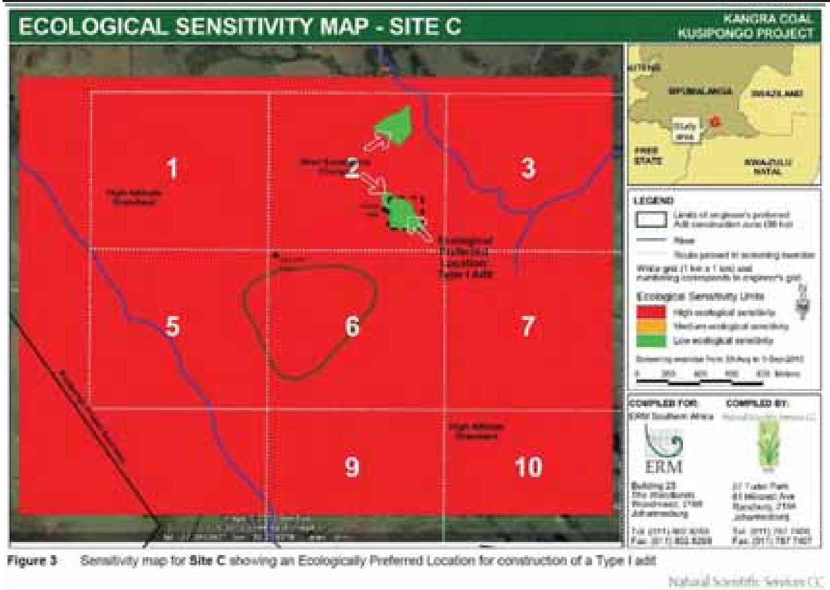
Figure 7.4 Ecological Sensitivity Map - Site C



Hydrgeological Aspects

From a hydrogeological point of view, and considering groundwater depth, topography, coal type and seam depth, and the proximity of springs and rivers to development areas, it was concluded that Site A and Site B are not hydrogeologically significantly different from each other.

At Site A, the topography and water levels are slightly higher and deeper respectively, and considering that Site A is in closer proximity to an already impacted area (Maquasa West operations), it was preferred over the more pristine environment at Site B.

The hydrogeological study recommended locations within quadrant 6 at Site A or quadrants 6 or 10 in Site B (*Figure 7.1*).

Social Aspects

The high level site social screening assessment (without any engagement and interaction with potentially affected stakeholders) concluded that Site A is the more appropriate area for placing a main mine Adit.

7.2.2 Environmental Site Screening Conclusions

Agreement was reached within all disciplines assessed, that Site A is the preferred site for the main mine Adit development. It was also concluded that Sites A and B are acceptable for the construction of ventilation Adits.

These studies, however recommended preferred locations for each Adit development on each site. Given the ecological sensitivities of the Project area, the Ecological Preferred Locations (as presented in *Figure 7.2*, *Figure 7.3*, and *Figure 7.4*) should be considered during the design phase of the Project.

7.3 HATCH PRE-FEASIBILITY STUDY – FEL2

In parallel to ERMs Site Screening Assessment, Hatch carried out a Pre-Feasibility Study (FEL 2), in which they considered Adit configurations involving Sites A, B and C (Refer to *Figure 7.1*). This was later refined in the FEL3 (Feasibility Study), based on a better understanding of the resource and resultant mine design, eliminating the need for a second ventilation site at C:

7.3.1 Preferred Option – Main Mine Adit at Site A

This option requires that the following Adit configurations be constructed at the following sites:

- *Site A* – Main Mine Adit;
- *Site B* – Ventilation Adit.

Please Note *– the description for the Preferred Option Adit configuration is the option selected in this study, and as such is detailed in Chapter 2 (Project Description).*

7.3.2 *Alternative 1 – Main Mine Adit at Site B*

This alternative requires that the following Adit configurations be constructed at the following sites:

- *Site A* – Ventilation Adit; and
- *Site B* – Main Mine Adit.

In this Alternative the following will be required:

- The existing gravel district road to Site A will provide access to the site and will be maintained by the district authorities.
- A gravel service road will be constructed to Site B in alignment with existing farm tracks.
- A community consisting of approximately 12 households will need to be relocated from the area of Site B to an area which is situated outside a 500m buffer zone from the perimeter of the mine workings.
- Potable water will be supplied to the new development from the existing facilities at Maquasa East. This proposed new route will follow the proposed new corridor from Maquasa East through to Site B.
- A proposed overland conveyor system between Site B and the existing conveyor system between Maquasa West Adit and Maquasa east.
- In addition to the potable pipeline and overland conveyor system, an OHTL from Maquasa West Adit, which will feed the conveyor belt drive units, will also be included in the corridor. The corridor will be fenced with a security fence to restrict access.
- A number of implement/vehicle cross-over's along the conveyor belt route.
- The coal quality at Site B is such that the first couple million tons might not be considered marketable coal. As such, if the Main Mine Adit were developed at Site B, the Main Mine Adit would require a much larger low-quality coal discard dump in comparison to having the Main Mine Adit at Site A.

7.3.3 *Alternative 2 – No Main Mine Adit/Full Underground Mining Option*

In this alternative all mining activities are to take place underground. This alternative requires that only ventilation adits be constructed at the following sites:

- *Site A* – Ventilation; and
- *Site B* – Ventilation.

In this Alternative the following will be required:

- The existing gravel road to Site A will provide access to the site and it is assumed that the road will be maintained by the district authorities.
- A gravel service road through to Site B will be constructed along existing farm tracks.

The main electrical supply by Eskom will terminate at the proposed substation at Site B.

7.3.4 *Alternative 3 – <u>Main Mine Adit at Site A and No Overland Conveyor</u>*

This alternative requires that the following Adit types be constructed at the following sites:

- *Site A* – Main Mine Adit; and
- *Site B* – Ventilation.

Please Note – the layout of the Main Mine Adit at Site A in this alternative will be similar to that of the Main Mine Adit at Site A in the preferred option (as described in *Chapter 2* of this report); however, *coal will be transported underground from the Adit to existing works at Maquasa West where it will then be brought to the surface for processing in the existing coal processing plant*. The differences to the Main Mine Adit in this alternative (when compared to the Main Mine Adit in the preferred option) will include the following:

- The near horizontal decline shaft will not accommodate a conveyor to bring coal to the surface.
- No product silos or overflow stockpiling areas shall be constructed.
- No additional screens and crushers or recycle-conveyor belts, feeder breakers and recycle chutes will be constructed.
- No new overland conveyors and /or transfer stations will be constructed.
- No new conveyor system for the cross-over for vehicles and implements, livestock and surrounding community members will be constructed.

In this Alternative the following will be required:

- It is assumed that the existing gravel district road will be maintained by the district authorities.
- A gravel service road through to Site B will be constructed along existing farm tracks.
- A relatively large number of households (approximately 20) will need to be relocated from Site A to outside a buffer of 500m around the perimeter of the mine workings.
- Potable water will be supplied to the new development from the existing facilities at the Maquasa West Adit. The corridor will be between the Maquasa West Adit and Site A.
- The main electrical supply by Eskom will terminate at the proposed substation at Site A.

7.3.5 *Alternative 4 – Main mine Adit at Site B and No Overland Conveyor*

This alternative requires that the following Adit Types be constructed at the following sites:

- *Site A* – Ventilation; and
- *Site B* – Main Mine Adit (with the same layout and configuration as is mentioned for Adit A in Alternative 3 above).

Please Note – the layout of the Main Mine Adit at Site B in this alternative will be similar to that of the Main Mine Adit at Site A in the preferred option (as described in *Chapter 2* of this report); however, *coal will be transported underground from the Adit to existing works at Maquasa West where it will then be brought to the surface for processing in the existing coal processing plant*. The differences to the Main Mine Adit in this alternative (when compared to the Main Mine Adit in the preferred option) will include the following:

- The near horizontal decline shaft will not accommodate a conveyor to bring coal to the mine surface.
- No product silos or overflow stockpiling areas shall be constructed.
- No additional screens and crushers or recycle-conveyor belts, feeder breakers and recycle chutes will be constructed.
- No new overland conveyors and /or transfer stations will be constructed.
- No new conveyor system for the cross-over for vehicles and implements, livestock and surrounding community members will be constructed.

In this Alternative the following will be required:

- It is assumed that the existing gravel district road to Site A will provide access to the site and will be maintained by the district authorities.
- A gravel service road through to Site B will be constructed along existing farm tracks.
- A relatively large number of households (approximately 12) will need to be relocated from Site B to outside a buffer of 500m around the perimeter of the mine workings.
- Potable water will be supplied to the new development at Site B from the existing facilities at the Maquasa East.
- The main electrical supply by Eskom will terminate at the proposed substation at Site.

An assessment of the alternatives identified in the Pre-feasibility Study, together with the Preferred Option, as presented above, are provided in***Error! Reference source not found.*** below.

Table 7.1 *Alternatives Assessment*

Alternative	Socio-environmental and Financial Advantages	Socio-environmental and Financial Disadvantages	Pre-feasibility Study Outcome
Preferred Option – Main Mine Adit at Site A	• There are more ecologically disturbed areas at Site A than at the other sites (refer to *Figures 7.1* to *7.3*). • The Preferred Option will have a smaller footprint (due to the length of the conveyor route) when compared to Alternative 1. • The Preferred Option has lower occupational health and safety risks as compared to Alternative 2 (where all mining services take place underground). • The Preferred Option has an overland conveyor, which is technically and financially more feasible than Alternatives 3 and 4. • The Preferred Option is technically feasible due to geotechnical stability (roof support and ground discontinuities) and access to mineable coal. • From a cultural and heritage perspective, the Preferred Option is more favourable than Alternative 1. • The quality of coal is suitable unlike coal quality at Site B. • Due to the thickness of the coal seam at Site A, the Preferred Option is deemed to be the most financially feasible.	• This project option has a larger footprint than Alternatives 2, 3 and 4. • Having the Main Mine Adit at Site A triggers significant traffic related health and safety concerns (if not mitigated) because of the Twyfelhoek School and the fact that this road is a well used public road, carrying pedestrians, horses and vehicles. • It is not expected that public perceptions about noise, visual and dust impacts would differ between the Preferred Option and Alternative 1. It is also not possible to, at this stage, determine with confidence whether the number of people exposed to these potential impacts would be higher for the Preferred Option or Alternative 1; however, it is estimated that more people will be exposed along the length of the conveyor belt for the Preferred Option when compared to Alternative 1. • Due to the higher concentration of people along the length of the conveyor belt, the Preferred Option is not preferred from a safety perspective. In addition, a conveyor belt from Site A is more likely to impact on the movement patterns of people compared to if the conveyor belt came from Site B (Alternative 1). • Although it would be possible to avoid the displacement and relocation of people, it could be necessary for the Preferred Option.	• Environmentally, the Preferred Option is favourable in comparison to Alternative 1. • Although it is not clear at this stage of the process as to the number of people that will most likely need to be relocated, there are fewer safety and inconvenience concerns associated with Alternative 1. • From a cultural and heritage perspective the Preferred Option is preferred in comparison to Alternative 1. • In relation to Alternative 2, the Preferred Option has lower occupational health and safety risks. • From a technical engineering and financial perspective, the Preferred Option is considered to be more feasible than Alternatives 3 and 4. • This Project option (having the Main Mine Adit at Site A) was the preferred option in the ERM site screening assessment. • As such, *this option has been selected as the preferred project option.*
Alternative 1 – Main Mine Adit at Site B	• Relative to the Preferred Option and Alternatives 2 to 4, there are no social and/or ecological advantages associated with Alternative 1. • Alternative 1 has lower occupational health and safety risks than Alternative 2. • Alternative 1 has an overland conveyor and is thus, from a technical, engineering and financial perspective, more feasible than Alternatives 3 and 4. • The Main Mine Access Road for Alternative 1 does not seem to be frequented by the public as intensely as the Preferred Option. • It is not expected that public perceptions about noise, visual and dust impacts would differ between the Preferred Option and Alternative 1. It is also not possible to, at this stage, determine with confidence whether the number of people exposed to these potential impacts would be higher for the Preferred Option or Alternative 1; however, it is estimated that more less people will be exposed along the length of the conveyor belt for Alternative 1 when compared to the Preferred Option.	• The conveyor route from Site B through to Maquasa West will need to be longer than the conveyor route in the Preferred Option. Ecologically, this is not favourable. • Due to the overland conveyor in Alternative 1 having a longer distance than the Preferred Option, financially, Alternative 1 is not as feasible as the Preferred Option. • Although it would be possible to avoid the displacement and relocation of people, it could be necessary for Alternative 1. • From a cultural and heritage perspective, Alternative 1 is less favourable than the Preferred Option, as there are more cultural and heritage resources at Site B. • The low quality coal at Site B means that the first few million tons of coal mined will not be regarded as marketable.	• Environmentally, the Preferred Option is more favourable than Alternative 1. • Although it is not clear at this stage of the process as to the number of people that will most likely need to be relocated, there are fewer safety and inconvenience concerns associated with Alternative 1. • From a cultural and heritage perspective the Preferred Option is preferred in comparison to Alternative 1. • In relation to Alternative 2, Alternative 1 has lower occupational health and safety risks. • From a technical engineering and financial perspective Alternative 1 is considered more feasible than Alternatives 3 and 4. • This alternative is more reasonable and feasible when compared to Alternative 2, 3 and 4; however, environmentally and financially is less favourable than the Preferred Option. *As such, this Alternative will not be considered further in the study.*

Alternative	Socio-environmental and Financial Advantages	Socio-environmental and Financial Disadvantages	Pre-feasibility Study Outcome
Alternative 2 – Full Underground Mining Option	• Will have the smallest footprint and as a result will have the least social and environmental impact.	• From a technical and cost saving perspective Alternative 2 is less financially favourable than the Preferred Option and Alternative 1. • Highest occupational health and safety risks from roof and pillar support instability and ventilation effects. • It is not feasible to have an additional 10.1km (above that installed in the existing mine) of underground conveyor. The system availability of nine (plus existing) conveyors in series would decrease the availability of the conveyors to below 80%. • The average travelling time required to provide people access to the underground workings would increase by 58 minutes per ten hour shift reducing the overall mining productivity to less than 30%. • Existing ventilation (in addition to the planned Kusipongo Expansion ventilation) would have to continue to be operated after the Maquasa West resource is depleted to ensure adequate ventilation for the extended underground conveying, people and equipment access.	• From a mining occupational health and safety and engineering point of view this alternative is less favourable than the Preferred Option and Alternatives 1, 3 and 4. • Occupational health and safety was the key consideration that Hatch took into consideration when assessing Project alternatives. As a result this alternative was not considered a feasible alternative by the Project engineers. • As such, *this alternative will not be considered further in the study.*
Alternative 3 – Main Mine Adit at Site A and No Overland Conveyor	• Socially and ecologically Alternative 3 is more favourable than the Preferred Option and Alternative 1, as the above ground footprint for this alternative will be smaller (as there will be no overland conveyor). • Alternative 3 is less costly than Alternative 4, as the underground conveyor route will be shorter in distance for Alternative 3. • Alternative 3 is more advantageous in comparison to Alternative 2, as it reduces the Health and Safety risk to mining personnel associated with travelling through the potentially unstable, old workings of the existing Maquasa West and Maquasa West Extension mine • This alternative reduces the amount of unproductive travelling time that personnel need to access the working areas as required in option 2 (58 minutes per shift)	• Having the Main Mine Adit at Site A triggers significant traffic related health and safety concerns. These are discussed in the Socio-environmental and Financial Disadvantages for the Preferred Option above. • Financially, due to having the conveyor route underground in this alternative, Alternative 3 will be more costly than the Preferred Option and Alternative 1. This additional cost would compromise the feasibility of this alternative. • The Life of Mine in this alternative would be reduced, as the underground conveyor will result in a loss of coal product. • From an engineering point of view, the technicalities associated with having an underground conveyor for the transportation coal to the existing Maquasa West Adit are not favourable (as described in Alternative 2 above).	• There are fewer safety and inconvenience concerns associated with Alternative 4 when compared to Alternative 3. • Although having an underground conveyor system is socially and environmentally more feasible, from a financial and technical perspective it is not deemed reasonable. • As such, *this alternative will not be considered further in the Study.*
Alternative 4 – Main Mine Adit at Site B and No Overland Conveyor	• The Main Mine Access Road for Alternative 1 does not seem to be frequented by the public as intensely as the Preferred Option. • Relative to the Alternative 3, there are no social/environmental advantages associated with Alternative 4. • Alternative 4 is more advantageous when compared to Alternative 2, as it reduces the Health and Safety risk to mining personnel associated with travelling through the potentially unstable, old workings of the existing Maquasa West and Maquasa West Extension mine • This alternative reduces the amount of unproductive travelling time that personnel need to access the working areas as required in option 2 (58 minutes per shift)	• Site B is more ecologically sensitive than Site A. • From an engineering point of view, the technicalities associated with having an underground conveyor for the transportation coal to the existing Maquasa West Adit are not favourable (as described in Alternative 2 above). • Furthermore as the underground conveyor system will need to be greater in length than Alternative 3, the costs associated with Alternative 4 will be greater. • The low quality coal at Site B means that the first few million tons of coal mined will not be regarded as marketable.	• Alternative 4 has fewer public safety and inconvenience concerns when compared to Alternative 3. • Although having an underground conveyor is socially and environmentally more feasible, from a financial and technical perspective it is not deemed reasonable. • Furthermore, Alternative 3 is more favourable ecologically and financially than Alternative 4. • As such, *this alternative is not considered to be either reasonable or feasible and will not be considered further in the study.*

7.3.6 *Pre-feasibility Study Conclusions*

Outcomes from the study identified that from an occupational health and safety perspective, a full underground mining option was not considered a feasible alternative. Furthermore, from a technical engineering and financial perspective, the provision of mining access to underground workings from the Maquasa West Adit was not considered feasible due to:

- Health and safety – greater exposure to roof and pillar instability;
- Travelling time – to access distant underground working areas;
- Conveying system, in-series reliability and availability;
- Higher ventilation and associated power requirements.

Although socially and ecologically more feasible, the option of having an underground coal conveyor route from either Site A (Alternative 3) or B (Alternative 4) to the Maquasa West Adit was, from an engineering and financial point of view, not feasible.

In summary, having the Main Mine Adit at either Site A, with an overland conveyor transporting coal to the existing Maquasa West Adit (Preferred Option) was deemed by Hatch and ERM as the most feasible and reasonable option.

7.4 *LAYOUT ALTERNATIVES FOR THE MAIN MINE ADIT AT SITE A*

After selection of the general location for the Main Mine Adit, design aspects of the actual portal or shaft, including the type of shaft required and the exact position of the shaft within the Site A area were considered.

7.4.1 *Shaft Type*

Three types of shaft systems were evaluated:

- Vertical shaft;
- Inclined shaft; and
- Horizontal shaft.

Based on the mine plan for the Kusipongo Resource, a shaft system has to be developed to accommodate for:

- ROM production of approximately 5Mt/annum;
- 300 persons working underground per shift, being transported by means of underground flame proof busses;
- Two 10 hour shifts;
- A peak ventilation volumetric air flow requirement (occurs in approximately year 10) of 1,225 m^3/s at 2.53 kPa;
- A minimum number of five intake airways of 4m x 6.5m (26m^2 cross-sectional area, each);

- The use of continuous mining equipment ; and
- Maintenance and store facilities that will be placed on the surface in close proximity to the shaft as part of holistic portal arrangements.

The vertical shaft option is the least attractive and could incur capital investment of up to ZAR1.5 billion for the shaft system alone. A vertical shaft would only be the preferred option in the event of shallow overburden (less than 80m).

The incline shaft option is the second most attractive option and is preferred where overburden is between 40 and 80m and in areas where overburden is not less than 40 meters. The incline shaft system will incur larger excavation to access the underground workings when compared to the vertical shaft, but due to the less expensive material handling system it can compete financially with the vertical shaft.

In shallow areas with a shallow overburden (less than 40m), the horizontal (or near horizontal) shaft poses the preferred option based on the reduced cost associated with removal of lower volumes of overburden (smaller excavation footprint) when compared to the development of the incline Adit.

7.4.2 Shaft Location within Site A

In the FEL 2 study and at the outset of the FEL3 study, numerous aspects were evaluated to define possible positions for the Main Mine Adit shaft at Sites A and B. These aspects included:

- Overburden thickness;
- Gus Seam thickness;
- *In-situ* coal qualities (ability to produce marketable products);
- Geological Discontinuities (faults and dykes);
- Slope stability (geotechnical consideration); and
- Shaft orientation in relation to topography and surrounding infrastructure.

Each of these aspects are discussed below.

Overburden Thickness

An area where the vertical distance between the surface topography and the first coal seam (referred to as the overburden) is located is *less than 20m* thick is not suitable for underground mining due to the lack of stability required for a safe, permanent access point to underground work.

An area where the overburden is *greater than 40m* in thickness is where an extensive inclined shaft would be required and would incur relatively large volumes of overburden to be excavated. The impacted surface area of the excavation would be large and the costs of the excavation would rise dramatically.

An area where overburden is between 20 and 40m is preferred from an access perspective.

Gus Seam Thickness

The majority of the coal in the Gus Seam is, on average four meters thick. In order to be financial feasible, a minimum seam thickness of 2.7m is required when using standard mining machinery to mine. Ideally, the thickness of the seam mined should be greater than 2.7m, thus allowing the amount of non-coal, shale or poor quality coal is to be kept to a minimum.

Unfortunately, this criterion cannot be met anywhere in the study area to which Kangra Coal has prospecting rights, even in the area of Site A. However, at Site A, the distance from the access point to areas where the coal seam is thicker than the 2.7m required is fairly small and this was considered as an acceptable trade-off against the other design criteria.

Coal Quality

Mined coal quality has to satisfy the specifications of the market. Coal with a volatile content of less than 20% will incur financial penalties and may even be rejected by customers. Areas where *in-situ* coal has a volatile content of less than 16% can be mined if it is blended with a significantly higher than 20% volatile coal from another section of the mine.

As such, at the outset of mining, coal will need to have a volatile content greater than 20%, thus making it a saleable product. This will prevent coal discarded, unnecessary stockpiling costs and a situation where no revenue is generated.

Geological Discontinuities

Traversing geological discontinuities (faults and dykes) results in major production delays and increased operational costs. Three discontinuities (identified from the geological modelling) in Site A had a significant effect on the final positioning of the Main Mine Adit shaft (***Error! Reference source not found.***).

Positioning the shaft to the north or north east of the discontinuity would necessitate mining through the discontinuity. Mining through this discontinuity would significantly delay the production of saleable coal and would result in additional drilling and blasting costs. Storage of the waste rock from the blasting would also require additional storage volume and associated mitigation of the impacts from these stockpiles.

Slope Stability

To ensure for safe access to the Gus coal seam, the overlaying strata and topography of soil, soft and hard rock must be stable. Stability can be investigated by carrying out a geotechnical analyses, which provides a shaft slope design with a safety factor that is acceptable, thus eliminating the risk of the shaft subsiding. The current position of the shaft at Main Mine Adit A is geotechnically stable.

At this stage in the mining feasibility study, it is not certain whether other potential positions for the location of the shaft in the Main Mine Adit will be acceptable from a geotechnical slope stability requirement.

Shaft Orientation in Relation to Direct Environment and Infrastructure

The orientation of the shaft at the Main Mine Adit at Site A was determined predominantly by the direction of the main trunk route within the mine. This arterial route and layout allows the main flow of coal on conveyors, access for machinery and personnel to the production sections, provision for electrical and piping utilities and the supply of fresh ventilation to the underground workings. A direction following the shallowest vertical distance from surface was selected to increase the stability of the trunk route in the long term. This orientation would follow a direction below the valley extending to the south and west of the site.

A secondary consideration was associated with the topography of the area. Ideally, the orientation of the trunk route would be along contours, thus optimising excavation volumes and reducing the risk of geotechnical instability.

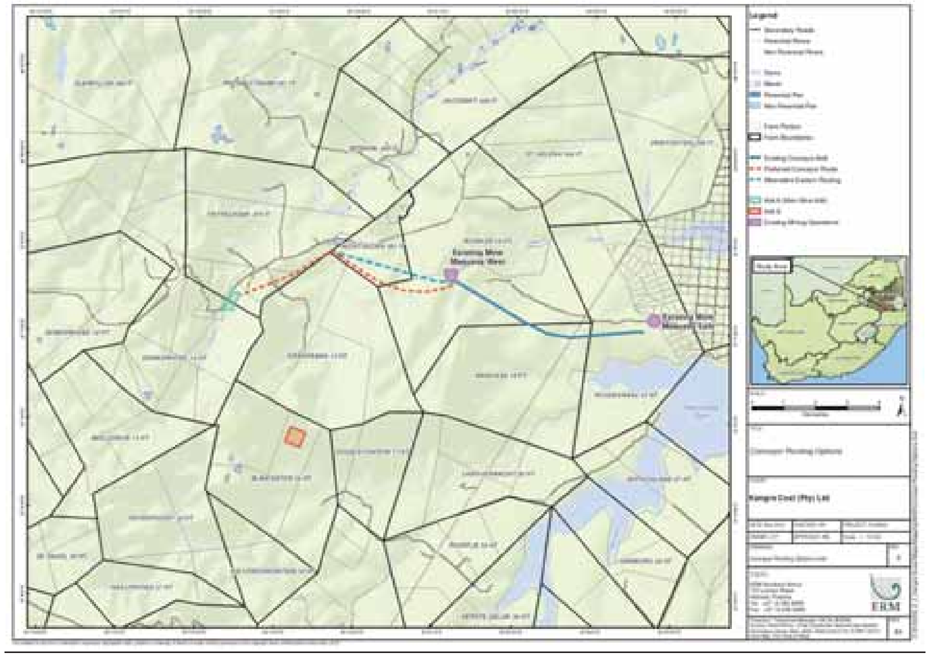
7.4.3 Conclusions – Main Mine Adit at Site A

When it became apparent that the majority of the Main Mine Adit at Site A was located in a wetland system, the Project engineering team reassessed the layout and positioning of the Main Mine Adit. As such, analyses of the above mentioned aspects were redone. Attempts were made to shift the Main Mine Adit layout to outside of the boundaries of the wetland system but no position could be identified which satisfied the critical design aspects mentioned above. Alternative positions for the Adit are either characterised by poor quality coal and/or too much or too little overburden. Given the life of mine projections, these aspects are sufficient to significantly compromise the financial viability of the mine. Accordingly, it was determined that there was no viable alternative to the layout of the Main Mine Adit at Site A.

7.5 ROUTING ALTERNATIVES FOR THE PROPOSED CONVEYOR ROUTE

The conveyor route proposed to transport coal from the Main Mine Adit through to the existing Maquasa West Adit is illustrated as the **Red Line** in *Figure 7.5* below. Initially Kangra Coal proposed routing the conveyor system along the **Alternative Eastern Routing** from the Transfer Point through to Maquasa West Adit; however, it became evident that it is in this area where Kangra Coal proposes the Maquasa mine expansion projects (as is discussed in *Chapter 2*). As such, this portion of the route (**Alternative Eastern Routing** as per *Figure 7.5* below) was not deemed feasible or reasonable.

Figure 7.5 Conveyor Route Options for the Proposed Kusipongo Expansion Project



7.6 LOCATION ALTERNATIVES FOR THE CONTRACTORS CAMP

At this stage of the study there is no preferred site option for the location of the contractors' camp (out of the three alternatives presented in *Chapter 2*). As such, the impacts assessment phase of the EIA will provide input into selection of a preferred site.

7.7 THE NO-GO ALTERNATIVE

Should the proposed Project not be approved, the "No-Go" option would mean that Kangra Coal would not be able to exploit this extensive coal reserve. With the existing mine life of approximately only another 3 to 5 years, the "No-Go" alternative would result in the mine ceasing operations in approximately three years. Further, the "No-Go" option would have a considerable opportunity cost, for the following reasons:

- It would result in large negative financial implications for Kangra Coal;
- It would potentially result in loss of employment (within the next 3 to 5 years) for 750 employees that are currently working at the Savmore Colliery and approximately 350 indirect jobs (contractors);
- An additional 300 additional jobs would not be created, as would be the case if the project were approved; and
- Would negatively affect the supply of coal to both international and local markets.

7.8 CONCLUSION

Following the FEL 1 Concept Study carried out by Hatch, it was concluded that capacity constraints associated with the Coal Link Railway Line and at RBCT would not allow for an increase in ROM for Kangra Coal once the proposed Project becomes operational. The study also identified that certain socio-environmental sensitivities will need to be assessed in detail as part of the EIA process, and that the PPP associated with the EIA will need to be robust and information relating to socio-environmental sensitivities needs to be relayed to I&APs. As part of the FEL 1, a number of coal handling and transport options were assessed; however, due to the anticipated quantity of product produced not increasing once the proposed Project becomes operational, and the complexity and unattractive economic viability of alternative handling and transport options, it was concluded that existing coal handling and transport facilities will continue to be used.

The Site Screening Assessment carried out by ERM identified that a Preferred Ecological Location (PEL) in Site A would be the most favourable location for the Main Mine Adit, and that Site B (with proper mitigation measures put in place) would be suitable for the development of a ventilation Adit. This assessment informed the Pre-feasibility Study (FEL 2) carried out by Hatch.

The Hatch Pre-feasibility Study (FEL 2) identified that the *Preferred Option* as being the most feasible and reasonable options for the proposed Project. For technical engineering, financial and occupational health and safety reasons, *Alternatives 1* to *4* in the Hatch Pre-feasibility Study were not considered to be feasible. In terms of the layout of the Main Mine Adit at Site A, attempts were made to shift the Main Mine Adit layout to outside of the boundaries of the wetland system but no position could be identified which satisfied the critical design aspects associated with overburden thickness, coal seam thickness, *in-situ* coal qualities, geological discontinuities, slope stability and shaft orientation in relation to topography and surrounding infrastructure.

The 'No-Go' alternative would not provide for any additional economic benefits or for further employment, and is therefore not considered a feasible alternative by Kangra Coal.

8 *THE RECEIVING ENVIRONMENT – PHYSICAL AND BIOLOGICAL BASELINE ASSESSMENT*

It is important to gain an understanding of the biophysical, biological and social attributes of the Study Area and its surroundings, as it will provide for a better understanding of the receiving environment in which the Project is proposed. This information will serve as a baseline according to which the potential impacts of the proposed Project may be compared. This information has been collected from desktop studies and specialist studies, and supplemented with site visits to the proposed Study Area.

In this Chapter, only a summary of the most pertinent baseline conditions are described. A synopsis of the baseline conditions and how they may affect the Project is also provided. Detailed descriptions of the baseline biophysical, biological and social environments are reported separately as detailed baseline reports, and will be provided during the EIA phase of this project.

Please Note - During the Kangra Coal pre-feasibility study conducted in March 2011, reference was made to Adits A, B and C. This Adit configuration was relayed to the specialists who then used this as their Terms of Reference to complete their baseline assessments. As such, *all* specialist baseline studies (except for the ecological assessment which makes mention of Adit D) make reference to Adits A, B and C. Since then, it was determined that the locality of Adit C was not feasible as information became available relating to the quality of the coal resource in the area, and this was replaced with *Adit D (*which is closer to the central mine location). However, now it has been concluded that Adit D is also no longer required and that *Adit B is the only external ventilation Adit required.*

8.1 PHYSICAL ENVIRONMENT

8.1.1 *Climate* [(1)]

Surface meteorological data was sourced from the Piet Retief Weather Service Station during the period 2002 to 2005. This station is located approximately 40km east of the proposed Project.

Wind

The predominant wind direction is from the northeast with a frequency of occurrence of 16%. Winds from the north are also predominant, occurring for 10% of the total period. During the day-time, strong winds from the north and north-easterly sectors predominate; during the night, north easterly winds are most common.

(1) Burger L. and Petzer G. (2010) - Airshed Planning Professionals (Pty) Ltd.

Precipitation

Piet Retief is located in the summer rainfall region of South Africa, in which more than 80% of the annual rainfall occurs between the period October to March. Total maximum rainfall is recorded during the month of January while no or little rainfall is recorded during the month of July. The rainfall events are highly localised and usually in the form of conventional thunderstorms; according to van Vuuren [1] thunderstorms occurred for an average of 44 days per annum.

According to the DWA, the closest reliable rainfall station to the Maquasa area is the Piet Retief Weather Station, which has rainfall records dating from January 1935 through to January 1979 and A-Pan evaporation data from March 1957 to March 1979. According to these records, the average mean annual precipitation (MAP) for that period was 877.5mm and average mean annual evaporation was 1, 654.2mm. According to van Vuuren a maximum rainfall event of 186mm within a 24-hour period was recorded in January 1984, with a maximum precipitation figure of 1, 474mm for the same year.

8.1.2 *Topography and Geomorphology*

The terrain morphological class of the area can be described as "Plains with moderate relief", either moderately or strongly undulating (Kruger, 1983) [2]. The area lies at an altitude of between 1,350 and 1,800 meters above sea level, with the highest elevations occurring in the west. Several small rivers and streams flow eastward out of the Study Area.

8.1.3 *Geology [3]*

Stratigraphy

The area is generally underlain by sedimentary rocks of the *Ecca Group*, which forms part of a segment of the north eastern margin of the basin, filled with sediments belonging to the *Karoo Supergroup*. The sedimentary rocks were deposited discordantly on the basement, defined by the *Undifferentiated Onverwacht Group*, consisting of lava, tuff, schists and chert. The former forms part of the *Barberton Sequence*.

The Karoo basin in the vicinity of the Kangra Coal Project consists of the *Pietermaritzburg Shale Formation* at the base, followed by the *Vryheid Formation* and the *Volksrust Shale Formation* at the top, with the coal bearing *Vryheid Formation* being the dominant formation. Underlying the *Pietermaritzburg Shale Formation* is the *Dwyka Formation* consisting of tillites.

(1) Anna van Vuuren is the appointed surface Water Specialists for this study
(2) Kruger, G.P. (1983). Terrain Morphological Map of Southern Africa. Department of Agriculture. Pretoria.
(3) Stoll A. (2011). - Environmental Resources Management Southern Africa (Pty) Ltd.

The *Vryheid Formation* consists of grit, sandstone and shale and contains a number of coal seams. In addition, pebble beds and intra formational conglomerate are locally developed and intercalations of siltstone and mudstone are common in the sandstone, especially in the upper part of the formation. Lenses of calcareous sandstone and sandy limestone are relatively common. The sandstone is generally feldspathic and weakly cemented, especially the coarser varieties.

The coal-bearing part of the Vryheid Formation contains sequential deposition of sediments represented by upward-fining cycles at the bottom with conglomerate and grit followed by sandstone, shale and eventually coal seams. These lithologies are interpreted to represent respectively the channel-lag deposit, the point-bar deposit and the overbank deposit of a meandering stream.

Furthermore, recent alluvial deposits occur along the larger drainage lines that traverse the area.

Structure

During the deposition of sediments in the Karoo basin, tension in the crust due to continuing loading lead to failure and subsequently intrusion of Post-Karoo dolerite sills and dykes along weak zones such as fractures, fissures and faults. Consequently dykes and sills varying between a few centimetres to a couple of metres in thickness intruded the Study Area. Most dolerite dykes have a vertical or near-vertical dip.

The rocks immediately adjoining dolerite intrusions, of both dyke and sill form, are frequently disturbed and fractured, and thermally metamorphosed as a result of the injection of the dolerite and have led to varying degrees of volatilisation of coal seams.

8.1.4 *Soils and Land Capability* [1]

Land and Soil Type

Within the Study Area, a total of seven land types occur, namely:

- **Ac39** (red and yellow, highly weathered, structureless soils)
- **Ba45, Ba51** (red, highly weathered structureless soils with plinthic subsoils)
- **Bb35, Bb36** (yellow, highly weathered structureless soils with plinthic subsoils)
- **Ca17** (Mixed plinthic and blocky clay soils)
- **Fa162** (shallow soils, no lime)

The soils were classified according to MacVicar *et al.*, (1977) [2], with the dominant agricultural potential class within each land type indicated in **bold type**.

Agricultural Potential

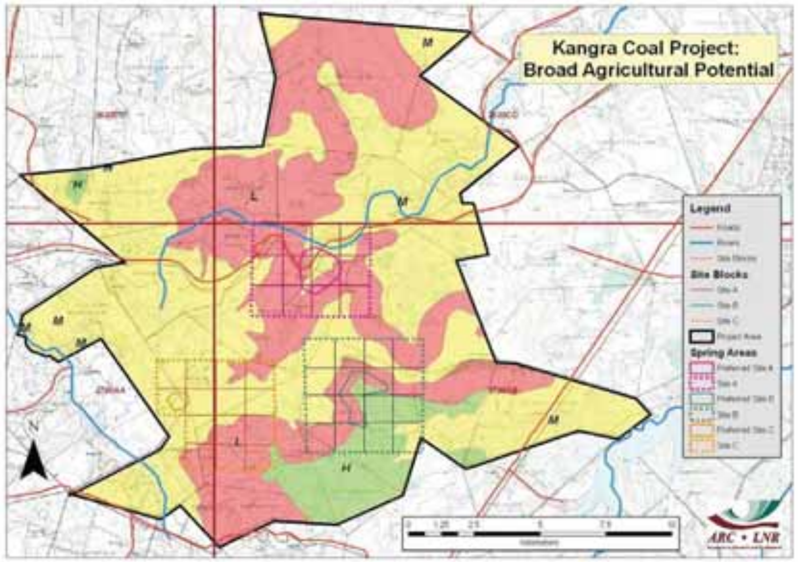
Most of the land types comprise predominantly either high (H) potential or medium (M) potential soils. The high potential soils are deep (>900 mm), red and yellow-brown, structureless, loamy to clayey soils of the Hutton, Clovelly, Avalon, Shortlands and Griffin forms. The medium potential soils are either these same soils, but shallower (500-900 mm), or the soils have a limitation in terms of moderate to strong structure. The low (L) potential soils include rocky areas, as well as shallow lithosols (mainly Mispah and Glenrosa soils, <450 mm deep) along with wet soils and stream bed areas.

The distribution of the land types occurring, in terms of their **<u>dominant</u>** agricultural potential, is shown in *Figure 8.1*.

(1) D.G. Paterson (2011) – ARC – Institute for Soil, Climate and Water

(2) MacVicar, C.N., de Villiers, J.M., Loxton, R.F, Verster, E., Lambrechts, J.J.N., Merryweather, F.R., le Roux, J., van Rooyen, T.H. & Harmse, H.J. von M., (1977) - Soil classification. A binomial system for South Africa. ARC-Institute for Soil, Climate & Water

Figure 8.1 Broad Agricultural Potential for the Proposed Kangra Coal Study Area



8.1.5 *Hydrology* [(1)]

Catchment Information

Catchment information for the Study Area is provided in *Figure 8.2* and *Figure 8.1.* The three adits are each located in a different quaternary river catchment area. Adit C is in catchment C11C within the westward draining Vaal River primary catchment area "C". The other two Adits are in the northern part of primary area "W", which includes a number of eastward draining rivers. The northern section of catchment W includes the tributaries of the Greater Usutu River with Adit A in catchment W52A located on the Ohlelo River and Adit B in catchment W51B on the Assegai (or Mkonda) River. The catchments areas are summarised in *Table 8.1*. The rainfall (and consequently the runoff) decreases in the westerly direction, causing the Vaal quaternary catchment to have only 72% of the runoff experienced to the east of the escarpment.

Table 8.1 Details of Quaternary Catchment Area

Adit	QUATERNARY CATCHMENT	TOTAL AREA (km^2)	MEAN ANNUAL PRECIPITATION (mm)	MEAN ANNUAL EVAPORATION (mm)	MEAN ANNUAL RUNOFF (mm)
A	W52A	289	836	1 400	107
B	W51B	496	864	1 400	90
C	C11C	450	765	1 400	77

Adit A

<u>*Water Use*</u>

The Hlelo River, including its major tributary the Ohlelo River, is largely undeveloped with no major impoundments. Other major tributaries of the Greater Usutu River are characterized by a number of large dams which deliver water westwards to the Vaal River catchment as part of water supply augmentation schemes. The Geelhoutboom Balancing Dam (located on the northern tributary) acts as a large pumping pond where water is transferred by canal from the Heyshope Dam.

The major consumers extracting water from the river are industries, *viz*. Mondi and NTE (an agricultural chemical producer). Some water is used for irrigation in the reach below the Donkerhoek Property. There are no farm dams indicated on the available 1:50 000 topo-maps.

An un-rehabilitated coal mine and its associated works are situated downstream from Adit A along both sides of the Hlelo River (*Figure 8.2*).

(1) A van Vuuren (2011) - WSM Leshika Consulting (Pty) Ltd.

Discarded coal can be found on the flood plain right alongside the main channel of the river. Stormwater control dams below the product storage sites, which are outside the river floodplain, have been breached allowing contaminated stormwater to drain to the Hlelo River.

Current surface water use in the upper reaches of the Ohlelo River is limited to the water used by forests and alien vegetation, as well as for domestic use and stock watering. The population density in this area is low; for example only 130 families reside in the Donkerhoek Property of 8,542 ha.

Hydrology at Adit A

The Ohlelo River runs adjacent to the site proposed for Adit A. The gross mean annual runoff of the Ohlelo River at the site is 2.39 million m^3/a. Water use by forests (mainly alien vegetation) upstream of Adit A will, however, likely reduce this total. The 1:100 year flood peak for the Ohlelo River at this site is estimated at 220 m^3/s. *Figure 8.4* below shows the narrow, overgrown flow channel at this site. It is expected that this site will be overtopped and the flood width would be wider than the channel at this site.

Proposed Developments in the Donkerhoek Area [(1)]

The Mpumalanga Department of Agriculture, Rural Development and Land Administration (DARDLA) selected the Donkerhoek Property to be developed as a Comprehensive Rural Development Project (CRDP) in 2009. The CRDP project boundaries cross the site of Adit A. The main aim of the CRDP is to provide the 130 families resident in the area with household water (to be sourced from springs in the Study Area) and to improve agriculture by developing a storage dam for irrigation purposes.

At present two sites for the construction of a storage dam are being investigated, namely Dam E on the Hlelo River in Twyfelhoek and Dam D on Prospect Farm on a local tributary (*Figure 8.2*). A site for this dam was also considered at the site of Adit A (Dam A on *Figure 8.2*) but it was found to be less favorable than the other localities, and is no longer being considered.

(1) WSM Leshika Consulting (Pty) Ltd. (2010) - CRDP Donkerhoek: Feasibility Study: Bulk Water Supply Options. DARDLA.

Figure 8.2 Hydrological Locality Map

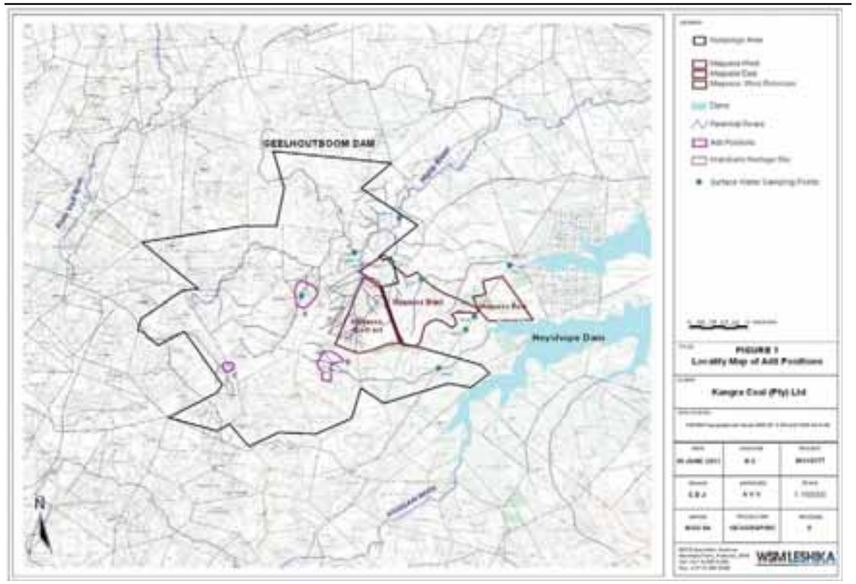


Figure 8.3 Hydrological Locality Map Illustrating Catchment Areas

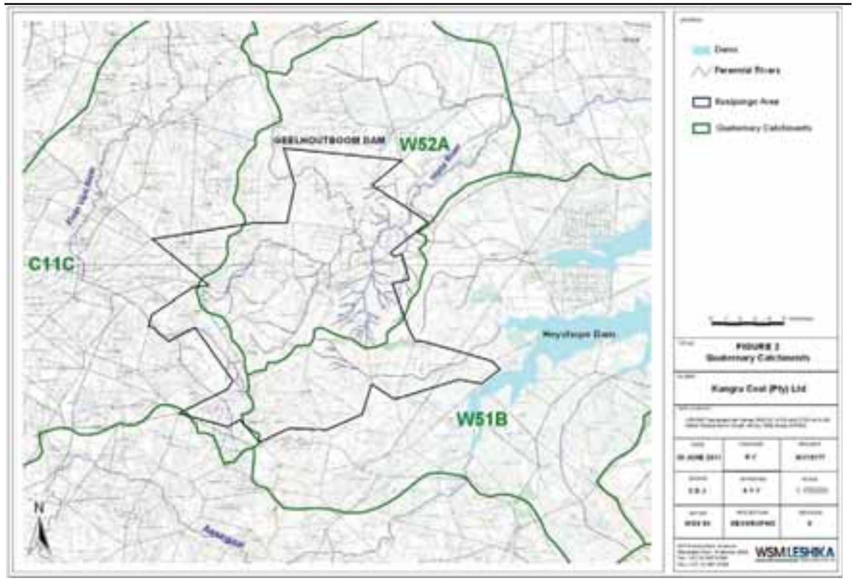


Figure 8.4 Ohlelo River at Adit A

Adit B

Water Use

The Assegai River flows eastward, to the south of the town of Piet Retief. The Heyshope Dam has been constructed 50km from the western border of primary catchment W. The dam was built to provide water to the Vaal River system. Other water users from the dam include Kangra Coal, who has a permit to abstract 830,000m^3/annum (Kotze, 2010). There are no irrigation water releases from the dam.

The town of Piet Retief is entitled to abstract 5,500m^3/day (2 million m^3/a) from the Assegai River, downstream of the Heyshope Dam (Kwezi V3 Engineers, 2009) (1). This amount was exceeded by about 30% in 2009. The Driefontein/Kwangema area use water directly from the Heyshope Dam via the transfer canal. The water to be used in these areas is treated in a treatment works, with a capacity of 1.28 million m^3/a; however, water use was 0.81 million m^3/annum in 2009, far below the capacity of the treatment works.

Hydrology at Adit B

Adit B is situated on a tributary of the Assegai River upstream of the Heyshope Dam and the Mpundu River. Based on the total area of the catchment upstream of Adit B, the affected runoff represents approximately

(1) Kwezi V3 Engineers (2009) – Water services development plan (WSDP) 2009-2013. Mkhondo LM.

540,000 m^3/a, or 4.7% of the Mpundu River's runoff into the Heyshope Dam (Kangra Coal, 2009) [(1)]. The expected 1:100-year flood peak in the vicinity of the site has been provisionally estimated as more than 100m^3/s, due to the very steep slopes in this catchment.

Adit C

The Klein Vaal River is one of at least nine well defined tributaries of the Vaal River feeding into the Grootdraai Dam near Standerton. The river initially flows northwards and then swings westwards for about 50km to enter the dam.

Hydrology at Adit C

Adit C is situated alongside an upper smaller tributary of the Klein Vaal River, which flows parallel to Adit C. Runoff at this site is from the slopes of Pêrelkop, with a catchment area of 2.3 km^2. The expected 1:100-year flood peak is estimated at 65m^3/s, which is high but can be attributed to the catchment's steep slopes at the adit site.

Surface Water Quality [(2)]

Dry season (August) and wet season (November) water quality results for one year were available and were compared to the SABS drinking water standard. The water as tested is fairly pristine, except for elevated levels of iron and aluminum in some localities. Elevated iron concentrations were also measured in water samples taken at some springs, as reported in Kotze, 2010.

8.1.6 Hydrogeology [(3)]

Regional Hydrogeology

According to the Hydrogeological Map of the Republic of South Africa (Sheets 2630 – Mbabane and 2730 - Vryheid, 1:500 000) the main water bearing strata in the area is an intergranular and fractured aquifer made up of predominantly arenaceous rocks (sandstone and conglomerate) and argillaceous rocks (shale and siltstone).

According to the map, groundwater resources are generally limited, with sustainable borehole yields ranging from 0.5 – 2L/s. The groundwater quality is thought to be good, with total dissolved solids (TDS) of less than 300mg/L.

In intergranular and fractured aquifers, the water occurs in both the upper weathered rock zone and the fractured but fresh rock formation below. These zones are in hydraulic contact. The regional aquifer system is defined as a Minor Aquifer System (Parsons, 1995) [(4)] with low to moderate vulnerability to

(1) Kangra Coal (Pty) Ltd. (2009) - Maquasa West Amendment EMP Report. CGS.
(2) Oryx Environmental. (2006) - Amendment to the Maquasa West EMP (Draft for Internal Review).
(3) Stoll A. (2011) - Environmental Resources Management Southern Africa (Pty) Ltd.
(4) Parsons, (1995) - Classification of Aquifer Systems in South Africa.

contamination. Minor Aquifer Systems can be fractured or potentially fractured rocks, which do not have a high primary permeability, or other formations of variable permeability. The aquifer extent may be limited and water quality may be variable. Although these aquifers seldom produce large quantities of water, they are important both for local supplies and in supplying base flow to rivers.

Local Hydrogeology

Three types of aquifer systems have been recognized in the Study Area, represented by:

(i) perched groundwater episodically contained in colluvial near-surface material above a less permeable substratum;
(ii) Karoo sediment (mainly sandstone) that possess a secondary porosity associated with weathering; and
(iii) fractured and baked lithologies associated with the contact zone between dolerite intrusions and the sedimentary host rock (Karoo).

Weathered Aquifer

The Ecca sediments are weathered to depths between 5 – 12 metres below surface throughout the Mpumalanga area. The upper aquifer, typically perched, is associated with this weathered zone and water is often found within a few metres below surface (Hodgson, 2001) [(1).]

This aquifer is recharged by rainfall which infiltrates into the weathered rock and soon reaches an impermeable layer of shale or dolerite, underneath the weathered zone. The movement of groundwater on top of this layer is lateral and in the direction of the surface slope (Hodgson, 2001).

The aquifer within the weathered zone is generally low yielding (0.03 – 0.6L/s) due to its insignificant thickness. Few farmers therefore tap this aquifer by borehole. However, wells or trenches dug into this upper aquifer are often sufficient to secure a constant water supply of excellent quality (Hodgson, 2001). The excellent quality of this water can be attributed to the many years of dynamic groundwater flow through the weathered sediments, where leachable salts have been washed from the system long ago (Hodgson, 2001).

Fractured Aquifer

The pores within the Ecca sediments are too well cemented to allow any significant permeation of water. All groundwater movement is therefore along secondary structures, such as fractures, cracks and joints. These structures are better developed in competent rocks such as sandstone, hence the better water-yielding properties of the latter rock type (Hodgson, 2001) [(2)].

(1) Hodgson, (2001) - Underground High Extraction of Coal and its Impact on Groundwater. WRC Report No 699/1/01.
(2) Hodgson, (2001) - Underground High Extraction of Coal and its Impact on Groundwater. WRC Report No 699/1/01.

It should, however, be emphasised that not all of the secondary structures are water-bearing. Many of these structures are closed due to compressional forces and the chances of intersecting a water-bearing fracture by drilling therefore decreases rapidly with depth. Water-bearing fractures with significant yields have been observed at depths of approximately 30m; these boreholes would, however have insufficient yields for organised irrigation (Hodgson, 2001).

Coal seams are often fractured and have some hydraulic conductivity. Underlying the coal is the Dwyka tillite, which is impermeable to groundwater flow due to its massive nature and fine matrix, forming a hydraulic barrier between Pre-Karoo aquifers and those high up in the succession (Hodgson, 2001).

In terms of water quality, the fractured Karoo aquifer always contains higher salt loads than the upper weathered aquifer. This is associated to the longer residence time of the water in the fractured aquifer (Hodgson, 2001). Although the sulphate, magnesium and calcium concentrations in the Ecca fractured aquifer are higher than those in the weathered zone, they are well within expected limits. The occasional high chloride and sodium levels are from boreholes in areas where salt naturally accumulates on surface, such as at pans and some of the springs (Hodgson, 2001).

Springs

The groundwater from the weathered aquifer reappears on surface as springs where the flow paths are obstructed by a barrier, such as a dolerite dyke, paleo-topographic highs in the bedrock, or where the surface topography cuts into the groundwater level at streams (Hodgson, 2001). Several springs occur throughout the Study Area. These springs provide the base flow to the numerous surface water courses, which form the main source of water supply in the area.

Groundwater Levels and Flow Direction

Groundwater depths range from 0 to 120 mbgl. In general, groundwater follows the topographical setting of the area. Groundwater levels are controlled by piezometric pressure in terms of the degree of confinement of aquifer systems and depth of boreholes – this indicates that boreholes in the topographical low areas tend to be artesian or have very shallow water levels (between 0 and 10 mbgl) and the boreholes on the higher elevated areas tend to indicate much deeper water levels.

The regional groundwater flow direction appears to be to the east. However, locally and on a small scale, flow directions can vary largely depending on topographic features.

Groundwater Recharge

According to the Groundwater Resources of the Republic of South Africa Map (Sheet 2, 1995) aquifer recharge in the area is between 50 - 75mm / a.

The main zones of groundwater recharge are areas underlain by weathered bedrock. This aquifer is of great importance due to the higher storage capacity. Rainwater recharge to the aquifer is stored in the weathered portion of the bedrock from where it either slowly recharges the deeper fractured aquifer or daylights as seepage or springs feeding the numerous streams in the area (GCS, 2002) (1).

In the Maquasa West area, recharge of the area underlain by the weathered aquifers was estimated using the chloride method to be between 10 - 20% of Mean Annual Precipitation (MAP) (GCS, 2002). In the groundwater model for the Maquasa West mine, however, a rainfall related aquifer recharge of 3 – 5% of the MAP was used to calibrate the model (Ivula, 2009)(2).

Groundwater Use and Receptors

Water use in the area is mainly related to domestic use, agriculture and industrial use. The main source of water to communities and farmers in the area is surface water from several perennial streams in the area, which in turn are fed by groundwater derived from numerous springs. Base flow occurs throughout the year.

Three groundwater abstraction points are located within the Study Area and 14 more boreholes are located in close proximity to it. Water levels in the boreholes close to the Kusipongo Study Area range from 0.7 to 18 mbgl, indicating shallow water levels. Borehole yields, ranging from 0.07 to 9.7l / s, are generally low with a few exceptions, where high yielding secondary structures are intersected.

Principal sensitive receptors in the Study Area are communities using water from the streams, which are fed by groundwater, for domestic use, including drinking. Furthermore, receptors in the area include farmers using borehole water and water from streams for domestic use, for irrigation and for livestock watering.

The streams and rivers in the area (i.e. Hlelo, Mpundu and Klein Vaal River) are also receptors as groundwater provides them with base flow.

Water Quality Assessment

Most of the determinants of the samples taken from selected springs in the Study Area comply with South African Water Quality Standards (SAWQS), which indicates a good baseline water quality in the area.

(1) GCS, (2002) - Environmental Management Program Report, Kangra Group: Maquasa West.
(2) Ivuzi, (2009) - Maquasa West Integrated Water Use License Application (IWULA).

Continuous groundwater monitoring is performed on the Maquasa West mine. Pre-mining water quality was good and most of the sampled boreholes conformed to the SAWQS (GCS, 2002) [1]. However, the current groundwater quality data show acidic pH levels for three boreholes in close proximity to the underground workings (GCS1, GCS3 and GCS4). Samples also indicate high Fe and occurrences of elevated SO_4 levels (GCS, 2009) [2]. Results from the sampling indicated that the geology was acid generating. It is therefore possible that the adjacent geology in the Kusipongo Resource is also likely to have acid generating potential.

8.1.7 *Noise [3]*

Noise measurements were taken during the day and early morning (night time measurements) on 11 and 12 November 2011 respectively. Ambient daytime sound levels ranged between 27.7 ($_{LA,90}$) and 24.9 ($_{LA,min}$) dBA away from any industrial activity. Average ambient night-time sound levels ($_{LA,90}$) ranged between 23.2 ($_{LA,90}$) and 21.4 dBA ($_{LA,min}$) away from any industrial activity. Mining activities were audible at some points at night, even though these points were relatively far away from the mining areas.

Based on an analysis of noise data collected, the area can be considered relatively quiet, excluding the eastern areas close to Maquasa, where mining activities alter the daytime soundscape. Due to low traffic volumes, roads do not contribute significantly to noise levels in the area.

The quiet environment is confirmed by the night-time ambient sound levels. While quieter than the daytime soundscape, it is still relatively noisy near the mining activities at Maquasa.

8.1.8 *Air Quality [4]*

Existing Sources of Air Emissions in the Study Area

A number of large tree plantation blocks occur between the Panbult Siding and the proposed expansion area. Albeit relatively far from the proposed mining sites, this activity could contribute some airborne dust during felling operations, although the significance of these emissions contributing to the current air quality in the Study Area is likely to be low.

Airborne particulates are expected to be released during the cultivation of agricultural land and wind erosion of exposed areas. This would be more significant during dryer periods.

(1) GCS, (2002) - Environmental Management Program Report, Kangra Group: Maquasa West.
(2) GCS, (December 2009) - Kangra Group Mines, Annual Water Quality Report for the Savmore Group Mines, Version-1.
(3) Morné de Jager (2010) - M2 Environmental Connections cc
(4) Burger L. and Petzer G. (2010) - Airshed Planning Professionals (Pty) Ltd.

The existing coal mining operations at Maquasa East and Maquasa West also contribute to the ambient particulate concentrations in the region. Most of the impact at the proposed mine sites would be in the form of small particles (less than 10 micron in aerodynamic diameters). The larger particles would deposit closer to the existing mining operations. Airborne dust emissions would also originate from discard and overburden heaps (*Figure 8.5*) until rehabilitation occurs.

Figure 8.5 Overburden Mine Heaps Near the Existing Coal Mine

Little dust is generated along the existing conveyor route; however, dust is generated by vehicle traffic along the public haul road to the Panbult siding. Mitigation measures to reduce fugitive dust from unpaved roads have however, been put in place (*Figure 8.6*).

Figure 8.6 *Dust Mitigation (Chemical Surface Treatment) on Public Roads to Panbult Siding*

Ambient Air Quality within the Region

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

The existing Kangra Coal Mine has a dust fallout network; currently, the mine has six single dust buckets at the Panbult siding and five single dust buckets at the Maquasa East Shaft.

Dust fallout monitoring results for the period January 2009 to October 2010 indicate that the Residential Action level of 600mg/m²/day is exceeded occasionally at both the Panbult Siding and at the Maquasa East mine sites. Generally, the fallout measured at the monitoring stations was below the Industrial Action level. No exceedances of the alert threshold of 2,400mg/m²/day were observed.

No particulate air concentration measurements area available at either of these two sites.

8.1.9 *Traffic*

Current Access Routes

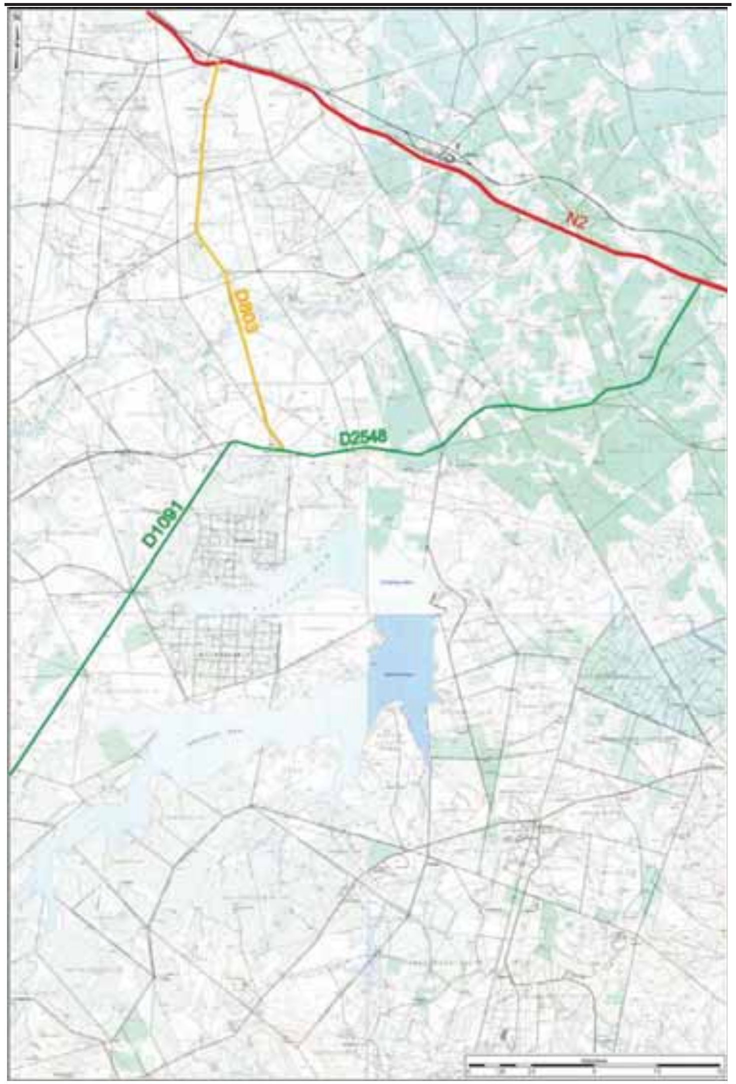
Mined coal from Maquasa West is transported via a conveyor belt to Maquasa East. This conveyor belt is 6.5km in length and has a capacity of 1,000 tons per hour. Coal from the open cast operation is transported by truck to Maquasa East. This transport is provided by a contractor to the mine.

Currently, there are three routes serving as access to the Kangra Coal mine (*Figure 8.7*).

National Route N2: This route is under the control and management of SANRAL (South African National Roads Agency Limited). It has a major long distance traffic function as it links (together with the N17) the Gauteng area, through Mpumalanga, with northern KwaZulu-Natal and eventually Durban. The route carries high volumes of heavy trucks, from many of the mining activities in the Mpumalanga region. The pavement and therefore riding quality, of the N17 and the N2 were allowed to deteriorate to a poor condition over the past twenty years. Rehabilitation is currently taking place at numerous locations. The overall condition of the N2 towards Piet Retief, as well as the N2 towards Ermelo from the D2548 intersection is assessed by the Mpumalanga provincial roads department to be as 5.08 percent good and 94.92 percent fair. This situation should improve substantially after the completion of present rehabilitation works.

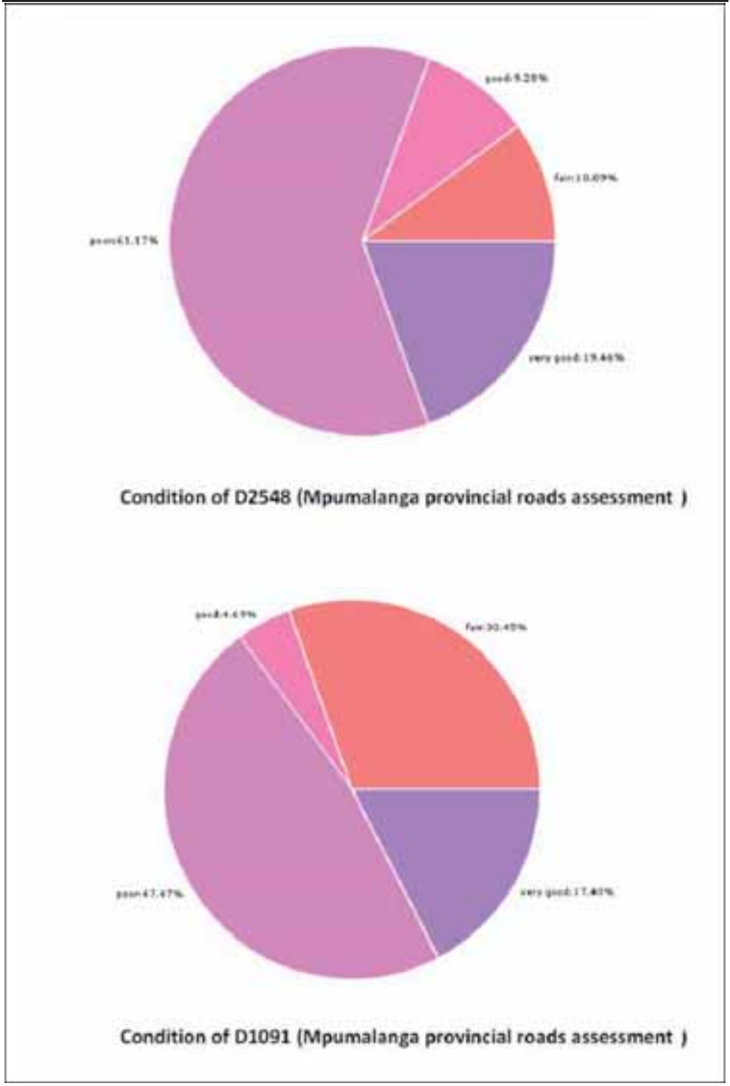
The section of N2 between Piet Retief and Ermelo currently has at least five sections being rehabilitated. It is accepted that the completed rehabilitated section will have one 3.7m lane per direction with surfaced shoulders of at least 1.5m in width.

Figure 8.7 Existing Access Routes to Kangra Mine



D2548 and D1091: These two roads linking the N2 and Driefontein, are good quality surfaced roads (one lane per direction). From the western boundary of Driefontein, the D1091 is a gravel road. The overall condition of the D2548 and the D1091, as assessed by the Mpumalanga provincial roads department, is summarised in *Figure 8.8*.

Figure 8.8 *Condition of D2548 and D1091*



The Maquasa East mining facility is located just to the east of the D1091, approximately four kilometres from the boundary of Driefontein. The access route from D1091 to Maquasa East is a gravel road that is maintained by the mine, as it is heavily used by coal carrying trucks.

D803: The D803 is a gravel road from the D2548 to the Panbult rail siding (a distance of approximately 16km). It is largely being used for the hauling of coal to the Panbult siding, from where it is transported by train to Richards Bay and elsewhere. Kangra Coal is assisting with the maintenance of this road in order to keep it in a good condition for the coal trucks. Visual observation indicated that it is largely in a good condition.

Mine Road Use

Two types of vehicle trips are being generated by the mine. The first type is related to the transport of the people working at the mine and business trips to the mine, whilst the second is related to the transport of the coal that is produced.

The mine currently employs approximately 750 employees and approximately 500 contractors, which includes the contractors appointed to transport coal at the mining sites and also to various external locations. Of the workers, 65% are transported by bus to the mine, whilst the rest travel by private vehicles (approximately 100 vehicles at any given time).

The estimated total number of daily vehicle trips to / from the mine related to the transport of personnel / business, are as follows:

- Private vehicles – 280 (assume average vehicle occupancy of 2.5)
- Buses – 30
- Business visitors (private vehicles) – 40

As such, the total daily personnel / business trips generated by the mine are approximately 350 vehicle trips. These trips are largely made on the N2 (Piet Retief to D2548 intersection), the D2548 and the D1091. The trips are spread over the day, but it is estimated that the peak hour are between 05:00 and 06:00 in the morning and between 14:30 and 15:30 in the afternoon. This does not coincide with the typical urban commuter peak hours (07:00 to 08:00 and 17:00 to 18:00).

The coal mined at Maquasa West is transported to Maquasa East with a conveyor belt of 6.5km in length. The coal from the open cast operation is transported by internal road to Maquasa East. From Maquasa East all export coal is transported by road to the siding at Panbult from where it is taken by train to Richards Bay. The coal sold locally is transported either by road or by rail (from Panbult) to the various local users. Approximately 240 truck trips are undertaken daily (personal communication, Mr Deon Erasmus, Kangra Coal Savmore Colliery) from Maquasa East to Panbult by a combination of 35 ton articulated trucks and 45 ton interlinks. Locally sold coal that is transported by road, is transported via the Haul Road to reach the N2, or D2548 and D1091 if it travels in the direction of Piet Retief. The total number of daily trips by trucks is as follows:

- Mine to Panbult – 480

- Mine to N2 – 120

As such, the total daily truck trips generated by the mine are approximately 600 trips. This is almost double the private vehicle (car) trips.

Traffic Volumes

Traffic volumes are typically expressed in hourly flows (vehicles/hour), as average daily traffic (ADT) or as the annual average daily traffic (AADT), when counts have been done for all the days of the year. The existing traffic flow information for the N2, D2548 and D1091 is discussed below.

N2 National Road

SANRAL operates a national traffic monitoring system on all national roads. Traffic data is being collected continuously with electronic counting stations located at numerous locations on the road network. The data was obtained from two count stations (P580, secondary station, just east of Ermelo and 1112, permanent station, just north of Piet Retief and south of the intersection with the road to Amsterdam). The salient information from these two sites is as follows:

- P580 just east of Ermelo (one week's data – 19/10/2010 to 26/10/2010):
  - Average daily traffic (ADT) – **5,605 vehicles**
  - Percentage trucks – **29.6**
  - Truck split % (short:medium:long) – **20:10:70**
  - Highest hourly volume (vehicles/hour) – **591 (17:00)**
- 1112 just north of Piet Retief (six week's data – 01/01/2010 to 16/02/2010):
  - Average daily traffic (ADT) – **5,768 vehicles**
  - Percentage trucks – **17.1**
  - Truck split percentage (short:medium:long) – **33:15:52**
  - Highest hourly volume (vehicles/hour) – **754 (13:00)**

The average daily traffic at both locations is quite similar at just below 6,000 vehicles/day. The percentage of trucks is high, especially at the site east of Ermelo. The portion of long trucks is also high at both locations, which clearly results from coal mining activities, as well as the power stations (such as Camden) in the area. The peak hour volume at both sites is close to 10% of the average daily flow, which is typical for urban areas.

From this information, it is concluded that Kangra Coal is presently contributing 8% to the traffic flow on the N2 (between D2548 and Piet Retief). This Kangra Coal traffic contains 120 trucks (or 26% of 470 vehicles), which is similar to the present vehicle split on the N2.

District Roads D2548 and D1091

The mine gains access from the N2 via the district roads, D2548 and D1091.

The critical section of the D2548 with respect to the presence of Kangra Coal traffic is the section between D1091 and the Haul Road turn off (between km 55.78 and 57.71). There Kangra Coal traffic constitutes approximately 950 vehicles out of a total 1,224 vehicles (or 78%) of the D2548 traffic. The heavy vehicles and buses linked to the mine constitute about 630 vehicles out of a total of 755 vehicles (or 83%). The presence of Kangra Coal traffic on the rest of D2548 is greatly reduced due to all the trucks turning north onto the Haul Road.

The proposed access road to Adit A will be along the existing extension of the D2548 in the direction of Amersfoord and Volksrust. The frequency / volume of use will be similar to that of the mine to N2 mentioned above. The intended use will be for commercial purposes (i.e. not for the transportation of coal); the existing coal product haulage practice will continue as-is to the existing Panbult Siding from Maquasa East.

The critical section of the D1091 with respect to the presence of Kangra Coal traffic is the section from the access to the mine northwards to Driefontein. There Kangra Coal traffic constitutes at least 950 vehicles out of a total 1,449 vehicles (or 66%) of the D1091 traffic. Heavy vehicles and buses associated with the mine constitute about 630 vehicles out of a total of 783 vehicles (or 80%). It should be noted here that the Kangra Coal traffic in reality constitutes even a higher percentage than calculated. This is due to the fact that the Kangra Coal traffic is probably slightly under estimated.

Haul Road

No traffic counts have been found for the Haul Road. It is expected that the Haul Road carries at least 480 truck trips on a daily basis. All of these trips are related to Kangra Coal mining activities.

8.1.10 *Visual* [(1)]

Landscape Character

The Study Area consists of four dominant natural landscape types: mountains and rolling hills, small rivers, streams and wetlands, the Heyshope Dam to the east of the site as well as the outstretched Eastern Highveld Grasslands. Three other types, mainly derived from man-made intervention, also occur within the Study Area. These include farmsteads and rural residential dwellings with their related out buildings, structures and landforms directly related to the mining activities as well as infrastructure such as the Driefontein Road and other local roads. *Figure 8.9* illustrates the spatial distribution of the various landscape character types.

(1) Martin. Y. (2010) – Newtown Landscape Architects

Figure 8.9 Landscape Character Types

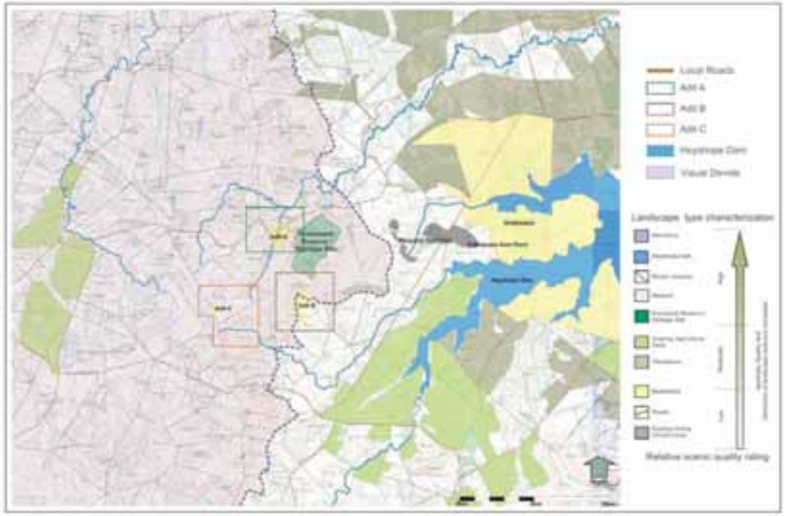


Figure 2 VISUAL RESOURCE: Kangra Coal Project

Visual Resource

Visual Resource Value / Scenic Quality

In determining the quality of the visual resource (both the objective and the subjective) all aesthetic factors associated with the landscape are considered.

The *highest* value is assigned to the Mantshangwe Mountains that runs through the middle of the Study Area and the Heyshope Dam to the east. The Hlelo River, smaller streams and the wetlands are also rated high. The outstretched grasslands have a moderate visual value. The combination of natural features characteristic of these areas, stand out within the context of the region and evoke distinct and unique images to produce a strong sense of place.

The landscape types with the *lowest* scenic quality rating are the plantations, residential areas, roads and other infrastructures as well as the mining areas.

Scenic quality values for the various landscape types (within the Study Area) vary from **high to moderate**. This is due to the fact that landscape types with a high scenic quality (mountains, river, streams and wetlands) are mixed with those with a lower quality (residential, roads, infrastructure and mining areas) around the site and within the Study Area.

Sense of Place

The sense of place can be divided into two different environments, the area to the east of the Mantshangwe Mountains and the area to the west of the mountains. The area to the west of the Mantshangwe Mountains have a rolling topography with the hills and mountains, the Hlelo River and associated streams, outstretched grassland and cultivated land. This environment emphasises the peaceful nature of the area and evokes a calm and pastoral sense of place.

This scene however changes once you move to the east of the Mantshangwe Mountains and enter into an environment that's been altered by the presence of manmade structures such as the residential area of Driefontein, roads and the existing mining activities as well as the plantations, which consist of exotic vegetation (*Figure 8.9*).

Visual Receptors

Views

Potential views towards the proposed sites will be views from the Driefontein Town, rural villages / residential areas scattered throughout the site, farmsteads, and local roads as well as from similar mining activities. The Mantshangwe Mountains forms a visual screen between the proposed plant and shaft activities on the eastern and western sides of the mountains.

Sensitive Viewer Locations

Potential sensitive viewers will include residential areas such as Driefontein Town, rural villages / residential areas as well as farmsteads. The residents located to the west of the Mantshangwe Mountains will be more sensitive to the proposed Project as there are no similar activities within this area. Residents on the eastern side of the Mantshangwe Mountains will be less sensitive as these areas already have mining activities within the views.

Other sensitive viewer locations will include the local farm roads, the Tweefontein Primary School as well as views along the Heyshope Dam. It should however be noted that haze plays a major role in this area and will decrease the visibility of the mining activities from the Heyshope Dam.

Box 8.1 Summary of Physical Environmental Sensitivities that will Potentially Influence Project Design

- Infrastructure design should consider the prevailing wind directions from the north and north-east.
- A high MAP, occurring mainly as thundershowers, will increase the areas propensity for erosion and infrastructure shall be designed to accommodate for high intensity/short duration events.
- Mine infrastructure (especially mine water ponds, waste rock and spoil dumps) should be able to accommodate a 186mm 24-hour design rainfall event.
- Soils in the proposed Study Area have a high to medium agricultural potential.
- The main source of water to communities and farmers in the area is surface water from several perennial streams in the area, which in turn are fed by groundwater derived from numerous springs. Base flow occurs throughout the year.
- Surface and groundwater quality in the Study Area is generally good. This water is used for potable use in the Study Area, for irrigation, livestock watering and is also dammed for transfer to the Vaal catchment and for industrial water use.
- Acid Mine Drainage has potentially occurred in current mining activities in the area.
- Day and night time noise levels in the Study Area are low and typical for a rural area. Sensitive receptors away from current mining activities are therefore sensitive to noise disturbances.
- Particulate fallout does occur around current project activities. Particulates will be the air pollutant of primary concern related to the proposed mining Project.
- Scenic quality values for the various landscape types (within the Study Area) vary from high to moderate. Potential sensitive viewers will include residential areas such as Driefontein Town, rural villages / residential areas as well as farmsteads. The residents located to the west of the Mantshangwe Mountains will be more sensitive to the proposed Project as there are no similar activities within this area.
- Kangra Coal is presently contributing 8% to the traffic flow on the N2 (between D2548 and Piet Retief), 78%of the D2548 traffic (between the D1091 and the Haul Road turn off) and 66% of D1091 (from the access road to the mine northwards to Driefontein). Heavy vehicles and buses associated with the mine constitute about 630 vehicles out of a total of 783 vehicles (or 80%).

8.2 BIOLOGICAL ENVIRONMENT [1]

8.2.1 *Ecological Regions*

Two ecological regions (Ecoregions) overlap the Study Area, that of the 11.02 Eastern Escarpment Mountains and 15.05 Highveld Ecoregions respectively (*Figure 8.10*). Both Ecoregions extend over different parts of all three quaternary catchments found within the Study Area and consequently give rise to the same three rivers namely the Hlelo, Mpundu (mostly from the Highveld Ecoregion) and Klein Vaal.

Regional Vegetation

The Study Area is located within the Mesic Highveld Grassland Bioregion which predominates throughout the higher rainfall, eastern regions of the Highveld and forms a part of the Grassland Biome (Mucina & Rutherford, 2006). The grasses of the Mesic Grassland bioregion are considered to be sour, and suitable for livestock grazing in the summer season only. The proposed expansion area for the Kangra Coal mining project spans four regional vegetation types within the grassland biome (*Figure 8.11*). These vegetation types are the (i) Eastern Highveld Grassland, (ii) Wakkerstroom Montane Grassland, (iii) Paulpietersburg Moist Grassland and (iv) Northern Afrotemperate Forest (Mucina & Rutherford, 2006) [2].

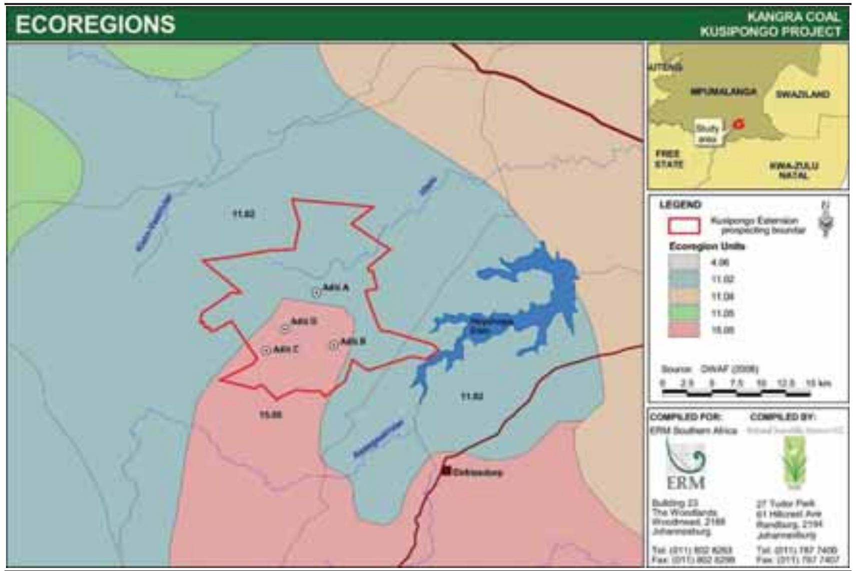
8.2.2 *Mpumalanga Biodiversity Conservation Plan*

According to the Mpumalanga Biodiversity Conservation Plan (MBCP), the highest proportion of the study site (29%) was listed as irreplaceable, this includes the proposed location of Adit A. The areas around Adits B and C have been classified as important and necessary. These occupy the second largest proportion of the Study Area (25.8%). A similarly high proportion of the Study Area (24.0%) has been listed as highly significant and predominates over the eastern and central parts of the Study Area. Only 12.3% has been classified as areas of least concern with no natural habitat remaining in fragmented portions (8%) in areas of rural residence.

(1) Natural Scientific Services (2011) - Specialist Study Baseline Assessment

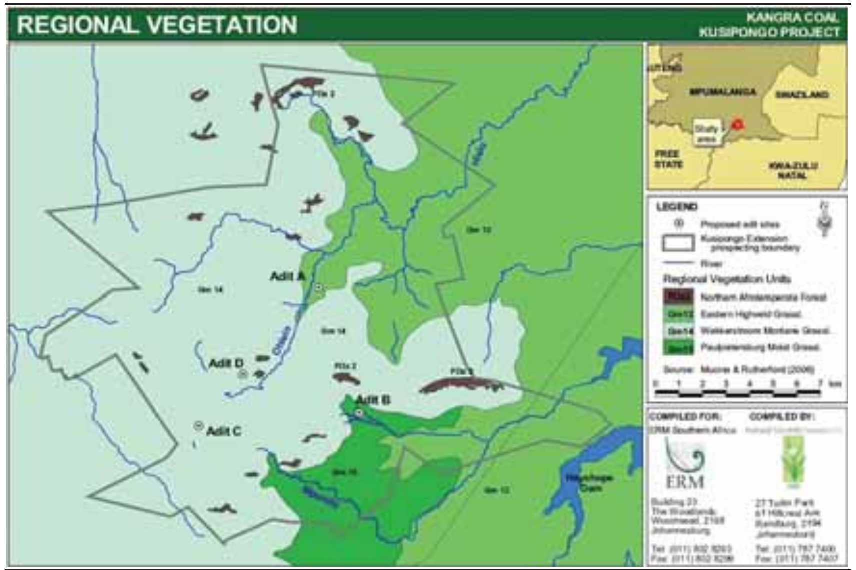
(2) Munica, L and Rutherford, M.C. (Eds). (2006) - The vegetation map of South Africa, Lesotho and Swaziland. Strelitzia 19, South African National Biodiversity Institute.

Figure 8.10 Ecoregion Land Units within the Greater Area Surrounding the Kangra Study Site



Source: DWAF's GIS data layers 2005 (DWAF, 2008)

Figure 8.11 Regional Vegetation in the Vicinity of the Proposed Project



Source: Munica and Rutherford (2006)

8.2.3 *Vegetation*

All major vegetation types covering the Study Area represent components of the Grassland Biome. This biome has an exceptional biodiversity, second only to the Fynbos Biome, although at a smaller spatial scale, the average species richness of the Grassland Biome is at times higher than that of many Fynbos communities (Cowling et al., 1997; van Wyk, 2002) [(1)]. The majority of rare and threatened fauna and flora reside within the high-rainfall grasslands, and since only 2.2% (Low & Rebelo, 1996) [(2)] of the total area is under formal protection the area is in need of urgent conservation action.

A total of 3,370 plant species have been recorded for the Grassland Biome. As many as 640 of these species are red listed, 136 of which are threatened with extinction with 6 species having already gone extinct (Hilton Taylor, 1996) [(3)]. Mucina & Rutherford (2006) [(4)] have assessed the conservation state of each regional vegetation unit based on the extent that is conserved in statutory reserves and the extent of transformation for cultivation, mining, urbanisation etc. The following classifications are provided for vegetation units occurring within the Kangra Study Area:

- The Eastern Highveld Grassland is classified as Endangered as approximately 44% of the unit has been transformed by cultivation, mining, plantations, urbanisations and construction of dams, while only a small proportion of that is currently conserved either in statutory reserves.
- The Wakkerstroom Montane Grassland is considered Not Threatened as little transformation of the land has occurred, presumably because the cooler climate and shallow soils restrict agricultural practices there. This region does however support 10 South African Natural Heritage sites. The riparian areas are prone to Black wattle (*Acacia mearnsii*) and *Leucosidea sericea* infestations.
- The Paulpietersburg Moist Grassland is classified as Vulnerable as approximately a third of the region has been transformed plantations or cultivation, while fire and overgrazing have destroyed most of the grassland of high conservation value. Only a small proportion of the area is formerly conserved.
- The Northern Afrotemperate Forest is considered Not Threatened with 30% of the unit formally conserved in reserves. Several plant species are endemic to this vegetation type and include *Scolopia oreophila*, *Maytenus albata*, *Sparrmannia ricinocarpa* and *Streptocarpus polyanthus subsp. dracomontanus*. Timber harvesting, medicinal plant harvesting, grazing and

(1) Cowling, R.M., Richardson, D.M. & Pierce, S.M. (eds). (1997) - Vegetation of Southern Africa. Cambridge University Press, Cambridge.
(2) LOW, A.B. & REBELO, A.G. (eds.) 1996. Vegetation of South Africa, Lesotho and Swaziland.
A Companion to the Vegetation Map of South Africa, Lesotho and Swaziland. Dept of Environmental affairs and Tourism, Pretoria.
(3) Hilton-Taylor, C. (1996) - Red Data List of Southern African Plants. Strelitzia 4. National Botanical Institute, Pretoria.
(4) Munica, L and Rutherford, M.C. (Eds). (2006) - The vegetation map of South Africa, Lesotho and Swaziland. Strelitzia 19, South African National Biodiversity Institute.

hot fires encroaching from surrounding vegetation pose a threat to these forests.

The Study Area contains the following clearly defined zones:

- Forested kloofs;
  - *Buddleja - Halleria* Mixed Forest
- The grassland exposed outcrops;
  - *Diospyros - Themeda* Rocky Outcrops
  - *Alloteropsis - Tristachya* Exposed Rocky Grassland
- Open plateau rocky grasslands and hydromorphic seep zones;
  - *Microchloa - Themeda* Upper Plateau Grassland
  - *Agrostis - Cyperus* Seepage Grassland
  - *Juncus - Leersia* Isolated Hydromorphic Grasslands
- Rocky slope grasslands and associated drainage lines; and
  - *Themeda - Harpochloa* Lower Slope Grasslands
  - *Juncus - Woodsia* Hillslope Drainage
- Valley bottom grassland and river systems.
  - *Hyparrhenia - Eragrostis* Pioneer Grasslands
  - *Juncus - Merxmuellera* Riparian Grasslands
  - *Juncus - Leersia* Isolated Hydromorphic Grasslands

Alien Invasive Species

Within data obtained through the PRECIS database, 50 alien species were recorded for the Study Area. Of these, *Cirsium vulgare* and *Acacia dealbata* were the only category listed species.

8.2.4 *Fauna*

A large diversity of faunal species were confirmed for the proposed Project Study Area, and a summary of the species (families for terrestrial macro-invertebrates) identified within the Study Area and within the surrounding areas (NSS, 2008) is presented in *Table 8.2*.

Table 8.2 Numbers of Faunal Species (Families and Invertebrates) Identified During Current and Previous Studies

	Habitat			
Animal Group	**Moderate Altitude Disturbed Grassland ADIT A**	**Low Altitude Tall Grassland ADIT B**	**High Altitude Short Montane Grassland ADIT C**	**Total**
Mammals	2	8	15	17
Avifauna	49	76	82	122
Reptiles	3	2	4	8
Amphibians	2	1	6	10
Macro-invertebrates	10	7	16	22

Source: NSS

Mammals

Research has demonstrated that the Mpumalanga Province supports a high faunal diversity, including 163 mammal species, of which 98 species fall into the small mammal category. A desktop study identified 104 species potentially occurring in the Study Area. This represents 63% of the provincial diversity of mammals.

The desktop review revealed 16 Red Data mammal species (Friedman & Daly, 2004) (1) that could potentially occur within the Study Area. A further three species without Red Data status are listed as protected species by NEMBA. These species are presented in *Table 8.3* with the likelihood of natural occurrence within the Study Area. None of these species have been confirmed to occur; however, 10 species may occur on site, while an additional 5 species are highly likely to occur.

Table 8.3 Threatened and Protected Mammal Species Potentially Occurring within the Study Area

Species	Common Name	Status	LoO
Chrysospalax villosus	Rough-haired golden mole	CR [1]	2
Amblysomus septentrionalis	Highveld golden mole	NT	2
Mystromys albicaudatus	White-tailed mouse	EN	3
Atelerix frontalis	Southern African hedgehog	NT [3]	2
Rhinolophus clivosus	Geoffroy's horseshoe bat	NT	2
Rhinolophus darlingi	Darling's horseshoe bat	NT	3
Miniopterus fraterculus	Lesser long-fingered bat	NT	3
Miniopterus natalensis	Natal clinging bat	NT	3
Myotis welwitschii	Welwitsch's hairy bat	NT	3
Myotis tricolor	Temminck's hairy bat	NT	3
Manis temminckii	Ground pangolin	VU [2]	3
Parahyaena brunne	Brown hyaena	NT [3]	2
Felis nigripes	Black-footed cat	LC [3]	3
Leptailurus serval	Serval	NT [3]	3
Lutra maculicollis	Spotted-necked otter	NT [3]	3
Mellivora capensis	Honey badger	NT [3]	2
Vulpes chama	Cape fox	LC [3]	2
Ourebia ourebi	Oribi	EN [1]	3
Redunca arundinum	Southern reedbuck	LC [3]	3

Key: [1] Species listed as Critically Endangered in NEMBA
[2] Species listed as Vulnerable in NEMBA
[3] Species listed as Protected in NEMBA
LoO (Likelihood of Occurrence): 1 – Present, 2 – Likely; 3 – Possible; 4 – Unlikely

Sources: Friedman & Daly (2004), NEMBA Schedule (2007)

(1) Friedmann, Y. & Daly, B. (eds). (2004) - Red Data Book of the Mammals of South Africa: a conservation assessment. CBSG Southern Africa, Conservation Breeding Specialist Group (SSC/IUCN), Endangered Wildlife Trust, South Africa.

Avifauna

Mpumalanga supports a highly diverse bird life, with over 567 birds recorded within the province. Of these, about 71 are Red Data species. According to the two South African Bird Atlas Projects (SABAP) (1), there are 301 bird species recorded within the Study Area. Over 10% of these species are threatened or have a Red Data status.

Considerable efforts were made to record the diversity of birds during this baseline assessment. The NSS team recorded 68 species in November 2010 and Delta Environmental Consultants (DEC) recorded 110 species during a dedicated bird assessment in December 2010.

The Desktop review lists 32 bird species having been recorded in the vicinity of the study site and having a Red Data classification (Barnes, 2000).This result agrees with Van Rooyen (2010) (2) who found that the area is particularly rich in Red Data bird species, particularly large terrestrial species. These species are presented in *Table 8.4* with their likelihood of occurrence in the Study Area based on an assessment of the habitat there.

(1) South African Bird Atlas Project (SABAP1) Data Extraction. (2007) - Website: http://birds.sanbi.org/sabap/sabap_select1.php Site accessed 6 April 2009.

(2) Van Rooyen, C. (2010) - Kusipongo Mine Bird Impact Study – Desktop Site Selection for a Shaft Location, Plant, Discard Dump and Road Infrastructure. 30 Rooseveldt Street, Robindale, Randburg 2194. Report prepared for GCS (Pty) Ltd, Rivonia.

Table 8.4 Conservation Important Bird Species Potentially Occurring within the Study Area

Species	Common Name	Status	LoO
Mycteria ibis	Yellow-billed Stork	NT	2
Ciconia nigra	Black Stork	NT ³	2
Geronticus calvus	Southern Bald Ibis	VU ³	1
Phoenicopterus ruber	Greater Flamingo	NT	4
Phoenicopterus minor	Lesser Flamingo	NT	4
Sagittarius serpentarius	Secretarybird	NT	1
Gyps coprotheres	Cape Vulture	VU ²	3
Falco biarmicus	Lanner Falcon	NT	1
Falco naumanni	Lesser Kestrel	VU ³	2
Polemaetus bellicosus	Martial Eagle	VU ³	2
Stephanoaetus coronatus	African Crowned Eagle	NT	2
Circus ranivorus	African Marsh-harrier	VU ⁰	1
Circus macrourus	Pallid Harrier	NT	2
Circus maurus	Black Harrier	NT	2
Crex crex	Corn Crake	VU	2
Balearica regulorum	Grey Crowned-crane	VU ²	1
Bugeranus carunculatus	Wattled Crane	CR ¹	2
Anthropoides paradiseus	Blue Crane	VU ²	1
Neotis denhami	Denham's Bustard	VU ⁰	1
Eupodotis senegalensis	White-bellied Korhaan	VU	1
Eupodotis caerulescens	Blue Korhaan	NT ³	2
Lissotis melanogaster	Black-bellied Bustard	NT	1
Rostratula benghalensis	Greater Painted-snipe	NT	2
Vanellus melanopterus	Black-winged Lapwing	NT	1
Glareola nordmanni	Black-winged Pratincole	NT	2
Tyto capensis	African Grass-owl	VU ³	3
Alcedo semitorquata	Half-collared Kingfisher	NT	1
Heteromirafra ruddi	Rudd's Lark	CR	2
Lioptilus nigricapillus	Bush Blackcap	NT	1
Anthus brachyurus	Short-tailed Pipit	VU	2
Anthus chloris	Yellow-breasted Pipit	VU	1

Key: ¹ Species listed as Critically Endangered in NEMBA
² Species listed as Endangered in NEMBA
³ Species listed as Vulnerable in NEMBA
⁰ Species listed as Protected in NEMBA
LoC (Likelihood of Occurrence): 1 – Present, 2 – Likely; 3 – Possible; 4 – Unlikely

Sources: Barnes (2000), SABAP1 and SABAP2 (ADU website, 2010)

Reptiles

Species richness for reptiles in South Africa is highest in the north-eastern parts, and declining in a south-westerly direction. The areas of highest species richness correspond with the savanna biome, while the grassland biome has moderately low reptile species richness compared on a national scale. However, a large component (up to 80%) of the grassland biome has been transformed, and as a result several reptile species are of conservation concern (Alexander & Marais, 2007) (1).

The list of reptiles of conservation importance that can be compiled is unfortunately inadequate as publication of the South African Reptiles Conservation Atlas (SARCA) is delayed, and the last comprehensive conservation assessments on reptiles was conducted by B. Branch in 1988 and is now very outdated. A limited list of conservation important reptiles has thus been compiled based on the NSS Desktop study of reptile species with a Likelihood of Occurrence (LoO) (*Table 8.5*).

Table 8.5 Conservation Important Reptile Species Potentially Occurring within the Study Site

Species	Common Name	Status	LoO
Nucras lalandii	Delalande's Lizard	NT	1
Kinixys natalensis	Natal hinged tortoise	NT	4
Cordylus giganteus	Sungazer / Giant girdled lizard	VU [1]	2

Key: [1] Species listed as Critically Endangered in NEMBA
[2] Species listed as Vulnerable in NEMBA
[3] Species listed as Protected in NEMBA
LoO (Likelihood of Occurrence): 1 – Present, 2 – Likely; 3 – Possible; 4 – Unlikely

Sources: Barnes (2000), SABAP1 and SABAP2 (ADU website, 2010)

Amphibians

Published data from the South African Frog Atlas (Minter et al. 2004) (2) was used to compile a list of 20 amphibian species that could occur within Study Area. The likelihood of occurrence of two of these species is rated as "*Possible*" while the remaining 18 species are considered "*Likely*" to occur. These results place the possible species richness slightly higher than the broad trend described by Du Preez & Carruthers (2009) (3). The habitat is particularly diverse within the vicinity of the proposed Study Area, which could be an explanation for the higher than expected frog diversity there.

The Desktop review, however, revealed that no conservation important amphibian species could potentially occur in the Study Area. Only one Red Data frog species occurs within the Mpumalanga grasslands, i.e. the Giant Bullfrog, but the nearest records are quite distant from the Study Area (Minter *et al.* 2004), and is not considered a possible species there.

(1) Alexander, G.J & J. Marais (2007) - A Guide to the Reptiles of Southern Africa. Struik Publishers, Cape Town.
(2) Minter, L., Burger, M.; Harrison, J.A.; Braak, H.H.; Bishop P.J.; & Kloepfer, D. (Eds.) (2004) - Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland. SI / MAB Series #9. Smithsonian Institution, Washington, DC.
(3) Du Preez, L. & Carruthers, V. (2009) - A complete guide to the frogs of Southern Africa. Struik Nature, Cape Town.

Terrestrial Macro-invertebrates

Two butterfly species, *Chrysoritis aureus* and *Pseudonympha swanepoeli* classified as threatened by Henning *et al.* (2009) [(1)] could potentially occur within the Study Area. The habitat is suitable for both of these species (Woodhall, 2005) [(2)] but their nearest distribution records do not correlate closely with the Study Area boundaries (SABCA, 2010).

The NEMBA schedule (2007) lists 6 protected invertebrate families for which there is the potential occurrence within the Study Area. One of these families, the *Opisthacanthus* scorpions, was found to be relatively abundant on rocky outcrops within the Study Area. Other families have a reasonable likelihood of occurrence within the Study Area based on limited distribution data in Leeming (2003) [(3)] and Dippenaar-Schoeman (2002) [(4)].

Table 8.6 Conservation Important Invertebrates Potentially Occurring within the Study Site

SPECIES	COMMON NAME	STATUS	LoO
Chrysoritis aureus	Golden Opal	VU	3
Pseudonympha swanepoeli	Swanepoel's Brown	CR	31
Opisthacanthus spp.	Creeping Scorpions	PS [1]	2/3
Opistophthalmus spp.	Burrowing Scorpions	PS [1]	2/3
Hadogenes spp.	Flat Rock Scorpions	PS [1]	2/3
Ceratogyrus sp.	-	PS [1]	2/3
Harpactira sp.	Baboon Spiders	PS [1]	2/3
Pterinochilus sp.	-	PS [1]	2/3

Key: [1] Species listed as Critically Endangered in NEMBA
[2] Species listed as Vulnerable in NEMBA
[3] Species listed as Protected in NEMBA
LoO (Likelihood of Occurrence): 1 – Present, 2 – Likely; 3 – Possible; 4 – Unlikely

Sources: Barnes (2000), SABAP1 and SABAP2 (ADU website, 2010)

Aquatics

Six study sites were selected for the purposes of characterising the Present Ecological Status (PES) of the aquatic ecosystems in the Study Area (*Figure 8.12*). Where possible, sites were selected upstream and downstream from proposed Adits A, B, C and D.

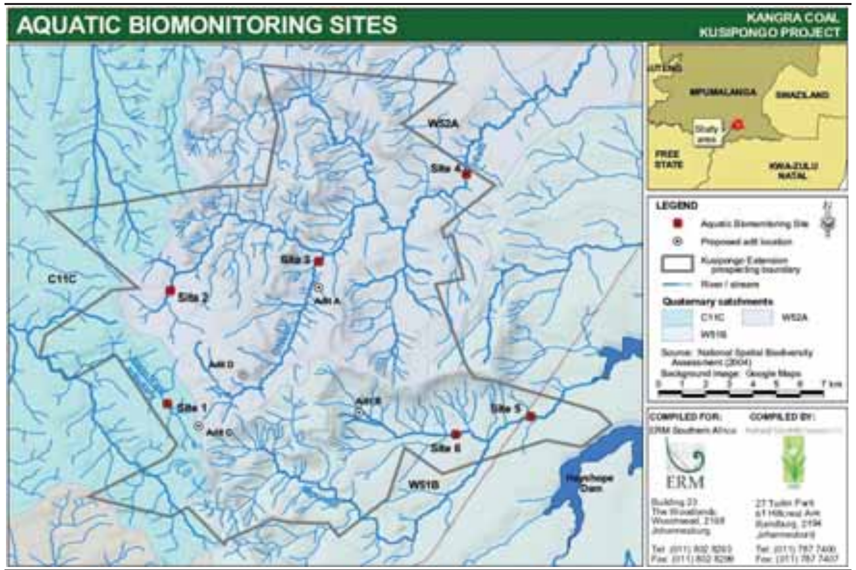
Water quality assessments showed few changes from natural water constituents. All sites were impacted with high levels of organic enrichment and turbidity, which were attributed to the surrounding agricultural activities within the area.

(1) Henning, G.A., Terblanche, R.F. & Ball, J.B. (Eds) (2009) - South African Red Data Book: Butterflies. SANBI Biodiversity Series 13. South African National Biodiversity Institute, Pretoria.
(2) Woodhall, S. (2005) - Field guide to the butterflies of South Africa. Struik Publishers, Cape Town.
(3) Leeming, J. (2003) - Scorpions of Southern Africa. Struik Publishers, Cape Town.
(4) Dippenhaar-Schoeman, A.S (2002) - Baboon and Trapdoor Spiders of Southern Africa: An Identification Manual. Plant Protection Research Institute handbook No. 13. Agricultural Research Council, Pretoria.

The habitat integrity PES was predominantly natural in the Klein Vaal and the Hlelo Rivers. The majority of modifications to the habitat integrity was observed in the Mpundu River, associated with the infestation of a number of exotic tress including the Black Wattle, Grey Poplar and the Weeping Willow.

The macro-invertebrate integrity at all of the sites showed generally few modifications, ranging from natural to moderately modified. At Sites 3 and 4, the macro-invertebrates indicated near natural macro-invertebrate integrity, with the presence of relatively rare and sensitive macro-invertebrate families. Although none had any conservation status, the generally high scarcity of such macro-invertebrate assemblage integrity in South Africa, highlights the need for the conservation of the upper Hlelo River system.

Figure 8.12 Aquatic Bio-monitoring Sites



The PES of the ichthyofauna assemblage ranged from near natural to moderately modified. Although none of the fish species were characterised as having a conservation status, numerous species were present in the Hlelo River catchment that have relatively low distributions and high sensitivities to ecosystem modifications. In addition to this, the presence of the Near Threatened *Barbus species*, B. *brevipinnis*, could not be discounted in the Hlelo tributary. These results highlight the sensitivity of the Hlelo tributary and consequently the need for the appropriate conservation and protection of the fish species in the upper Hlelo tributaries, downstream from the proposed sites of Adits A and C, as was shown in the macro-invertebrate assemblages.

In contrast, the sites situated in the Mpundu catchment show relatively low fish community integrities, albeit natural.

8.2.5 Wetlands

The proposed Study Area is in a high rainfall area and Sandstone and Dolerite dykes are a prominent feature of the geology and are cause for considerable linkage between surface and ground water systems. Wetlands are thus widespread within the area and are dominant features covering a large area of the landscape.

The general area is mountainous with plateaus, numerous steep slopes facing various directions and valley bottoms. Some valley bottoms are wide landscape features, whereas others are narrow steep kloof-like landscape features. The multitude of terrain forms give rise to numerous wetlands of diverse characteristics.

An intricate network of wetlands and drainage lines exists within the proposed Study Area, and almost all types of wetlands described by DWAF (2007) [1] can be identified there.

(1) DWAF, 2007. Manual for the assessment of a Wetland Index of Habitat Integrity for South African floodplain and channelled valley bottom wetland types. By M. Rountree (ed); C.P. Todd, C.J. Kleynhans, A.L. Batchelor, M.D. Louw, D. Kotze, D. Walters, S. Schroeder, P. Illgner, M. Uys and G.C. Marneweck. Report no. N/0000/00/WEI/0407. Resource Quality Services, Department of Water Affairs and Forestry, South Africa.

Figure 8.13 *Summary of Biological Environmental Sensitivities that will Potentially Influence Project Design*

- According to the MBCP[1], the highest proportion of the study site (29%) was listed as irreplaceable (this includes the site proposed for Adit A). The areas around proposed Adits B and C have been classified as important and necessary. These occupy the second largest proportion of the Study Area (25.8%). A similarly high proportion of the Study Area (24.0%) has been listed as highly significant and predominates over the eastern and central parts of the Study Area.
- All major vegetation types covering the Study Area represent components of the Grassland Biome. This biome has an exceptional biodiversity.
- The majority of rare and threatened fauna and flora reside within the high-rainfall grasslands; only 2.2% of the total area is under formal protection.
- A desktop study identified 104 mammal species potentially occurring in the Study Area. This represents 63% of the provincial diversity of mammals. 16 Red Data mammal species could potentially occur within the Study Area.
- 32 bird species recorded in the vicinity of the study site have a Red Data classification.
- Water quality assessments showed few changes from natural water constituents. All sites were impacted with high levels of organic enrichment and turbidity, which were attributed to the surrounding agricultural activities within the area.
- Habitat integrity is predominantly natural in the Klein Vaal and the Hlelo Rivers, but modified in the Mpundu River.
- The macro-invertebrate integrity at all of the sites showed generally few modifications, ranging from natural to moderately modified.
- Ichthyofauna (fish) assemblages ranged from near natural to moderately modified. Although none of the fish species were characterised as having a conservation status, numerous species were present in the Hlelo River catchment that have relatively low distributions and high sensitivities to ecosystem modifications.
- There are a range of wetlands occurring in the vicinity of the proposed Study Area. These wetlands were identified to have a range of anthropogenic and ecological services.

8.3 SOCIAL ENVIRONMENT

8.3.1 Socio-economic (2)

District and Local Municipalities

The Mpumalanga Province of South Africa has within its area of jurisdiction three District municipalities, which include Gert Sibande, Nkangala and Ehlazeni. The Project is located within the Gert Sibande District Municipality. This District Municipality consists of seven constituent Local Municipalities, including (refer to *Figure. 8.14*Figure.):

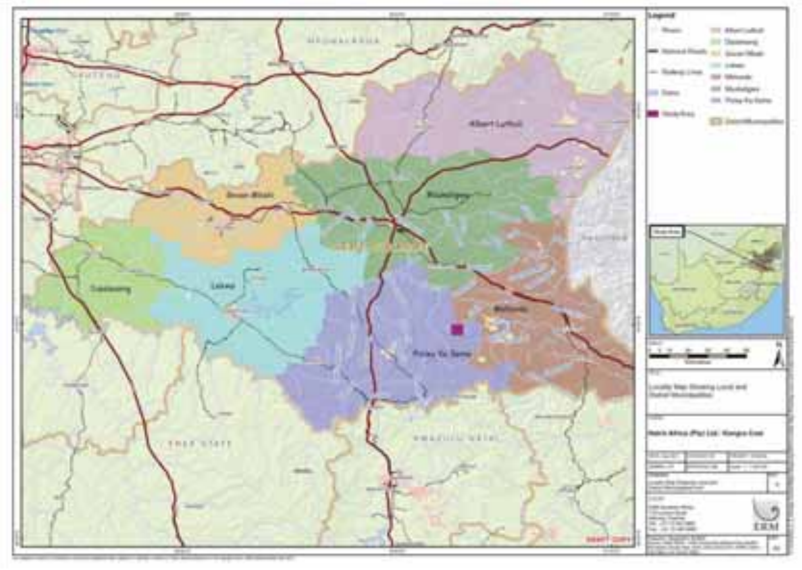
- Mkhondo Local Municipality;
- Dr. Pixley KaIsaka Seme Local Municipality (formerly known as Pixley Ka Seme Local Municipality);
- Govan Mbeki Local Municipality;
- Albert Luthuli Local Municipality;
- Msukaligwa Local Municipality;

[1] The Study Area will be ground-truther with reference to the claasification listsed in the Mpumalanga Biodiversity Conservtion Plan, 2007.

(2) Moonsamy. K. and L. Bungartz (2011) - Environmental Resources Management (Pty) Ltd.

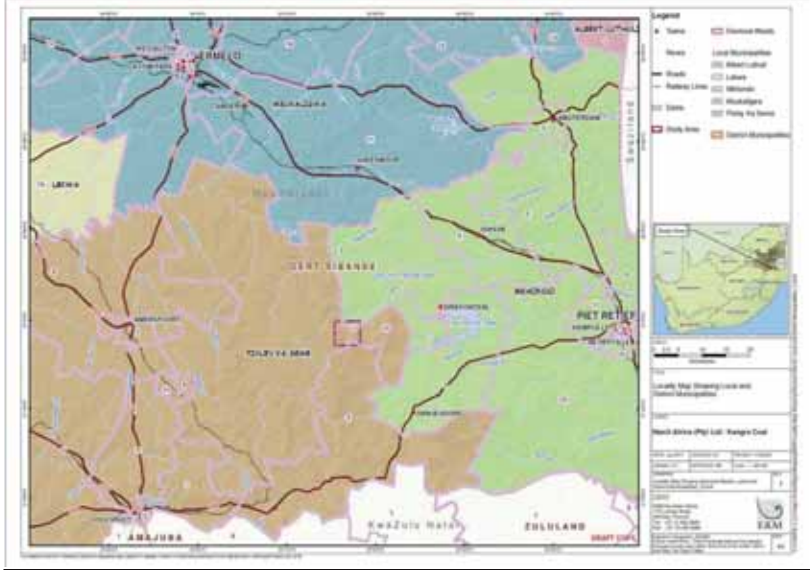
- Lekwa Local Municipality; and
- Dipaleseng Local Municipality.

Figure. 8.14 Gert Sibande District Municipality



The Study Area lies within the Mkhondo and Dr. Pixley Kalsaka Seme Local Municipalities. Local Municipalities are further divided into Wards. Of relevance to this Project is Ward 2 and 3 of the Mkhondo Local Municipality and Wards 5 and 10 of the Dr. Pixley Kalsaka Seme Local Municipality (*Figure 8.15)*.

Figure 8.15 Applicable Wards in Dr Pixley Kalsaka Seme and Mkhondo Local Municipalities



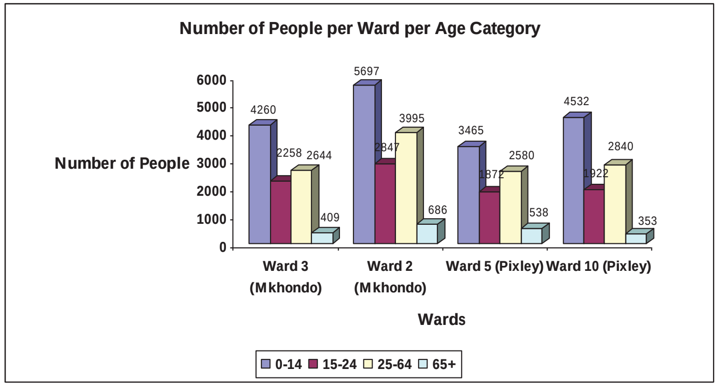
This section reflects the social and economic characteristics of the Study Area, reflected at Ward level.

Demography

The total population across the four relevant wards is 40,897 people; of which 32% reside in Ward 2 of Mkhondo, 23% in Ward 3 of Mkhondo, 21% and 24% in Ward 5 and 10 of the Dr. Pixley Kalsaka Seme Local Municipality respectively. All four Wards have an average percentage male/female population of 53% females and 47% males.

Age group representation at Ward level is shown in *Figure. 8.16.* Collectively (across all Wards), a greater percentage of the population (44%) are in the 0-14 year age group, with 21% in the 15-24 year age group, 30% in the 25-64 year age group and 5% in the over 65 year age group. Of the population, 51% fall within the 'working age' population, i.e. between 15-64 years.

Figure. 8.16 Age Group Presentation at Ward Level

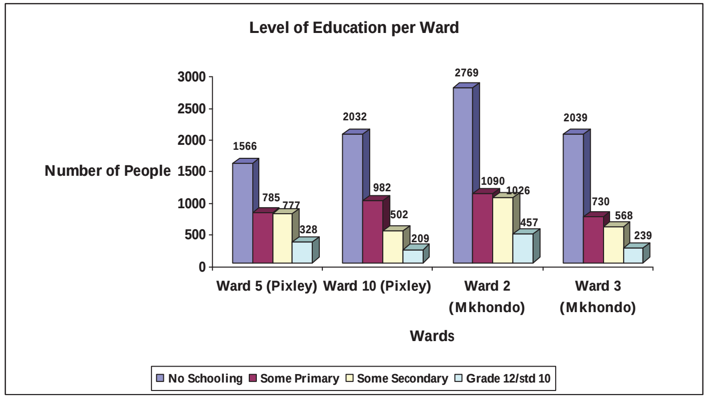


Source: South Africa Population Census. 2001. Statistics South Africa. Government Printer.

Educational Status

Education levels are reflected in *Figure. 8.17.* Collectively, all Wards have a higher percentage of its working age population without schooling (52%). A large proportion of the working age population are without a Grade 10 or 12 certificates; only 8% of the population across all Wards, have such certification.

Figure. 8.17 Educational Levels for the Working Age Population in Relevant Wards



Source: South Africa Population Census. 2001. Statistics South Africa. Government Printer.

Access to Services

Ward 5 has the higher percentage of households utilising electricity for lighting (76%), compared to 53%, 21% and 13% for Wards 2, 3 and 10 respectively. Wood is used as the primary heating agent in Ward 2 (91% of households) and Ward 3 of Mkhondo (83%), whereas coal is used mainly for heating in Ward 5 (55%) and Ward 10 (43 %). Wood is used by 90% of households in Ward 2 and 77% of households in Ward 3 for cooking purposes, whilst 53% of households in Ward 5 use coal and 42% of households in Ward 10 use wood.

Of the households in Ward 5, 7% have no access to piped water; this is compared to 23% of households in Ward 10, 19% in Ward 2 and 27% of households in Ward 3. Of the households in Ward 5, 10, 2 and 3; 39%, 18% 20% and 11% of residents respectively use standpipes located on local school properties as their source of water supply.

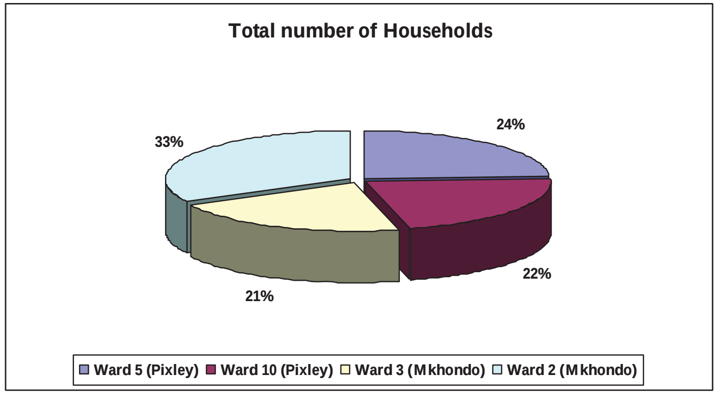
Of the households in Ward 5, 75% have access to flush toilets; 90% of households in Ward 2, 85% in Ward 3 and 64% of households in Ward 10 use pit latrines; 31% of households in Ward 10 have no access to sanitation, this is much higher than in Ward 5 (18%), Ward 3 (11%) and Ward 2 (6%).

Public transport systems within these Wards are poor; 41% of residents across all four Wards walk to their destinations, as opposed to the utilisation of any form of transport.

A Typical Household in the Wards

The total number of households recorded across all four Wards is 7,709. The number of households per Ward (as a percentage) is reflected in *Figure 8.18* below. Given the populations in each of the four wards, it can be roughly assumed that approximately one third of households across all four Wards have four to six members per household unit.

Figure 8.18 *Total number of Households*

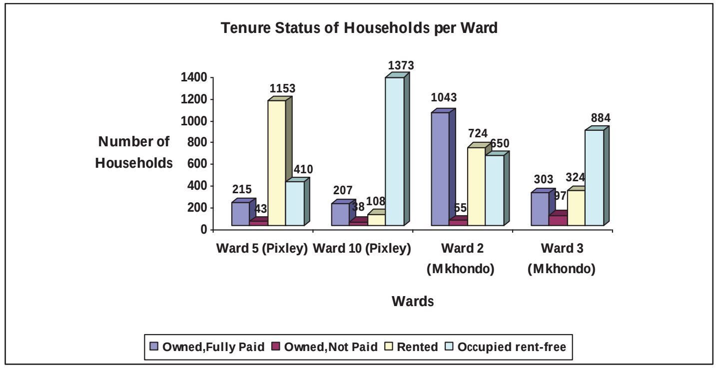


Source: South Africa Population Census. 2001. Statistics South Africa. Government Printer.

Housing Tenure

Housing tenure for each Ward is shown in *Figure. 8.19.* The percentage of people that own their residence (whether fully paid or not) are 44%, 24% 14% and 14% in Wards 2, 3, 5 and 10, respectively. Those renting residence is highest in Ward 5 (63%). Those identified as occupying their residence 'rent-free' is estimated at 25%, 23%, 54% and 79% in Wards 2, 5, 3 and 10, respectively.

Figure. 8.19 *Tenure Status of Households*



Source: South Africa Population Census. 2001. Statistics South Africa. Government Printer.

Employment Status and Occupation

The number of 'employable' people (i.e. between the ages of 15 and 64 years) is 20,958 (or 51% of the collective Ward's population). It must be noted that the category of 'employed' persons presented relates to those only formally employed. The 'not economically active' category relates to those that are capable of working, but are currently unemployed.

Collectively, 33% of the employable population reside in Ward 2, 21% in Ward 5, 23% in Ward 10 and 23% in Ward 3. These figures also reflect the distribution of the total working age population within each Ward (*Table. 8.7*).

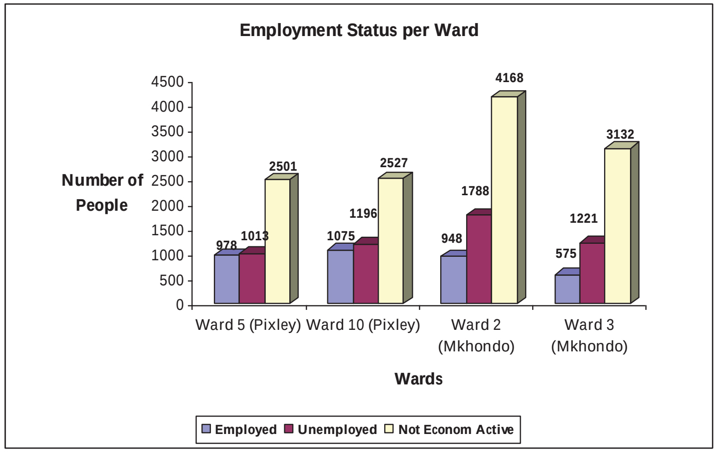
Table. 8.7 *Total Ward Population and Total Employable Population*

Ward	Total Population	%	Total Employable Population	%
Ward 2 (Mkhondo)	13, 224	32	6,842	33
Ward 3 (Mkhondo)	9,571	23	4,902	23
Ward 5 (Pixley)	8,455	21	4,452	21
Ward 10 (Pixley)	9,647	24	4,762	23
Total	**40,897**		**20,958**	

Source: South Africa Population Census. 2001. Statistics South Africa. Government Printer.

The data in *Table. 8.7* above shows that there is a greater number of work seekers (employable population) in all four Wards as compared to those employed in each Ward. Approximately 14% of the working age population are employed in Ward 2, 22% in Ward 5, 22% in Ward 10 and 12% in Ward 3 (*Figure. 8.20*).

Figure. 8.20 Employment Status per Ward



Source: South Africa Population Census. 2001. Statistics South Africa. Government Printer.

Of the total number of people employed within the Wards, 16% are identified as plant operators, 19% as skilled agricultural workers, with the largest proportion of employed people (38%) classifying themselves as being involved in "elementary occupations".

Employment by industry data is provided in *Table. 8.8* below. This data reveals that the agricultural sector is the highest employer; collectively across all Wards, this sector provides work to approximately 37% of those employed. Work in 'private households'[1] accounts for approximately 17% of employment provided.

Table. 8.8 Employment by Industry[2]

Ward	Agriculture-related work	Community Services	Wholesale and Retail	Private Household
Ward 2 (Mkhondo)	31%	12%	10%	3%
Ward 3 (Mkhondo)	59%	2%	7%	23%
Ward 5 (Pixley)	26%	15%	14%	33%
Ward 10 (Pixley)	57%	2%	6%	23%

Source: South Africa Population Census. 2001. Statistics South Africa. Government Printer.

According to the Dr. Pixley Kalsaka Seme Local Municipality, the mining sector accounts for 8% of employment in the local municipality. The Mkhondo Local Municipality's Integrated Development Plan (2010) does not provide any statistics relating to employment in the mining sector; however, mining is a well established economic sector in the local municipality.

(1) [1] 'Private households' may refer to those working as domestic workers or gardeners.
(1) [2] Stats SA data unfortunately has a greater number of 'undetermined' data, possibly indicating that not all respondents had answered the census question relating to 'industry occupation.'
(2)

Household Income

Approximately 47% of households in Ward 3 of Mkhondo have no household income in comparison to 41% of households in Ward 2, 32% in Ward 5 and 31% in Ward 10. This accounts for 38% of the total number of households across all four wards. Additionally a total of 15% of households in Wards 2, 3, 5 and 10 collectively generate an income of between R1 and R4,800 per month and 45% generate a household income of more than R4,800 per month.

8.3.2 *Cultural and Heritage Study*

Types and Ranges of Heritage Resources in the Larger Study Area

Contextual evidence and fieldwork indicates that the following types and ranges of heritage resources occur in the larger Study Area, namely:

- Graveyards dating from the historical period (older than sixty years) or from the recent past (*Figure 8.22*);
- Homesteads dating from the historical period (older than sixty years) or from the recent past (*Figure 8.23*); and
- Colonial farmstead complexes consisting of farmhouse, cattle enclosures and graveyards which date from the second half of the nineteenth century and from the early twentieth century. When such structures and features are spatially associated with each other in time and space they may constitute small cultural landscapes.

The baseline heritage survey for the Study Area

The baseline heritage survey for the three proposed Adit locations and for the conveyer route revealed the following types and ranges of heritage resources (as outlined in *Section 3* of the National Heritage Resources Act (No 25 of 1999)) in and near the Study Area, namely:

- A single grave in proximity to proposed Adit A (*Figure 8.21*);
- A cluster of approximately 20 graves within a distance of approximately 35m from the south eastern border of the Main Mine Adit (*Figure 8.22);*
- A small cultural landscape incorporating a cattle enclosure, graveyard and the remains of a possible dwelling on the outskirts of proposed Adit C The remains of a third structure, which may be those of a dwelling, are located further from these two structures and from the Adit C area (*Figure 8.26*);
- Stone walls dating from the Late Iron Age near the conveyer route [(1)] running between Adit B and the existing Kangra Coal Plant;
- A sandstone bank or reef is located near the centre of the Adit B area. No Stone tools or rock paintings were observed at this natural feature. (*Figure 8.25*); and

(1) *Please note* - the proposed conveyor route from Adit B through to the exisitng Maquasa West Adit is no longer proposed. The proposed conveyor route is between Adit A (Main Mine Adit) and the exisitng Maquasa West Adit.

- Stone walls (Site LIA01) dating from the Late Iron Age are located near the proposed Study Area (*Figure 8.27*). These stone walls date from the Late Iron Age (AD1600 to AD1880) and were possibly used as cattle enclosures or as outer walls which demarcated dwellings. Site LIA01 was probably occupied by a Sotho or Nguni speaking community during the eighteenth century.

Figure 8.21 Graveyard Dating from the Historical Period and from the More Recent Past on the Farm Maquasa 19HToutside the Study Area

Figure 8.22 Graveyard Possessing Graves of a Variety of Ages approximately 35m from the South Eastern Perimeter of Adit A

Figure 8.23 Remains of Two Kinds of Homesteads in the Larger Study Area which have Historical Affinities as Both are Older than Sixty Years

Figure 8.24 A Single Grave near a Homestead in the Vicinity of Proposed Adit A

Figure 8.25 Sandstone Bank or Reef

Figure 8.26 A Colonial Graveyard Demarcated with Dolerite Walls on Beelzebub 13HT, outside of Proposed Adit C

Figure 8.27 Stone Wall Enclosures near the Proposed Study Area

In summary remains of cultural and heritage significance are as follows:

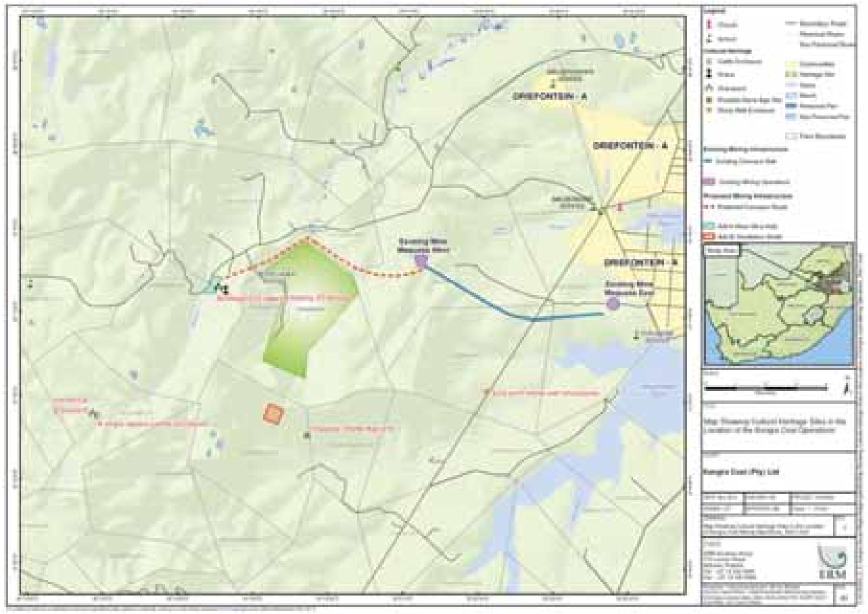
Table 8.9 Cultural and Heritage Remains at Proposed Kangra Coal Expansion Site

Remains	Coordinates
A single grave near Adit A	27º 01.072'S; 30º 17.405'E
Graveyard 35m from the south eastern border of Main Mine Adit A	27^{0} 01' 01.96"S; 30^{0} 17' 15.25" E
A single square cattle enclosure near Adit B	27º 03.353'S; 30º 14.852'E
LIA01 site with stone wall enclosures	27º 02.842'S; 30º 22.634'E
Historical graveyard near Adit B	27º 03.307'S; 30º 14.764'E
Possible Stone Age site	27º 03.665'S; 30º 19.055'E

These sites are shown relative to the proposed Project infrastructure (1) in *Figure 8.28*.

(1) *Please Note* - the map used in this figure illustrates the latest Adit configuration and not that which was used in the terms of reference for the cultural and heritage baseline assessment.

Figure 8.28 Cultural and Heritage Sites situated Around the Study Area



Box 8.2 Summary of Socio-economic, Cultural and Heritage Sensitivities that will Potentially Influence Project Design

- There is a large labour pool in the four Wards affected by the Project. Across the four Wards, 51% of the population (or 20,958 people) fall within the 'working age' of between 15-64 years. There is a greater number of work seekers in all four Wards as compared to those employed in each Ward.
- The labour force is, however largely uneducated. All Wards have a higher percentage of its population without schooling (52%). Only 8% of the population across all Wards have a Grade 10 or Grade 12 certificate.
- Income levels for households within all Wards are generally low. Approximately 15% of households earn between R1 to R4, 800 per month. Approximately 47% of households in Ward 3 of Mkhondo have no income in comparison to 41% in Ward 2 and 32% in Ward 5 and 31% in Ward 10.
- Access to services in all Wards is generally poor. For example, 23% of households in Ward 10 have no access to piped water and 31% of households in Ward 10 have no access to sanitation.
- Public transport systems within these Wards are poor; 41% of residents across all three Wards walk to their destinations, as opposed to the utilisation of any form of transport.
- There are a number of cultural and heritage artefacts in the vicinity of all Adit locations. Of most significance is a graveyard of approximately 20 graves about 25m from the south eastern border of Main Mine Adit A.

9 *IMPACTS DETERMINATION*

The following section describes the perceived environmental effects associated with the proposed Project. The determination of anticipated impacts associated with the proposed Project is a key component to the EIA process. Perceived environmental effects will be discussed in a way that outlines how the proposed Project will potentially affect the environment. Furthermore, this section will discuss how physical, biological and social environmental attributes may influence and potentially impact on the proposed Project. The issues identified stem from those aspects investigated and presented in Chapter 8 of this document. Each significant issue identified will be investigated further during the impact assessment phase of this Project.

9.1 *POTENTIAL PHYSICAL ENVIRONMENTAL IMPACTS*

9.1.1 *Climate*

Climate will influence, in particular, the dispersion of air pollutants, the extent of noise impacts, the degree of groundwater recharge, and the surface water flows (and floods) of surface water features prevalent in the Study Area. In this EIA, climatic inputs are therefore used as inputs into the various models used to quantify the nature and extent of such impacts. Although the proposed Project will also contribute to Greenhouse Gas (GHG) emissions, the expansion will not increase the ROM throughput, but rather the lifespan of the current operations, as current mining reserves within existing mining rights are diminishing. As such, ***no climatology specialist studies are deemed necessary for the EIA phase of the study.***

9.1.2 *Topography and Geomorphology*

Potential Impact

Local topography and geomorphology will influence a wide range of environmental and social aspects. The undulating topography and the Mantshangwe Mountains in particular, will influence, for example, the visual impacts posed on receptors to the west of this range. The topography and geomorphology will also influence the dispersion of noise impacts, air pollutants, and surface and groundwater levels and flows. The topography and geomorphology of the Study Area will be considered as input into the various models used to quantify the nature and extent of such impacts. As such, ***no topographic or geomorphologic specialist studies are deemed necessary for the EIA phase of the study.***

9.1.3 *Geology*

Potential Impact

Although underground mining of the Gus and Dundas coal seams in the Kusipongo Resource will have a direct impact on the geology of the area, no specialist geology study is anticipated for this EIA. Rather, the impact of the geology on the behavior of groundwater, and of underground mining on the quality of groundwater resources will be investigated in detail. As such, ***no geological specialist studies are deemed necessary for the EIA phase of the study.***

9.1.4 *Soils and Landuse Capability*

Potential Impact

The establishment of the mine adits and associated infrastructure will result in the removal of topsoil. In addition, the removal of vegetation during construction may lead to accelerated soil erosion and degradation of overall soil productivity. The Project is proposed on land that has a medium to high agricultural potential. As such, the proposed Project will contribute to a reduction in land that is suitable for agriculture.

Further Studies Required in the EIA Phase

In order to gain a full understanding of how the proposed Project will potentially impact on the soils and landuse capability of the area ***a Soil and Landuse Capability Impact Assessment will be conducted as part of the EIA process.***

9.1.5 *Hydrology*

Potential Impact

Hydrology covers all surface water features located within the Study Area, including riverine systems, tributaries, associated riparian areas and wetlands. Most importantly, the Study Area covers the headwaters of the Ohlelo, Assegaai and Klein Vaal rivers, and the quality of these headwaters is deemed to be close to natural.

Risks associated with hydrology to the proposed Project include risks to mine adits and associated infrastructure as a result of flooding. Furthermore, the Project has the potential to pollute hydrological resources in the immediate area, either through groundwater contamination, waste water generation as part of coal processing, the generation of acid mine drainage, or the mixing of dirty water with clean runoff water during high intensity rainfall events.

Further Studies Required in the EIA Phase

In order to gain a full understanding of how the proposed Project will potentially impact on the hydrology of the area ***a full Hydrological Impact Assessment will be conducted as part of the EIA process.*** This specialist report will also serve to assess the risks due to flooding of mine adits and associated infrastructure.

9.1.6 Hydrogeology

Potential Impact

Contamination sources associated with underground coal mining and coal storage are generally related to the following:

- Mine dewatering;
- AMD and related water contamination; and
- Post closure decanting.

Source areas will be determined primarily by the final location of the Adits, the extent of the underground mine, the location and extent of waste rock dumps, and local topography.

Receptors using groundwater for domestic use (irrigation and drinking) could be negatively affected by mine dewatering and groundwater contamination. Ecosystems related to the numerous groundwater fed streams, springs and wetlands in the area are also receptors and could also be negatively impacted through mine dewatering and groundwater contamination.

Pre-mining water quality is good and most of the sampled boreholes conformed to the South African Water Quality Standards (GCS, 2002). Continuous groundwater monitoring performed on the Maquasa West mine shows acidic pH levels for three boreholes in close proximity to the underground workings. Samples also indicate high iron and occurrences of elevated sulphate levels (GCS, 2009). From these results, it is concluded that AMD has occurred, indicating a potential for AMD in the adjacent Kusipongo mine area if not better managed.

Further Studies Required in the EIA Phase

In order to gain a full understanding of how the proposed Project will potentially impact on the geohydrology of the area ***a full Geohydrology Impact Assessment will be conducted as part of the EIA process.*** This study will be complemented by a geochemical study to understand the impacts of/or potential for, AMD resulting from the proposed Project.

9.1.7 *Noise*

Potential Impact

The main sources of noise pollution as a result of the proposed Project are likely to include the movement of heavy haul trucks and other vehicles, ventilation fans and the conveyor belts.

Given the location of sensitive receptors (notably residential dwellings and the Twyvelhoek Primary School) in proximity to the proposed main mine adit, coupled with the current low ambient noise levels, it is highly likely that the Project will have a noise impact.

Further Studies Required in the EIA Phase

Given that noise impacts are highly likely to occur as a result of the proposed Project, ***a full Noise Impact Assessment will be conducted as part of the EIA process.***

9.1.8 *Air Quality*

Potential Impact

The main source of air pollution in coal mining and production primarily consists of fugitive sources of particulates. Particulates are generally constituted of coal dust generated during excavation and transport, as well as dust resulting from vehicle entrainment on gravel access roads.

The nature and severity of the impact will be determined by the volumes of emissions generated, the spatial distribution of emissions, the location of sensitive receptors and prevailing wind conditions. Given the location of sensitive receptors in proximity to the proposed Main Mine Adit, it is likely that the Project will have an impact on air quality.

Further Studies Required in the EIA Phase

Given that air quality impacts are likely to occur as a result of the proposed Project, ***an Air Quality Impact Assessment will be conducted as part of the EIA process.***

9.1.9 *Traffic*

Potential Impact

A detailed traffic baseline assessment has been completed for the proposed Project. Traffic is expected to increase slightly during the construction phase of the proposed Project; however, operational phase traffic associated with the new mine is not expected to significantly increase current traffic flows, as mining output will remain the same.

Further Studies Required in the EIA Phase

As operational phase traffic associated with the new mine is not expected to significantly increase current traffic flows (as mining output will remain the same), it can be assumed that there will be no additional impacts arising from the proposed Project on current traffic volumes on the main access routes to the mine. As such, ***no further traffic studies are deemed necessary for the EIA phase of the study.***

9.1.10 Visual

Potential Impact

It is likely that visual impacts will result from the construction and operation phases of the proposed Project. The Main Mine Adit will likely be visible from farmsteads and rural villages/residential areas to the west of the Mantshangwe Mountains. These viewsheds are considered sensitive owing to the general lack of development in this area, and the resultant "sense-of-place".

Further Studies Required in the EIA Phase

Given that visual impacts may occur as a result of the proposed Project, ***a Visual Impact Assessment will be conducted as part of the EIA process.***

9.2 BIOLOGICAL ENVIRONMENT

Potential Impact

The proposed Project is located in an ecologically sensitive area; these sensitivities are listed in *Box 8.2* of *Chapter 8*. In summary, the highest proportion of the Study Area (29%) was listed as irreplaceable in the Mpumalanga Biodiversity Conservation Plan. Furthermore, the proposed Project is located within the Grassland Biome, which is recognised to have an exceptional biodiversity, a large diversity of faunal species is confirmed for the Study Area, and the rivers and streams in the Study Area showed water quality, habitat integrity, macro-invertebrate integrity and fish assemblages to be close to natural conditions. Furthermore, an intricate network of wetlands and drainage lines exists within the proposed Study Area, and almost all types of wetlands are present in the Study Area.

Further Studies Required in the EIA Phase

Given these sensitivities, ***a full Ecological Impact Assessment (including flora, fauna, aquatic ecology and wetland delineation studies) will be conducted as part of the EIA process.***

9.3 SOCIAL ENVIRONMENT

Potential Impact

The most pertinent sensitivities relevant to the social and socio-economic environment of the Study Area were provided in *Box 8.3* of *Chapter 8*. Of most relevance to the proposed Project is the fact that work seekers residing in the applicable Wards outnumber the number of people employed by just over 2:1. The affected Wards have a large labour pool, with 51% of the population falling within the working age; however, the workforce is largely uneducated, with only 7% of the population across the Wards having a Grade 10 or Grade 12 certificate. This has resulted in generally low income levels, with approximately 16% of households earning between R1 to R4, 800 per month. In addition, within the applicable Wards, there is a general lack of services (such as health care facilities, public transport, refuse removal, access to piped water supplies etc).

Landowners/residents located in the Study Area will be affected by the Project, should it go ahead. Although not within the scope of this EIA, people living directly within the Study Area will need to be compensated and/or resettled.

The proposed Project has the potential to result in both negative and positive social impacts. Working within the current framework of Kanga Coal's SLP, this proposed Project will need to aim at enhancing the positive impacts resulting from this Project and minimizing any negative social impacts which may arise as a result of the Project proposed.

Further Studies Required in the EIA Phase

In order to satisfy the full scope of work envisaged for the social baseline study (i.e. primary data collection) and to provide a firm foundation for the Social Impact Assessment, ***further social specialist input in the form of a Social Impact Assessment (SIA) will be required during the EIA phase of the study***.

9.3.2 *Cultural and Heritage*

Potential Impact

Cultural and heritage resources (in particular graves) have been identified in the vicinity of the Study Area. These were listed in *Table 8.9* in *Chapter 8*. Grave avoidance and/or the potential for grave relocation will also need to be considered as part of the EIA.

Further Studies Required in the EIA Phase

As a result of the presence of cultural and heritage resources found in the Study Area, a Heritage Impact Assessment (HIA) is required to fulfil all the requirements of the National Heritage Resources Act. As such, ***a full Cultural and Heritage Impact Assessment will be conducted as part of the EIA process.***

9.4 *CONCLUSION*

In summary, the following potential ***negative*** impacts associated with the proposed Project are deemed to be the most significant, and will be addressed through detailed Terms of Reference for specialist studies, presented in *Chapter 10*:

- The potential *loss of suitable land for agriculture*;
- The potential *contamination of surface hydrological features* in and around the Study Area;
- Impacts associated with *groundwater drawdown* on local boreholes, springs and wetlands;
- The potential for Acid Mine Drainage (especially for Adit A) resulting in *contamination of groundwater* and subsequent impact on groundwater fed streams and wetlands and groundwater users;
- An increase in noise levels to a number of sensitive receptors (including fauna);
- The potential for *airborne emissions* (mainly particulates) from the proposed Project impacting on sensitive receptors;
- The potential for a *visual impact* to rural villages, residential areas and farmsteads to the west of the Mantshangwe Mountains.
- The potential to impact on both the terrestrial and aquatic (including wetlands) *ecology of the area*.
- The potential to impact on a *number of informal households and commercial landowners* in the area, that may need to be compensated and/or relocated from the proposed Adit construction footprint; and
- The potential to impact on identified *cultural heritage resources (and in particular graves) in the area,* as they will have to either be avoided or relocated.

In addition to the above, the following ***positive*** potential impacts have been identified for the Project; to enhance such positive impacts, these aspects will also be addressed through detailed Terms of Reference for specialist studies, presented in *Chapter 10*:

- Continued *revenue* to the affected District and Local Municipalities;
- Continuation (and the potential creation) of *employment opportunities* for the local communities;
- A continuation (and potential increase) in financial benefits for *local businesses and vendor*s; and
- *Community and infrastructure development* within the Wards affected by the Project.

10 PLAN OF STUDY FOR ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

All potentially significant physical, biological, socio-economic, and cultural heritage impacts (both positive and negative) associated with the proposed Project have been identified in this Scoping Study and where applicable, will be further investigated and assessed within the EIA through specialist studies. Where required, mitigation measures will be proposed. This chapter sets out a plan of study for the EIA, in order for this to be achieved.

The EIA will suitably investigate and address all environmental issues in order to provide the competent authorities with sufficient information to make an informed decision regarding the proposed Project.

10.1 AIM OF THE ENVIRONMENTAL IMPACT ASSESSMENT

The EIA will aim to achieve the following:

- Provide an overall assessment of the physical, biological, socio-economic and cultural heritage environments affected by the proposed Project;
- Assess the study area in terms of its environmental criteria;
- Identify and recommend appropriate mitigation measures for potentially significant environmental impacts; and
- Undertake a fully inclusive PPP.

10.2 ENVIRONMENTAL IMPACT ASSESSMENT METHODOLOGY

The assessment and evaluation of the potential impacts and benefits that will be associated with the proposed Project necessitate the development of a scientific methodology that will reduce the subjectivity involved in making such evaluations. A clearly defined methodology is used in order to accurately determine the significance of the predicted impact on, or benefit to, the surrounding natural and / or social environment. For this the proposed Project must be considered in the context of the area and the people that will be affected.

Nonetheless, an impact assessment will always contain a degree of subjectivity, as it is based on the value judgment of various specialists and EIA practitioners. The evaluation of significance is thus contingent upon values, professional judgement, and dependent upon the environmental and community context.

The impact assessment stage comprises a number of steps that collectively assess the manner in which the Project will interact with elements of the physical, biological, cultural or human environment to produce impacts to resources / receptors. The steps involved in the impact assessment stage are described in greater detail below.

10.3 IMPACT ASSESSMENT

The impact characteristic terminology to be used is summarised in *Table 10.1*.

Table 10.1 Impact Characteristic Terminology

Characteristic	Definition	Designations
Type	A descriptor indicating the relationship of the impact to the Project (in terms of cause and effect).	Direct Indirect Induced
Extent	The "reach" of the impact (e.g., confined to a small area around the Project Footprint, projected for several kilometres, etc.).	Local Regional International
Duration	The time period over which a resource / receptor is affected.	Temporary Short-term Long-term Permanent
Scale	The size of the impact (e.g., the size of the area damaged or impacted, the fraction of a resource that is lost or affected, etc.)	[no fixed designations; intended to be a numerical value]
Frequency	A measure of the constancy or periodicity of the impact.	[no fixed designations; intended to be a numerical value]

In the case of *type*, the designations are defined universally (i.e., the same definitions apply to all resources / receptors and associated impacts). For these universally-defined designations, the definitions are provided in *Table 10.2*.

Table 10.2 Designation Definitions

Designation	Definition
Type	
Direct	Impacts that result from a direct interaction between the Project and a resource / receptor (e.g., between occupation of a plot of land and the habitats which are affected).
Indirect	Impacts that follow on from the direct interactions between the Project and its environment as a result of subsequent interactions within the environment (e.g., viability of a species population resulting from loss of part of a habitat as a result of the Project occupying a plot of land).
Induced	Impacts that result from other activities (which are not part of the Project) that happen as a consequence of the Project (e.g., influx of camp followers resulting from the importation of a large Project workforce).
Extent	
Local	Defined on a resource / receptor-specific basis.
Regional	
International	

Designation	Definition
Duration	
Temporary	Defined on a resource / receptor-specific basis.
Short-term	
Long-term	
Permanent	

In the case of *extent* and *duration*, the designations themselves (shown in *Table 10.1*) are universally consistent, but the definitions for these designations will vary on a resource / receptor basis (e.g., the definition of what constitutes a "short term" duration for a noise-related impact may differ from that of a "short term" duration for a habitat-related impact). This concept is discussed further below.

In the case of *scale* and *frequency*, these characteristics are not assigned fixed designations, as they are typically numerical measurements (e.g., number of acres affected, number of times per day, etc.).

The terminology and designations are provided to ensure consistency when these characteristics are described in an impact assessment deliverable. However, it is not a requirement that each of these characteristics be discussed for every impact identified.

An additional characteristic that pertains only to unplanned events (e.g., traffic accident, operational release of toxic gas, community riot, etc.) is *likelihood*. The likelihood of an unplanned event occurring is designated using a qualitative (or semi-quantitative, where appropriate data are available) scale, as described in *Table 10.3*.

Table 10.3 Definitions for Likelihood Designations

Likelihood	Definition
Unlikely	The event is unlikely but may occur at some time during normal operating conditions.
Possible	The event is likely to occur at some time during normal operating conditions.
Likely	The event will occur during normal operating conditions (i.e., it is essentially inevitable).

Likelihood is estimated on the basis of experience and / or evidence that such an outcome has previously occurred.

It is important to note that likelihood is a measure of the degree to which the unplanned event is expected to occur, *not* the degree to which an impact or effect is expected to occur as a result of the unplanned event. The latter concept is referred to as *uncertainty*, and this is typically dealt with in a contextual discussion in the impact assessment deliverable, rather than in the impact significance assignment process.

In the case of impacts resulting from unplanned events, the same resource / receptor-specific approach to concluding a magnitude designation is utilised, but the 'likelihood' factor is considered, together with the other impact characteristics, when assigning a magnitude designation. There is an inherent challenge in discussing impacts resulting from (planned) Project activities and those resulting from unplanned events. To avoid the need to fully elaborate on an impact resulting from an unplanned event prior to discussing what could be a very low likelihood of occurrence for the unplanned event, this methodology incorporates likelihood into the magnitude designation (i.e., in parallel with consideration of the other impact characteristics), so that the "likelihood-factored" magnitude can then be considered with the resource / receptor sensitivity / vulnerability / importance in order to assign impact significance. Rather than taking a prescriptive (e.g., matrix) approach to factoring likelihood into the magnitude designation process, it is recommended that this be done based on professional judgment, possibly assisted by quantitative data (e.g., modelling, frequency charts) where available.

Once the impact characteristics are understood, these characteristics are used (in a manner specific to the resource / receptor in question) to assign each impact a *magnitude*. In summary, magnitude is a function of the following impact characteristics:

- Extent;
- Duration;
- Scale;
- Frequency; and
- Likelihood.

Magnitude essentially describes the degree of change that the impact is likely to impart upon the resource / receptor. As in the case of extent and duration, the magnitude designations themselves (i.e., negligible, small, medium, large) are universally used and across resources / receptors, but the definitions for these designations will vary on a resource / receptor basis, as is discussed further below. The universal magnitude designations are:

- Positive;
- Negligible;
- Small;
- Medium; and
- Large.

The magnitude of impacts takes into account all the various dimensions of a particular impact in order to make a determination as to where the impact falls on the spectrum (in the case of adverse impacts) from *negligible* to *large*. Some impacts will result in changes to the environment that may be immeasurable, undetectable or within the range of normal natural variation. Such changes can be regarded as essentially having no impact, and should be characterised as having a *negligible* magnitude. In the case of *positive* impacts no magnitude will be assigned.

In addition to characterising the magnitude of impact, the other principal step necessary to assign significance for a given impact is to define the sensitivity / vulnerability / importance of the impacted resource / receptor. There are a range of factors to be taken into account when defining the sensitivity / vulnerability / importance of the resource / receptor, which may be physical, biological, cultural or human. Where the resource is physical (for example, a water body) its quality, sensitivity to change and importance (on a local, national and international scale) are considered. Where the resource / receptor is biological or cultural (for example, the marine environment or a coral reef), its importance (for example, its local, regional, national or international importance) and its sensitivity to the specific type of impact are considered. Where the receptor is human, the vulnerability of the individual, community or wider societal group is considered.

Other factors may also be considered when characterising sensitivity / vulnerability / importance, such as legal protection, government policy, stakeholder views and economic value.

As in the case of magnitude, the sensitivity / vulnerability / importance designations themselves are universally consistent, but the definitions for these designations will vary on a resource / receptor basis. The universal sensitivity / vulnerability / importance designations are:

- Low;
- Medium; and
- High.

Once magnitude of impact and sensitivity / vulnerability / importance of resource / receptor have been characterised, the significance can be assigned for each impact.

Impact significance is designated using the matrix shown in *Table 10.4*.

Table 10.4 Impact Significances

		Sensitivity/Vulnerability/Importance of Resource/Receptor		
		Low	**Medium**	**High**
Magnitude of Impact	**Negligible**	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major

The matrix applies universally to all resources/receptors, and all impacts to these resources/receptors, as the resource/receptor- or impact-specific considerations are factored into the assignment of magnitude and sensitivity designations that enter into the matrix. *Box 10.1*provides a context for what the various impact significance ratings signify.

Box 10.1 Context of Impact Significances

An impact of ***negligible*** significance is one where a resource/receptor (including people) will essentially not be affected in any way by a particular activity or the predicted effect is deemed to be 'imperceptible' or is indistinguishable from natural background variations.

An impact of ***minor*** significance is one where a resource/receptor will experience a noticeable effect, but the impact magnitude is sufficiently small (with or without mitigation) and/or the resource/receptor is of low sensitivity/ vulnerability/ importance. In either case, the magnitude should be well within applicable standards.

An impact of ***moderate*** significance has an impact magnitude that is within applicable standards, but falls somewhere in the range from a threshold below which the impact is minor, up to a level that might be just short of breaching a legal limit. Clearly, to design an activity so that its effects only just avoid breaking a law and/or cause a major impact is not best practice. The emphasis for moderate impacts is therefore on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that impacts of moderate significance have to be reduced to minor, but that moderate impacts are being managed effectively and efficiently.

10.4 MITIGATION OF IMPACTS

Once the significance of a given impact has been characterised using the above matrix, the next step is to evaluate what mitigation measures are warranted. In keeping with the Mitigation Hierarchy, the priority in mitigation is to first apply mitigation measures to the source of the impact (i.e., to avoid or reduce the magnitude of the impact from the associated Project activity), and then to address the resultant effect to the resource/receptor via abatement or compensatory measures or offsets (i.e., to reduce the significance of the effect once all reasonably practicable mitigations have been applied to reduce the impact magnitude).

It is important to have a solid basis for recommending mitigation measures. The role of any given socio-environmental impact assessment is to help our clients develop a consentable Project, and to help them achieve their business objectives in a responsible manner. Impact assessment is about identifying the aspects of a Project that need to be managed, and demonstrating how these have been appropriately dealt with and have left us with good quality and appropriate development. As key influencers in the decision making process, the role of the impact assessment is not to stop development or propose every possible mitigation or compensatory measure that we can imagine, but rather to make balanced judgements as to what is warranted, informed by a high quality evidence base.

Additional mitigation measures should not be declared for impacts rated as not significant, unless the associated activity is related to conformance with an ‘end of pipe’ applicable requirement. Further, it is important to note that it is not an absolute necessity that all impacts be mitigated to a not significant level; rather the objective is to mitigate impacts to an ALARP level.

Embedded controls (i.e., physical or procedural controls that are planned as part of the Project design and are not added in response to an impact significance assignment), are considered as part of the Project (prior to entering the impact assessment stage of the impact assessment process).

10.5 Residual Impact Assessment

Once mitigation measures are declared, the next step in the impact assessment process is to assign residual impact significance. This is essentially a repeat of the impact assessment steps discussed above, considering the assumed implementation of the additional declared mitigation measures.

10.6 Cumulative Impacts/Effects

Cumulative impacts and effects are those that arise as a result of an impact and effect from the Project interacting with those from another activity to create an additional impact and effect. These are termed cumulative impacts and effects.

The impact assessment process should predict any cumulative impacts / effects to which the Project may contribute. The approach for assessing cumulative impacts and effects resulting from the Project and another activity affecting the same resource / receptor is based on a consideration of the approval / existence status of the ‘other’ activity and the nature of information available to aid in predicting the magnitude of impact from the other activity.

10.7 SPECIALIST INVESTIGATIONS

This scoping study has identified the following specialist investigations required in order to ensure that potential social and environmental impacts are fully understood, and that appropriate mitigation measures are developed for the proposed Project:

10.7.1 *Soils*

A soil survey to determine the soil's agricultural and/or rehabilitation potential will be undertaken during the impact assessment phase. The survey will take place only in those areas where surface infrastructure will be constructed (such as the ventilation Adits, haul roads, conveyor belt routes, etc.). This information will be used to inform the EIA and any management measures proposed.

10.7.2 *Hydrology*

The proposed Project is situated in the upper reaches of the Hlelo River. Surface water from this source will not be used by the proposed Project.

Hydrological specialist input into the EIA phase will therefore include:

- The identification of potentially impacted rivers and streams;
- Baseline surface water quality and the design of a surface water quality monitoring programme;
- The determination of normal dry weather flows;
- The determination of flood peaks and volumes (for affected rivers and streams) as per SANRAL's Drainage Manual;
- The determination and mapping of flood lines (flood widths) for major streams using HecRas, in conjunction with River Cad. (Calculation of floodlines will be limited to those streams estimated to have flood widths wider than the "nominal" prescribed 64 metres); and
- The incorporation of this information into a comprehensive Water Management and Monitoring Plan for the Project, incorporating those findings from the hydrogeological study, as described below.

10.7.3 *Hydrogeology*

Comprehensive sets of data have been collected during baseline groundwater studies in the Study Area. Data has been collected through:

- Geophysical Surveys and on-site drilling;
- Aquifer Testing of drilled boreholes;
- Geochemical Assessment of Hydro-geochemical samples and borehole core samples, drilled in the respective mining blocks; and
- Data from a Comprehensive Hydrocensus and Selective Water Sampling.

Existing Kangra Coal Mine information as well as the results from the intrusive studies and hydrocensus will be used to characterise the groundwater regime and to construct a groundwater conceptual model of the baseline groundwater conditions.

The conceptual site model will describe the following:

- The type of aquifer(s) present and its relationship with the surface topography;
- Depth to the aquifer and aquifer parameters such as transmissivities and storability;
- Borehole yields;
- Description of the groundwater chemistry;
- Geochemical leach characteristics of coal and spoils;
- Groundwater use within the Study Area;
- Subsurface extent and thickness of aquifers and confining units (hydrogeological framework);
- Groundwater flow direction;
- Natural groundwater flow boundaries (also referred to as boundary conditions), which control the rate and direction of movement of groundwater;
- Yields and hydraulic properties of the aquifers;
- Estimation of groundwater recharge;
- Seasonal variations of the above stresses; and
- Aquifer classification and vulnerability.

A numerical groundwater model will be constructed, based on the conceptual site model, to include a complete steady state model as well as a transient state model for the construction and operational phase and up to 100 years post mine closure.

The model should be used to evaluate:

- Mine dewatering and resultant groundwater drawdown cones;
- Existing and future groundwater contaminant plumes from plant and mine waste areas; and
- Potential mine decant.

The results of the numerical modelling exercise will be used to make informed management decisions regarding to all phases of the mine life cycle, and will be incorporated into a detailed Water Management and Monitoring Plan.

10.7.4 Noise

As part of the Noise Impact Assessment, more detailed information for each phase of the Project, relating to mining infrastructure, day time and night time operations and associated mining equipment will be sourced and used as input data into a noise model (using the SANS stipulated methodology).

The noise impact assessment will be done as per the SANS 10328:2003 standard. The calculated level of operational noise $L_{Aeq,d}$ will be compared against the measured background noise levels, the zone sound levels as well as the change in noise levels to determine the impact on the surrounding environment, focusing on identified potential sensitive receptors.

Should noise levels exceed the set zone sound levels, mitigation will be proposed and where possible, modelled (barriers and / or enclosure), allowing a visual and definitive estimation of projected future noise levels. All data will be presented on aerial images using contours of constant noise levels. The standards to evaluate the environmental impact used will be SANS 0328:2003.

10.7.5 *Air Quality*

The Air Quality Impact Assessment will involve the following:

- Compilation of an emissions inventory, comprising the identification and quantification of potential routine and upset sources of emissions;
- Dispersion simulations of ambient inhalable particulate concentrations and dust fallout from the mining and transport activities for the following scenarios (the detail of which will be dependent on available engineering design information):

    - Construction Phase: Highest daily PM_{10} concentrations and total daily dust deposition due to routine emissions from infrastructure creation and road construction; and
    - Operational Phase: Gaseous and particulate concentrations due to routine and upset emissions.

- Analysis of dispersion modelling results, including:

    - Assessment of the predicted incremental ground level concentrations;
    - Assessment of the predicted cumulative ground level concentrations;
    - Evaluation of potential for human health and environmental impacts; and
    - Recommendation of emission controls and management measures to be taken into account in the Project design phase in order to minimise the potential for air quality impacts.

- Mitigation for unacceptable environmental impacts.

The modelling scope includes the dispersion of air pollutants arising from all potential sources at the proposed mining operations (e.g. particulates due to wind erosion, materials handling, materials preparation and road dust). Given the Project background, most of the emissions would be ill-defined, such as wheel entrainment or windblown dust from exposed areas and conveyor belts. Emissions from the Adits will therefore need to be estimated and point source emissions included in the predictions. Where applicable, air quality data from existing operations will be used in model simulations.

The most readily available emission factors are those published by the United States Environmental Protection Agency. However, local experience in previous monitoring campaigns may be utilised to estimate emission rates for, for example, vehicle traffic on paved and unpaved roads, emissions from outdoor stockpiles, dust emissions generated by wind erosion of exposed areas, and other sources of fugitive emissions from crushing, screening; and conveying.

Ground level concentrations of particulates for all these sources and various scenarios will be performed by employing a suitable atmospheric dispersion model. The model selection will need to be based on the complexity of the terrain and the availability of detailed meteorological data. The AERMOD and CALPUFF models require upper air data, which is not always readily available. Since the emissions are mainly generated at ground level, it is anticipated that either the ADMS or AERMOD models will be used.

10.7.6 Visual

The Visual Impact Assessment will involve the following key steps:

- *Determine visual intrusion* - Photographs taken during the site visit will be digitally manipulated to simulate the physical presence and nature of the visual intrusion of the proposed Project components from critical viewing areas. These simulations will model the Project, within the landscape context and would illustrate the ability/inability of the landscape to absorb the 'intrusion'.
- *Determine visibility and visual exposure* – Visibility is determined by conducting a view shed analysis. A semi-quantitative digital terrain model (DTM) which consists of features that normally occur on 1:50 000 maps, such as roads and settlements, will be "draped" over contours (derived from 1:50 000 maps) to generate an analysis that determines all potential observation sites (the view shed) from which Project components would be visible.
- *Describe the visual resource* – Landscape character, landscape quality and sense of place will be used to determine the visual resource. These measures are intrinsic to the landscape and thus they enable a value to be placed on the landscape that is independent of the person doing the viewing.
- *Environmental impact assessment* – The overall environmental impact will be assessed using the ERM impact rating system.
- *Mitigation measures and environmental management plan* – Detailed mitigation measures to reduce the visual impact and the impact on the sense of place will be proposed. The effectiveness of mitigation will be evaluated. An indication of methods for implementation, timeframes, costs and responsibilities will be given. This information will be fed into the EMP.

10.7.7 *Ecological*

Flora

In addition to an initial desktop review already undertaken, a detailed summer (November 2010 to March 2011) field investigation was undertaken, giving special attention to any areas of potential conservation importance; for example ridges, river/wetland systems etc.

Results from the field sampling exercise undertaken will include:

- The identification and mapping of individual habitats and vegetation communities;
- A description of the vegetation communities (structure, dominant plant composition and condition);
- Listing the Red Data / Conservation Important species that could occur on site. If any species are located, their GPS readings will be noted and mapped; and
- Ranking of each habitat type based on conservation importance (in terms of provincial biodiversity priorities) and ecological sensitivity.

Fauna (including avi-fauna)

In addition to an initial desktop review already undertaken, a five day detailed summer (November 2010 to March 2011) field investigation was undertaken. Recording of faunal species involved both visual observations (including night investigations) and the laying of live-traps. Trapping sites included small mammal, insect and herpetofaunal trapping. An array trap, consisting of three lines, each consisting of plastic drift fences, with pitfall traps at the end of each line, with a pitfall at the centre of the array will be used.

Bird data was collected by means of point counts placed within each homogenous area or habitat type. Data from the point counts was then analysed to determine typical or dominant species. Birds were identified and, where necessary, verified using Roberts Birds of Southern Africa, VIIth ed. (Hockey *et al.*, 2005). Birds were also identified by means of their calls and other signs such as nests, discarded egg shells (Tarboton, 2001) and feathers. Particular attention was paid to suitable roosting, foraging and nesting habitat for Red Data species. The occurrence of cryptic or elusive Red Data species was verified by playback of their respective calls.

Results from the field sampling exercise undertaken will include:

- Faunal species linked to each habitat type identified in the floral assessment;
- A full list of bird species observed and expected to occur will be provided, including habitat preferences;

- A list of the Red Data / Conservation Important species that could occur on site; and
- Identification of areas of conservation importance based on the species and habitats identified.

Aquatic Assessment

The aquatic assessment study will be undertaken in accordance with the Department of Water Affair's (DWA) Section 21 (i) and (c) supplementary water use license requirements. This requires that the PES of the habitat, water quality, aquatic macro-invertebrates and fish assemblages must be assessed.

The assessment will follow DWA approved River Health Programme (RHP) methodologies at four sites, two in the Hlelo River and two in a first order tributary of the Mpundu River.

A baseline assessment of the riparian and in-stream habitat involved:

- *Fluvial geomorphology*: a brief baseline description of the fluvial geomorphology will be done, based on the RHP site characterisation field manual by Dallas (2005);
- *Vegetation*: a description of the riparian vegetation zones and species composition will be conducted; and
- *Habitat Integrity*: Impacts on habitat will be evaluated using the Index of Habitat Integrity (IHI) derived by Kleynhans (1999) and the habitat availability will be assessed using the RHP site characterisation field manual by Dallas (2005).

A baseline assessment of the water quality involved both in-situ water quality testing and collection of water samples for analysis in a laboratory.

A baseline assessment of the biota involved:

- *Aquatic macro-invertebrate assemblage assessment*: Aquatic macroinvertebrate sampling will be conducted using the South African Scoring System version 5 (SASS5) methodologies, according to Dickens and Graham (2002), as well as the Macro-invertebrate Response Assessment Index (MIRAI) methodology (Thirion, 2007); and
- *Fish assemblage assessment*: Sampling will be undertaken using standardised methodologies as per the Fish Response Assessment Index (FRAI), (Kleynhans, 2007). The data collected will be used to determine the PES for the fish assemblage in accordance with FRAI as well as the conservation status of species present.

A detailed baseline report will be compiled stipulating the current ecological status, which will include results on baseline conditions including:

- PES based on the macro-invertebrate and fish responses as well as the

water quality and habitat indicators will be discussed and the results mapped and visually represented;
- Highlight presence of aquatic fish species of conservation significance as well as exotic faunal and floral species present;
- Incorporation / comparison of reference and historical data with the current data obtained in this study;
- The PES of the major wetland systems;
- The Eco-services provided by the identified wetlands; and
- Identification of present and impacts on the aquatic and wetland ecosystems.

Baseline data collected will be used to inform the impact assessment, and where appropriate, detailed mitigation measures will be included in the EMP.

Wetland Delineation

During the baseline assessment, potential wetland systems were identified within the proposed project footprint. As such, wetland delineations will be undertaken within the proposed Study Area. This will be carried out in accordance with the Department of Water Affairs Guideline "*A practical field procedure for identification and delineation of wetlands and riparian areas*" (DWAF, 2005).

In addition to wetland delineation, the following will be was applied to identified wetlands:

- The assessed wetlands will be classified based on its hydro-geomorphic (HGM) unit. This method focuses on the HGM determinants of wetlands and incorporates geomorphology; water movement into, through and out of the wetland; and landscape / topographic setting.
- A functional assessment of the assessed wetlands, using the WET-EcoServices technique will be applied to reveal the ecosystem services supplied by each wetland.
- The Present Ecological State of each wetland will be assessed.

Based on this information collected, the potential impacts to wetlands will be assessed and, if possible, practical and implementable mitigation measures will be provided.

10.7.8 Socio-economics

Social

The following information will be collected as part of the social baseline study:

- Administrative and leadership structures including community forums and networks;
- Socio-political factors;
- Land uses and tenure arrangements;

- Demographics (e.g., total population, age, gender, ethnicity, language, religion, household size and structure);
- In- and out-migration;
- Levels of education, skills and education facilities;
- Levels of (and access to) water and sanitation;
- Levels of (and access to) transport infrastructure and services;
- Levels of (and access to) power infrastructure / sources;
- Levels of (and access to) waste management infrastructure and services;
- Levels of (and access to) communication infrastructure;
- Levels of (and access to) social, recreational (and tourism) facilities;
- Cultural practices/sensitivities e.g., traditional medicine, sacred sites, graves; and
- Human rights, safety and security.

Economic

The following information will be collected as part of the socio-economic baseline study:

- Current economic and livelihood activities (e.g., farming, tourism, commercial, and other industries) specifying the nature, extent and capacity of these activities;
- Future economic and strategic development plans;
- Workforce, levels of employment (formal, informal and subsistence), unemployment and underemployment;
- Income and expenditure (including rates and taxes);
- Levels of poverty and distribution of wealth; and
- Savings/investment culture and access to micro-finance/banking institutions.

In addition to the above, a full and detailed understanding of Kangra Coal's Social and Labour Plan (SLP) commitments which are to be incorporated into community upliftment planning initiatives, will be obtained.

Following the data collection activities, impacts will be identified that are associated with the construction, operation and closure phase activities of the proposed Project. The identification of potential positive and negative impacts will be informed by the stakeholder engagement process (primary data collection), the baseline study and the public consultation process.

Management and mitigation measures to address the identified impacts will be recommended and drafted. These measures will be formulated to maximise the positive impacts and reduce the extent of the negative impacts.

It is assumed that the mine's SLP has identified strategies and programmes to address employment, local economic development, and management of mine closure. The SLP will be reviewed to identify current / future alignment to mitigation measures proposed within the Social Impact Assessment.

10.7.9 *Cultural Heritage*

The Heritage Impact Assessment (HIA) will involve a thorough and focused assessment of mitigation and heritage impacts of the proposed Project infrastructure, including the identification of appropriate management actions. The HIA will fulfil all the requirements of *Section 38 (3)* of the National Heritage Resources Act, 1999 (NHRA), namely the identification and mapping of heritage resources and the assessment of the significance thereof, an assessment of the positive and negative impacts of the proposed Project, the results of consultation with Interested and Affected Parties (I&APs), the consideration of alternatives, and plans for the mitigation of any adverse impacts.

The heritage component of the full EIA report will be submitted to the relevant heritage authority for comment (and approval) before a Record of Decision (RoD) is issued.

10.8 *ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN*

The EIA will present and describe the residual impacts of the proposed Project (and their significance) and how these will be further reduced through measures incorporated into the engineering and design of the Project. This will culminate in the preparation of an Environmental and Social Management Plan (ESMP) for those key issues identified. An ESMP is a requirement of *Section 33* of the EIA Regulations, and will comprise recommendations for on-site use during the construction phase and for ongoing management and monitoring during the operational phase of the proposed Project. For each issue and impact identified in the EIA, the draft ESMP will provide clear guidelines for monitoring, analysis of results, interpretation of results and reporting of results to management.

10.9 *REPORTING AND PUBLIC PARTICIPATION*

A draft EIA document and ESMP will be compiled on conclusion of the EIA process detailed above. The EIA will contain all necessary information as stipulated in *Sections 28, 31, 32* and *33* of the EIA Regulations (contents of scoping reports, EIA Reports, ESMPs, and Specialist Reports).

The draft EIA document will be made available to all registered I&APs for a 60 day comment period. Any additional comments received will be addressed and included in the final EIA Document.

11 *CONCLUSION*

It is evident that coal is a key global resource, providing 27% of the global primary energy needs and generating 41% of the world's electricity. South Africa is a significant coal producer and possesses Africa's only significant coal reserves (over 70%), is the world's sixth largest coal producer, and produced 4.3% of the world's coal in 2009.

South Africa is also Africa's only significant coal consuming country and coal plays a crucial role in the South African energy-economy and is fuelling local industry. Furthermore, South African coal exports are expected to increase to 105 million tonnes per annum by the year 2020. This will increase the country's export earnings, which in turn will reduce the country's negative trade balance and current account deficit and contribute to economic growth.

In light of the above, local and international markets are, at present, highly dependant on South Africa being a main provider of coal, both now and in the future. The identification and exploitation of new coal reserves in South Africa is thus a prerequisite in meeting this demand.

The proposed Project is key from a strategic point of view for Kangra Coal. Given that the current Maquasa mining areas have reserves sufficient to ensure mining can continue for approximately the next 3 to 5 years, the expansion of Kangra Coal's operations into the Kusipongo Resource (this Project) would extend the life of mine for approximately an additional 10 to 20 years. Furthermore, the scoping study identified that Kangra Coal are also proposing to expand mining operations at the existing Maquasa Works. This involves the proposed installation of eight new opencast pits, two new underground mining areas (1) (accessed from the opencast pits) and the provision of an expanded or new discard dump(s).

As part of the proposed Project, Kangra Coal is required to obtain a Mining Rights Permit, Environmental Authorisation, a Waste License and a Water Use License prior to construction and operation of the proposed mining expansion into the Kusipongo Resource. As such, ERM have been appointed as the independent Environmental Assessment Practitioners to facilitate the aforementioned permitting, authorisation and licensing processes in accordance with the NEMA EIA Regulations.

The environmental scoping study (this report) is the first phase of the overall EIA process being undertaken in support of the proposed Project. The purpose of the scoping study was to identify the environmental and social impacts potentially resulting from the proposed Project, in order to prepare detailed Terms of References and a plan of study for each, to be addressed

(1) these two new underground mining areas does not include the proposed Kusipongo Expansion Project

during the EIA phase. Potential environmental and social impacts were identified through environmental (physical and biological) and social baseline assessments, and through engagement with key stakeholders and other I&APs.

Based on this scoping exercise, the key issues that were identified for further study in the EIA phase relate to potential environmental impacts associated with the loss of suitable land for agriculture, contamination of surface water, contamination of groundwater through acid mine drainage, potential decant volumes after mine closure, air emissions, audible and visual impedance to sensitive receptors, impacts to both terrestrial and aquatic ecology, relocation of informal dwellings and loss/disruption to cultural heritage resources. In addition, scoping identified certain positive environmental impacts should the Project be authorised; these include continued revenue generation for Kangra Coal (and hence the Mpumalanga Province), employment retention/opportunities for local communities and a continued benefit (and potential increase in financial benefits) for local businesses and vendors.

Based on the initial assessment of potentially significant issues, it has been concluded that there are no environmental or social fatal flaws which inhibit this Scoping and EIA study from progressing into the impact assessment phase. The potential environmental and social sensitivities highlighted in this report will need to be further investigated and assessed during the EIA phase before any recommendations can be made regarding the socio-environmental feasibility of the proposed Project.

The EIA will suitably present and describe the residual impacts of the proposed Project (and their significance). This will culminate in the preparation of an Environmental and Social Management Plan (ESMP) for those key issues identified. The ESMP will comprise requirements for on-site management of environmental and social aspects during the construction phase, ongoing management and monitoring of environmental and social aspects during the operational, and the same for the closure phases of the proposed Project.