance-find procedures for fossils

If fossils are uncovered in the alluvial deposits during the course of development it will create a unique opportunity to explore the area for fossils. It is thus recommended that if fossils are exposed in the alluvial deposits as a result of development activities, a qualified palaeontologist must be contacted to assess the exposure for fossils before further development takes place so that the necessary rescue operations are implemented. Depending on the nature of the fossils discovered this could entail excavation and removal to a registered palaeontological museum collection. A list of professional palaeontologists is available from South African Heritage Resources Agency (SAHRA).

22. REQUIREMENTS IN TERMS OF SECTION 24(4)(a) AND (b) OF THE ACT

An Environmental Impact Assessment Report checklist Table (Table 22(a)) has been compiled in accordance with the guideline as set out in the EIA Regulations (GNR 982) of 04 December 2014 (as amended); Appendix 4.

Table 22(a) serves to show that the Appendix guideline has been adhered to when compiling this report.

The chapter which relays the specific information required as per the regulation is given in the second column of Table 22(a).

Table 22(a): An Environmental Impact Assessment Report Checklist Table

Environmental Impact Assessment Report Guideline - Appendix 3 GNR 982 EIA Regulations 04 December 2014 as amended	
Headings	**Section**
Environmental Practitioner (EAP)	
Details of the EAP who prepared the report	2
Expertise of the EAP	2
CV of the EAP	2
Location of Activity	
Location of Activity - 21 digit Surveyor General code	3
Location of Activity - Physical address	3
Location of Activity - Farm name	3
** coordinates of boundary of the property*	3
Map/ Plan which locates Proposed Activity as well as associated Infrastructure	3
**linear activity = description and coordinates of the corridor in which the proposed activity is to be undertaken*	3
**property not defined = coordinates within which the activity is to be undertaken*	3
Description of the Scope of the proposed Activity	
All listed and specified activities triggered and being applied for	4
Description of the associated structures and infrastructure related to the development	4
Description of the Policy and Legislative Context	
Identification of all legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks applicable to this activity and have been considered in preparation of this report	5
How the proposed activity complies with and responds to the legislation and policy context, plan guidelines, tools and frameworks and instruments	5
Motivation for the Need and Desirability for the Proposed Development	
Need and desirability for the proposed development and the need and desirability of the activity in the context of the preferred location	6
Motivation for the Preferred Development footprint within the approved site	7
Description of the Process followed to reach the Proposed Development footprint within the approved site	
Details of the development footprint alternatives considered	7 & 8.1
Details of the PPP undertaken in terms of regulation 41 of the Regulations, including copies of the supporting documents and inputs	8.2
Summary of issues raised by IAPs and an indication of the manner in which the issues were incorporated, or the reasons for not including them	8.3
Environmental attributes associated with the development footprint alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects	8.4
Impacts and risks identified including the nature, significance, consequence, extent, duration and probability of impacts, including the degree to which these impacts can (a) be reversed (b) may cause irreplaceable loss of resources and (c) can be avoided, managed or mitigated.	8.5
The methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks	8.6

Environmental Impact Assessment Report Guideline - Appendix 3 GNR 982 EIA Regulations 04 December 2014 as amended	
Headings	**Section**
Positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community that may be affected focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects	8.7
Possible mitigation measures that could be applied and level of residual risk	8.8
If no alternative development locations for the activity were investigated, the motivation for not considering such	8.9
Concluding statement indicating the preferred alternative development location within the approved site	8.10
A full description of the process undertaken to identify, assess and rank the impacts of the activity and associated structures and infrastructure will impose on the preferred location through the life of the activity, including (a) a description of all environmental issues and risks that were identified during the environmental impact assessment process and (b) an assessment of the significance of each issue and risk and an indication of the extent to which the issue and risk could be avoided or addressed by the adoption of mitigation measures	
A Description of all environmental issues and risks that were identified during the environmental impact assessment process	9
An assessment of the significance of each issue and risk and an indication of the extent to which the issue and risk could be avoided or addressed by the adoption of mitigation measures	9
Assessment of each identified Potentially significant Impact and Risk including	
Cumulative impacts	10.1
The nature, significance and consequences of the impact and risk	10.2
The extent and duration of the impact and risk	10.2
The probability of the impact and risk occurring	10.2
The degree to which the impact and risk can be reversed	10.2
The degree to which the impact and risk may cause irreplaceable loss of resources	10.2
The degree to which the impact and risk can be avoided, managed or mitigated	10.2
Summary of the Findings and Recommendations of any specialist report complying with Appendix 6 to these Regulations and an indication as to how these findings and recommendations have been included in the final report	11
An Environmental Impact Statement which contains	
Summary of key findings of the environmental impact assessment	12.1
Map at an appropriate scale which superimposes the proposed activity and its associated structures and infrastructure on the environmental sensitivities of the preferred site indicating any areas that should be avoided, including buffers	12.2
Summary of the positive and negative impacts and risks of the proposed activity and identified alternatives	12.3
Recommendations from specialist reports, the recording of Proposed Impact Management Objectives, and the Impact Management Outcomes for the development for inclusion in the EMPr as well as for inclusion as conditions of authorisation	13
The final Proposed Alternatives which respond to the Impact Management Measures, Avoidance, and Mitigation Measures identified through the assessment	14
Any Aspects which were conditional to the findings of the assessment either by the EAP or specialist which are to be included as conditions of authorisation	15
A description of Assumptions, Uncertainties and Gaps in knowledge which relate to the Assessment and Mitigation Measures proposed	16
Reasoned Opinion as to whether the proposed activity should or should not be authorised and if the opinion is that it should be authorised any conditions that should be made in respect of that authorisation	17
Where the proposed activity does not include operational aspects, the Period for which the environmental authorisation is required, the date on which the activity will be concluded, and the post construction monitoring requirements finalised	18
Undertaking under oath or affirmation by the EAP in relation to	19
The correctness of information provided in the reports	19
The inclusion of comments and inputs from stakeholders and IAPs	19
The inclusion of inputs and recommendations from the specialist reports where relevant	19
Any information provided by the EAP to IAPs and any responses by the EAP to the comments or inputs made by interested and affected parties	19

Environmental Impact Assessment Report Guideline - Appendix 3 GNR 982 EIA Regulations 04 December 2014 as amended	
Headings	**Section**
An Indication of any Deviation from the approved Scoping Report, including the Plan of Study, including	20
Any deviation from the methodology used in determining the significance of potential environmental impacts and risks	20
Motivation for the deviation	20
Any specific Information that may be required by the CA	21
Any other matters required in terms of section 24(4)(a) and (b) of the Act	22

Table 22(b) serves to show that section 24(4)(a) and (b) of the Act have been adhered to when compiling this report.

The chapter which relays the specific information required as per the regulation is given in the second column of the Table.

Table 22(b): Section 24(4)(a) and (b) of the Act Checklist Table

24 (4)	Procedures for the investigation, assessment and communication of the potential consequences or impacts of activities on the environment -	
(a)	**must ensure, with respect to every application for an environmental authorisation -**	**Section**
(i)	coordination and cooperation between organs of state in the consideration of assessments where an activity falls under the jurisdiction of more than one organ of state;	N/A
(ii)	that the findings and recommendations flowing from an investigation, the general objectives of integrated environmental management laid down in this Act and the principles of environmental management set out in section 2 are taken into account in any decision made by an organ of state in relation to any proposed policy, programme, process, plan or project;	5 of EIAR
(iii)	that a description of the environment likely to be significantly affected by the proposed activity is contained in such application;	8 of EIAR
(iv)	investigation of the potential consequences for or impacts on the environment of the activity and assessment of the significance of those potential consequences or impacts; and	9 & 10 of EIAR
(b)	**must include, with respect to every application for an environmental authorisation and where applicable-**	**Section**
(i)	investigation of the potential consequences or impacts of the alternatives to the activity on the environment and assessment of the significance of those potential consequences or impacts, including the option of not implementing the activity;	8 of EIAR
(ii)	investigation of mitigation measures to keep adverse consequences or impacts to a minimum;	8, 13 of EIAR & 5 of EMPR
(iii)	investigation, assessment and evaluation of the impact of any proposed listed or specified activity on any national estate referred to in section 3(2) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999), excluding the national estate contemplated in section 3(2)(i)(vi) and (vii) of that Act;	10, 21 of EIAR
(iv)	reporting on gaps in knowledge, the adequacy of predictive methods and underlying assumptions, and uncertainties encountered in compiling the required information;	16 of EIAR
(v)	investigation and formulation of arrangements for the monitoring and management of consequences for or impacts on the environment, and the assessment of the effectiveness of such arrangements after their implementation;	6 of EMPR
(vi)	consideration of environmental attributes identified in the compilation of information and maps contemplated in subsection (3); and	8 of EIAR
(vii)	provision for the adherence to requirements that are pre scribed in a specific environmental management Act relevant to the listed or specified activity in question	5 of EIAR

END OF EIAR