7 MOTIVATION FOR THE PREFERRED DEVELOPMENT FOOTPRINT ON THE SITE INCLUDING THE PROCESS FOLLOWED TO DEFINE THE PREFERRED DEVELOPMENT ALTERNATIVES

7.1 DETAILS OF THE DEVELOPMENT FOOTPRINT CONSIDERED

This section describes land use or development alternatives, alternative means of carrying out the operation, and the consequences of not proceeding with the proposed project.

The main project alternatives to be considered include:

- Property or locality
- Type of activity
- Design or layout
- Technology
- Operational aspects
- The “no-go” alternative

7.1.1 PROPERTY OR LOCALITY

The property on which mining related activities takes places is dependent on the location of the ore body. It follows that only the remaining extent of the farm Gloria 266 was considered for the location of the open cast strip mine given that this is where the ore body is located.

7.1.2 TYPE OF ACTIVITY TO BE UNDERTAKEN

Opencast mining activities will be undertaken as part of the proposed project. Underground mining was considered, however due to the shallow nature of the ore body and the lack of a stable ground (for underground roofing) within the shallow area this option was not considered.

7.1.3 DESIGN OR LAYOUT

In order to reduce the carbon footprint, reduce energy use, limit haulage costs and to optimise mining, infrastructure is placed in close proximity to the ore body. If follows that infrastructure and mining activities will be located in the north eastern section of the proposed project site (Figure 31). Moreover, the placement of infrastructure in close proximity to the ore body allows for the western section of the proposed project area to remain undisturbed.

In terms of the placement of infrastructure in the north eastern section of the proposed project area, two main site layout alternatives were considered (Figure 31). While the open pit position is dictated by the

location of the ore body, the aim is to place the remaining infrastructure as close to the open pit so as to limit the overall project footprint. In this regard, Option 1 includes the location of the proposed infrastructure to the south of the existing R380 (Figure 31). Option 2 includes the realignment of the R380 and the location of the proposed infrastructure to the north and south of the current R380 (Figure 31). Section 7.7 provides a discussion of the advantages and the disadvantages of the site layout options. The outcome of the discussion concluded that Option 2 is the preferred site layout.

7.1.4 TECHNOLOGY

Given the simplicity of the proposed project, no technology alternatives were considered in terms of ore processing. It follows that no technical alternatives were considered as part of the proposed project.

7.1.5 OPERATIONAL ASPECTS

WATER SUPPLY ALTERNATIVES

As part of the environmental assessment process, Mokala investigated the use of groundwater, or sourcing water from the Vaal Ga-Mogara Water Supply Scheme or from neighbouring mines. Sourcing water from groundwater is the preferred option, however based on the outcome of the investigations to date groundwater cannot be the only source of water for the duration of the proposed project. It follows that Mokala will also apply to obtain water from the Vaal Ga-Mogara Water Supply Scheme at such time when groundwater is no longer a reliable source. Sourcing water from neighbouring mines is not considered to be a viable option, given that this source of water will not be reliable as available water quantities will fluctuate. In addition, neighbouring mines use any water accumulated as part of their mining operations in their existing processes.

TRANSPORT ALTERNATIVES

Numerous road transportation alternatives were considered as part of the proposed project. These included the transportation of ore from the mine via road to existing railway sidings located at Lohatla and Glossom from where the ore will be transported to port or market via rail to Port Elizabeth for sale to third parties. Alternatively the ore could be transported from the mine via road directly to Port Elizabeth, Durban or East London for sale to third parties. The preferred option is to transport the ore via road directly to Durban and Port Elizabeth. The use of the railheads at Lohatla and Glossom are currently not an option as these facilities are not equipped to cater for the additional tonnages. Mokala will however continue to engage with Transnet should this option become available in the future and will participate in the transnet long term allocation process in an attempt to obtain a rail allocation.

Mokala also investigated the possibility of transporting ore from the mine via road to existing loadout stations at neighbouring mines in the area, from where the ore would be transported via rail to either Port

Elizabeth or Durban for sale to third parties. Neighbouring mines that were consideration included the following:

- Kudumane Mine: The entrance to the mine is located approximately 2km south east of the proposed project area.
- Tshipi Borwa Mine: Located approximately 20km south southeast of the proposed project area
- Kalagadi Mine: Borders the proposed project area to the south
- United Manganese of Kalahari Mine – Located approximately 14km south east from the proposed project area
- Mamatwan Mine – Located approximately 20km south east from the proposed project area
- Gloria Mine – Located directly north of the proposed project area

The United Manganese of Kalahari Mine and the Mamatwan mines are not viable options as these mines are currently engaging with other role players for the use of their loadout stations. The Gloria Mine loudout station is not suitable given that it is not in good working order. The Tshipi Borwa Mine, Kalagadi Mine and the Kudumane Mine may be viable options and will be investigated further during the course of the mining operation.

7.1.6 THE "NO-GO" ALTERNATIVE

The assessment of this option requires a comparison between the options of proceeding with the proposed project with that of not proceeding with the proposed project. Proceeding with the proposed project attracts potential economic benefits and potential negative environmental and social impacts. Not proceeding with the proposed project leaves the status quo.

In addition to the above this assessment also requires a comparison between the options of proceeding with the proposed realignment of the Ga-Mogara drainage channel and the realignment of the R380 to not proceeding with these activities. Proceeding with the proposed river realignment will allow Mokala to access underlying ore. If this ore is not accessed, approximately 2 million tons of ore will be lost and if the strips close to the Ga-Mogara drainage channel or not accessed, the stripping ratio to commence the project will be too high and as such the project will not be viable. Similarly, not proceeding with the proposed realignment of the R380 will result in the loss of approximately 6 million tons of ore and as such the project will not be viable. Not proceeding with the proposed river realignment and the realignment of the R380 leaves the status quo.

7.2 DETAILS OF THE PUBLIC PARTICIPATION PROCESS FOLLOWED

This section describes the information provided to landowners, adjacent landowners, regulatory authorities and other interested and affected parties (IAPs) to inform them in sufficient detail of what the

proposed project will entail on the land, in order for them to assess what impact the operation will have on them or the use of the land.

7.2.1 DATABASE

The proposed project's public involvement database was developed by sourcing IAPs details relating to immediate landowners and adjacent landowners by means of a deed search. This information was verified during social scans including site visits in the surrounding area, networking and direct consultation with IAPs. In addition to this, the project's public involvement database was supplemented with information on IAPs provided in the scoping meetings. A copy of the project's public involvement database is included in Appendix E. The database will be updated on an on-going basis throughout the environmental process.

7.2.2 BACKGROUND INFORMATION DOCUMENT (BID)

A BID was compiled in both English and Afrikaans and distributed by hand (at the scoping meetings), via e-mail and posted to IAPs and regulatory authorities on the project's public involvement database. The purpose of the BID was to inform IAPs and regulatory authorities about the proposed project, the environmental assessment process, the current status of the environment, possible environmental impacts, and means of providing input into the environmental assessment process. Attached to the BID was a registration and response form, which provided IAPs with an opportunity to submit their names, contact details and comments on the project. A copy of the BID is provided in Appendix E.

7.2.3 REGULATORY AUTHORITIES NOTIFICATIONS

Regulatory authorities were informed in writing of the proposed project. Proof of this notification is provided in Appendix E.

7.2.4 SITE NOTICES AND ADVERTISEMENTS

Site notices in English and Afrikaans were placed at key conspicuous positions in and around the proposed project site and block advertisements were placed in the Kalahari Bulletin and Kathu Gazette on 12 March 2015 and 14 March 2015, respectively. Photographs of the site notices and copies of the newspaper advertisements are provided in Appendix E.

7.2.5 SCOPING MEETINGS – IAPS AND REGULATORY AUTHORITIES

IAPs were notified of the public meeting in the following manner:

- Formal invitations to the public meeting sent via email, fax and post (Appendix E)

- Advertisements placed in the Kalahari Bulletin and Kathu Gazette (Appendix E)
- Site notices placed in and around the proposed project site (Appendix E).

Regulatory authorities were notified of the regulatory authorities meeting in the following manner:

- Telephonic discussions to notify regulatory authorities of the proposed date for the authorities meeting
- Formal invitations to the regulatory authorities meeting sent via email, fax and post (Appendix E) including telephonic discussions.

The following public scoping and regulatory authority meetings were held for the proposed project:

- One (1) regulatory authorities meeting was held on 15 April 2015 at the Hotazel Recreation Club. Meeting attendance registers and minutes are provided in Appendix E.
- One (1) public scoping meeting was held on 15 April 2015 at the Hotazel Recreation Club. Meeting attendance registers and minutes are provided in Appendix E.
- A pre-application meeting was held with the DMR on 21 April 2015 at the department offices in Kimberley. Meeting attendance registers and minutes are provided in Appendix E.

The purpose of the public scoping and regulatory authorities meetings was as follows:

- To provide an overview of the proposed project
- To provide an overview of the environmental assessment process that will be undertaken for the proposed project
- To provide an overview and obtain input on the existing status of the environment
- To outline and obtain input on potential impacts identified for the proposed project
- To record any comments and issues raised. These issues and concerns will be used to inform the Plan of Study for the EIA Phase.
- Agree on the way forward and the logistics for report distribution

7.2.6 RELEVANT REGULATORY AUTHORITIES AND IAPS

The relevant regulatory authorities, agencies and institutions responsible for the various aspects of the environment, land and infrastructure that may be affected by the proposed project are listed below:

- Regulatory authorities:
  - Department of Mineral Resources (DMR)
  - Department of Water and Sanitation (DWS)
  - Department of Environment and Conservation (DENC)
  - South African Heritage Resource Agency (SAHRA)
  - Department of Agriculture and Land Affairs (DALA)
  - Department of Agriculture, Forestry and Fisheries (DAFF)

- The Northern Cape Department of Rural Development and Land Reform (DRDLR)
- Department of Public Works, Roads and Transport (DPWRT)
- John Taolo Gaetsene District Municipality
- Joe Morolong Local Municipality
- Ward councillor (Ward 4).

- Parastatals:
  - Telkom
  - Transnet
  - Eskom
- Non-government organisation
  - Tshiping Water Use Association
  - Kalagadi Water User Forum
- Others:
  - Landowners and land users
  - Surrounding mines

7.2.7 REVIEW OF THE SCOPING REPORT

The scoping report was made available for public and regulatory authorities review from **10 July to 11 August 2015**. Full copies of the scoping report were made available for public review at the following venues:

- Joe Morolong Local Municipality
- John Taolo Gaetsewe District Municipality
- Hotazel, Black Rock (For both Black Rock and Gloria mine village) community public libraries
- Kuruman and Kathu town libraries
- SLR's offices in Johannesburg
- Electronically on a CD were made available on request.

Summaries of the scoping report were sent by post or e-mail to all IAPs and authorities that were registered on the public involvement database. In addition, IAPs were notified when the scoping report was available for review via SMS. Copies of the scoping report summary are included in Appendix E.

The scoping report that was subjected to public and regulatory authority review was updated with any comments received during the review period. This updated scoping report was made available to the DMR for decision making on 14 August 2015.

7.2.8 REVIEW OF THE EIA AND EMP REPORT

The EIA and EMP report will be made available for public and regulatory authorities review from **12 November 2015 to 12 December 2015**. Full copies of the EIA and EMP report will be made available for public review at the same venues that the scoping report was made available (Section 7.2.7). Electronic copies of the EIA and EMP report will be made available on request.

Summaries of the EIA and EMP report will be sent by post or e-mail to all IAPs and authorities that were registered on the public involvement database. In addition, IAPs will be notified when the scoping report is available for review via SMS.

7.3 SUMMARY OF ISSUES RAISED BY IAPS

A summary of the issues and concerns raised by IAPs and regulatory authorities is provided in Table 16 below.

TABLE 16: SUMMARY OF ISSUES RAISED BY IAPS AND REGULATORY AUTHORITIES

Interested and affected parties		Date comments received	Issues raised	EAPs response to issues (as amended for the purposes of the EIA and EMP report)
Affected parties				
Landowners or lawful occupiers on adjacent properties				
Comment raised by E E Reynecke	X	01 March 2015 during the social scan	I am concerned about groundwater availability.	With reference to Appendix F, the groundwater model indicates that the cone of depression extends approximately 5km to the north and south of the proposed open pit area and approximately 1 to 1.5km to the east and west of the proposed open pit area. The hydrocensus identified six boreholes along the Ga-Mogara drainage channel that are located within the zone of influence. With reference to Figure 25, these include boreholes MH3, MH10, MH5, MH 14, MHsw2 and Mhsw1. All of these boreholes are used by neighbouring manganese mines for groundwater monitoring. It is therefore unlikely that the proposed project will influence groundwater availability within boreholes utilised for third party use. It is however important to note that in the event that Mokala's operations do result in the lowering of groundwater levels that influence third party users, Mokala is committed to supply third party users with an alternative source of water.
Comment raised by Ryno van Schalkwyk,		01 March 2015 during the social scan	I am concerned about the impact that the project will have towards groundwater availability.	
Comment raised by Lourika Delaport (L van der Merwe)		01 March 2015 during the social scan	My concern about the proposed project is groundwater availability.	
Comment raised by Gert A Noeth		01 March 2015 during the social scan	I am concerned about groundwater availability.	
Comment raised by Jurie Kriek		15 April 2015 at the public scoping meeting	I have boreholes in the area and I am concerned about the impacts that the project will have on existing groundwater levels.	
Comment raised by Jurie Kriek		15 April 2015 at the public scoping meeting	There is a concern that the shallow aquifer is dry. This could be due to the sinkholes upstream at the Kumba Mine. This project will add additional pressure on the existing aquifers which will have an impact on downstream users.	

Interested and affected parties		Date comments received	Issues raised	EAPs response to issues (as amended for the purposes of the EIA and EMP report)
Comment raised by Eben Anthonissen		15 April 2015 at the public scoping meeting	The Ga-Mogara drainage channel has limited surface water run-off. The first aquifer is not replenishing. This has a major impact on users as far as Kathu. The proposed project will only add additional pressure.	
Comment raised by Jeff Leader		13 July 2015, Scoping report comments	The Vaal Ga-Mogara pipeline and Kathu are the biggest consumers of Kumba/Sishen water.	Thank you for this input.
Comment raised by Louis Hauman		15 April 2015 at the public scoping meeting	A major problem in the area is underground water. The river does not flow and aquifers don't get water. In addition, the cumulative impacts by each mine must be calculated. The Kumba Mine is currently the biggest user of groundwater.	With reference to Section Appendix F, the groundwater model indicates that the cone of depression extends approximately 5km to the north and south of the proposed open pit area and approximately 1 to 1.5km to the east and west of the proposed open pit area. As part of the groundwater study, a hydrocensus was undertaken to determine the baseline environment (groundwater quality and quantity) which is used to inform the groundwater model. The baseline environment has already been influenced by existing mining operations. It follows that the development of the groundwater model took into account abstractions and ingress of water from neighbouring mines in so far as the baseline reflects historical and current regional impacts. In this way the potential dewatering cone of depression was modelled and assessed cumulatively within the context of existing conditions and water uses.
Comment raised by Gert Theart		15 April 2015 at the public scoping meeting	We would like to know what the cone of depression is for the project taking into account other mines in the area. When considering the other mines in the area, Mokala will cause the existing cone of depression to extend. We are not interested in seeing a site specific cone of depression.	
Comment raised by Gert Theart		15 April 2015 at the public scoping meeting	The groundwater resources in the area are already under pressure. The existing mining companies shift blame where groundwater shortages are concerned. There needs to be a proper way of managing water usage for each mining company in order to assess the cumulative impacts on groundwater.	
Comment raised by Eben Anthonissen		15 April 2015 at the public scoping meeting	Groundwater usage by Mokala will just add more pressure on existing users. More pressure on the Vaal Ga-Mogara pipeline which also	As part of the proposed project, Mokala will need to apply to the Vaal Ga-Mogara water supply scheme. This will result in an

Interested and affected parties		Date comments received	Issues raised	EAPs response to issues (as amended for the purposes of the EIA and EMP report)
			affect livestock.	additional user relying on water supply from this scheme. It is understood that there are plans to upgrade the Vaal Ga-Mogara pipeline and that mines in the areas are being approach by Sedibeng Water to assist with these upgrades.
Comment raised by Jeff Leader		13 July 2015, Scoping report comments	The property has no significant groundwater. The deep aquifer as described in the scoping report (section 8.4.1.7 Groundwater) was not found on site.	A deep aquifer does underlie the proposed project area. As part of the groundwater investigation this was confirmed by the outcome of test results which are consistent with a deep aquifer system.
Comment raised by Ryno van Schalkwyk,		01 March 2015 during the social scan	I am concerned about the impact that the proposed project will have on existing transport networks.	The proposed project will require the use of 130 trucks per day during operations for the transportation of ore. This equates to less than six trucks per hour. With reference to Section 7.4.1.12, the traffic specialist has concluded that the current level of service along the R380 is considered to be very good and is predicted to operate at acceptable levels of service as part of the proposed project. It is however important to note that while the current intersection to the Gloria Mine is considered to be good, the traffic specialist has concluded that this intersection will require upgrading in terms of road safety and intersection functionality in order to cater for the proposed project. The proposed upgrade of the intersection to the proposed mine is illustrated in Figure 4. The upgrade of the intersection will include an additional turning lanes into the proposed Mokala Mine and an additional turning lane to the Gloria Mine.
Comment raised by Jurie Kriek		15 April 2015 at the public scoping meeting	If Mokala is intending on mining approximately 1.3 million tonnes of ore per year this means that approximately 300 trucks will be leaving the mine every day. That will require a highway. The existing roads cannot accommodate that number of trucks.	
Comment raised by Jeff Leader		13 July 2015, Scoping report comments	With reference to the comment above, about 100 trucks per day will be leaving the mine every day.	

Interested and affected parties		Date comments received	Issues raised	EAPs response to issues (as amended for the purposes of the EIA and EMP report)
Comment raised by Ryno van Schalkwyk,		01 March 2015 during the social scan	I am concerned about housing.	No workers will be housed on-site as part of the proposed project. Instead workers will be accommodated in nearby towns.
Comment raised by Gert A Noeth		01 March 2015 during the social scan	I am concerned that the proposed project will result in an increase in veld fires.	With reference to Section 28, Mokala is committed to be part of existing forums and initiatives in the area which aid in managing the environment effectively. Mokala will also implement fire breaks around the project area.
Comment raised by Jan Theart	X	15 April 2015 at the public scoping meeting	The area is well known for veld fires. Will Mokala join other mining companies in assisting with veld fires?	
			Has the application for re-zoning of the land been submitted as the current land zoning is agricultural?	Mokala is aware that a re-zoning application needs to be submitted; however this has not been done yet. Prior to the development of the proposed mine, Mokala will ensure that the land has been re-zoned.
			When will blasting take place? The law states that blasting should only take place during the day. Mokala should also be aware that there is an existing forum which assists in notifying people of planned blasts.	The blasting management measures as outlined in Section 28 indicate that blasting activities should be limited to the day time hours and that scheduled blasts need to be communicated with IAPs.
			There is a Kalagadi Forum which is in the process of becoming a water use association. We would like Mokala to form part of the association	Mokala is willing to be part of existing forums and initiatives in the area which aid in managing the environment effectively.
Comment raised by Jurie Kriek		15 April 2015 at the public scoping meeting	The life of mine, being approximately 15 years is a short period for a project with such anticipated impacts, particularly the realignment of the Ga-Mogara drainage channel. We hope that your plan is not to mine, pack up and leave the area dry.	The EMP commits Mokala to rehabilitate the proposed project site as part of closure. This includes removing all surface infrastructure, maintaining the Ga-Mogara drainage channel realignment and backfilling the open pit. The aim of these commitments is to rehabilitate the site as close to the pre-mining environment as possible.

Interested and affected parties		Date comments received	Issues raised	EAPs response to issues (as amended for the purposes of the EIA and EMP report)
			How much will Mokala contribute to road maintenance? Some mining companies in the area have contributed towards upgrading existing roads. The roads in this area are not designed for heavy vehicles especially trucks.	At this stage it is not possible to determine what amount Mokala will contribute to road maintenance. With reference to Section 28. It should however be noted, that Mokala is committed to work together with other mines including the relevant roads departments to maintain roads.
Comment raised by Louis Hauman		15 April 2015 at the public scoping meeting	Has the mining right been granted?	The mining right application was submitted on 03 July 2015. For the mining right to be granted the DMR needs to approve the EIA and EMP report in support of a mining right application. The environmental assessment process should take approximately 300 days as per legislated timeframes from the date of submission of the mining right application. It is only after these 300 days that the DMR should make a decision as to whether or not to grant the mining right.
			How much manganese do you intend to mine per year?	Approximately 1.3 million tonnes per annum.
			The Ga-Mogara drainage channel is going to flow again in 2025.	Thank you for your input.
			The wind direction is from the North West not South East; please update this in your documents.	Reference to the wind direction from the north west has been noted in Section 7.4.1.3.
			In your report it needs to be clearly indicated what amount of water is required for dust suppression.	The amount of water required for dust suppression is approximately 49 396 l/day (1502 m^3/month) for the processing plant area and a minimum of 94 750.58 l/day (2882 m^3/month) is required for dust suppression along roads and at the overburden stockpile.
			The impact that the project will have on the river	It is not anticipated that the flow of the Ga-

Interested and affected parties		Date comments received	Issues raised	EAPs response to issues (as amended for the purposes of the EIA and EMP report)
			flow must be calculated.	Mogara drainage channel will not be impacted as part of the proposed project. The design of the realignment of the Ga-Mogara drainage channel will allow for the continuation of flow when this occurs. Moreover, there is no base flow in the river at the moment which means that mine dewatering impacts will not impact the base flow. Refer to Appendix F for the relevant impact assessment.
Comment raised by Eben Anthonissen	X	15 April 2015 at the public scoping meeting	Will Mokala wait for a water use license to be issued by the Department of Water and Sanitation before commencing with mining? In our experience, mines operate without a water use license.	Mining will not take place until feedback has been received from the Department of Water and Sanitation.
			How deep is the ore body?	The depth of the ore body ranges between 40 to 180m.
			The financial provision must include the realignment of the Ga-Mogara drainage channel and the realignment of the R380. Will these be returned back to their original positions?	The re-alignment of the R380 will be permanent. It is important to note that once the R380 has been diverted, this road becomes the responsibility of the South African National Roads Agency (SANRAL). It is for this reason that the financial provision will not cater for the relocation of the R380 to its original alignment. The design of the Ga-Mogara drainage channel re-alignment will take place in two phases. Phase 1 will include a temporary realignment for approximately three years. This temporary realignment will be included as part of the financial provision. After three

Interested and affected parties		Date comments received	Issues raised	EAPs response to issues (as amended for the purposes of the EIA and EMP report)
				years, mining would have progressed westward which will provide the required space for the implementation of the permanent realignment (Phase 2). The design of the permanent realignment will be as natural as possible and will therefore incorporate natural curves, natural soil and indigenous vegetation. It follows that once the permanent realignment has been implemented, no further rehabilitation is required and will therefore not be catered for in the financial provision.
Comment raised by Eben Anthonissen		15 April 2015 at the public scoping meeting	What will happen to the treated sewage effluent?	The treated sewage effluent will be re-cycled / re-used within the plant process.
Comment raised by Jeff Leader		13 July 2015, Scoping report comments	This is a dry process. What about Dust suppression?	Dust suppression will be provided at all material handling points. The amount of water required for dust suppression is approximately 49 396 l/day (1502 m^3/month) for the processing plant area and a minimum of 94 750.58 l/day (2882 m^3/month) is required for dust suppression along roads and at the overburden stockpile.
Comment raised by Eben Anthonissen		15 April 2015 at the public scoping meeting	Where is Mokala planning on disposing of general and hazardous waste? The closest landfill site is in Kuruman and they are not accepting additional waste. Due to this, many mining companies resort to dumping their waste next to the roads which poses a major challenge for farmers. If our livestock eat waste material, it can be fatal which results in a loss of income.	Mokala will ensure that not waste is dumped illegally. At the time of commencement of the proposed project, if Kuruman is unable to accept waste, then Mokala will send the waste to the next nearest licensed facility.
Comment raised by Jeff		13 July 2015,	With reference to the comment above, Hotazel	Deben and Hotazel may be a possibility if

Interested and affected parties		Date comments received	Issues raised	EAPs response to issues (as amended for the purposes of the EIA and EMP report)
Leader		Scoping report comments	and Deben are closer.	these sites are operational when the proposed project commences.
Comment raised by Eben Anthonissen		15 April 2015 at the public scoping meeting	What is the depth of the shallow aquifer?	The depth of the shallow aquifers varies from 13m to 66m below ground at the project site. The result of the groundwater study indicates that the shallow aquifer is of limited extent.
Comment raised by Jeff Leader		13 July 2015, Scoping report comments	With reference to the comment above, the depth of the shallow aquifer is 40m plus.	
Comment raised by Eben Anthonissen		15 April 2015 at the public scoping meeting	Can the quarterly monitoring reports be made available to the public and the farmers' associations? We have existing arrangements with other companies in the area. We are also willing to provide access to our boreholes for monitoring for baseline purposes.	Mokala will make the monitoring reports available to the public. On the issue of baseline monitoring - a hydrocensus was undertaken for the project. Farmers in the area were contacted in order to gain access to their boreholes. Refer to Figure 25, for an illustration of the boreholes that were sampled as part of the hydrocensus.
Comment raised by Gert Theart			Yes, that is correct. SLR was at my farm and took measurements.	Thank you for this clarification.
Comment raised by Eben Anthonissen			It is important to note, that when it comes to protected plant species, the Tolbos is not taken into consideration.	The *Boophane disticha* (Tolbos) is considered to be declining in terms of the IUCN. With reference to Section 7.4.1.6, the Tolbos was not specifically identified on-site during the site survey undertaken by the biodiversity specialist.
			We are concerned that the opencast mine will produce a significant amount of dust especially during blasting. Hotazel is located North East of the proposed project site. Given that the prevailing wind direction is from the north west, Hotazel will be covered with dust.	The modelled results indicate that dust fallout will not exceed the National Dust Control Regulations outside the proposed project area (Refer to Appendix F for the impact assessment). It follows that it is unlikely that Hotazel which is located approximately 4km

Interested and affected parties		Date comments received	Issues raised	EAPs response to issues (as amended for the purposes of the EIA and EMP report)
				from the proposed project site will experience elevated dust fallout concentrations that will exceed the National Dust Control Regulation limits. Mokala will, however implement a dust fallout monitoring programme as illustrated in Figure 32 as part of the proposed project to monitor dust fallout levels and where necessary implement additional mitigation.
			What is Mokala's intention regarding the transportation of ore?	Ore will be transported via road to either Port Elizabeth and Durban. It should however be noted that Mokala will investigate the transportation of ore by road to nearby existing railway sidings at existing mining operations for loading onto trains to relieve road congestion.
			We would prefer if Mokala made use of rail to transport ore as opposed to road.	
			Will the proposed mine make use of local labour?	Mokala will make use of local labour as far as practically possible.
			We would like a visual impact assessment to be undertaken for the project. Our concern is lighting at night from the mine.	A qualitative visual assessment was undertaken given that the proposed project is surrounded by existing mining operations to the north, south and south east and as such the proposed project is not expected to present negative visual views that differ from the current baseline situation. Refer to Section 7.4.1.11.
Comment raised by Bonolo Lekwa	X	15 April 2015 at the public scoping meeting	Please can SLR ensure that copies of the relevant reports are made available at the Black Rock Library?	A copy of the scoping report was placed at the Black Rock Library for public review on 10 July 2015. Copies of the EIA and EMP report will also be placed at the Black Rock Library for review and comment by IAPs.
			Mokala must take note that there are existing plans to expand the capacity of the Vaal Ga-	Mokala is aware of the current water challenges that the Hotazel area experiences.

Interested and affected parties		Date comments received	Issues raised	EAPs response to issues (as amended for the purposes of the EIA and EMP report)
			Mogara Pipeline by Sedibeng Water.	As far as possible Mokala will aim to source water from on-site groundwater for use as both potable and process water. Mokala will however need to apply to Sedibeng Water to obtain water from the Vaal Ga-Mogara Water Supply Scheme as groundwater may not be able to sustain the mine for the full duration of the operation.
Comment raised by Jeff Leader		13 July 2015, Scoping report comments	With reference to the comment above, the primary source of this water is Sishen/Kumba and the source is already strained.	
Comment raised by Thivha Tshithavhane		15 April 2015 at the public scoping meeting	It is strongly advised that Mokala applies to Sedibeng Water to obtain water from the Vaal Ga-Mogara water supply scheme in order to benefit. It was mentioned that one of the water supply alternatives was to source water from neighbouring mines. This will not be possible due to the water shortages in the area.	
Comment raised by Bonolo Lekwa		15 April 2015 at the public scoping meeting	Assmang undertook a heritage impact assessment during the expansion of the railway bridge. Some stone age tools were found near the Ga-Mogara drainage channel.	With reference to section 7.4.1.13, five heritage sites were identified as part of the proposed project. These heritage sites are located within close proximity of the Ga-Mogara drainage channel and are associated with the middle to late stone age. These sites vary from low to medium in terms of heritage significance. The proposed project will require the disturbance of a low heritage significance site (HKM1) that is located within the footprint area of the planned R380 realignment route. Given that this is a low heritage significant site, it can be destroyed. Apart from HKM1 management measures focus on the avoidance of heritage resources as part of the proposed project.
Comment raised by Thivha Tshithavhane		15 April 2015 at the public scoping meeting	Will the reports be made available for review in any of the communities?	Yes.
			I think that it is important that communities receive hard copies of the reports. I will send you a list of which communities should receive	The scoping report was placed in the closest communities namely: Hotazel and Black Rock (For both Black Rock and Gloria mine village)

Interested and affected parties		Date comments received	Issues raised	EAPs response to issues (as amended for the purposes of the EIA and EMP report)
			reports.	as part of the public review process. In addition, summaries of the scoping report were distributed to all IAPs that are registered on the projects database and electronic copies of the report were made available on request. Similarly, the EIA and EMP report will also be made available at the same venues and in the same manner in which the scoping report was made available to the public for review.
Comment raised by Gert Theart	X	15 April 2015 at the public scoping meeting	There are many mines requesting access to the Ga-Mogara Pipeline from Sedibeng Water. If Mokala also applies for water from this scheme, more pressure will be placed on the pipeline.	With reference to Section 7.1.5, Mokala's preferred means of sourcing water for the proposed operation is from on-site sources. It is however important to note that based on the outcome of the investigations on site water may need to be supplemented It follows that Mokala will also apply to obtain water from the Vaal Ga-Mogara Water Supply Scheme at such time when on site water is no longer a reliable source.
Issue raised by Jeff Leader	X	13 July 2015, Scoping report comments	With regards to the statement raised by the DMR on 21 April 2015 that mines do not undertake concurrent backfilling, please note that the Mamatwan Mine has been backfilling for years and the United Manganese of Kalahari Mine has started to backfill.	Thank you for your comment.
			A comment was raised by DENC on 15 April 2015 that the impact of the project towards agricultural potential of the project site needs to be investigated. This land is too small for economical farming activity which is why the ground has been unused for a number of years.	Thank you for your comment. It is however important to note that the proposed project area does have grazing land potential. Even though the area that will be disturbed as part of the proposed projects infrastructure and activities is not currently utilised for livestock

Interested and affected parties		Date comments received	Issues raised	EAPs response to issues (as amended for the purposes of the EIA and EMP report)
				or game grazing, this grazing potential will however be temporarily lost during the course of the mining operation.
			The annual minimum temperature range personally recorded in the area is -8°C, and not -0.6°C.	Temperature data for the proposed site was simulated using available information for the general area. It follows that slight variations in temperatures can be expected.
			I have personally seen many more faunal species in the area that was not recorded in the scoping report such as Kori Bustard (1), Namaqua Dove (many), Pale chanting goshawk common, black shouldered kite, Black breasted and brown snake eagles, kudu, grey duiker and steenbok as well.	Animals are mobile and are not restricted to the proposed project area and as such it is possible that certain animal species were not present on-site when field work was undertaken by the biodiversity specialist. Your comment has however been noted and reference to animal species that were not present on-site when field work was undertaken by the biodiversity specialist has been included in Section 7.4.1.6.
			Mitigation measures associated with blasting could disrupt traffic.	With reference to Section 28, Mokala is committed to ensure that no blasting takes place within 500m of any third party infrastructure. This includes the R380. It follows that it is unlikely that traffic will be disturbed as part of blasting activities associated with the proposed project.
			The proposed activity could potentially increase surrounding property value as opposed to reduce property value.	Based on the economic investigation (included in Appendix R) undertaken for the proposed project and with reference to Section 7.4.2, mineral resources and existing operating mines in the area has resulted in the escalation of land value in the region over the past few years. It is however important to note, that post closure, agricultural activities

Interested and affected parties		Date comments received	Issues raised	EAPs response to issues (as amended for the purposes of the EIA and EMP report)
				can be resumed and the property value can therefore be restored but will likely be a lower value due to past mining activities.
			With reference to Section 8.7.5 of the scoping report is it really possible to re-establish drainage patterns if soil heaps will be on-site.	As part of rehabilitation all surface infrastructure, excluding the realignment of the R380, will be removed from site, this includes any stockpiles. With the implementation of correct rehabilitation measures, effective drainage patterns can be restored.
Organs of state				
Issues raised by Raisibe Sekepane from the Department of Mineral Resources	X	21 April 2015 at the pre-application meeting	In terms of the proposed road realignment and the realignment of the Ga-Mogara drainage channel, has SLR consulted with the Department of Roads and Public Works and the Department of Water and Sanitation (DWS) respectively?	Both departments have been notified of the proposed project. In this regard, a background information document was distributed to both departments. In addition to this, both departments were invited to the regulatory authorities meeting. These departments will continue to be involved throughout the environmental assessment process.
			What is the depth of the ore body?	The depth of the ore body ranges between 40m to 180m.
			The impact assessment needs to focus on the cumulative impacts.	All identified impacts are considered in a cumulative manner such that the current baseline conditions on site and in the surrounding area are discussed and assessed together with the potential proposed project impacts. Refer to Appendix F for the full assessment of potential impacts associated with the proposed project.
			Please can you provide details regarding the grade of the ore and market requirements? We	Mokala will produce a minimum manganese ore grade of 34% with an average grade of

Interested and affected parties		Date comments received	Issues raised	EAPs response to issues (as amended for the purposes of the EIA and EMP report)
			acknowledge that Mokala intends to backfill the open pit, however in our experience with existing mining operations in the area, backfilling does not take place even it if is a commitment in an environmental management programme report. The reason for this is that the grade of the ore and market conditions are poorly understood and mines end up not having the money to backfill open pits.	37.5%. This will depend on the price of the manganese at any given stage of the project. Provision for rehabilitation is a legal requirement and is reviewed independently each year and will form part of concurrent backfilling. The mining procedure has been designed on a rollover basis which methodology requires con-current backfilling.
Issues raised by Raisibe Sekepane from the Department of Mineral Resources		21 April 2015 at the pre-application meeting	In terms of the water system on-site, will it be a closed loop?	Yes. The intension is to manage all dirty and recycle water on-site in accordance with Regulation 704 (4 June 1999).
Issue raised by the Department of Agriculture, Forestry and Fisheries		03 August 2015, Scoping Report Comments	The report indicated that about 148 ha of natural vegetation would be disturbed as part of the proposed development. It would include realignment of a section of the R380 road and realignment of a section of the Ga-Mogara drainage channel, affecting sensitive areas. Large protected Camel thorn trees (*Acacia (Vachellia) erioloba)* are usually associated with the riparian vegetation on the banks of the Ga-Mogara River, hence it is anticipated that a large number of protected trees would be destroyed as a result of the proposed activities and that an environmental offset may be required to compensate for the permanent loss of slow growing protected trees.	As part of the biodiversity assessment that was undertaken by an independent specialist, a survey was undertaken in order to determine the number of protected trees that would be removed as a result of the proposed project. It is estimated that approximately 17000 *Vachellia haematoxylon* trees and approximately 500 *Vachellia* erioloba trees will need to be removed as part of the proposed project and as such a biodiversity offset will be required. The size classes associated with the *Vachellia haematoxylon* include: • 1m - 2m: 45% of *Vachellia haematoxylon* within disturbance footprint • 50cm: 28% of *Vachellia haematoxylon* within disturbance footprint
Issue raised by the Department of Agriculture, Forestry and Fisheries		03 August 2015, Scoping Report Comments	A detailed assessment should be undertaken during the EIA phase to provide an accurate estimation of the number of protected trees per size classes, which might be directly affected by	

Interested and affected parties		Date comments received	Issues raised	EAPs response to issues (as amended for the purposes of the EIA and EMP report)
			the proposed development. Please supply this information to the DAFF (Forestry) as soon as possible.	• 2m – 4m: 15% of *Vachellia haematoxylon* within disturbance footprint • Less than 50cm: 12% of *Vachellia haematoxylon* within disturbance footprint • No *Vachellia haematoxylon* taller than 4m were identified with the disturbance footprint area. The size classes associated with the *Vachellia erioloba* include: • Less than 50cm: 28% of Vachellia erioloba within the disturbance footprint • 50cm – 1m: 11% of Vachellia erioloba within the disturbance footprint • 2m – 4m: 8% of Vachellia erioloba within the disturbance footprint • 4m-6m: 28% of Vachellia erioloba within the disturbance footprint • 6m-8m: 18% of Vachellia erioloba within the disturbance footprint • Greater than 8m: 7% of Vachellia erioloba within the disturbance footprint
Department of Environmental Affairs (Department on Environment and Nature Conservation – Northern Cape)				
Issues raised by Moses Ramakulukusha from the Department of Environment and Nature Conservation	X	15 April 2015 at the regulatory authorities meeting	Please send me a list of specialists that will be undertaking work for the proposed project. I would like to know what specialist studies will be conducted for the project?	A list of specialists that undertook work as part of the proposed project is included in Section 10.
			Will you determine the carbon footprint of the proposed project? I am aware that it is currently not legislated and thus not mandatory but be	Provision has been made for a carbon footprint assessment to be undertaken as part of the environmental management

Interested and affected parties		Date comments received	Issues raised	EAPs response to issues (as amended for the purposes of the EIA and EMP report)
			aware that it is what the environmental department is moving towards to for future EIA processes.	programme (Section 28). This will be done if the project is approved.
			It is important that SLR engages in an effective public consultation process. Was the proposed project advertised in newspapers? What other means were used to inform interested and affected parties (IAPs) about the proposed project? I do not think newspapers are an effective means of informing IAPs about a project.	The proposed project was advertised in the Kathu Gazette and the Kalahari Bulletin. Site notices were also placed in and around the proposed project site. A social scan was undertaken to identify IAPs such as landowners, land users, non-government organisations, regulatory authorities and surrounding mining companies. Identified IAPs were notified of the proposed project by means of background information documents and site notices placed within and surrounding the proposed project site. Further detail is provided in Section 7.2
			What communities have been involved as part of the proposed project? Has the ward councillor been engaged?	The relevant ward councillor has been notified of the proposed project and was invited to the regulatory authorities meeting. A land claim has been lodged on the farm Kipling 271 by the Tsineng Communal Association (CPA). The Tsineng CPA has been notified of the proposed project and was invited to the public scoping meeting. The communities of Black Rock, Hotazel are the two closest communities. People within these communities have both been notified
			Has the environmental authorisation application been submitted to the Department of Mineral Resources (DMR) for listed activities in terms of the NEMA/NEM:WA? Similarly have water use	The mining right application in terms of the MPRDA including the environmental authorisation application in terms of both NEMA and NEM:WA were submitted to the

Interested and affected parties		Date comments received	Issues raised	EAPs response to issues (as amended for the purposes of the EIA and EMP report)
			activities been identified, that required authorisation from the Department of Water and Sanitation?	DMR on 03 July 2015. A copy of the acceptance letter is included in Appendix E. Further to this, a notice of intent letter was submitted to the DWS in order to inform the department of Mokala's intension to submit a water use license application as well as to outline the preliminary list of water uses associated with the proposed project. Prior to the submission of the water use license application a pre-application meeting will be held with the DWS to refine the list of water uses to be applied for as part of the proposed project. A copy of the notice of intent letter submitted to the DWS is included in Appendix E.
			Was the DMR invited to this meeting and have they been to site?	The DMR was invited to the regulatory authorities meeting. The DMR undertook a site inspection of the proposed project site on 07 July 2015.
			Are you aware of the Hotazel town expansion project? The town will be expanding towards the direction of the project. The expansion is currently not approved but it is definitely in the pipeline. Black Rock had to adjust their mining plans because of the proposed expansion. Please also note that BHP Billiton owns the land where the town will be expanding.	It is understood that the Hotazel town expansion area is likely to take place on the farms Hotazel 280 and Kipling 271. The impact assessment does acknowledge the potential development. It must be noted that the existing and proposed land use in the area (including Mokala) must be taken into account in the detailed design and execution phase of the possible development. In this regard the closest potential mining operations would be the proposed Kudumane operations.

Interested and affected parties		Date comments received	Issues raised	EAPs response to issues (as amended for the purposes of the EIA and EMP report)
			Will the project rely on the municipal sewage facilities?	During the operational phase it is proposed that an on-site sewage treatment plant will be established in order to treat any sewage generated as part the proposed mine. During construction when portable toilets are utilised, certified contractors will remove sewage from site and dispose off-site at a licensed facility.
			Will a geotechnical study be undertaken for the project?	Yes, a geotechnical study was undertaken for the proposed project.
			Please assess the post land rehabilitation and potential.	Through the implementation of rehabilitation measures as outlined in Sections 28 that focus on con-current backfilling, removal of all infrastructure (except for the R380) and the permanent realignment of the Ga-Mogara drainage channel, the land can be rehabilitated to achieve a condition approximating its natural state, or as that the envisaged end use of wilderness and grazing is achieved.
			Please assess what impact the proposed project will have towards the agricultural potential of the project site?	From an agricultural perspective the proposed project area is considered to have grazing potential. The grazing potential of the site will be temporarily lost in areas where the mining activities will disturb the surface area. Once mining is completed, con-current effective rehabilitation should restore the land capability to grazing. It is important to note that the area that will be disturbed as part of the proposed projects infrastructure and activities is not currently used for grazing purposes. Kgalagadi currently uses the far western section of the remaining extent of the

Interested and affected parties		Date comments received	Issues raised	EAPs response to issues (as amended for the purposes of the EIA and EMP report)
				farm Gloria for game grazing purposes. These grazing activities will continue and will not be disturbed as part of the proposed project.
Issues raised by Moses Ramakulukusha from the Department of Environment and Nature Conservation		15 April 2015 at the regulatory authorities meeting	Will there be a biodiversity offset.	The proposed project will require the removal of more than 1000 protected trees. The DAFF requires that a biodiversity offset is required in support of a tree removal permit in the event that more than 1000 protected trees will be removed. Taking this into account and with reference to Section 28, Mokala is committed to submit a biodiversity offset to the DAFF for approval prior to the removal of any protected trees.
Other interested and affected parties				
Issue raised by Mr Wayne Green from Telkom	X	14 April 2015 via email	Telkom SA SOC Ltd is affected by this proposal. Existing overhead plant is affected between Hotazel and Santoy (Black Rock). If any plant is damaged or must be moved, the cost involved will be repayable. Please note that important overhead route is affected and should be treated as important. On completion of this project, please certify that all requirements as stipulated in this letter have been met. Please note that should any Telkom SA SOC Ltd infrastructure has to be relocated or altered as a result of your activities the cost for such alterations or relocation will be for your account in terms of section 25 of the Electronic Communication Act. This approval is valid for 6 months, after which re-application must be made if the work has not been completed.	Mokala is aware that the proposed project will require the realignment of the Telkom line that runs parallel to the R380. In this regard, negotiations are underway between Mokala and Telkom.

Interested and affected parties		Date comments received	Issues raised	EAPs response to issues (as amended for the purposes of the EIA and EMP report)
Comment received from L Ramatladi from Transnet		24 April 2015 via email	No objections as the proposed mine is more than 5km away from Transnet Freight Rail Property at Hotazel Station and no foreseen issues with regards to the project.	Thank you for your comment.
Comment received by Seikaneng Keatlegile		16 March 2015 via email	I am interested in job opportunities.	Your comment has been noted. The proposed project will create approximately 321 construction job opportunities and approximately 370 operational job opportunities.
Comment raised by Errol Motlhatlhedi		15 April 2015 at the public scoping meeting	What is the difference between construction and operational jobs?	Construction jobs are required for a few months at a time while the mine is being established. Operational jobs are required for a longer period of time while the mine is operational, which in the case of the proposed project is approximately 15 years.

X = indicates IAPs that were consulted

7.4 ENVIRONMENTAL ATTRIBUTES ASSOCIATED WITH THE PROJECT AND ALTERNATIVES

The baseline information provided is aimed at giving the reader perspective on the existing status of the cultural, socio-economic and biophysical environment. Where appropriate it includes the detail derived from the specialist reports and other research undertaken for the EIA.

7.4.1 BASELINE ENVIRONMENT AFFECTED BY THE PROPOSED ACTIVITY

7.4.1.1 Geology

INTRODUCTION AND LINK TO IMPACT

As a baseline, the geology and associated structural features provides a basis from which to understand:

- The potential for sterilisation of mineral reserves
- The geochemistry and related potential for the pollution of water from mineralised waste facilities and stockpiles
- The related potential for geological lineaments such as faults and dykes. Faults, dykes and other lineaments can act as preferential flow paths of groundwater which can influence both the dispersion of potential pollution plumes and the inflow of water into mine workings.

Geological processes also influence soils forms (see Section 7.4.1.4) and the potential for palaeontological resources (see Section 7.4.1.13).

To understand the basis of these potential impacts, a baseline situational analysis is described below.

DATA SOURCES

Information in this section was sourced from the groundwater study (SLR, October 2015) included in Appendix H and the geochemistry study (SLR, August 2015) included in Appendix I.

Information pertaining to regional and local geology was sourced from available literature as well as borehole logs.

Geochemical analysis was undertaken on different lithologies located within the proposed project area that are likely to be stockpiled as overburden or used as part of construction for roads and platforms. These samples were selected either from cores on-site, ore samples and historical borrow pits on-site and were used to determine the potential for acid mine drainage, minerology percentages and the potential leachate from the various lithologies.

RESULTS

Regional geology

The world's largest land based sedimentary manganese deposit is contained in the Kalahari Manganese Field, situated 47 km north-west of Kuruman in the Northern Cape. The Kalahari Manganese Field comprises five erosional, or structurally preserved, relics of the manganese bearing Hotazel Formation of the Paleoproterozoic Transvaal Supergroup. These include the Mamatwan-Wessels deposit (also known as the main Kalahari Basin), the Avontuur and the Leinster deposits, and the Hotazel and Langdon Annex/Devon deposits (SLR, October 2015).

Within the main Kalahari Basin (from which the resources will be mined) is the largest of the five deposits in the Kalahari Manganese Field, comprising a basin with a strike length of approximately 56 km and a width varying between 5 and 20 km (SLR, October 2015).

Local and operational geology

The proposed project area is located on the south-western outer rim of the Kalahari Manganese Field. Mokala intends to exploit the manganese from the Hotazel Formation (Transvaal Supergroup). The manganese deposits of the Kalahari Manganese Field represent structurally preserved erosional relics of the Paleoproterozoic Hotazel Formation of the Voelwater Subgroup (Transvaal Supergroup) along the axis of the Dimoten Syncline. The strata of the Hotazel Formation dip gently towards the west at about 5° to 8°. The Formation consists of Superior type iron-formation interbedded with manganese ore in three sedimentary cycles of which the lowermost unit is the most economically viable (SLR, October 2015).

At the proposed project site, the Hotazel Formation is unconformably overlain by Early Permian Dwyka diamictite (tillite) of the Karoo Supergroup or Cenozoic Kalahari calcrete, clay and windblown sand. The Hotazel Formation is underlain by hyaloclastic, pillow and massive lavas of the Ongeluk Formation (Transvaal Supergroup). The Dwyka glaciation of the Karoo Supergroup carved a deep southeast-northwest striking valley into the Proterozoic basement, which are now filled with thick beds of tillite (diamictite). The lucknow formation and Mapedi formation of the olifantshoek supergroup are not present beneath the proposed project area as these formation have been eroded away. The general stratigraphy of the proposed project area there consists of the following (Table 17):

- Kalahari Formation (or "beds"), consisting of sand, clay and limestone
- Dwyka Formation, consisting of tillite (a sedimentary rock derived from glacial deposits and consisting of rock fragments in a clay-rich matrix)
- Mooidraai Formation, consisting of dolomite
- Hotazel Formation which consists of Banded Iron Formation (BIF). The ore is contained within a mineralised zone which is made up of three manganese rich zones; the Upper Manganese Ore Body (UMO), the Middle Manganese Ore Body (MMO) and the Lower Manganese Ore Body (LMO)
- Ongeluk Formation, consisting of basaltic lava.

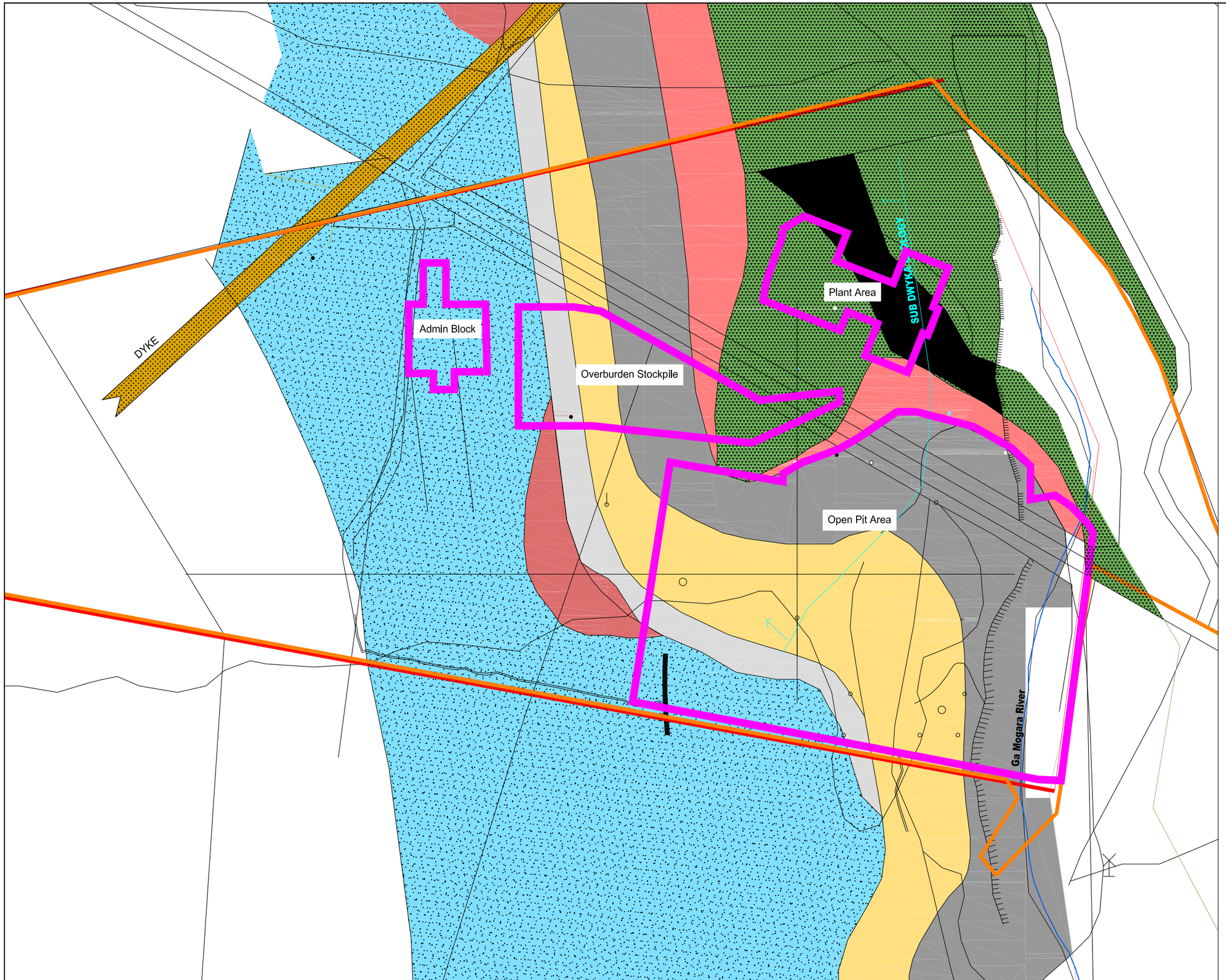
TABLE 17: GENERAL STRATIGRAPHIC PROFILE FOR THE KALAHARI MANGANESE FIELD (SLR, OCTOBER 2015)

Supergroup / group / subgroup / formation				Geological description	Approximate thickness (m)
Kalahari Group				Sand, clay, gravels and calcrete	70.00
Kalahari Unconformity					
Karoo Supergroup				Dwyka Tillite	30.00
Dwyka Unconformity					
Olifantshoek Supergroup			*Lucknow Formation*	Quartzite	Not present
			Mapedi Formation	Red and Grey Shales and quartzites	Not present
Olifantshoek Unconformity					
Transvaal Supergroup	Postmansburg Group	Voelwater Subgroup	Mooidraai Formation	Dolomite	30.00
			Hotazel Formation	Upper Banded Iron Formation	20.00
				Upper Mn Ore Body	10.00
				Middle Banded Iron Formation	10.00
				Middle Mn Ore Body	-
				Middle Banded Iron Formation	15.00
				Lower Mn Ore Body	20.00
				Lower Banded Iron Formation	5.00
		Ongeluk Formation		Basaltic Lava	-

The geological settings at the proposed project site is shown in Figure 15.

Lineaments

Dykes can be considered to be preferential path flows. With reference to Figure 15 a dyke is located to the west of the proposed project area; however no surface infrastructure is planned to overlay the dyke as part of the proposed project (SLR, October 2015).



LEGEND

PROPOSED PROJECT AREA

SAMPLING POINTS

STRATIGRAPHY

- KALAHARI
- DOLOMITE
- UPPER BIFS
- UPPER BODY
- MIDDLE BIFS
- LOWER BODY
- LOWER BIFS
- DYKE
- LAVA

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LOCAL GEOLOGICAL SETTING OF THE PROPOSED PROJECT AREA

Date : 10.2015

Scale : N.T.S

Project No : 720.09012.00001

FIGURE 15

Geochemistry analysis – acid base accounting (ABA)

Acid–Base Accounting (ABA) is an internationally accepted analytical procedure that was developed to screen the acid-producing and acid-neutralizing potential of rocks. A total of eight samples were used to determine the acid drainage potential associated with the overburden stockpile and material to be used as part of the construction of road and platforms. The ABA results are provided in Table 18 (SLR, August 2015).

The Acid Base Accounting (ABA) results show that the total sulphur content and more importantly the sulphide sulphur content of all samples are low, with the majority below the laboratory detection limit of <0.01%. The low sulphide sulphur content suggests the potential to generate acid is negligible. In addition, the neutralising potential ratio (NPR) of all samples is above 2, (minimum NPR 392), which implies all lithologies have sufficient neutralising potential to offset the low acid potential. The paste pH for all samples was neutral to alkaline and indicates that there is little potential for the generation of short-term acidity (SLR, August 2015).

TABLE 18: ACID BASE ACCOUNTING RESULTS FOR THE PROPOSED PROJECT (SLR, AUGUST 2015)

Sample ID	Lithology	Paste pH	Acid potential (AP) (KG/T)	Neutralization potential (NP)	Nett neutralization potential (NNP) (NP-AP)	Neutralising potential ratio (NPR) (NP : AP)	Total sulphur (%)	Sulphate sulphur (%)	Sulphide sulphur (%)	Classification
Criteria		***>5.5 (Non-PAG)***	***-***	***-***	***NNP>0 (Non-PAG)***	***>2 (Non-PAG)***	***-***	***-***	***Sulphide-S <0.3 (Short-term PAG)***	
MO1	Kalahari	8.4	<0.31	206.00	206	666	<0.01	<0.03	<0.01	Non-PAG
MO2	Kalahari	8.1	<0.31	139.00	139	449	<0.01	<0.03	<0.01	Non-PAG
MO6	Dwyka	7.9	<0.31	173.00	173	559	<0.01	<0.03	<0.01	Non-PAG
MO8	Mooidraai Dolomite	8.4	<0.31	208.00	208	673	0.03	0.07	<0.01	Non-PAG
MO11	Upper BIF	8.6	0.31	123.00	122	392	0.03	0.05	0.01	Non-PAG
MO14	Middle BIF	9.1	<0.31	404.00	404	1310	<0.01	<0.03	<0.01	Non-PAG
MO22	Calcrete	8.9	<0.31	775.00	774	2500	<0.01	<0.03	<0.01	Non-PAG
MO23	Calcrete	8.6	<0.31	719.00	719	2330	<0.01	<0.03	<0.01	Non-PAG

Note: PAG refers to Potentially Acid Generating and Non-PAG refers to Non Potentially Acid Generating

Geochemistry analysis - mineralogy

Mine drainage quality is generally a function of mineral present dissolution (or precipitation) during interaction of rocks with water. X-ray Diffraction (XRD) analysis identifies the main crystalline mineral phases in each sample. Twelve samples were used to determine the mineralogy percentage for various lithologies associated with the proposed project area (SLR, August 2015).

The key minerals of each of the samples are consistent with the different lithological units at the proposed project area (SLR, August 2015):

- Quartz, the weathered clay mineral smectite, and calcite are dominant in samples of the Kalahari Formation (sand, calcrete, clay and quartzite).
- Calcite was the dominant mineral in three of the four calcrete samples, as expected. Dolomite was dominant in sample MO22. The minerals smectite, palygorskite (magnesium aluminium phyllosilicate) and quartz were also present.
- The two Dwyka samples were consistent with smectite and quartz being the key minerals.
- The Upper and Middle BIF samples showed variance with only hematite being a common mineral. Quartz made up 36% of the Upper BIF sample whereas only present below 1% in the Middle BIF. Dolomite was also present in the Upper BIF samples which could indicate heterogeneity of the BIF lithology or potential contamination from other lithologies.
- Dolomite was the key mineral in the Mooidraai Dolomite sample, as expected, followed by quartz.

The mineralogy of the sampled rocks is dominated by calcite ($CaCO_3$) and quartz. This is a source of neutralising potential and may be expected to buffer mine water at neutral pH.

TABLE 19: MINERALOGY (%) FOR SAMPLES FOR THE PROPOSED PROJECT AREA

Mineral Name	Approx. Formula / Sample ID	MO01	MO06	MO12	MO02	MO07	MO22	MO23	MO24	MO25	MO14	MO11	MO8
Lithology of Sample		**Kalahari**	**Dwyka**	**Upper Mn Ore**	**Kalahari**	**Dwyka**	**Calcrete**	**Calcrete**	**Calcrete**	**Calcrete**	**Middle BIF**	**Upper BIF**	**Mooidraai Dolomite**
Quartz	SiO_2	49	32.8	6	40.2	27.8	9.8	7.3	11.3	13.3	0.5	36	17.6
Magnetite	Fe_3O_4	-	-	-	-	-	-	-	-	-	-	18.7	-
Hematite	Fe_2O_3	0.9	1.4	8.3	0.7	3.1	0.4	0.1		0.2	29.1	12.5	
Dolomite	$CaMg(CO_3)_2$	18.5	11.5		11.4	2.4	68.3	5.7	0.3	2.5		13.6	70.5
Braunite	Mn_7SiO_{12}	-	-	35.4	-	0.1	-	-	-	-	-	1.5	
Calcite	$CaCO_3$	1.4	5.5	25.2	4.3	9.7	10.1	72.6	77.6	72.3	-	-	-
Smectite	$(Ca, Na, H)(Al, Mg, Fe, Zn)_2(Si, Al)_4O_{10}(OH)_2 - xH_2O$	26.8	39.4	-	33.9	50.5	5.1	7.8	4.2	6	-	-	-
Palygorskite	$(Mg,Al)_2Si_4O_{10}(OH)_4(H_2O)$	2.8	8.7		9	6.4	6.2	6.5	6.2	5.4	-	-	-
Kaolinite	$Al_2Si_2O_5(OH)_4$	-	-	-	-	-	-	-	-	-	-	-	-
Lizardite	$Mg_3Si_2O_5(OH)_4$	-	-	-	-	-	-	-	-	-	12.7	-	-
Magnetite	Fe_3O_4	0.3	0.4	-	0.5	-	0.2	0.1	0.4	0.3	-	-	-
Rutile	TiO_2	0.4	0.2	-	-	-	-	-	0.2	-	-	-	-
Clinopyroxene	$CaMgSi_2O_6$	-	-	-	-	-	-	-	-	-	38.4	-	-
Bixbyite	$(Mn+++,Fe+++)_2O_3$	-	-	0.5	-	0.1	-	-	-	-	-	-	-
Thaumasite	$Ca_3Si(CO_3)(SO_4)(OH)_612H_2O$	-	-	-	-	-	-	-	-	-	-	-	-
Titanite	$CaTiO(SiO_4)$	-	-	-	-	-	-	-	-	-	-	-	-
Kurchatovite	$Ca(Mg,Mn,Fe)B_2O_5$	-	-	-	-	-	-	-	-	-	-	17.7	-
Ankerite	$Ca(Fe,Mg,Mn)(CO_3)_2$	-	-	-	-	-	-	-	-	-	-	-	11.9
Kutnohorite	$Ca(Mn,Mg,Fe)(CO_3)_2$	-	-	15.9	-	-	-	-	-	-	19.4	-	-
Hausmannite	Mn_3O_4	-	-	8.7	-	-	-	-	-	-		-	-

Geochemistry analysis – Leachate potential

Synthetic Precipitation Leaching Procedure (SPLP) is a laboratory extraction method designed to determine the leachability of both organic and inorganic elements present in liquids, soils, and wastes under certain conditions. Leach test results are not an indicator of drainage quality as the conditions of the test do not represent actual field conditions. Therefore, leachate concentrations are not representative of seepage or run-off that could emanate from site, however, the results may indicate chemicals of concern (CoCs) in mine drainage (SLR, August 2015).

As part of the proposed project SPLP tests were undertaken on 20 samples using distilled water (pH 7) to represent neutral drainage conditions, as suggested by the limited acid generating potential. The SPLP results are included in Table 20 below. Based on the results elements that exceed the South African National Standards (SANS) 241 (2011) Drinking Water limits, include aluminium, conductivity, manganese, nitrate and total dissolved solids. The pH exceeds the limits for the International Finance Corporation (IFC) (SLR, August 2015).

TABLE 20: LEACHATE RESULTS FOR THE PROPOSED PROJECT (SLR, AUGUST 2015)

Relevant standards		Alkalinity (Phenolpht halein) as CaCO3	Bicarbonate Alkalinity as CaCO3	Carbonate Alkalinity as CaCO3	Alkalinity (Total) as CaCO3	Aluminium	Ammonia	Ammonia as N	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chloride	Chromium	Cobalt	Conductivity	Copper
SANS 241 (2011) Operational						**0.3**													
SANS 241 (2011) Aesthetic								**1.5**							**300**			**170**	
SANS 241 (2011) Acute Heath																			
SANS 241 (2011) Chronic Health									**0.02**	**0.01**			**0.003**			**0.05**	**0.5**		**2**
IFC (2007)										**0.1**			**0.05**			**0.1**			**0.3**
WHO (2011)									**0.02**	**0.01**	**0.7**		**0.003**			**0.05**			**2**
		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mS/m	mg/l
BH	**Description**	12	12	12	12	0.02	0.1	0.08	0.02	0.01	0.002	0.0001	0.001	0.5	0.05	0.002	0.005	2	0.02
GL42	Kalahari	<12	67.00	20.00	87.00	<0.02	0.24	0.20	<0.02	<0.01	0.14	<0.0001	<0.001	16.00	33.00	<0.002	<0.005	39.00	<0.02
GL39	Kalahari	17.00	32.00	35.00	67.00	<0.02	0.18	0.15	<0.02	<0.01	0.15	<0.0001	<0.001	21.00	56.00	<0.002	<0.005	52.00	<0.02
GL49	Kalahari	13.00	53.00	25.00	78.00	<0.02	<0.1	<0.08	<0.02	<0.01	0.09	<0.0001	<0.001	15.00	35.00	<0.002	<0.005	41.00	<0.02
GL42	Dwyka	<12	42.00	<12	52.00	<0.02	0.15	0.12	<0.02	<0.01	0.11	<0.0001	<0.001	64.00	272.00	<0.002	<0.005	180.00	<0.02
GL39	Dwyka	<12	42.00	20.00	62.00	<0.02	0.23	0.19	<0.02	<0.01	0.09	<0.0001	<0.001	47.00	198.00	<0.002	<0.005	137.00	<0.02
GL27	Mooidraai	18.00	75.00	35.00	110.00	<0.02	<0.1	0.08	<0.02	<0.01	0.09	<0.0001	<0.001	15.00	37.00	<0.002	<0.005	50.00	<0.02
GL55	Sand	<12	38.00	20.00	58.00	0.64	<0.1	<0.08	<0.02	<0.01	0.17	<0.0001	<0.001	16.00	0.63	<0.002	<0.005	14.00	<0.02
GL41	Upper BIF	<12	25.00	15.00	40.00	<0.02	0.13	0.11	<0.02	<0.01	0.04	<0.0001	<0.001	11.00	12.00	0.01	<0.005	17.00	<0.02
GL27	Upper BIF	18.00	65.00	35.00	100.00	<0.02	0.12	0.10	<0.02	<0.01	0.07	<0.0001	<0.001	19.00	31.00	<0.002	<0.005	40.00	<0.02
GL42	Middle BIF	12.00	27.00	25.00	52.00	<0.02	0.43	0.35	<0.02	<0.01	0.43	<0.0001	<0.001	7.50	3.50	<0.002	<0.005	15.00	<0.02
GL41	Middle BIF	15.00	113.00	30.00	143.00	<0.02	0.18	0.15	<0.02	<0.01	0.05	<0.0001	<0.001	18.00	16.00	<0.002	<0.005	42.00	<0.02
Quarry	Calcrete	<12	37.00	15.00	52.00	<0.02	0.34	0.28	<0.02	<0.01	0.09	<0.0001	<0.001	15.00	20.00	<0.002	<0.005	30.00	<0.02
Quarry	Calcrete	<12	37.00	20.00	57.00	<0.02	0.81	0.67	<0.02	<0.01	0.13	<0.0001	<0.001	13.00	0.87	<0.002	<0.005	14.00	<0.02
Quarry	Calcrete	<12	42.00	15.00	57.00	<0.02	0.46	0.38	<0.02	<0.01	0.13	<0.0001	<0.001	8.10	0.46	<0.002	<0.005	14.00	<0.02
Quarry	Calcrete	<12	30.00	15.00	45.00	<0.02	0.35	0.29	<0.02	<0.01	0.09	<0.0001	<0.001	12.00	0.64	<0.002	<0.005	14.00	<0.02

Relevant standards		Final pH	Fluoride	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Nitrate	Potassium	Selenium	Silver	Sodium	Strontium	Sulphate	TDS	Thorium	Vanadium	Zinc
SANS 241 (2011) Operational		**5 - 9.7**																			
SANS 241 (2011) Aesthetic				**0.3**			**0.1**								**200**			**1200**			**5**
SANS 241 (2011) Acute Heath											**11**						**250**				
SANS 241 (2011) Chronic Health			**1.5**	**2**	**0.01**		**0.5**	**0.006**		**0.07**			**0.01**				**500**			**0.2**	
IFC (2007)		**6-9**		**2**	**0.2**			**0.002**		**0.5**											**0.5**
WHO (2011)			**1.5**		**0.01**			**0.006**		**0.07**	**11**		**0.04**								
		mg/l	mg/l		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
BH	**Description**	0.1	0.05	0.05	0.01	0.01	0.01	0.0001	0.005	0.005	0.1	0.2	0.01	0.002	0.5	0.001	0.05	21	0.04	0.001	0.01
GL42	Kalahari	8.40	0.33	<0.05	<0.01	13.00	<0.01	<0.0001	0.01	<0.005	29.00	5.60	<0.01	<0.002	19.00	0.21	23.00	246.00	<0.04	0.015	<0.01
GL39	Kalahari	8.30	0.30	<0.05	<0.01	17.00	<0.01	<0.0001	<0.005	<0.005	51.00	6.30	<0.01	<0.002	22.00	0.23	27.00	344.00	<0.04	0.01	0.01
GL49	Kalahari	7.90	1.20	<0.05	<0.01	14.00	<0.01	<0.0001	<0.005	<0.005	17.00	6.30	<0.01	<0.002	31.00	0.16	32.00	220.00	<0.04	0.02	<0.01
GL42	Dwyka	8.00	0.40	<0.05	<0.01	59.00	0.01	<0.0001	0.02	<0.005	250.00	12.00	<0.01	<0.002	76.00	0.94	70.00	1502.00	<0.04	0.00	0.03
GL39	Dwyka	8.10	0.40	<0.05	<0.01	44.00	<0.01	<0.0001	<0.005	<0.005	176.00	9.20	<0.01	<0.002	68.00	0.43	119.00	1036.00	<0.04	0.00	0.02
GL27	Mooidraai	8.30	0.36	<0.05	<0.01	38.00	0.02	<0.0001	0.02	<0.005	6.40	2.70	<0.01	<0.002	16.00	0.09	38.00	318.00	<0.04	<0.001	<0.01
GL55	Sand	7.90	0.32	0.46	<0.01	3.60	<0.01	<0.0001	<0.005	<0.005	1.80	4.20	<0.01	<0.002	1.20	0.06	0.84	90.00	<0.04	<0.001	0.02

Relevant standards		Final pH	Fluoride	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Nitrate	Potassium	Selenium	Silver	Sodium	Strontium	Sulphate	TDS	Thorium	Vanadium	Zinc
SANS 241 (2011) Operational		**5 - 9.7**																			
SANS 241 (2011) Aesthetic				**0.3**			**0.1**								**200**			**1200**			**5**
SANS 241 (2011) Acute Heath											**11**						**250**				
SANS 241 (2011) Chronic Health			**1.5**	**2**	**0.01**		**0.5**	**0.006**		**0.07**			**0.01**				**500**			**0.2**	
IFC (2007)		**6-9**		**2**	**0.2**			**0.002**		**0.5**											**0.5**
WHO (2011)			**1.5**		**0.01**			**0.006**		**0.07**	**11**		**0.04**								
		mg/l	mg/l		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
GL41	Upper BIF	7.70	0.25	<0.05	<0.01	5.70	<0.01	<0.0001	0.01	<0.005	7.10	0.80	<0.01	<0.002	8.80	0.08	5.30	104.00	<0.04	<0.001	<0.01
GL27	Upper BIF	8.20	0.96	<0.05	<0.01	15.00	0.03	<0.0001	<0.005	<0.005	<0.1	1.50	<0.01	<0.002	28.00	0.16	25.00	190.00	<0.04	<0.001	<0.01
GL42	Middle BIF	9.10	0.12	<0.05	<0.01	6.30	0.21	<0.0001	<0.005	<0.005	0.70	0.60	<0.01	<0.002	7.10	0.16	4.30	96.00	<0.04	<0.001	<0.01
GL41	Middle BIF	8.40	0.97	<0.05	<0.01	17.00	0.04	<0.0001	<0.005	<0.005	5.10	2.50	<0.01	<0.002	37.00	0.01	14.00	240.00	<0.04	<0.001	<0.01
Quarry	Calcrete	8.40	0.19	<0.05	<0.01	8.50	<0.01	<0.0001	<0.005	<0.005	12.00	3.50	<0.01	<0.002	16.00	0.08	37.00	192.00	<0.04	0.01	<0.01
Quarry	Calcrete	8.10	0.19	<0.05	<0.01	3.80	<0.01	<0.0001	<0.005	<0.005	3.20	2.60	<0.01	<0.002	1.30	0.05	4.50	108.00	<0.04	0.01	0.02
Quarry	Calcrete	8.40	0.30	<0.05	<0.01	8.80	<0.01	<0.0001	<0.005	<0.005	1.20	1.60	<0.01	<0.002	1.20	0.09	1.40	82.00	<0.04	0.09	<0.01
Quarry	Calcrete	8.40	0.20	<0.05	<0.01	4.70	<0.01	<0.0001	<0.005	<0.005	1.60	3.10	<0.01	<0.002	1.30	0.07	3.30	96.00	<0.04	0.01	<0.01

CONCLUSION

Where new infrastructure is placed within close proximity to mineable ore there is the possibility that sterilization can occur. Geochemical tests and analysis indicate that the proposed overburden to be stockpiled and used in construction is non-acid generating, however there is a potential for seepage concentrations to exceed the SANS 241 (2011) Drinking Water limits for various parameters. This presents a potential pollution risk for both surface and groundwater in the both the short and long term. It follows that short and long term pollution prevention and/or treatment measures must be considered.

7.4.1.2 Topography

INTRODUCTION AND LINK TO IMPACT

Changes to topography through the development of the proposed project may impact on surface water drainage (Section 7.4.1.7), visual aspects (Section 7.4.1.11) and the safety of both people and animals. To understand the basis of these potential impacts, a baseline situational analysis is described below.

DATA SOURCES

Information in this section was sourced from site visits undertaken by the project team.

RESULTS

The proposed project area is relatively flat with a gentle slope towards the east where the Ga-Mogara flows along the eastern boundary of the proposed project site (Figure 2). The elevation on site varies from 1087 m to 1107 m above mean sea level (mamsl). An analysis of topographical data indicated a slope of less than 1:10 over most of the proposed project area.

It is important to note that the natural topography of the proposed project site has been disturbed by historical borrow pit activities on the eastern boundary of the proposed project site (Figure 2).

CONCLUSION

Mining activities and infrastructure have the potential to alter the topography and the natural state of areas. An alteration of the natural topography has the potential to present dangers to both animals and people.

7.4.1.3 Climate

INTRODUCTION AND LINK TO IMPACT

Climate can influence the potential for environmental impacts and related mine design. Specific issues are listed below:

- Rainfall could influence erosion, evaporation, vegetation growth, rehabilitation planning, dust suppression, and surface water management planning;

- Temperature could influence air dispersion through impacts on atmospheric stability and mixing layers, vegetation growth, and evaporation which could influence rehabilitation planning; and
- Wind could influence erosion, the dispersion of potential atmospheric pollutants, and rehabilitation planning.

To understand the basis of these potential impacts, a baseline situational analysis is described below.

DATA SOURCES

Information in this section was sourced from the surface water study (SLR, October 2015) included in Appendix L and the air quality study (Airshed, September 2015) included in Appendix M.

Rainfall data was extracted from three sources, namely the Daily Rainfall Extraction Utility (DRU) programme, the Department of Water and Sanitation (DWS) online database and the Water Resources of South Africa 2005 Study (WR2005). The rainfall data extracted using the DRU program include the two South African Weather stations, Winton (0392148 W) and Milner (0393083 W). The rainfall data extracted from the DWS online database was the Kuruman weather station (D4E004). The rainfall data extracted from the WR2005 database was for the quaternary catchment D41K (SLR, August 2015).

Rainfall depth and wettest period data was sourced from the Winton weather station (0392148 W). The Winton weather station is considered to have the highest percentage reliability given that it has the greatest number of years (104) of recorded data when compared to the Milner weather station (0393083 W) (85 years) and as such the Winton weather station was chosen to determine the five greatest rainfall depths.

Evaporation data was obtained from the Water Resources of South Africa 2005 Study, (WR2005, 2009). The evaporation data obtained is based on Symons pan evaporation measurements and was converted to lake evaporation using factors obtained from WR2005.

RESULTS

Regional climate

The proposed project area falls within the Northern Steppe Climatic Zone, as defined by the South African Weather Bureau. This is a semi-arid region characterised by seasonal rainfall, hot temperatures in summer, and colder temperatures in winter (SLR, October 2015).

Rainfall, rainfall depths and wettest periods

Monthly rainfall data for the Winton, Milner and Kuruman weather stations including rainfall data for quaternary catchment D41K is summaries in Table 21 below. The closest weather station to the

proposed project site is the Milner weather station which is located approximately 19km from the proposed project area, while the Winton weather station is located approximately 40km from the proposed project site.

TABLE 21: SUMMARY OF MONTHLY RAINFALL DATA FOR THE PROPOSED PROJECT AREA (SLR, OCTOBER 2015)

	Rainfall (mm)			
Month	**Winton (392148 W)**	**Milner (393083 W)**	**Kuruman (D4E004)**	**WR2005 (Quaternary catchment D41K)**
January	56.3	59.8	85.3	63.8
February	63.5	63.0	84.7	52.2
March	62.7	72.3	92.7	53.3
April	34.2	39.9	49.1	29.5
May	16.4	19.2	23.9	10.0
June	5.1	9.1	7.5	4.4
July	3.4	1.3	3.7	2.2
August	5.5	5.4	8.4	3.4
September	6.2	6.4	8.0	8.5
October	14.7	19.2	25.9	26.2
November	24.5	31.5	42.9	40.5
December	42.3	44.5	45.9	50.1
Annual	**335**	**372**	**478**	**344**

The WR2005 data indicates that the mean annual precipitation (MAP) for the quaternary catchment D41K is 344 mm, which correlates reasonable well with the Winton station. In addition to this, given that the Winton weather station is considered to be the most reliable in terms of data, the adopted MAP for the proposed project site is 335mm.

A review of the daily rainfall records from the Winton weather station shows that the maximum daily rainfall depth between 1878 and 2000 was 138.5 mm. Several other high rainfall depths are also shown in Table 22 (SLR, October 2015).

TABLE 22: FIVE GREATEST DEPTH OF RAINFALL RECORDED AT THE WINTON WEATHER STATION (SLR, OCTOBER 2015)

Date	Rainfall (mm)
22/12/1999	125.0
02/03/1920	124.1
01/03/1974	103.5
08/03/1956	101.5

A review of the wettest multi-day periods recorded are presented in Table 23, which shows the maximum depth of rain falling over consecutive days for the Winton weather station, ranging from 1 to 30 days. The greatest depth of rain falling within a 30 day period was 483.6 mm which exceeds the MAP and the greatest depth within a 180 day period was 1014.5 mm which is nearly three times the MAP. It is concluded that whilst MAP in this area is low there has been significant rainfall on occasions (SLR, October 2015).

TABLE 23: WETTEST PERIODS RECORDED ON CONSECUTIVE DAYS (SLR, OCTOBER 2015)

Number of consecutive days	Total depth of rainfall (mm)
2	204.5
3	204.5
4	247.0
5	255.5
6	259.6
7	259.6
15	323.0
30	483.6
60	656.5
120	915.0
180	1014.5

Evaporation

The proposed project area lies within evaporation zone 8A, which has a total mean annual evaporation (MAE) of 2351 mm. Table 24 provides a monthly summary of the adopted evaporation for the proposed project area (SLR, October 2015).

TABLE 24:SUMMARY OF EVAPORATION DATA (SLR, OCTOBER 2015)

Months	Symons pan evaporation (mm)	Lake evaporation factor	Lake evaporation (mm)
January	276.9	0.84	232.6
February	209.9	0.88	184.8
March	193.3	0.88	170.1
April	144.1	0.88	126.8
May	114.7	0.87	99.8
June	91.0	0.85	77.3
July	106.0	0.83	88.0
August	153.8	0.81	124.5
September	213.0	0.81	172.5
October	269.7	0.81	218.4
November	248.0	0.82	232.9
December	294.6	0.83	244.5
Total	**2351**	**N/A**	**1972**

Temperature

Monthly mean, maximum and minimum temperatures for the proposed project area are provided in Table 25 below. Temperatures ranged between -0.6 °C and 35 °C although local residents have recorded lower temperatures. During the day, temperatures increase to reach maximum at around 15:00 in the afternoon. Ambient air temperature decreases to reach a minimum at around 06:00 just before sunrise (Airshed, September 2015).

TABLE 25: MONTHLY TEMPERATURE DATA (AIRSHED, SEPTEMBER 2015)

Months	Minimum	Maximum	Average
January	15.3	35.0	26.4
February	14.1	34.1	25.8
March	10.1	32.5	24.5
April	4.4	29.9	18.7
May	2.4	26.9	15.4
June	-0.6	22.3	10.8
July	1.0	21.7	11.4
August	0.4	28.3	13.1
September	2.1	27.8	16.8
October	6.7	32.3	20.5
November	8.8	34.7	23.3
December	11.9	35.0	25.2

Wind

Wind roses comprise 16 spokes which represent the directions from which winds blew during the period. The colours reflected the different categories of wind speeds, the orange area, for example, representing winds of 3 m/s to 6 m/s. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories. The frequency, at which calms occurred, i.e. periods during which the wind speed was below 1 m/s, is also indicated.

The period wind field and diurnal variability in the wind field are shown in Figure 16, while the seasonal variations are shown in Figure 17. Wind direction within the proposed project area is dominated by winds from the north, northeast and east, with an average wind speed of 3.4 m/s. The strongest winds (more than 6 m/s) were also from the east and northeast and occurred mostly during the day (06:00 to 18:00). Calm conditions occurred 8.55 % of the time. A distinct increase in winds from the south occurred at night (18:00 to 06:00).

Wind direction within the proposed project area shows considerable differences between the seasons. During summer, autumn and winter the dominant winds are from the east, northeast and south, while in

spring, the southerly winds dominate. Wind direction from the North West also occurs within the proposed project area (Airshed, September 2015).

CONCLUSION

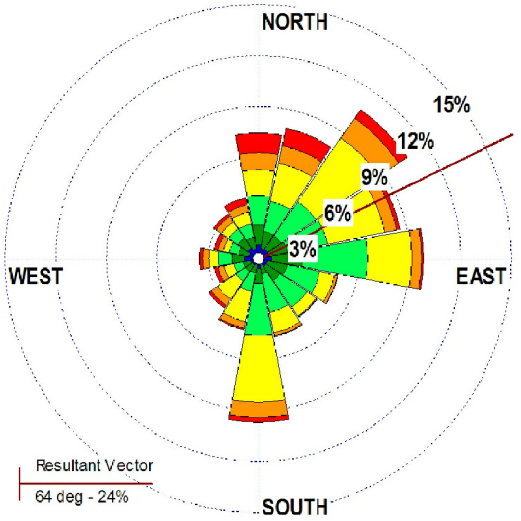
The proposed project area is characterised by hot summers and cool winters with rain generally occurring in the form of thunderstorms that last for short periods at a time during rainy periods. High evaporation rates reduce infiltration, while rainfall events can increase the erosion potential and the formation of erosion gullies. The presence of vegetation does however reduce the effects of erosion. The mixing of layers resulting in the formation of temperature inversions, and the presence of cloud cover limits the dispersion of pollutants into the atmosphere. Wind significantly affects the amount of material that is suspended from exposed surface to the atmosphere. The wind speed determines the distance of downward transport as well as the rate of dilution of pollutants in the atmosphere. On average, wind speeds are below 5.3 m/s and not able to carry all types of dust particles. These climatic aspects need to be taken into consideration during rehabilitation and surface water management planning.

Period, Day-time and Night-time Wind Roses

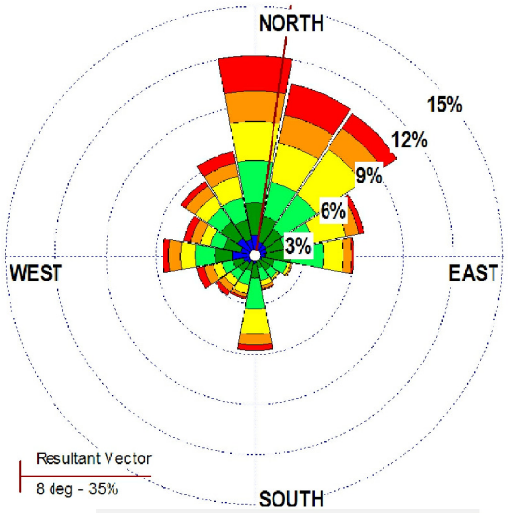
Hotazel MM5 Data for the period 2011 to 2013

Wind speed categories (m/s)

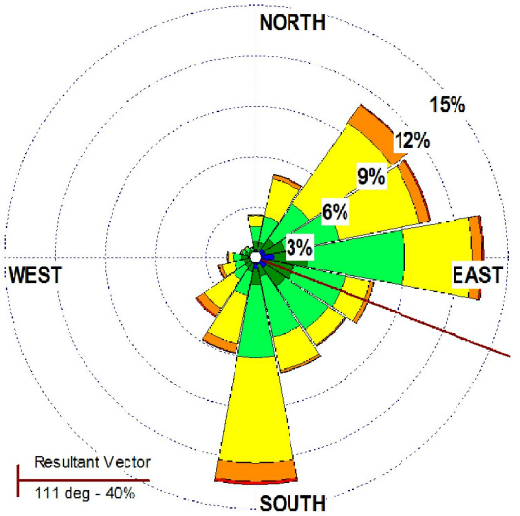
- >= 10.0
- 6.0 - 10.0
- 5.0 - 6.0
- 4.0 - 5.0
- 3.0 - 4.0
- 2.0 - 3.0
- 1.0 - 2.0



Period (8.55% calms)



Day-time (11.16% calms)



Night-time (5.97% calms)

PERIOD, DAY AND NIGHT TIME WIND ROSES
(Airshed, September 2015)

10/2015

720.09012 00001

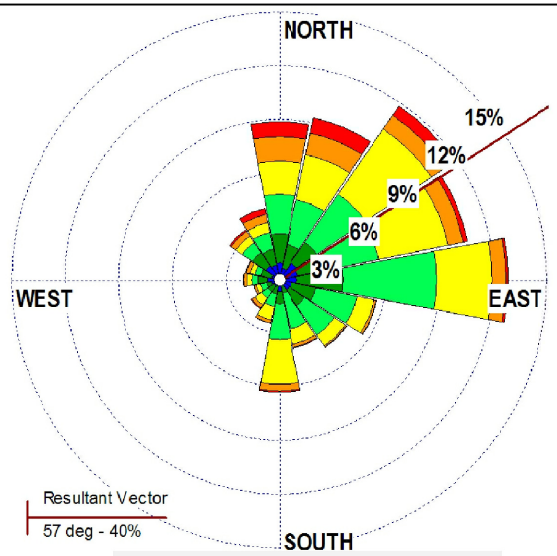
FIGURE 16

Seasonal Wind Roses

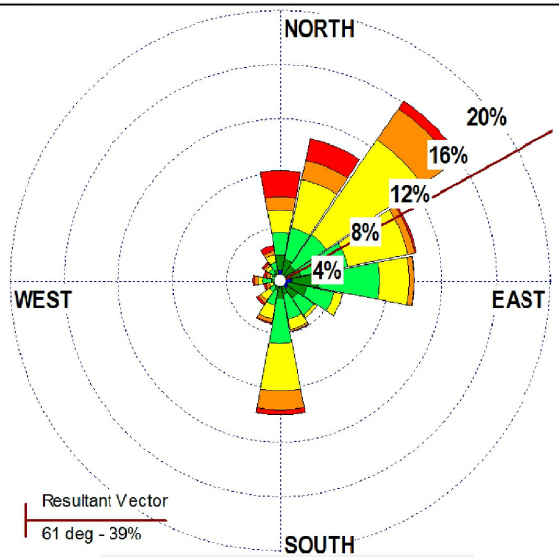
Hotazel MM5 Data for the period 2011 to 2013

Wind speed categories (m/s)

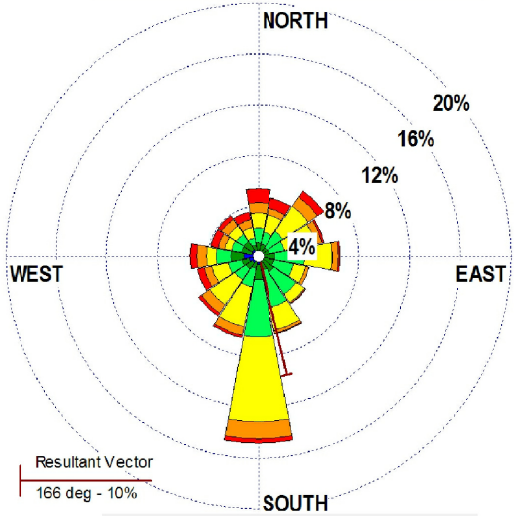
- >= 10.0
- 6.0 - 10.0
- 5.0 - 6.0
- 4.0 - 5.0
- 3.0 - 4.0
- 2.0 - 3.0
- 1.0 - 2.0



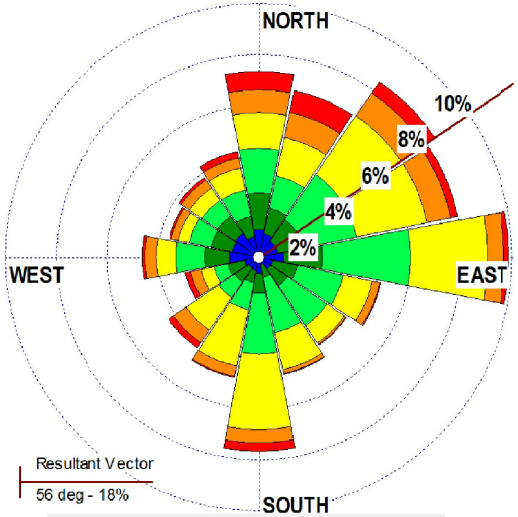
Autumn (8.57% calms)



Winter (8.11% calms)



Spring (7.72% calms)



Summer (9.83% calms)

SEASONAL WIND ROSES
(Airshed, September 2015)

10/2015

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00001

FIGURE 17

7.4.1.4 Soil

INTRODUCTION AND LINK TO IMPACT

Soils are a significant component of most ecosystems. As an ecological driver, soil is the medium in which most vegetation grows and a range of vertebrates and invertebrates exist. In the context of mining operations, soil is even more significant if one considers that mining is a temporary land use where after rehabilitation (using soil) is the key to re-establishing post closure land capability that will support post closure land uses.

Mining projects have the potential to damage soil resources through physical loss of soil and/or the contamination of soils, thereby impacting on the soils' ability to sustain natural vegetation and altering land capability. Contamination of soils may in turn contribute to the contamination of surface and groundwater resources. Loss of the topsoil resource reduces chances of successful rehabilitation and restoration. To understand the basis of these potential impacts, a baseline situational analysis is described below.

DATA SOURCES

Information in this section was sourced from the soils, land use and land capability study for the proposed project (Terra Africa, July 2015) included in Appendix J.

A soil survey was undertaken in order to identify the soil forms located within the proposed project area. Observations were made regarding soil texture, structure, colour and soil depth. The soil forms were classified using the S.A. Soil Classification Taxonomic System (Soil Classification Working Group, 1991) published as memoirs on the Agricultural Natural Resources of South Africa No.15. In addition to this, samples of the various soil forms were taken in order to determine the chemical composition of the soil forms (Terra Africa, July 2015).

RESULTS

Soil forms

Soil forms located within the proposed project area include clovelly, Molopo, Witbank, Brandvlei and Kinkelbos. A more detailed description of the various soil forms located within the proposed project area is provided below. The distribution of the soil forms within the proposed project area is illustrated in Figure 18.

Clovelly

The Clovelly soil form located within the proposed project area consists of an orthic A horizon overlying an apeadal B horizon. The A horizon is sandy to loamy in texture. The B horizon is yellowish brown in colour. The depth of the Clovelly soil form was deeper than 1.5m.

Molopo

The Molopo soil form located within the proposed project area consists of an orthic A horizon overlying a apedal B horizon that is underlain by a soft carbonate horizon. This soil form is fine sandy loamy in texture and is yellowish brown in colour.

Brandvlei

The brandvlei soil form located within the proposed project area consists of an orthic A horizon, overlying a soft carbonate horizon. The accumulation of secondary lime as a distinctive horizon consisting mainly of calcite is a widely observed feature of soils in arid climates. In the calcic soils either hardpan carbonate (calcrete) or a soft carbonate horizon (as in the case of Brandvlei soil form) dominates the morphology of the subsoil. The brandvlei soil form is sandy to loamy in texture

Kinkelbos

The Kinkelbos soil form consists of an orthic A horizon overlying an E horizon that is underlain by a neocarbonate B horizon. The orthic A horizon is sandy and may have been darkened by organic matter. The E horizon is greyish and paler in colour than the overlying topsoil as well as the underlying neocarbonate horizon. The neocarbonate horizon directly underlies the E horizon and contains within 1500mm of the surface sufficient calcium carbonate in the soil matrix to effervesce visible when treated with cold 10% hydrochloric acid. The vegetation on this soil form is denser than the surrounding areas. This soil form is associated with the Ga-Mogara drainage channel.

Witbank

In South Africa there is currently only one soil form that caters for the anthropogenic group according to the Soil Classification Working Group (1991), namely Witbank soil form. Anthropogenic soils are those soils that have been so profoundly affected by human disturbance that their natural genetic character (i.e. their link to the natural factors of soil formation) has largely been destroyed. The witbank soils are associated with the historical borrow pits within the proposed project area.

<u>Soil chemical properties</u>

The general chemical properties of the soils located within the proposed project area are discussed below.

The pH (measured in a KCl solution) of the analyzed soil samples ranges from 5.5 to 6.5 and can be described as moderately acid to neutral. Phoshorus levels are as low as expected for natural, unfertilized veld conditions in South Africa (1 to 2 mg/kg).

The majority of the site consists of deep, well-drained soil where a thick sandy covering of yellow-brown apedal soil covers a carbonate horizon. These soils are very sandy and the texture consists of more than 90% sand fraction. As a result of the well-drained soil horizons under dry climatic conditions, the organic carbon content of the topsoil is relatively low at 1.46%. The calcium, magnesium and potassium levels are within suitable range for the production of crop plants which is not possible due to the climate.

The soil chemistry of soils located within the Ga-Mogara drainage channel has a clayey-sand texture consisting of 18 to 24% clay particles and 72 to 80% sand particles. This slows down the water infiltration rate resulting in higher organic carbon content in the topsoil layer (2.70%). As a result of slow, vertical soil-water movement in the riverbed soil profiles, cations of magnesium, calcium and potassium becomes mobile and accumulates in soil surface horizons, especially with the high evaporation rate experienced in the area. It follows that cations levels are extremely high.

Agricultural potential

Soil forms located within the proposed project area have limited to no agricultural potential (crop production) as the soils are sandy and will therefore drain rapidly. In addition to this, the hot, dry climate is not suitable for dry crop production. In this regard, agricultural potential within the proposed project area is limited to grazing.

Irrigation potential

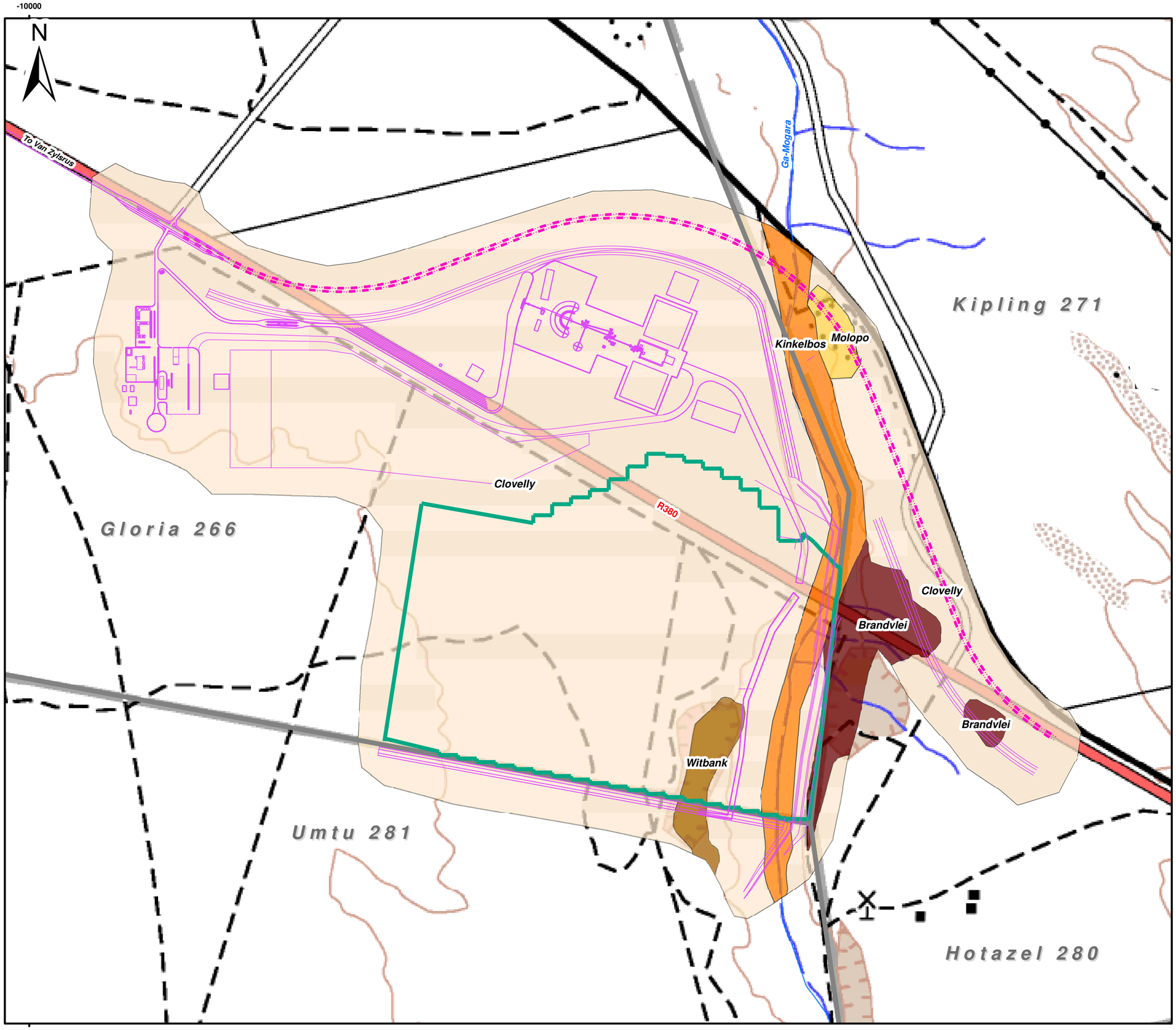
The irrigation potential for the soil forms identified within the proposed project area is low because of the very low water holding capacity of the soils as a result of the sandy nature of the soils.

CONCLUSION

In general soils (Witbank, Molopo, Brandvlei and Clovelley) located within the proposed project area are deep, well-drained sandy soils which allows for high infiltration rates and low organic content. These soils are therefore highly erodible. The Kinkelbos soil located within the Ga-Mogara drainage channel has a higher clay content when compared to the Witbank, Molopo, Brandvlei and Clovelley soil forms. It follows that water infiltration is slower in the Kinkelbos soil form resulting in a higher organic content and is less erodible than the remainder of the soil forms located within the proposed project area.

Soil fertility within the proposed project area is generally good, however due to the hot, dry climate and rapid drainage nature of the soils there is limited to no agricultural and irrigation potential.

These soils will require appropriate management measures during construction and operation to prevent the loss of soil resources through pollution and erosion as soil resources form a crucial role during rehabilitation.



Legend

- Proposed Infrastructure
- Proposed Road Re-Alignment of R380
- Proposed Open Pit Area
- Farm Boundaries
- Rivers

Soil Forms

- Clovelly
- Brandvlei
- Kinkelbos
- Molopo
- Witbank

0 200 400 Meters

Scale: 1:10 000 @ A3

Projection:Transverse Mercator
Datum: Hartebeeshoek, Lo 23

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Figure 18

Soil Forms
(Terra Africa, July 2015)

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7.4.1.5 Land capability

INTRODUCTION AND LINK TO IMPACT

The land capability classification is based on the soil properties and related potential to support various land use activities. Mining operations have the potential to significantly transform the land capability. To understand the basis of this potential impact, a baseline situational analysis is described below.

DATA SOURCES

Information in this section was sourced from the soils, land use and land capability study for the proposed project (Terra Africa, July 2015) included in Appendix J.

Land capability within the proposed project area was classified into different classes by applying the classification system in terms of the South African Chamber of Mines Land Capability Rating System.

RESULTS

Three different land capability classes were identified within the proposed project area. In this regard, deeper soils of the Clovelly soil form have grazing land capability. If the proposed project area had higher rainfall rates, the Clovelly soil forms could have been suitable for dryland crop production. The Brandvlei, Molopo and Witbank soil forms have wilderness land capability as a result of the shallow soil depth and disturbance of soils located to the east of the proposed project area as a result of historical borrow pit activities. The Kinkelbos soil form is associated with wetland type capabilities. It is however important to note, that even though a soil form may have wetland capabilities this does not classify a feature as a wetland. In this regard no wetland based plant species were located within the proposed project area and the area does not indicate significant hydromorphic properties. Further to this, the results of soil samples and testpit data confirm that no wetland is present within the proposed project area. Refer to Figure 19 for the distribution of the various land capabilities within the proposed project area.

CONCLUSION

The current land capability within the proposed project areas is a mixture of grazing, wilderness and wetland potential. The land capability within the proposed project area will be changed with the placement of infrastructure. Therefore, impact management and rehabilitation planning is required to achieve acceptable post rehabilitation land capabilities.

-10000

N

To Van Zylsrus

Gloria 266

Kipling 271

Ga-Mogara

R380

Umtu 281

-10000

Legend

- Proposed Infrastructure
- Proposed Road Re-Alignment of R380
- Proposed Open Pit Area
- Farm Boundaries
- Rivers

Land Capability

- Grazing
- Wetland
- Wilderness

0 200 400 Meters

Scale: 1:10 000 @ A3

Projection:Transverse Mercator
Datum: Hartebeeshoek, Lo 23

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Figure 19

Land Use Capability (EMS, July 2015)

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7.4.1.6 Biodiversity

INTRODUCTION AND LINK TO IMPACT

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

- Soil formation and fertility maintenance
- Primary production through photosynthesis, as the supportive foundation for all life
- Provision of food and fuel
- Provision of shelter and building materials
- Regulation of water flows and water quality
- Regulation and purification of atmospheric gases
- Moderation of climate and weather
- Control of pests and diseases
- Maintenance of genetic resources.

The establishment of infrastructure as well as certain supportive activities have the potential to result in the loss of vegetation, habitat and related ecosystem functionality through physical disturbance and/or contamination of soil and/or water resources.

As a baseline, this section provides an outline of the type of vegetation occurring on site and the status of the vegetation, highlights the occurrence of sensitive ecological environments including sensitive/ endangered species (if present) that require protection and/or additional mitigation should they be disturbed.

DATA SOURCE - FLORA

Information in this section was sourced from the biodiversity study undertaken for the proposed project (EMS, August 2015) included in Appendix K.

Aerial photographs and satellite imagery was used to identify vegetation types located in the proposed project area which was verified during site surveys. The various habitats and floral species located within the proposed project area were identified through on-site observations. Focus was given to the species composition, cover estimation of each species according to the Braun-Blanquet scale, vegetation height, amount of bare soil and rock cover, slope/aspect and the presence of biotic disturbances. Available literature was reviewed to confirm the status of vegetation according to national conservation databases. The ecological sensitivity of the proposed project area was determined based on information collected at various levels (including the national conservation status of the vegetation, the presence of red data or protected species, as well as the condition of the vegetation (EMS, August 2015).

The present ecological state of the Ga-Mogara drainage channel was determined using a desktop approach that focused on ecological sensitivity and ecological importance of surrounding vegetation and habitats given that the Ga-Mogara drainage channel does not flow.

DATA SOURCES - FAUNA

Faunal species located within the proposed project area were identified by means of a site survey which focussed on on-site observations, bird and mammal calls, spoor, faeces and the presence of burrows and nests. Further to this, existing databases were reviewed in order to confirm the likelihood of the occurrence of protected species within the proposed project area (EMS, August 2015).

RESULTS - FLORA

Vegetation types

The proposed project area falls within the Kathu Bushveld and the Gordonia Duneveld. The Kathu Bushveld can be described as an open savannah which consists of prominent tress species such as *Vachellia erioloba* (Camel Thorn), formerly known as *Acacia erioloba*, and *Boscia albitrunca* (Shepards Tree). The shrub layer is dominated by *Senegalia mellifera* (Black thorn), formerly known as *Acacia mellifera*, *Diospyros lycioides* (Blue bush) and *Lycium hirsutum* (River Honey-thorn).

The Gordonia Duneveld consists of undulating dunes which is characterised by open shrubland with grasslands on the dune ridges. *Vachellia haematoxylon* (Grey camel thorn), formerly known as *Acacia haematoxylon*, are predominately located on the dunes slopes while *Senegalia mellifera* (Black thorn) is prominent on the lowers slopes. *Rhigozum trichotomum* (Tree thorn) is found in the inter dunes.

The Kathu Bushveld consists of five vegetation types, namely the Mixed *Vachellia* Savannah, *Senegalia mellifera* Mixed Woodland, *Vachellia haematoxylon* Savannah, *Tarchonanthus camphoratus* Scrub and Riverine Vegetation (EMS, August 2015). Further information pertaining to the various vegetation types is summaries in Table 26. The distribution of the various vegetation types within the proposed project area are illustrated in Figure 20.

TABLE 26: VEGETATION TYPES IDENTIFIED WITHIN THE PROPOSED PROJECT AREA (EMS, AUGUST 2015)

Vegetation type	Description
Mixed *Vachellia* Savannah	• Contains a tree layer which is mainly comprised of tall *Vachellia erioloba* (Camel Thorn) trees. • The smaller shrub layer consists of *Vachellia haematoxylon* (Grey Camel Thorn), *V. mellifara* (Black Thorn), *Ziziphus mucronata*, and *Grewia flava* are prominent. • There are patches within this vegetation type that seemed to have a higher density of *Vachellia erioloba* (Camel Thorn) trees.
Senegalia mellifera Mixed	• Predominantly consists of the tree species *Senegalia mellifera* (Black

Vegetation type	Description
	thorn). • Characterised by a moderate to high shrub density with a poor to moderate grass coverage (40–60%) in some areas the *Senegalia mellifera* (Black thorn) forms dense thickets.
Vachellia haematoxylon Savannah	• Predominantly consists of the tree species *Vachellia haematoxylon* (Grey Camel Thorn). • The tree layer within this vegetation type is poorly developed with individuals of *Vachellia erioloba* (Camel Thorn) occurring within the community.
Tarchonanthus camphoratus Scrub	• Has a high percentage occurrence of *Tarchonanthus camphoratus* (Camphor bush). Although *Tarchonanthus camphoratus* (Camphor bush) is the dominant shrub, *Lycium hirsutum* (Kriedoring) and *Vachellia mellifera* (Black thorn) are also prominent within this community.
Riverine Vegetation	• Found within the Ga-Mogara non-perennial river. • This vegetation type has a high occurrence of *Vachellia erioloba* (Camel Thorn) trees but is also heavily invaded by *Prosopis grandulosa* (Honey mesquite).

Red data and protected species

Trees species located within the proposed project area that are protected in terms of the National Forests Act of 1998 (Act 84 of 1998) include the *Vachellia erioloba* (Camel Thorn), *Vachellia haematoxylon* (Grey Camel Thorn). The *Vachellia erioloba* (Camel Thorn) is also listed as declining in terms of the International Union for Conservation of Nature (IUCN). These species are present throughout the proposed project area although their density does vary across the site. The Mixed *Vachellia* Savannah type consists of the highest density of *Vachellia erioloba* (Camel Thorn). The density of the *Vachellia haematoxylon* (Grey Camel Thorn) is higher in the *Senegalia mellifera* woodland and the *Vachellia haematoxylon* Savannah vegetation types (EMS, August 2015). Some of the *Vachellia erioloba* located on-site are more than 6m high and have a stem diameter of approximately 20cm while *Vachellia haematoxylon* are on average 2m in height with a stem diameter of less than 10 cm.

Other species listed in terms of the Northern Cape Nature Conservation Act No. 9 of 2009 that are likely to occur within the proposed project area include *Harpagophytum procumbens* (Devils Claw), *Moraea longistyla,* (Goldblatt), *Moraea pallida* (Yellow Tulip), and *Babiana hypogaea* (Geelbobbejaantjie) (EMS, August 2015).

Alien and invasive species

Alien and invasive species located within the proposed project area are provided in Table 27 below.

TABLE 27: ALIEN AND INVASIVE SPECIES LOCATED WITHIN THE PROPOSED PROJECT AREA (EMS, AUGUST 2015)

Scientific name	Common name	Category
Argemone mexicana	Mexican Poppy	1

Scientific name	Common name	Category
Argemone ochroleuca	White Flowered Mexican Poppy	1
Prosopis cf. *glandulosa*	Mesquite	2
Prosopis velutina	Mesquite	2
Datura stramonium	Thorn apple	1

Alien and invasive species are controlled in terms of Regulation 15 and Regulation 16 (R. 280 of 2001) of the Conservation of Agricultural Resources Act (No. 43 of 1993). In this regard, plants classified in terms of Category 1 must be removed and destroyed immediately. These plants serve no economic purpose and possess characteristics that are harmful to humans, animals and the environment. Category 2 plants may only be grown under controlled conditions. These plants have certain useful qualities and are allowed in demarcated areas. In other areas they must be eradicated and controlled.

Areas of disturbance

The proposed project area has been disturbed by historical borrow pit activities located near the Ga-Mogara drainage line and the old crusher yard located to the centre of the proposed project area (Figure 20). In addition to this the tarred R380 traverses the proposed project site (Figure 2). Other types of disturbances are associated with past farming practices, such as disturbances caused by over grazing, and trampling effects. In addition to this, the vegetation types and plant species identified within the proposed project area have been further disturbed due to on-going prospecting related activities being undertaken by Mokala.

Ecological sensitivity

The proposed project area falls within the Griqualand West Centre of Endemism which is an area with a high concentration of plant species with very restricted distribution. The Griqualand West Centre of Endemism is one of the 85 centres of endemism and one of 14 centres in southern Africa, and these centres are of global conservation significance. The Griqualand West Centre of Endemism is considered a priority in the Northern Cape, as the number of threats to the area is increasing rapidly and it has been little researched and is poorly understood. Furthermore, this centre of endemism is extremely poorly conserved, and is a national conservation priority. Centres of endemism are important because it is these areas which if conserved would safeguard the greatest number of plant species. The location of the Griqualand West Centre of Endemism is illustrated in Figure 22 (EMS, August 2015).

In terms of the National Protected Areas Expansion Strategy, the proposed project area is not located in any focus areas but is located approximately 7km from an area identified as a potential protected area for the eastern Kalahari Bushveld.

In terms of the mining and biodiversity guideline the proposed project area does not fall into any biodiversity priority areas and is therefore not deemed a risk for mining.

The proposed project area is not considered a threatened ecosystem and does not fall within a National Freshwater Ecosystem Priority Area (NFEPA).

No Critical Biodiversity Areas (CBA's) were identified within the proposed project area in terms of the South African National Botanical Institute (SANBI) database. Aquifer Dependent Ecosystems (ADE) are located within the proposed project area and are ecosystems which depend on groundwater. Deep rooted species such as the *Vachellia Erioloba* (Camel thorn), *Vachellia haemotoxylon* (Grey Camel Thorn), *Rhus Lancea, Tamarix usneoides* and *Euclea pseudebenus* may be associated with ADE's, unfortunately there is very little information available on how ADE plants access groundwater and at what depth. ADE's particularly in arid ecosystems provide habitats for an array of species and are considered important in ecological processes and making resources available to biodiversity in the area that would otherwise not be available. Taking this into consideration ADEs could be considered CBAs although not specifically included on biodiversity databases (EMS, August 2015).

The area considered to be of a high sensitivity includes the Riverine area. Areas considered to have a moderate sensitivity include the mixed *Vachellia* Savannah and the *Vachellia haematoxylon* Savannah vegetation types. The *Senegalia mellifera* Mixed Woodland vegetation type and the *Tarchonanthus camphoratus* Scrub vegetation type is considered to have a low sensitivity as this area has been disturbed mostly through overgrazing. The distribution of the sensitive areas is illustrated in Figure 21.

The Present Ecological State (PES) of the Ga-Mogara drainage channel is classified as C, which means it is moderately modified, some loss and change of natural habitat and biota has occurred, but the basic ecosystem functions are still predominantly unchanged. The ecological importance (EI) of the Ga-Mogara drainage channel is an expression of its importance to the maintenance of biological diversity and ecological functioning on local and wider scales and this is considered to be moderate for this section of the Ga-Moraga. Ecological sensitivity (ES) refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred. The ES for this section of the Ga-Moraga is considered to be very low.

-10000

N

To Van Zylsrus

Gloria 266

Ga-Mogara

Historical Borrow Pit

Kipling 271

R380

Old Crusher Yard

Historical Borrow Pit

Umtu 281

Hotazel 280

-10000

Legend

- Proposed Infrastructure
- Proposed Road Re-Alignment of R380
- Proposed Open Pit Area
- Farm Boundaries
- Rivers

Vegetation Types

- Mixed Vachellia Savannah
- V. haematoxylon Savannah
- S. mellifera woodland
- T. camphoratus scrub
- Riverine Vegetation
- Areas of Disturbance

0 200 400 Meters

Scale: 1:10 000 @ A3

Projection:Transverse Mercator
Datum: Hartebeeshoek, Lo 23

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Figure 20

Vegetation Types (EMS, July 2015)

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N

To Van Zylsrus

Gloria 266

Ga-Mogara

Historical Borrow Pit

Kipling 271

R380

Old Crusher Yard

Historical Borrow Pit

Umtu 281

Hotazel 280

-10000

Legend

- Proposed Infrastructure
- Proposed Road Re-Alignment of R380
- Proposed Open Pit Area
- Farm Boundaries
- Rivers

Sensitivity

- High
- Moderate
- Low
- Areas of Disturbance

0 200 400 Meters

Scale: 1:10 000 @ A3

Projection:Transverse Mercator
Datum: Hartebeeshoek, Lo 23

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Figure 21

Biodiversity Sensitivity (EMS, August 2015)

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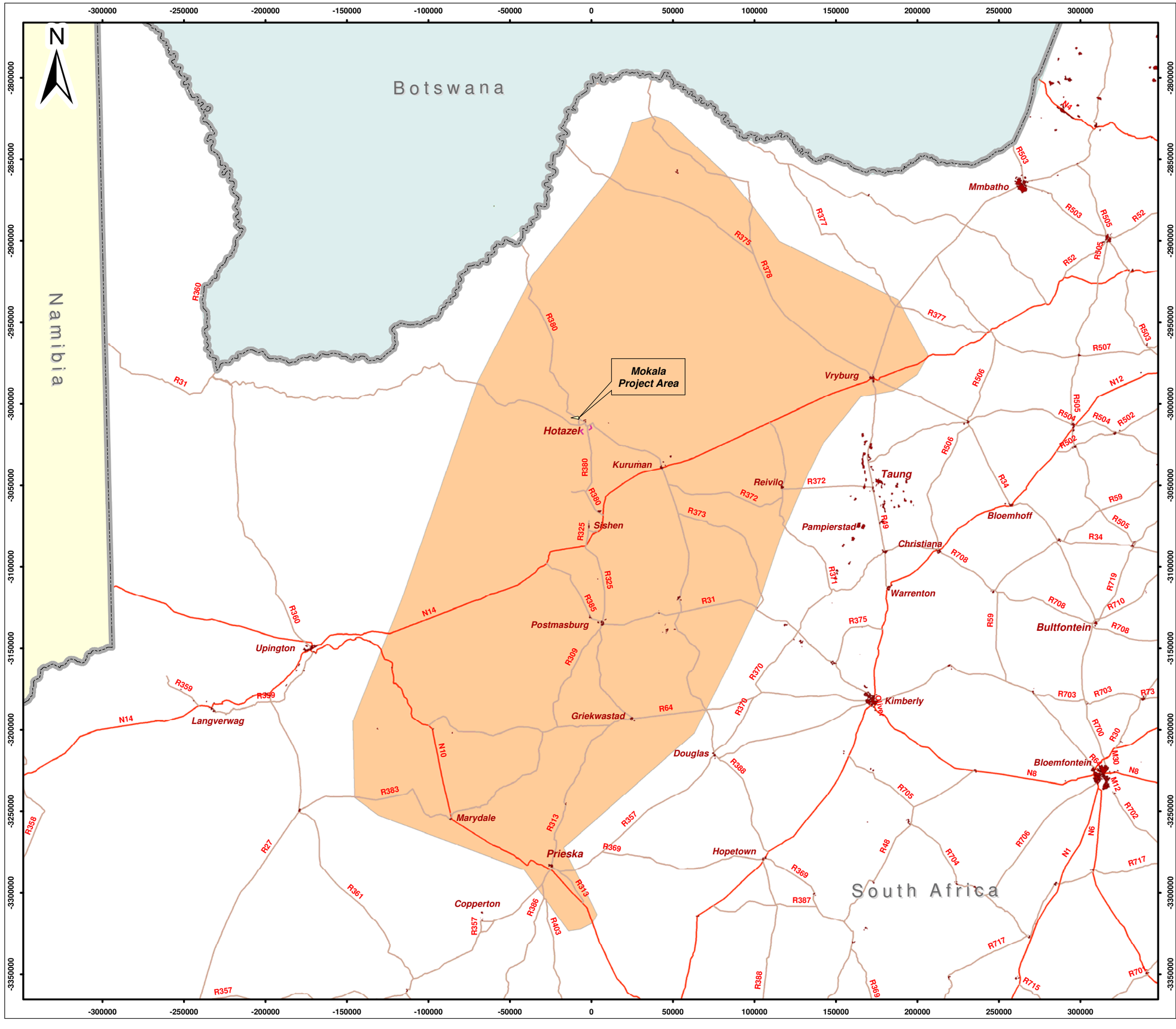

Legend

- National Boundary
- National Roads
- Route Roads
- Urban Areas
- Griqua West Center of Endemism

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Figure 22

Griqualand and West Center of Endemism (EMS, August 2015)

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RESULTS - FAUNA

Fauna species

Farming practises and mining activities surrounding the proposed project area have disturbed the local faunal population and as such very few faunal species were identified within the proposed project area. Bird species that were observed on-site include the Diederik Cuckoo, European Bea-Eater, White Throated Swallow, Red Faced Mousebird, Fork tailed Drongo, Ashy Tit, Redeyed Bulbul, and Clapper lark. Evidence of burrowing animals such as Suricate, White-tailed Mongoose and ground squirrels were observed within the proposed project site. Warthogs were also observed on-site by the SLR project team.

Red data species

No red data faunal species were observed on-site (EMS, August 2015). Species of conservation concern that are however likely to occur within the proposed project area are listed in Table 28 and Table 29 below.

TABLE 28: BIRD SPECIES OF CONSERVATION CONCERN LIKELY TO OCCUR WITHIN THE PROPOSED PROJECT AREA (EMS, AUGUST 2015)

Common name	Scientific name	Conservation status*	Potential for occurrence within the proposed project area
Martial Eagle	*Polemaetus bellicosus*	Vulnerable	High - Nesting habitat in the Mixed Savannah vegetation type
Secretary bird	*Sagittarius serpentarius*	Near threatened	High – Patches of open savannah will accommodate this species.
African Whitebacked Vulture	*Gyps africanus*	Vulnerable	High -No nest sites were recorded within the proposed project area, however the presence of large *Vachellia erioloba* trees present ideal nesting habitats for these birds.
Kori Bustard	*Ardeotis kori*	Vulnerable	Medium – Moderate to high shrub density throughout the proposed project area
Black stork	*Ciconia bigra*	Near threatened	Low – No suitable habitat on site, may occur during periods of high rainfall
Lesser Kestrel	*Falco naumanni*	Vulnerable	Low - Area too densely wooded for ideal habitat.
Bateleur	*Terathopius ecaudatus*	Vulnerable	Medium – Some suitable habitat on site
Lappetfaced Vulture	*Torgos tracheliotos*	Vulnerable	High - Suitable habitat within the Mixed Savannah vegetation type

* IUCN red list

TABLE 29: MAMMAL SPECIES OF CONSERVATION CONCERN POTENTIALLY AND/OR OCCURRING IN THE PROJECT AREA (EMS, AUGUST 2015)

Common name	Scientific name	Conservation status*	Potential for occurrence within the proposed project area
Dent's Horseshoe Bat	*Rhinolophus denti*	Near threatened	Very little – Roosting habitat in the form of rock crevices may be available in the old mining area adjacent to the proposed project area. However, as the landscape in the area is flat and does not offer suitable roosting habitat for this species, it is unlikely that this species would have colonised the adjacent mining areas.
Honey badger	*Mellivora capensis*	Near threatened	High– Suitable habitat within the proposed project area.
Schreiber's long-fingered bat	*Miniopterus schreibersii*	Near threatened	Very little – No caves occur within the proposed project area. In addition, as the landscape in the area is generally flat sand veld and does not offer suitable roosting habitat for this species, it is unlikely that this species would have colonised the area.
South African Hedgehog	*Atelerix frontalis*	Near threatened	High to Medium – Suitable habitat available.

* IUCN red list

CONCLUSION

The placement of infrastructure as well as mining activities in general have the potential to disturb and/or destroy vegetation, habitat units and related ecosystem functionality including the disturbance of sensitive/ endangered species. Protected species in accordance to the NFA located within the proposed project area include *Acacia erioloba* (Camel thorn) and *Acacia haematoxylon (*Grey camel thorn). The *Vachellia erioloba* (Camel Thorn) is also listed as declining in terms of the IUCN. Other red data species that are likely to occur within the proposed project area in terms of the NCNCA include *Harpagophytum procumbens* (Devils Claw), *Moraea longistyla,* (Goldblatt), *Moraea pallida* (Yellow Tulip), and *Babiana hypogaea* (Geelbobbejaantjie).

It is important to note that the proposed project area falls within the Griqualand West Centre of Endemism (EMS, August 2015) (Figure 22). In addition to this, areas considered to have a high sensitivity include the Ga-Mogara drainage channel.

It is important to note that the proposed project area has already been disturbed due to historical borrow pit activities, the old crusher yard, historical farming practices and on-going prospecting activities and the existing R380 traverses the proposed project site.

During the design of the infrastructure layout, areas of sensitivity should be taken into consideration in order to minimise the disturbance and destruction of these areas. In addition to this, mitigation measures need to be formulated to conserve and reduce the impacts that the proposed project may have towards these areas.

7.4.1.7 Surface water

INTRODUCTION AND LINK TO IMPACT

Surface water resources include drainage lines and paths of preferential flow of stormwater runoff. Mine related activities have the potential to alter the drainage of surface water through the establishment of infrastructure and/or result in the contamination of the surface water resources through seepage and/or spillage of process materials, non-mineralised (general and hazardous) and mineralised wastes (overburden stockpile). To understand the basis of these potential impacts, a baseline situational analysis is described below.

DATA SOURCES

Information in this section was sourced from the surface water assessment undertaken for the proposed project (SLR, October 2015) included in Appendix L and the biodiversity assessment (EMS, August 2015) included in Appendix K.

Information pertaining to catchments, mean annual run-off and water management areas was sourced from the National Water Resource Strategy, 2004. Information regarding the relevant rivers located within the proposed project area was sourced from the review of topographical data.

The Ga-Magara drainage channel does not flow regularly and as such typical best practice methods for peak flow are not considered to accurately represent the flood hydrology. It follows that as part of the surface water study, flow peaks were determined through the review of both regional and local hydrological information (fluvial geomorphology), evidence from historical flood events, flow estimates using regional methodologies (Regional Maximum Flood method) and statistical analysis of nearby flow gauging stations. For further detail on the various flow peak methods used, refer to the surface water study included in Appendix L.

Floodlines were determined using the HEC-RAS numerical hydraulic modelling programme. The method performs flow simulations for natural river channels using data from a digital elevation model in the ArcGIS software package. This allows river cross sections to be automatically generated and the resulting floodlines to be plotted. For further details on the numerical hydraulic modelling programme and parameters used within the model, refer to the surface water study included in Appendix L.

RESULT

Catchments within the context of South Africa

South Africa is divided into 19 water management areas (National Water Resource Strategy, 2004), managed by separate water boards. Each of the water management areas (WMA) is made up of quaternary catchments which relate to the drainage regions of South Africa. The proposed project area falls within the Lower Vaal water management area. The major rivers associated with this water management area include the Molopo River, Harts River and the Vaal River which ultimately drain into the Orange River. In this regard, all runoff from the proposed project area is eventually drained westward into the Orange River (SLR, October 2015).

Regional hydrology

The proposed project area falls within the quaternary catchment D41K (Figure 23) which has a gross total catchment area of 4216 km^2, with a net MAR of 1.92 million cubic meters (mcm).

The major river within quaternary catchments D41K is the Ga-Mogara drainage channel which flows through the proposed project area (Figure 23). The Ga-Mogara drainage channel forms a tributary of the Kuruman River. The Kuruman River flows west joining the Molopo River approximately 250 km from the confluence of the Ga-Mogara drainage channel and Kuruman River (Figure 23). The Molopo River drains in a southerly direction eventually joining the Orange River (SLR, October 2015).

Local hydrology

The Ga-Mogara drainage channel is located on the eastern boundary of the proposed project site (Figure 23). Any natural runoff from the proposed project site will drain in an easterly direction towards the Ga-Mogara drainage channel. Several minor non-perennial rivers form tributaries of the Ga-Mogara drainage channel in the broader Hotazel area; these include the Dooimansholte, Ga-Mmatshephe, Vlermuisleegte, Witleegte Rivers (Figure 1) and various other unknown non-perennial rivers. Most notably the Witleegte River forms a confluence with the Ga-Mogara immediately upstream of the site.

A perched water table was identified at least 15 m beneath the Ga-Mogara drainage channel, the depth of which indicates that the river loses surface water flow to ground water as opposed to gaining water from a shallow water table. As there is no shallow water table beneath the river bed, and very flat river bed gradients of less than 0.17 %, there is no significant subsurface (base) flow in the Ga-Mogara drainage channel.

It is important to note that while the Ga-Mogara drainage channel is illustrated as a non-perennial water course on topographical maps (Figure 23) it is understood by SLR from local farmers in the area that

notable flows within Ga-Mogara drainage channel last occurred between 1974 and 1976 and again in 1988 (SLR, October 2015).

Flow peaks

The peak flow rates for the Ga-Mogara drainage channel for the 1:50, 1:100 and 1:200 year return period are summarised in Table 30 for the various methods used to determine peak flows.

TABLE 30: PEAK FLOWS FOR THE GA-MOGARA DRAINAGE CHANNEL (SLR, OCTOBER 2015)

Annual Exceedance Probability	Fluvial Geomorphology (m^3/s)	Statistical Analysis (m^3/s)	RMF Method (m^3/s)	Historical Flows (m^3/s)
1:200	-	<198	251	76
1:100	<127	<170	198	64
1:50	<100	<146	154	53

With reference to Table 30, the most robust estimates are considered to be those based on historical evidence, which fit with the maximum flows estimated by fluvial geomorphology and statistical analysis of local gauging stations. The RMF method estimates are considered least accurate and in this case return flows which are much higher than the other methods.

Floodlines

The peak flows that were used within the hydraulic modelling to determine the floodlines within the proposed project area were based on the historical flows as discussed in the section above. The 1:100 and the 100m buffer from the edge of the Ga-Mogara drainage channel are illustrated in Figure 24. The proposed project will encroach on the 1:100 floodline and will be within 100m of the Ga-Mogara drainage channel (SLR, October 2015).

Surface water quality

No water sampling within the proposed project site has been conducted because there are no permanent surface water features. Given this, no surface water quality data is available.

Surface water users

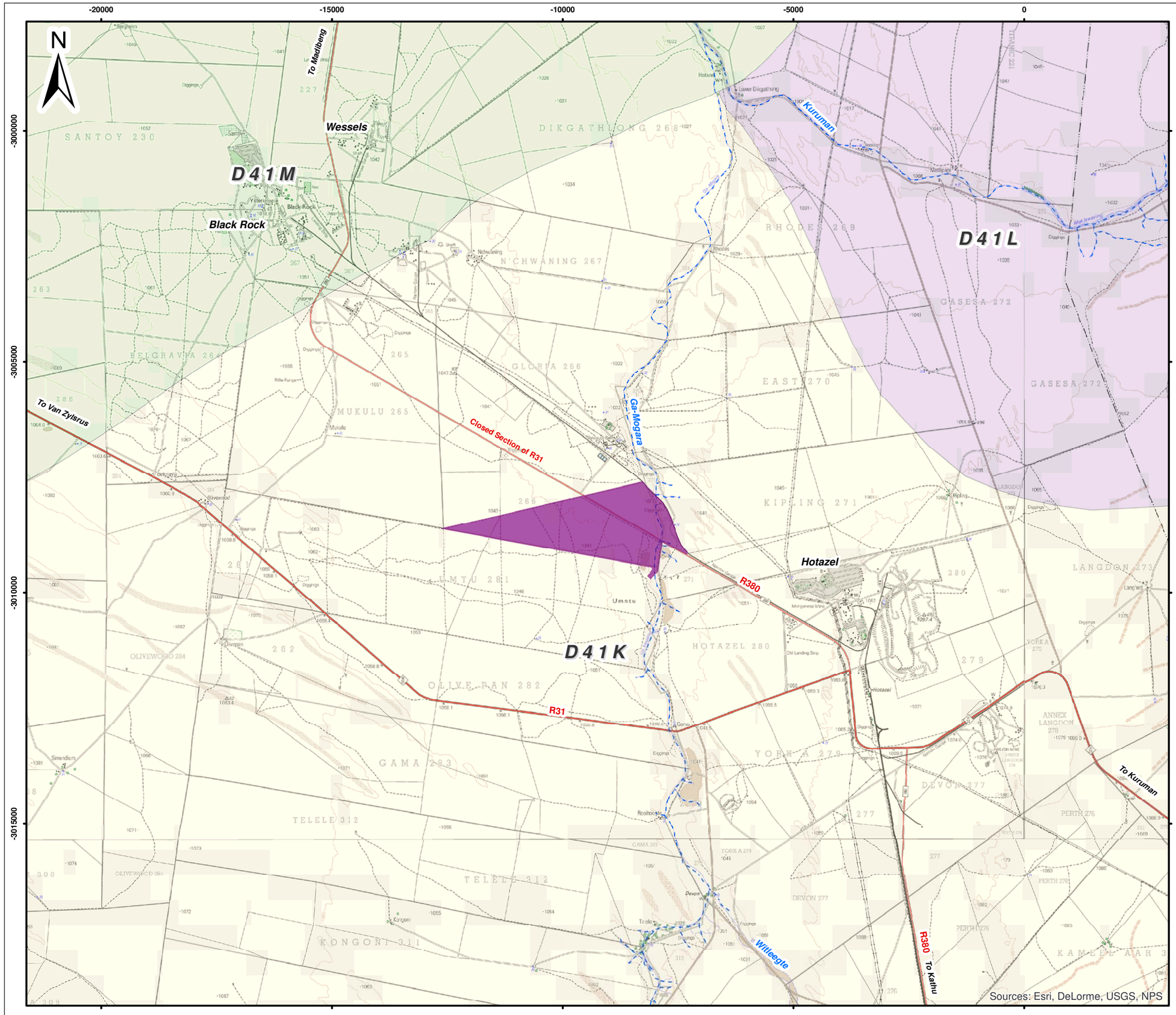
Due to the ephemeral nature of the Ga-Mogara drainage channel, there is no third party reliance on surface water.

Wetlands

No wetlands are present within or immediately adjacent to the project area (EMS, August 2015).

CONCLUSION

The nature of the proposed project and activities are such that they present potential for pollution of water resources. The proposed project must therefore be managed/implemented in a way that pollution of water resources is prevented. Moreover, care is required to ensure that surface run-off patterns are disturbed as little as possible to promote the continued flows of water and nutrients.



Legend

- Proposed Project Area
- Rivers - Perennial
- Rivers - Non Perennial
- Roads

Quaternary Catchments

- D41K
- D41L
- D41M

0 1 2 Kilometers

Scale: 1:150 000 @ A3

Projection:Transverse Mercator
Datum: Hartebeeshoek, Lo 23

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Figure 23

Catchments

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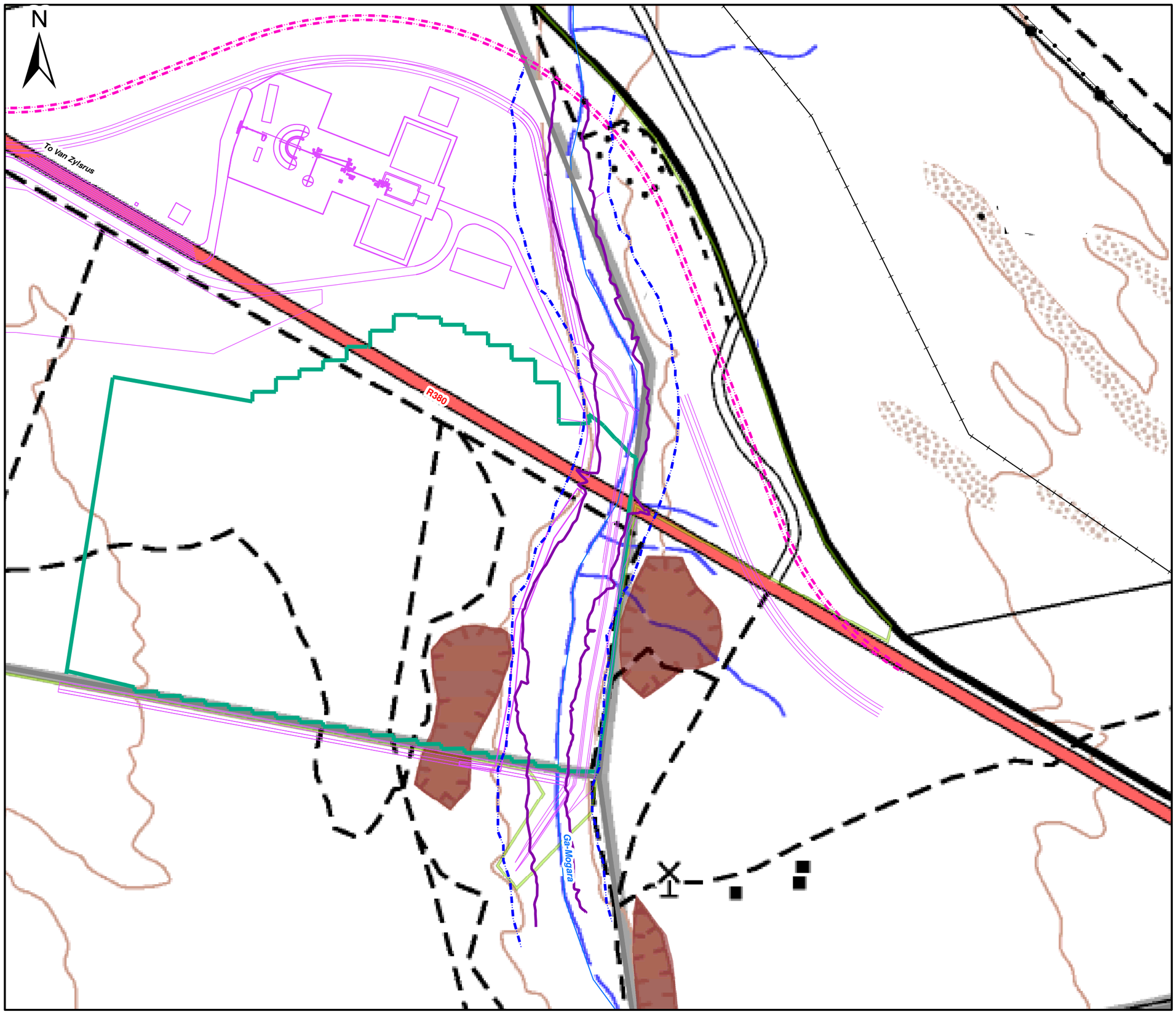

Legend

- 100m River Buffer
- 100yr Floodlines
- Proposed Infrastructure
- Proposed Road Re-Alignment of R380
- Proposed Open Pit Area
- Tracks/Paths
- Farm Boundaries
- Rivers
- Powerlines
- Railway
- Historical Borrow Pits
- Roads

0 100 200 Meters

Scale: 1:18 000 @ A3

Projection:Transverse Mercator
Datum: Hartebeeshoek, Lo 23

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Figure 24

Floodlines
(SLR, October 2015)

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7.4.1.8 Groundwater

INTRODUCTION AND LINK TO IMPACT

Groundwater is a valuable resource and is defined as water which is located beneath the ground in soil/rock pore spaces and in the fractures of lithological formations. Activities such as the handling and storage of hazardous materials and handling and storage of mineralised and non-mineralised wastes have the potential to impact groundwater resources, both to the environment and third party users, through pollution. In addition, where mining requires dewatering in order to provide a safe working environment and for water supply, there is the potential for a dewatering cone to develop and this can result in a loss of water supply to surrounding users. To understand the basis of these potential impacts, a baseline situational analysis is described below.

DATA SOURCES

Information in this section was sourced from the groundwater assessment (SLR, October 2015) included in Appendix H.

Information pertaining to aquifer characteristics was sourced from available information including borehole logs and pumping tests.

A hydrocensus was undertaken to identify water users as well as to determine the quality and quantity of water resources within and surrounding the proposed project area. In addition to this, groundwater samples were also taken as part of pumping test to determine the groundwater quality.

The regional groundwater flow pattern was determined by linear interpolation of available groundwater levels and hydraulic heads. Water levels measured during the hydrocensus, water level information in the National Groundwater Database (NGDB), and water level information from published literature was used.

Groundwater yields for the proposed project area were determined through pumping tests.

RESULTS

Presence of groundwater

Two distinct aquifers are present in the proposed project area namely a shallow unconfined Kalahari aquifer and a deep confined fractured aquifer. Based on the DWA Aquifer Classification map, the proposed project area falls in the "poor" aquifer region. This is defined as a " low to negligible yielding aquifer system of moderate to poor water quality". This refers to the shallow Kalahari bed aquifer, however, the yield in the deeper aquifer is also expected to be low. Further information regarding the aquifers underlying the proposed project area is discussed below (SLR, October 2015).

Shallow Aquifer: An unconfined, perched aquifer occurs in the sediments and calcretes of the Kalahari Formation or on the contact with Kalahari clay or the underlying Dwyka Formation. The thick clay bed acts as a confining layer. While the sediments and calcretes could have a moderate hydraulic conductivity, the clay is relatively impermeable.

This continuous presence of an impermeable or semi-permeable interface between the upper, unconfined Kalahari aquifer and the deeper, confined fractured aquifer is important to regional groundwater flow. It prevents rapid vertical drainage of the Kalahari aquifer and also permits lateral groundwater flow by topographic gradients. It also delays recharge to the underlying fractured aquifer(s).

Lithological logs and test pumping data indicate that there is a limited groundwater body accessed in these boreholes. This groundwater body is likely to be perched on low permeability layers and is of limited extent. It is consistent with the groundwater elevations showing a regional groundwater flow pattern towards the northeast. This suggests that the groundwater body accessed in these boreholes is the unconfined Kalahari aquifer. There is no significant aquifer associated with the Ga-Mogara drainage channel.

Deep Aquifer: The fractured aquifer is present in the bedrock formations below the Kalahari Formation. These formations consist of low permeability hard rock. Groundwater occurrence is dependent on secondary faults and fractures, joints and other discontinuities. Although borehole yields in the deeper aquifer are generally low, structural features such as faults and fractures can produce higher yielding boreholes. It is however important to note that initially high borehole yields may decrease under sustained pumping, since water will be required to drain from the surrounding rock, or connected fracture systems which have a lower yield.

In the proposed project area the fractured aquifers are considered to occur in the Dwyka Formation, the Hotazel Formation and the Ongeluk Formations.

The Dwyka aquifer consists of diamictite (tillite) with clay lenses influencing the overall hydraulic properties of this unit. The lithology is generally massive with little jointing, but it may be stratified in places. The Dwyka Group constitutes a very low-yielding fractured aquifer and water is confined within narrow discontinuities like jointing and fracturing. They therefore tend to form aquitards rather than aquifers (DWAF, 2011).

The Hotazel Formation is the ore-bearing unit, comprised of Banded Ironstone (BIF) and Manganese Ore. Groundwater associated with the Hotazel Formation rocks appears to be associated with fracture systems that are generally of limited extent.

The lava of Ongeluk Formation underlies the Hotazel Formation and is of hydrogeological importance east of the proposed developments (east of the syncline) where younger bedrock is eroded and only preserved in down faulted grabens (e.g. at dormant mines on Hotazel and Devon).

Groundwater levels and flow

The regional average water levels in the D41K catchment are 40m below ground level. In general, the regional groundwater flow reflects topography, with groundwater flow from high lying areas in the direction of low lying drainage features..

Water levels associated with the proposed project area range between 13m to 100m (Table 31) below ground level. Water levels measured within the proposed project area do not show significant correlation to topography, instead water levels vary considerably over short distances. This might be attributed to the following:

- Slow recharge after drilling in a low hydraulic conductivity environment
- The influence of current and previous mining activities in the area
- The influence of confined aquifer conditions in the underlying fractured bedrock
- The local absence of the confining clay layer

Water levels associated with the proposed project site deepen towards the west and are shallower towards the east of the Ga-Mogara River where the Kalahari is underlain by lava or the Ongeluk Formation.

Hydrocensus and groundwater use

As part of the groundwater investigation a total of fifteen boreholes were identified as part of the hydrocensus undertaken in March 2015. Details pertaining to the boreholes selected for the hydrocensus are included in Table 31 below and illustrated in Figure 25 (SLR, October 2015).

TABLE 31: HYDROCENSUS BOREHOLES (SLR, OCTOBER 2015)

Relevant borehole	Relevant farm	Elevation (mamsl)	Depth of Borehole (mbgl)	Water Level (mbgl)	Groundwater Use
MH1	Olivewood 284	1061	~100	50.15	Domestic, and livestock use, Wind powered
MH2	Olivewood 284	1069	N/A	N/A	Wild animal supply point
MH3	Umtu 281	1046	N/A	64.03	Monitoring by neighbouring mines
MH4	York 279	1040	150	27.98	Monitoring by neighbouring mines
MH5	Hotazel 280	1034	50	37.23	Monitoring by neighbouring mines
MH6	Devon 277	1082	100	29.77	Not yet used but earmarked for livestock water supply

Relevant borehole	Relevant farm	Elevation (mamsl)	Depth of Borehole (mbgl)	Water Level (mbgl)	Groundwater Use
MH7	Devon 277	1086	N/A	-	N/A
MH8	Devon 277	1091	200	25.0	N/A
MH9	Olivewood 284	1067	N/A	74.48	N/A
MH10	Olive pan 282	1048	N/A	63.49	Monitoring by neighbouring mines
MHsw1	East 270	1012	-	-	N/A
MHsw2	Hotazel 280	1024	-	-	N/A
MH12	Umtu 281	1048	>300	>100	N/A
MH13	York 279	1047	150	25.44	Monitoring by neighbouring mines
MH14	Olive pan 282	1029	50	35.7	Monitoring by neighbouring mines

With reference to Table 31 groundwater is not used extensively surrounding the proposed project area. Where borehole water is used, this is limited to domestic, stock watering, and game watering. Water within the town Hotazel is primarily sourced from the Vaal Ga-Mogara Water Supply Scheme.

Groundwater quality and use

A total of 13 groundwater quality samples (Table 32) were taken within and surrounding the proposed project area. The location of the boreholes that were selected for groundwater quality sampling is illustrated in Figure 25. Groundwater quality sampling was undertaken as part of the hydrocensus including pumping tests. The groundwater quality results are presented in Table 33 below (SLR, October 2015).

TABLE 32: BOREHOLES SELECTED FOR GROUNDWATER SAMPLING (SLR, OCTOBER 2015)

Relevant borehole	Relevant farm	Depth of borehole (mbgl)	Water level (mbgl)
Hydrocensus			
MH1	Olivewood 284	~100	50.15
MH2		-	Non measurable
MH3	Olive pan 282	-	64.03
MH4	York 279	150	27.98
MH5	Hotazel 280	50	37.23
MH6	Devon 277	100	29.77
Pumping test boreholes			
GL15	Remaining extent of Gloria 266	64.17	-
GL27		175.70	>100
GL35		136.85	80
GL37		120.49	74.75
GL56		86.77	48.33
BH1			-
BH2		30.63	24.63

Based on the results, all the boreholes that were sampled showed elevated concentrations of various elements. With reference to Table 33 the following exceedances of guidelines limits were observed:

- World Health Organisation (WHO) Guidelines for drinking-water quality (WHO, 2011): Guideline limits for manganese, iron and selenium were exceeded.
- South African National Standards (SANS) 241 (2011) water quality standards (SANS 241 (2011) aesthetic guidelines: Guideline limits for sodium, chloride, electrical conductivity, iron, manganese and zinc were exceeded.
- South African National Standards (SANS) 241 (2011) water quality standards (SANS 241 (2011) operational guidelines: Guideline limits for pH and aluminium were exceeded.
- South African National Standards (SANS) 241 (2011) water quality standards (SANS 241 (2011) acute health guidelines: Guideline limits sulphate and nitrate were exceeded.
- South African National Standards (SANS) 241 (2011) water quality standards (SANS 241 (2011) chronic health guidelines: Guideline limits for fluoride, iron, manganese and selenium were exceeded.
- Department of Water Affairs (DWAF) Target Water Quality Range Livestock watering (1996): Guidelines limits for chloride and sulphate were exceeded.

Groundwater yields

The pumping tests undertaken at the proposed project site suggests that the groundwater yield potential of the aquifers at Mokala is generally low. Pumping tests indicate that the yield for the shallow aquifer system is much lower than 1 L/s. The yield for the deep aquifer is approximately 1 L/s (SLR, October 2015).

TABLE 33: GROUNDWATER QUALITY DATA (SLR, OCTOBER 2015)

SANS 241 (2011) Water Quality Standard	pH	Electrical Conductivity	Alkalinity as $CaCO_3$	Chloride as Cl	Sulphate as SO_4	Nitrate as N	Fluoride as F	Al	Ca	Fe	K	Mg	Mn	Na	Se	Zn
	pH Value	mS/m	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
SANS 241 (2011) Operational	**5 - 9.7**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**0.3**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
SANS 241 (2011) Aesthetic	**N/A**	**170**	**N/A**	**300**	**250**	**N/A**	**N/A**	**N/A**	**N/A**	**0.3**	**N/A**	**N/A**	**0.1**	**200**	**N/A**	**5**
SANS 241 (2011) Acute Health	**N/A**	**N/A**	**N/A**	**N/A**	**500**	**11**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
SANS 241 (2011) Chronic Health	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**1.5**	**N/A**	**N/A**	**2**	**N/A**	**N/A**	**0.5**	**N/A**	**0.01**	**N/A**
WQG (1996): Livestock Watering	**N/A**	**N/A**	**N/A**	**1500**	**1000**	**200**	**4**	**5**	**1000**	**10**	**N/A**	**500**	**10**	**2000**	**50**	**20**
WHO DWQS (2011)	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**50**	**1.5**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**0.04**	**N/A**
IFC Mining Effluent (2007)	**6 - 9**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**2**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**0.5**
MH1	7.7	82	264	88	26	11	0.2	0.033	69.070	0.096	7.758	32.470	0.004	47.590	0.006	0.226
MH2	8.3	86	336	55	35	9.9	0.5	0.018	5.739	0.009	17.380	3.488	0.001	177.000	0.012	0.018
MH3	9.2	140	20	362	128	0.2	0.3	0.050	28.340	0.002	8.275	40.910	0.062	154.800	0.028	0.016
MH4	7.9	69	304	65	5	0.2	0.2	0.071	57.430	2.414	3.560	33.100	1.123	41.490	0.000	0.017
MH5	7.8	118	476	116	5	0.2	0.9	0.066	62.480	0.145	4.850	44.930	1.709	149.700	0.012	0.016
MH6	7.5	348	144	613	149	180	0.2	0.087	203.000	0.013	6.470	151.600	0.109	281.500	0.184	0.276
GL15	7.7	289	188	704	251	2.2	1.3	0.027	113.100	0.013	7.475	102.400	1.755	327.400	0.216	1.340
GL27	7.2	758	188	1783	1137	0.2	2.8	0.959	131.000	1.220	15.100	29.000	0.612	1535.000	0.206	5.430
GL35	7.9	565	64	1478	646	14	0.5	0.074	262.600	0.009	30.660	315.500	5.943	490.800	0.133	0.698
GL37	7.3	567	200	1289	722	3	1.8	0.080	119.000	0.007	8.800	87.000	0.065	757.000	0.000	2.670
GL56	7.2	246	444	463	210	9.6	1	0.074	108.100	0.464	11.000	98.700	0.063	277.200	0.090	0.116
BH1	7.3	369	316	913	191	49	0.8	0.077	217.300	0.252	9.520	205.500	0.645	249.300	0.174	0.122
BH2	7.5	94.6	316	102	68	0.3	0.8	0.071	43.010	6.519	4.552	43.300	0.568	91.360	0.006	0.046

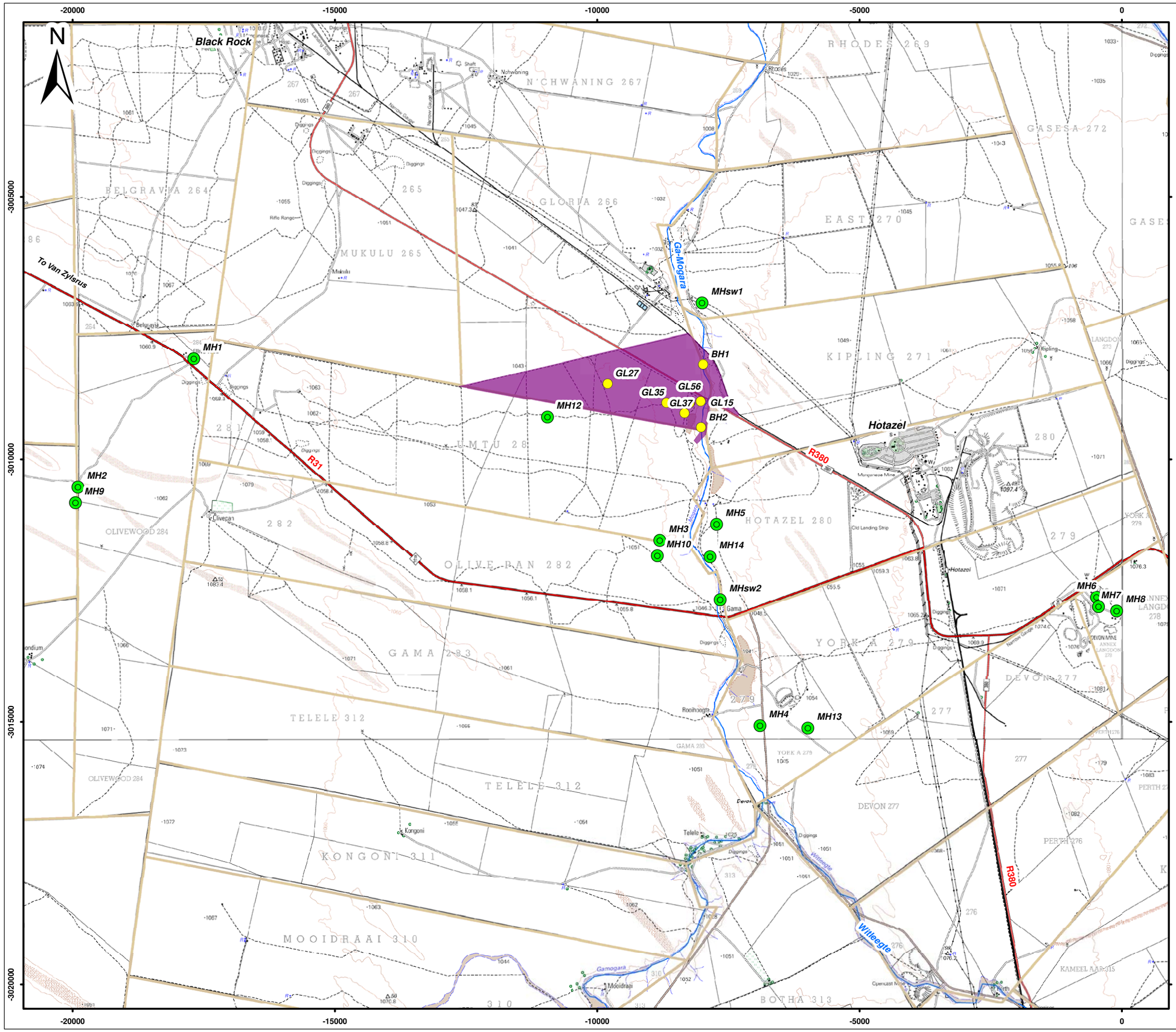

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Figure 25

Boreholes Selected for Groundwater Quality Sampling (SLR, October 2015)

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710.0912.00001	October 2015

CONCLUSION

The nature of the proposed infrastructure and activities are such that they present potential for pollution of groundwater resources and the lowering of groundwater levels. The proposed project must be implemented/ managed in a way that pollution and reduction of groundwater resources is prevented.

7.4.1.9 Air quality

INTRODUCTION AND LINK TO IMPACT

Existing sources of emissions in the region and the characterisation of existing ambient pollution concentrations is fundamental to the assessment of cumulative air impacts. A change in ambient air quality can result in a range of impacts which in turn may cause a disturbance and/or health impacts to nearby receptors. To understand the basis of these potential impacts, a baseline situational analysis is described below.

DATA SOURCES

Information in this section was sourced from the air quality specialist study undertaken by Airshed Planning Professionals (Airshed, September 2015) for the proposed project and included in Appendix M.

Data provided in the section below was obtained from the review of existing literature.

RESULTS

Ambient air quality within the region

Neighbouring land-use in the area surrounding the proposed project comprises predominantly livestock farming and mining activities. These land-uses contribute to baseline pollutant concentrations via the following sources (Airshed, September 2015):

- Mining sources: Particulates represent the main pollutant of concern at mining operations, whether it is underground or opencast. The amount of dust emitted by these activities depends on the physical characteristics of the material, the way in which the material is handled and the weather conditions. Current mining operations in relatively close proximity to the proposed project area include Kalagadi, Mamatwan, Black Rock, Gloria, Wessels, N'Chwaning, Tshipi Borwa Mine, UMK and Kudumane (Figure 29).
- Unpaved and paved roads: Emissions from unpaved roads constitute a major source of emissions to the atmosphere in the South African context. Dust emissions from unpaved roads vary in relation to the vehicle traffic and the silt loading on the roads. Emission from paved roads are significantly less than those originating from unpaved roads, however they do contribute to the particulate load of the atmosphere. Particulate emissions occur whenever vehicles travel over a paved surface. The fugitive dust emissions are due to the re-suspension of loose material on the road surface.

- Wind erosion and open areas: Windblown dust generates from natural and anthropogenic sources. Erodible surfaces may occur as a result of agriculture and/or grazing activities.
- Vehicle tailpipe emissions: Emissions resulting from motor vehicles can be grouped into primary and secondary pollutants. While primary pollutants are emitted directly into the atmosphere, secondary pollutants form in the atmosphere as a result of chemical reactions. Significant primary pollutants emitted combustion engines include carbon dioxide (CO_2), carbon (C), sulphur dioxide (SO_2), oxides of nitrogen (mainly NO), particulates and lead. Secondary pollutants include NO_2, photochemical oxidants such as ozone, sulphur acid, sulphates, nitric acid, and nitrate aerosols (particulate matter). Transport in the vicinity of the proposed project area is via trucks and private vehicles along the R380 (public) road, which are the main sources of vehicle tailpipe emissions.

Emission sources associated with the proposed project

The activities associated with the proposed project that will contribute to ambient air quality include:

- Excavations
- Earthworks
- Ground preparations prior to construction of the buildings
- Grading and levelling the ground prior to construction of new roads
- Removal of soil
- Storage of materials
- Vehicles on haulage routes and public roads
- Materials handling (loading / unloading from trucks and conveyors)
- Crushing of ore
- Vehicle entrainment of dust on haul road
- The use of diesel generators
- Wind erosion on exposed areas (e.g. stockpiles and overburden stockpiles)
- Drilling and blasting

Potential air receptors

Potential air receptors surrounding the proposed project site (refer to Figure 29) includes the following:

- The Hotazel town situated approximately 4km south east from the boundary of the proposed project area
- The Black Rock mining community located approximately 8km north west from the boundary of the proposed project area
- The Gloria Mine village located approximately 1.3km north of the proposed project area
- The Black Rock mine village located approximately 5km north west of the proposed project area
- The Kalagadi Mine located approximately 700m to the south of the proposed project site

- Isolated farmstead located approximately 5.3 km south west from the boundary of the proposed project site
- Isolated farmstead located approximately 5 km north from the boundary of the proposed project site
- Isolated farmstead located approximately 5km west from the boundary of the proposed project area
- Isolated homestead located approximately 6.5km west from the boundary of the proposed project area
- Isolated farmstead located approximately 6.2 km north east from the boundary of the proposed project site

CONCLUSION

The proposed project area is situated within a region that is surrounded by activities and infrastructure that contribute towards sources of emissions such as dust fallout and PM10. The proposed project will present additional sources of pollutants that may influence existing pollutant concentrations. The proposed activities should therefore be carefully designed and managed to ensure that contributions from the proposed project remain within acceptable limits.

7.4.1.10 Noise

INTRODUCTION AND LINK TO IMPACT

Certain noise generating activities associated with the proposed project infrastructure/activities could cause an increase in ambient noise levels in and around the proposed project area. This may cause a disturbance to nearby receptors. To understand the basis of these potential impacts, a baseline situational analysis is described below.

DATA SOURCE

Information in this section was sourced from the noise specialist study undertaken by Airshed Planning Professionals (Airshed, September 2015) for the proposed project and included in Appendix N.

Data provided in this section was sourced through the review of available literature including on-site observations. Further to this, day-time and night-time ambient noise levels for the proposed project area were obtained through an on-site noise sampling survey that was undertaken in accordance to the International Finance Corporation (IFC) General Environmental Health and Safety Guidelines and the South African National Standards (SANS) 10103 of 2008 (Airshed, June 2015).

RESULTS

As part of the proposed project a noise sampling survey was undertaken to determine the day-time and night-time ambient noise levels. The location of the sampling points is illustrated in Figure 26. The sampling results are provided in Table 34 below (Airshed, September 2015).

TABLE 34: SUMMARY OF NOISE SAMPLING SURVEY (AIRSHED, SEPTEMBER 2015)

Sampling point	P1		P2		P3		P4	
Time of Day	**Day**	**Night**	**Day**	**Night**	**Day**	**Night**	**Day**	**Night**
L_{Aeq} (dBA)	37.4	36.1	51.5	44.5	51.7	42.6	42.5	47.7

Ambient noise levels at P1 and P4 correspond to what SANS 10103 states is typically found in rural areas. In this regard noise levels range between 45 dBA during the day and 35 dBA at night. The small difference between day-time and night-time noise levels at these locations corresponds with what is found in areas with limited human activity. Insect noise at night often results in night-time noise levels that are slightly higher than during the day.

Ambient noise levels at P2 and P3 correspond to what SANS 10103 states is typically found in suburban areas (areas with some human activity). In this regard, typical noise levels range between 50 dBA during the day and 40 dBA at night. The difference between day-time and night-time noise levels at these locations is as a result of changes in traffic volumes along the R380.

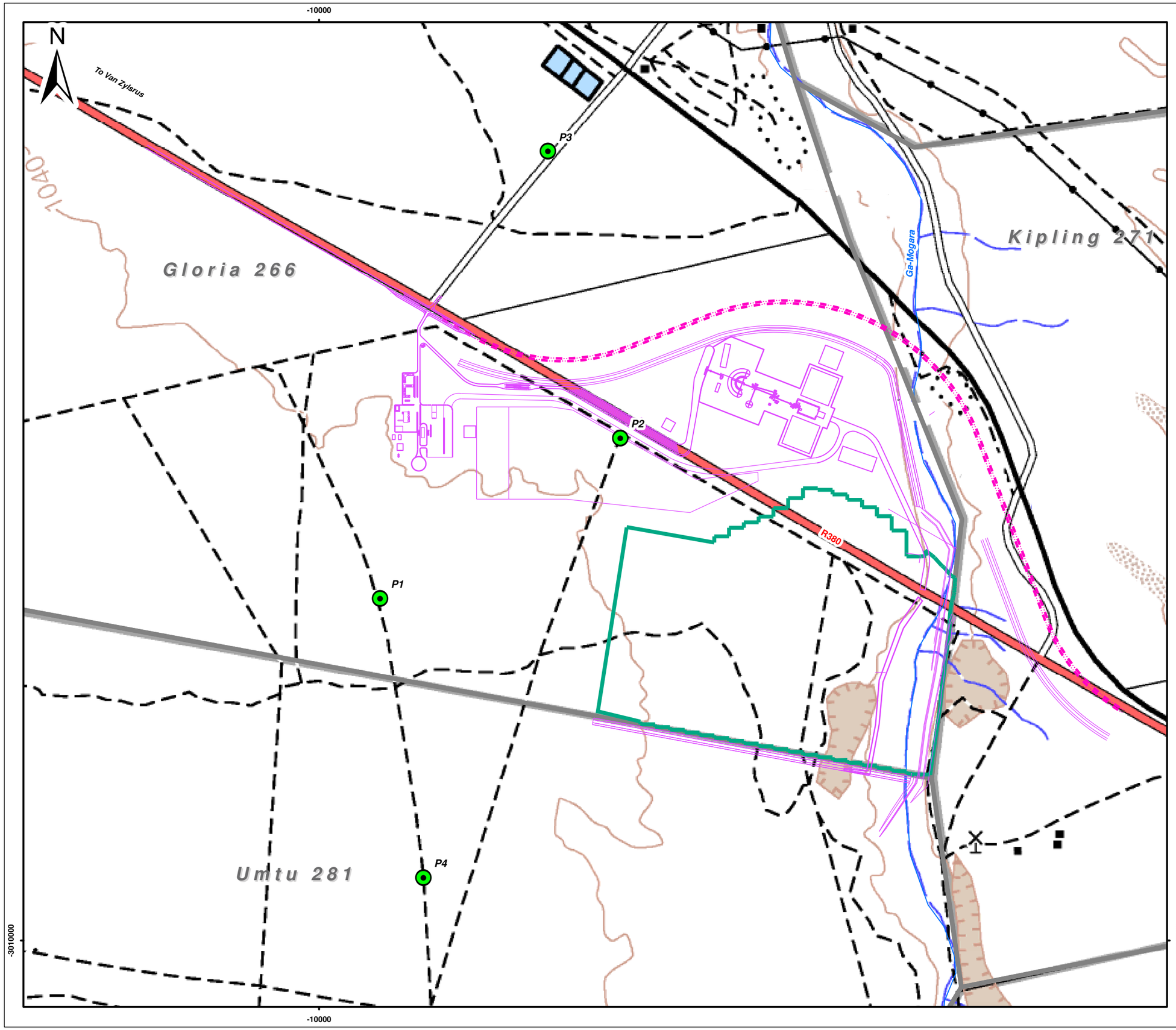
Potential noise receptors

An increase in ambient noise levels is unlikely to extend more than 5km from the source. It follows that potential noise receptors (refer to Figure 30) that are located within a 5km radius from the proposed project site include the following:

- The Hotazel town situated approximately 4km south east from the boundary of the proposed project area
- The Gloria Mine village located approximately 1.3km north of the proposed project area
- The Kalagadi Mine located approximately 700m to the south of the proposed project site

CONCLUSION

The proposed project has the potential to increase disturbing noise levels within and surrounding the project area. It is however important to note that the current mining activities associated with surrounding mines (Kudumane Manganese Mine, Kalagadi Manganese Mine and Gloria Manganese Mine) including traffic along the R380 already generate noise. An increase in disturbing noise levels may influence nearby potential noise receptors. Careful planning should therefore be taken into consideration for the proposed project in order to minimise increasing disturbing noise levels.



Legend

- Noise Sampling Points
- Proposed Infrastructure
- Proposed Road Re-Alignment of R380
- Proposed Open Pit Area
- Farm Boundaries
- Rivers

0 200 400 Meters

Scale: 1:12 500 @ A3

Projection:Transverse Mercator
Datum: Hartebeeshoek, Lo 23

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Figure 26

Noise Sampling Points (Airshed, September 2015)

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710.0912.00001 | October 2015

7.4.1.11 Visual aspects

INTRODUCTION AND LINK

Project-related activities have the potential to alter the landscape character of the site and surrounding area through the establishment of both temporary and permanent infrastructure. To understand the basis of these potential impacts, a baseline situational analysis is described below.

DATA SOURCE

Information in this section was sourced from on-site observations and through the review of satellite imagery.

RESULTS

Landscape character

The proposed project area lies in a flat, open area characterised by semi-arid vegetation and ephemeral drainage lines. Livestock and game farms and associated isolated farmsteads are typical of the region. To the south, north and south east of the proposed project site the landscape is characterised by scattered operational and closed mining operations and supportive infrastructure such as rail and road networks, powerlines, and the residential and business centre of Hotazel (Figure 30).

The landscape character within the proposed project area has been disturbed due to presence of historical borrow pit activities located to the eastern section of the proposed project site (Figure 30).

Scenic quality

The scenic quality of the proposed project site and surrounding area is linked to the type of landscapes that occur within an area. In this regard, scenic quality can range from high to low as follows:

- High – these include the natural features such as mountains and koppies and drainage systems;
- Moderate – these include agricultural activities, smallholdings, and recreational areas; and
- Low – these include towns, communities, roads, railway line, industries and existing mines.

Although numerous mining related structures dominate the landscape to the north, south east and south of the proposed project area and the R380 and Telkom lines traverse the proposed project site, the overall scene is characterised by the Ga-Mogara drainage channel and open views of the bushveld. The result is a landscape with a moderate scenic quality.

Sensitivity of Visual Resource

It follows that the highest value visual resource described above is also the most sensitive to changes. In contrast, areas, which are not considered to have a high scenic value, are expected to be the least sensitive to change such as the mining and infrastructure areas.

Sense of place

The sense of place results from the combined influence of landscape diversity and distinctive features. The primary informant of these qualities is the spatial form and character of the natural landscape taken together with the cultural transformations and traditions associated with the historic use and habitation of the area. The proposed site is located within a “mining belt”. The mining activity, and the infrastructure that supports these mines, dominates the agricultural type landscape characteristics of the area to the north, south and southeast of the proposed project area. The fact that the proposed project will take place within the context of these existing mining activities, gives the immediate study area a relatively weak sense of place (when the viewer is within the mining belt). However, seen in context with the site surrounded by large open spaces of arid vegetation the harsh nature of the mining activities is “softened”. When the viewer views the area from outside the “mining belt”, the larger area has a stronger sense of place.

Visual receptors

When viewed from the perspective of tourists and residences within the area, mining activities could be associated with a sense of disenchantment. People who benefit from the proposed project (employees, contractors, service providers etc.) may not experience this disenchantment but rather see the mine with a sense of excitement and anticipation.

It follows that the sensitive viewers are a combination of landowners/land users on surrounding farms and possibly the residents of the Gloria mine village and the Hotazel village, albeit that this is a mining village.

CONCLUSION

Visual impacts require consideration, particularly as part of closure planning, but none of the potential visual impacts are considered new given the existing mining activities and infrastructure on site and in the greater area.

7.4.1.12 Traffic

INTRODUCTION AND LINK

Traffic from mining developments has the potential to affect the capacity of existing road networks as well as result in noise, air quality and public road safety issues. This section provides an overview of the current road network, conditions and road use. Information on use of the rail network is also provided. Understanding the layout, use and conditions of transport systems relevant to the proposed project site provides a basis for understanding a change as a result of project contributions.

DATA COLLECTION

Information was sourced from the traffic specialist study (Siyazi, March 2015) included in Appendix O.

The study comprised sourcing relevant data from a site inspection of the existing road network, consultations with the roads authorities, traffic counts, calculations and reference to relevant traffic impact assessment guideline documents. Further details is provided in the traffic study.

RESULTS

The proposed project area is located approximately 4km north west of the town Hotazel. The R380 from which access to the town Hotazel is obtained traverses the proposed project site. An overview of the relevant intersections and road sections along the R380 that were investigated by the traffic specialist are included in Table 35 below and Table 36 below and are illustrated in Figure 27.

The traffic specialist has concluded that the current level of service on the R380 are considered to be very good and are predicted to operate at acceptable levels of service as part of the proposed project. It is however important to note that while the current intersection to the Gloria Mine is considered to be very good, the traffic specialist has concluded that this intersection will require upgrading in terms of road safety and intersection functionality in order to cater for the proposed project. In this regard, refer to Section 4.2.1 for the details around the proposed upgrade.

TABLE 35: INTERSECTIONS RELEVANT TO THE PROPOSED PROJECT

Intersection	Description	Intersection control	Pedestrian Activities
A	Gloria Mine Access Road and Proposed Mine Access Road	Free-flow on Road R380	Pedestrians loaded and off-loaded
B	Hotazel Western Access Road and Airfield Access Road	Free-flow on Road R380	Pedestrians loaded and off-loaded
C	Hotazel Eastern Access Road and Kudumane Mine Access Road	Free-flow on Road R380	Pedestrians loaded and off-loaded

TABLE 36: ROAD CHARACTERISTICS (SIYAZI, MARCH 2015)

Relevant Road Section	Access spacing	Road Reserve	Number of Lanes	Lane Width	Type Of Surface	Anticipated Traffic Growth Per Annum	Speed Limit
Road Section 1 (Road R380) - Road link between Black Rock and Kuruman	600m	40m	One lane per direction	3.7m wide, 1.3m shoulder	Asphalt	4%	80km/h to 100 km/h
Road Section 2 (Access to Kudumane Mine) - Provides access to mining developments from and to Road R380	200 to 500m	30m	One lane per direction	3.7m wide	Asphalt	4%	80 km/h

Relevant Road Section	Access spacing	Road Reserve	Number of Lanes	Lane Width	Type Of Surface	Anticipated Traffic Growth Per Annum	Speed Limit
Road Section 3 (Hotazel Eastern Access Road) - Provides eastern part of Hotazel access from and to Road R380	200 to 500m	30m	One lane per direction	3.7m wide	Asphalt	4%	60km/h
Road Section 4 (Hotazel Western Access Road) - Provides western part of Hotazel access from and to Road R380	200 to 500m	30m	One lane per direction	3.7m wide	Asphalt	4%	60 km/h

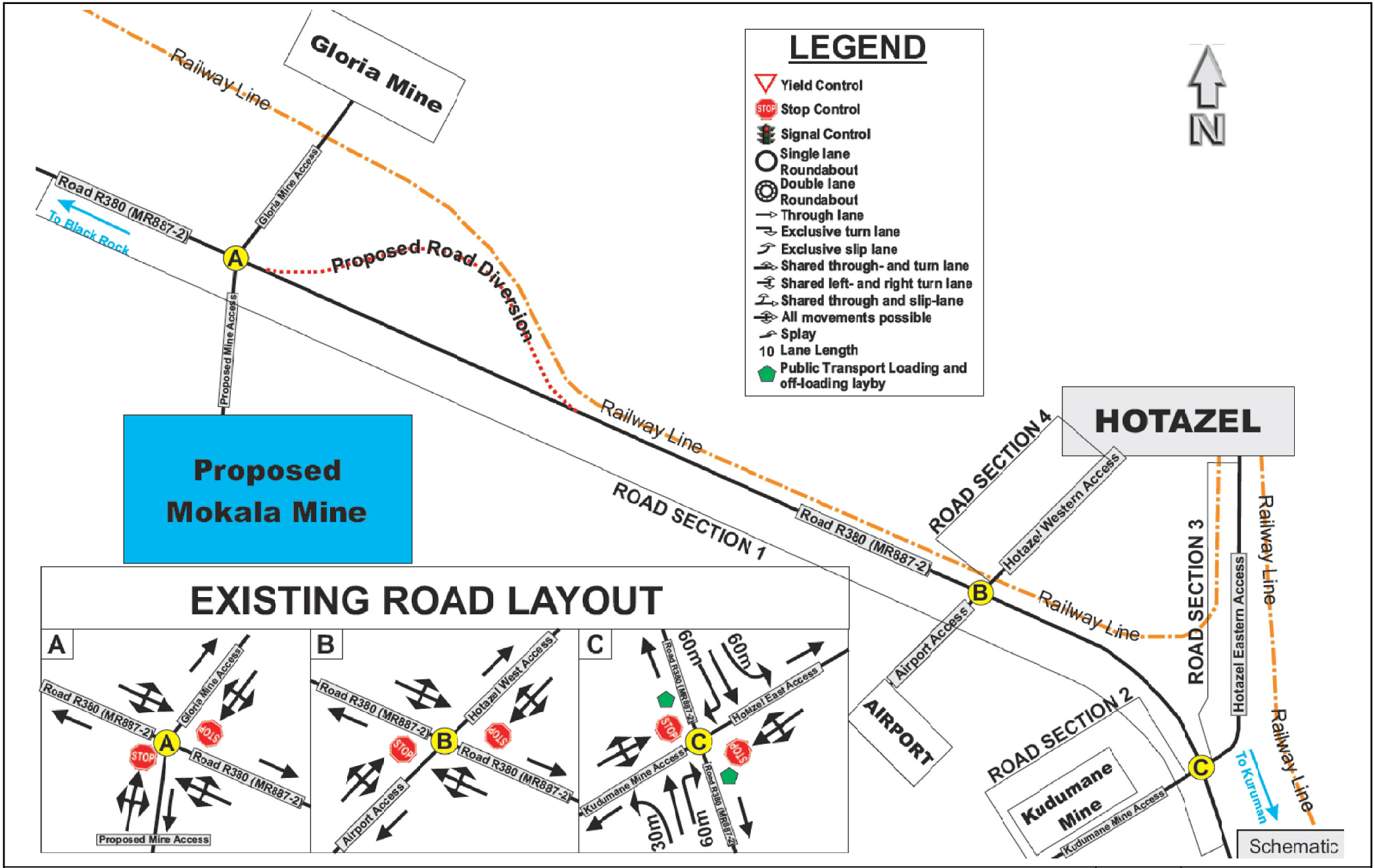
Peak-hour traffic counts were conducted for intersections along the R380 (Table 37). The peak-hour traffic flow at the relevant intersections shows a general increase in traffic volumes during the morning (PM) peak period on the assessed day (a Friday) (Table 37). With reference to Section 7.4.2, numerous mining operations are located within the general Hotazel area. In this regard, a greater number of trucks transporting ore from mines and/or trucks arriving at mines to collect ore was noted in the peak-morning hours.

TABLE 37: PEAK-HOUR TRAFFIC COUNTS AT THE RELEVANT INTERSECTIONS ALONG THE R380 (SIYAZI, MARCH 2015)

Intersection	Description	Am peak		Pm peak	
		Time interval	Number of vehicles	Time interval	Number of vehicles
A	Gloria Mine Access Road and Proposed Mine Access Road	05:30 – 06:30	438	13:00 – 14:00	299
B	Hotazel Western Access Road and Airfield Access Road	05:30 – 06:30	429	13:00 – 14:00	350
C	Hotazel Eastern Access Road and Kudumane Mine Access Road	05:30 – 06:30	470	13:00 – 14:00	375

CONCLUSION

Traffic along the R380 in the vicinity of the proposed project area is freeflow and this will need to be maintained. The intersection to the Gloria mine which will also form the entrance to the proposed project area will need to be upgraded as part of the proposed project. Any changes to the road network or designs of traffic management measures will need consider both road capacity and safety-related issues.



EXISTING ROAD NETWORK LAYOUT
(SIYAZI, MARCH 2015)

10/2015	
710.02038.00001	FIGURE 27

7.4.1.13 Heritage/cultural and palaeontological resources

INTRODUCTION AND LINK

This section describes the existing status of the heritage and cultural environment that may be affected by the proposed project. Heritage (and cultural) resources include all human-made phenomena and intangible products that are the result of the human mind. Natural, technological or industrial features may also be part of heritage resources as places that have made an outstanding contribution to the cultures, traditions and lifestyles of the people or groups of people of South Africa.

Paleontological resources are fossils, the remains or traces of prehistoric life preserved in the geological (rock stratigraphic) record. They range from the well-known and well publicized (such as dinosaur and mammoth bones) to the more obscure but nevertheless scientifically important fossils (such as palaeobotanical remains, trace fossils, and microfossils). Paleontological resources include the casts or impressions of ancient animals and plants, their trace remains (for example, burrows and trackways), microfossils (for example, fossil pollen, ostracodes, and diatoms), and unmineralised remains (for example, bones of Ice Age mammals).

DATA SOURCE

Information was sourced from the review of available heritage/cultural (PGS, May 2013) and desktop palaeontological (Gideon Groenewald, April 2013) studies undertaken for the farm Gloria 266 as part of prospecting activities. In addition to this, information was sourced from the review of an available heritage/cultural study (PGS, July 2014) undertaken for a neighbouring mine on the farm Kipling 271.

In addition to the above information was sourced from the heritage/cultural study undertaken on the farm Kipling 271 and Umtu 281 (PGS, October 2015) as part of the proposed project and included in Appendix Q.

As part of the heritage/cultural and palaeontological studies information was sourced from the review of available literature and through on-site observations.

RESULTS

Resources of historical importance are mostly restricted to relatively recent farming and mining activities. Stone Age arteficts also occur in the region (particularly near drainage lines) due to the historical presence of southern African hunter-gatherer communities typical of arid Northern Cape landscape. A number of heritage resources were identified within the proposed project area as indicated in Table 38. The location of the heritage sites within the proposed project area are illustrated in Figure 28. The significance of each site as per the SAHRA classification standards is also provided in Table 38.

TABLE 38: HERITAGE RESOURCES LOCATED WITHIN THE PROPOSED PROJECT AREA

Site identification	Description	Significance
GL1	Middle stone age site: Low density scatter of lithics consisting of side scrapers and triangular flakes.	Low heritage significance
GL 2	Middle stone age site: Low density scatter of lithics consisting of side scrapers and triangular flakes.	Low heritage significance
HMK 1	Middle stone age and late stone age: Low density scatter of lithics manufactured from hornfels and jasper material and is generally rough flakes	Low heritage significance
HMK 2	Middle and late stone age: Site extends approximately 220m and as such is illustrated as HKM2a and KHM2b on Figure 28. Site included lithics consisting of raw materials such as red and brown jasper as well as quartzite and quarts	Low to medium heritage significance
HKM3	Middle stone age: Low density scatter of lithics	Low heritage significance

The palaeontological sensitivity of the proposed project area is found to be low, however there is a possibility that the Hotazel Formation manganese ore body could contain stromatolites. Taking this into consideration it is possible that fossil resources may be found at the proposed project site. These resources are protected by the National Heritage Resources Act (No 25 of 1999) and may not be affected (demolished, altered, renovated, removed) without approval.

CONCLUSION

Although no palaeontological resources were found on site, there is a possibility that the Hotazel Formation manganese ore body could contain stromatolites and this should be taken into account during the planning and development phases of the proposed project. Numerous middle and late stone age resources were identified within the proposed project area which are important to the history of South Africa and are protected by national legislation and require permits from the SAHRA prior to disturbance. It is however important to note that while heritage sites within the proposed project area are protected, according to the SAHRA classification standards, sites of low heritage significance can be destroyed without obtaining permits.

-10000

N

To Van Zylsrus

Gloria 266

Kipling 271

Umtu 281

Hotazel 280

Ga-Mogara

R380

GL2

GL1

HMK2A

HMK1

HMK2B

HMK3

-10000

Legend

- Heritage September 2015
- Heritage Sites
- Proposed Infrastructure
- Proposed Road Re-Alignment of R380
- Proposed Open Pit Area
- Farm Boundaries
- Rivers

0 200 400 Meters

Scale: 1:10 000 @ A3

Projection:Transverse Mercator
Datum: Hartebeeshoek, Lo 23

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Figure 28

Heritage Sites Located Within the Proposed Project Area

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710.0912.00001

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7.4.1.14 Socio-economic

INTRODUCTION AND LINK

The proposed project has the potential to result in both positive and negative socio-economic impacts. The positive impacts are usually economic in nature with mines contributing directly towards employment, procurement, skills development and taxes on a local, regional and national scale. In addition, mines indirectly contribute to economic growth in the national, local and regional economies by strengthening the national economy and because the increase in the number of income earning people has a multiplying effect on the trade of other goods and services in other sectors.

The negative impacts can be both social and economic in nature. In this regard, mines can cause:

- Influx of people seeking job opportunities which can lead to increased pressure on basic infrastructure and services (housing, health, sanitation and education), informal settlement development, increased crime, introduction of diseases and disruption to the existing social structures within communities
- A change to not only pre-existing land uses, but also the associated social structure and meaning associated with these land uses and way of life. This is particularly relevant in the closure phase when the economic support provided by mines ends, the natural resources that were available to the pre-mining society are reduced, and the social structure that has been transformed to deal with the threats and opportunities associated with mining finds it difficult to readapt

DATA SOURCE

Information in this section was sourced from the Social and Labour Plan (MTS, January 2015). As part of the SLP, socio-economic profile data was sourced from the John Taolo Gaetsewe District Municipality (JTGDM) and the Joe Morolong Local Municipality (JMLM) Integrated Development Plans.

RESULTS

Population

The Northern Cape Province has a population number of 1 145 861. The JTDGM has a population number of 224 797 while JMLM has a total population of 89 531 people. The Hotazel community has a total of approximately 1 755 people.

Dwellings

The most dominant type of dwelling utilized within the Northern Cape Province, the JTGDM, the JMLM and Hotazel is a formally constructed house or brick structure. This consists of 76% in the Northern Cape Province, 73% within the JTGDM, 71% within the JMLM and 82% within Hotazel. Traditional dwellings (e.g. huts/ structures made of traditional material) are the second highest used dwelling type with percentages ranging from 12% to 22% within the JTGDM and the JMLM respectively. No traditional

dwellings are located within the town Hotazel, rather the second highest used dwelling type is flats. The second highest dwelling type within the Northern Cape Province is informal dwellings (eg. shacks).

The population profile of the Northern Cape Province, JTGDM and JMLM demonstrates a consistent average household size of four people per household despite the significant decline in population numbers between the regional levels as reflected in Table 39 below. The local community of Hotazel has a slightly more favourable household size with an average of three members per household. These results are relatively typical of rural or semi-rural developing communities, however the low household density within Hotazel may be attributed to the fact that the town is largely a mining community established for and servicing surrounding mines.

TABLE 39: SOCIO ECONOMIC PROFILE - POPULATION

Category	Northern Cape Province	John Taolo Gaetsewe District Municipality	Joe Morolong Local Municipality	Hotazel
Number of households	301 405	61 330	23 707	600
Average number of people per household	4	4	4	3

Basic services

In general, despite the relatively formalized housing infrastructure, basic services infrastructure appears to be far less formalized. With reference to Table 40, majority of the Northern Cape Province have access to flush toilets and Hotazel primarily utilising the flush toilets, however the JTGDM and the JMLM mostly make use of pit toilets. Similarly, while in general the Northern Cape Province and Hotazel have access to piped water inside dwellings and yards, a large percentage of households rely on piped water to community stands at varying distances from their dwellings in both the JTGDM and the JMLM (Table 40). A total of 64% of the households in the Northern Cape Province have their waste removed by the local municipality or a private company once a week. This depicts that basic services are not provided to the whole province, with 36% of the province not receiving refuse removal services (Table 42). The occurrence of refuse removal by the JTGDM and JMLM constitutes only 26% and 6% of households respectively, however Hotazel is largely (96%) receiving the required services (Table 42).

In general, Hotazel is well formalised in terms of basic services. This may be attributed to the Hotazel area being more urbanized having been developed and supported by surrounding mines in recent years.

TABLE 40:SOCIO-ECONOMIC PROFILE – TOILET FACILITIES

Category	Northern Cape Province	John Taolo Gaetsewe District Municipality	Joe Morolong Local Municipality	Hotazel
None	8%	9%	10%	1%

Category	Northern Cape Province	John Taolo Gaetsewe District Municipality	Joe Morolong Local Municipality	Hotazel
Flush toilet (connected to sewerage system)	60%	26%	6%	97%
Flush toilet (with septic tank)	6%	3%	1%	1%
Chemical toilet	1%	1%	2%	0%
Pit toilet with ventilation (VIP)	9%	22%	40%	0%
Pit toilet without ventilation	11%	34%	37%	1%
Bucket toilet	4%	2%	2%	0%
Other	2%	2%	2%	1%

TABLE 41: SOCIO-ECONOMIC PROFILE– POTABLE WATER ACCESS

Category	Northern Cape Province	John Taolo Gaetsewe District Municipality	Joe Morolong Local Municipality	Hotazel
Piped (tap) water inside dwelling/institution	46%	23%	9%	89%
Piped (tap) water inside yard	32%	18%	7%	11%
Piped (tap) water on community stand: distance less than 200m from dwelling/institution	13%	35%	50%	0%
Piped (tap) water on community stand: distance between 200m and 500m from dwelling/institution	4%	13%	18%	0%
Piped (tap) water on community stand: distance between 500m and 1000m (1km) from dwelling /institution	2%	5%	5%	0%
Piped (tap) water on community stand: distance greater than 1000m (1km) from dwelling/institution	1%	3%	4%	0%
No access to piped (tap) water	3%	4%	8%	0%

TABLE 42: SOCIO-ECONOMIC PROFILE – REFUSE REMOVAL

Category	Northern Cape Province	John Taolo Gaetsewe District Municipality	Joe Morolong Local Municipality	Hotazel
Removed by local authority/private company at least once a week	64%	26%	6%	96%
Removed by local authority/private company less often	2%	1%	1%	1%
Communal refuse dump	2%	2%	1%	0%
Own refuse dump	25%	59%	80%	2%
No rubbish disposal	5%	7%	11%	1%
Other	2%	4%	1%	0%
Unspecified	0%	0%	0%	0%
Not applicable	0%	0%	0%	0%

Education

In general, statistics throughout the identified regions indicate poor educational profiles. With reference to Table 43, significant numbers of the population have received no schooling (9% of JTGDM, 13% of

JMLM and 8% of the Northern Cape Province) or only limited primary education (35% of JTGDM, 42% of JMLM, 33% of Northern Cape Province and 22% of Hotazel). The average number across the regions profiled of people completing high school education were relatively consistent (on average 25%) however there is greater disparity when considering Grade 12 education, further education and training and tertiary education. The education profile within Hotazel is more positive in terms of the percentage of the population that have received further education and tertiary education when compared to the Northern Cape Province, the JGDM and the JMLM.

TABLE 43: SOCIO-ECONOMIC PROFILE – EDUCATION

Category	Northern Cape Province	John Taolo Gaetsewe District Municipality	Joe Morolong Local Municipality	Hotazel
No Schooling	8%	9%	13%	3%
Primary School	33%	35%	42%	22%
High School	28%	24%	21%	27%
Grade 12 / Std 10 / Form 5	14%	12%	7%	17%
Further Education and Training	1%	2%	0%	5%
Tertiary Education	4%	4%	2%	14%
Not applicable	12%	14%	15%	13%
Other	0%	0%	0%	0 %

Economic profile

Majority of the population within the Northern Cape, JGDM and JMLM are not economically active, while 48% of the Hotazel population is employed (Table 44). In general, Table 44 is an indication of the job scarcity of the area.

TABLE 44: SOCIO-ECONOMIC PROFILE – EMPLOYMENT

Category	Northern Cape Province	John Taolo Gaetsewe District Municipality	Joe Morolong Local Municipality	Hotazel
Employed	25%	19%	9%	48%
Unemployed	9%	8%	5%	5%
Discouraged work-seeker	3%	5%	7%	2%
Other not economically active	27%	29%	33%	23%
Not applicable	36%	39%	46%	23%

CONCLUSION

In general mining activities has the potential to influence socio-economic conditions both positively and negatively. In terms of the proposed project, positive socio-economic influences include contributions in various ways to the local and regional economies while negative socio-economic influences include inward migration of people with the resultant pressure on basic infrastructure and services, informal

settlement development, increased crime, introduction of diseases and disruption to the existing social structures within established communities.

7.4.2 CURRENT LAND USES

INTRODUCTION AND LINK

Mining activities have the potential to affect land uses both within the project area and in the surrounding areas. This can be caused by physical land transformation and through direct or secondary impacts. The key related potential environmental impacts are: loss of soil, loss of biodiversity, pollution of water, dewatering, air pollution, noise pollution, damage from blasting, visual impacts and the influx of job seekers with related social ills. To understand the basis of the potential land use impacts, a baseline situational analysis is described below.

DATA SOURCE

Information provided in this section was sourced by SLR as part of the proposed project. Mining right and land ownership details were sourced from Mokala and a deed search undertaken by SLR as part of the proposed project. On-site and surrounding land use data was sourced from site observations, and the review of topographical maps and satellite imagery.

RESULTS – MINERAL AND PROSPECTING RIGHTS

Mokala currently holds a prospecting right (NC30/5/1/1/2/1250PR) over the remaining extent of the farm Gloria 266. Mokala is still undertaking prospecting related activities on the remaining extent of the farm Gloria 266.

Kalagadi Manganese (Pty) Ltd currently holds a mining right over the farm Umtu 281 and Assmang (Pty) Ltd currently holds a mining right over portion 1 of the farm Gloria 266. Kudumane Manganese (Pty) Ltd has applied for a mining right on the farms Kipling 271 and Hotazel 280.

RESULTS - EXISTING ENVIRONMENTAL AUTHORISATIONS IN TERMS OF NEMA

Assmang (Pty) Ltd currently holds an environmental authorisation (NC/EIA/JTG/ASS/HOT/2010 / NCP/EIA/0000030/2011) in terms of NEMA on the remaining extent of the farm Gloria and the farm Kipling 271. Kudumane has submitted an application for environmental authorisation (NC/EIAl05/JTG/HOT/KUD/2013 / NCP/EIAl0000219/20I3) in terms of NEMA on the farm Kipling 271 and Hotazel 280. This environmental authorisation is still pending.

RESULTS - LAND OWNERS WITHIN THE PROPOSED PROJECT AREA

The surface right owners and corresponding title deeds numbers of the land in and adjacent to the proposed project area is listed in Table 45 and Table 46 respectively.

TABLE 45: LANDOWNERS LOCATED WITHIN THE PROPOSED PROJECT AREA

Relevant farms	Relevant portion	Title deed number	Landowner
Gloria 266	Remaining extent	T1488/2011	Ntsimbintle Mining Pty Ltd
	Portion 1	T506/1966	Assmang Pty Ltd
Kipling 271	Whole farm	T953/1968	Assmang Pty Ltd
Umtu 281	Whole farm	T2793/2010	Kalagadi Manganese Pty Ltd

TABLE 46: LANDOWNERS ADJACENT TO THE PROPOSED PROJECT AREA

Relevant farms	Relevant portion	Title deed number	Landowner
Mukulu 265	Whole farm	T288/1956	Assmang Pty Ltd
Olive pan 282	Portion 0	T2793/2010	Kalagadi Manganese Pty Ltd
	Portion 1	T2123/1992	Louw Pretorius van der Walt
Gasesa 272	Portion 0	T175/2010	Tsineng Communal Property Association
Langdon 273	Whole farm	T613/2007	Moshaweng Local Municipality
Hotazel 280	Portion 0	T3049/2010	Hotazel Manganese Mines (Pty) Ltd
	Portion 1	T170/1985	Kerkraad van die gemeente Kalahari to Hotazel
	Portion 2	T1414/1991	Telkom SA (Ltd)
	Portion 3	T643/2009	Samancor Manganese (Pty) Ltd
Nchwaning 267	Portion 0	T1492/1970	Engela Elizabeth Reynecke
	Portion 3	T1491/1970	Assmang Pty Ltd
	Portion 6	T1761/1989	Republic of South Africa
East 270	Portion 0	T791/2002	Nicolaas Jacobus Pretorius
	Portion 1	T1998/2004	Sishen Iron Ore Company (Pty) Ltd
	Portion 2	T3469/2013	Nicolaas Jacobus Pretorius

RESULTS - LAND CLAIMS

According to the Department of Rural Development and Land Reform: Regional Land Claim Commissioner; a land claim has been lodged on the farm Kipling 271 (Appendix E). The claimant is the Tsineng Communal Property Association.

No land claims have been lodged on the remaining extent and portion 1 of the farm Gloria 266 and the farm Umtu 281 (Appendix E).

RESULTS – LAND USE WITHIN THE PROPOSED PROJECT AREA

Land use within the proposed project area includes mining activities and infrastructure associated with neighbouring mines, road and Telkom line infrastructure, historical mined out areas and ad-hoc game and cattle grazing. This is discussed in more details below.

Neighbouring mines

Mining companies with existing and/or proposed operations located within the proposed project area include:

- Assmang (Pty) Ltd (Gloria Mine) – Located on portion 1 of the farm Gloria 266
- Kalagadi Manganese (Pty) Ltd (Kalagadi Mine) – Located on the farm Umtu 281
- Kudumane Manganese (Pty) Ltd (Kudumane Mine) – Located on the farm Kipling 271

Road infrastructure

The tarred R380 (refer to Figure 30), that runs between the towns Black Rock and Kathu traverses the proposed project site. As part of the proposed project this road will be realigned. Negotiations between Mokala and the Northern Cape Department of Roads and Public Works are underway. It is important to note that it is the Northern Cape Department of Roads and Public Works intention to transfer the responsibility of the maintenance of the R380 to the South African National Roads Agency (SANRAL).

Regional Telkom line infrastructure

A Telkom line currently runs parallel to the R380 and is not located within an existing servitude. As part of the proposed project, Mokala is proposing on diverting this Telkom line to follow the proposed R380 realignment route. Negotiations between Mokala and Telkom regarding the realignment of this Telkom line are underway.

Historical mined out areas

The south eastern section of the proposed project site has been influenced by historical borrow pit activities to remove calcrete in order to establish the R380 by the Department of Roads and Public Works (Figure 30). In addition to this, other areas of disturbance include the old crusher yard that was utilised by Mokala as part of prospecting activities.

Ad-hoc game and cattle grazing

The far western section of the remaining extent of the farm Gloria 266 is currently utilised for game farming by Kalagadi Mine (Figure 30). This area has been fenced off from the rest of the remaining extent of the farm Gloria 266. The rest of the remaining extent of the farm Gloria 266 was utilised for cattle grazing and game in the past. The farm Kipling 271 is currently used for ad-hoc grazing.

RESULTS – LAND USE SURROUNDING THE PROPOSED PROJECT AREA

Land use surrounding the proposed project area includes mining activities and infrastructure associated with active and dormant mines, road and rail networks, powerlines, communities/towns and isolated farmsteads. This is discussed in more details below.

Mines surrounding the proposed project area

Mining companies surrounding the proposed project area include the following (Figure 29):

- United Manganese of Kalahari (Pty) Ltd (United Manganese of Kalahari Mine) – Located approximately 14km south east from the boundary of the proposed project area
- Tshipi é Ntle Manganese (Pty) Ltd (Tshipi Borwa Mine) – Located approximately 20km south southeast from the boundary of the proposed project area
- BHP Billiton (Mamatwan Mine) - Located approximately 20km south east from the boundary of the proposed project area
- Assmang (Pty) Ltd (Nchwaning Mine) – Located approximately 9km north west from the boundary of the proposed project area
- Assmang (Pty) Ltd (Black Rock Mine) – Located approximately 8.5km north west from the boundary of the proposed project area
- BHP Billiton (Wessels Mine) – Located approximately 8km north northwest from the boundary of the proposed project area

Numerous dormant/closed mines are also located within the area surrounding the proposed project area. These include the following (Figure 29):

- The old Hotazel Mine located approximately 4.5km south east from the boundary of the proposed project site
- The old Black Rock Mine located approximately 8km north west from the boundary of the proposed project site
- The old Devon Mine located approximately 8km south east from the boundary of the proposed project site
- The old York Mine located approximately 7km south south east from the boundary of the proposed project area
- The old Perth located approximately 12km south east from the boundary of the proposed project area
- The old Smartt Mine located approximately 14km south east from the boundary of the proposed project area
- The old Middelplaats Mine located approximately 19km south from the boundary of the proposed project area
- The old Adams Mine located approximately 24km south east from the boundary of the proposed project area

Existing operating mines in the area has resulted in the escalation of land value in the region over the past few years. It is however important to note, that post closure, agricultural activities can be resumed and the property value can therefore be restored but will likely be a lower value due to past mining activities.

Communities/towns and isolated farmsteads

With reference to Figure 29 the nearest residential areas include the following:

- The Hotazel town situated approximately 4km south east from the boundary of the proposed project area
- The Black Rock community located approximately 8km north west from the boundary of the proposed project area
- Gloria Mine village located approximately 1.3km north of the proposed project area
- Black Rock mine village located approximately 5km north west of the proposed project area
- Isolated farmstead located approximately 5.3 km south west from the boundary of the proposed project site
- Isolated farmstead located approximately 5 km north from the boundary of the proposed project site
- Isolated farmstead located approximately 5km west from the boundary of the proposed project area
- Isolated homestead located approximately 6.5km west from the boundary of the proposed project area
- Isolated farmstead located approximately 6.2 km north east from the boundary of the proposed project site
- The town Kuruman located approximately 57km to the south east from the boundary of the proposed project area
- The town Kathu located approximately 63km to the south from the boundary of the proposed project area

The Hotazel Town Planning Board with input from BHP Billiton are planning on extending the Hotazel residential area onto the farms Hotazel 280 and Kipling 281 in a westerly and northerly direction respectively. It must be noted that the expansion plan will have to take into consideration all surrounding land uses including the imminent Kudumane mine plan for the same properties. In this regard the closest potential mining operations would be the proposed Kudumane operations.

No informal settlements are located in immediate proximity to the proposed project area.

Regional powerline infrastructure

A regional powerline is located approximately 800m north east of the proposed project area (Figure 30).

Regional railway infrastructure

A railway line connecting Kathu, Hotazel and Black Rock runs along the east of the proposed project area and is located within an existing servitude (Figure 30).

Local Road Network

A network of roads surrounding the proposed project area (refer to Figure 30) include:

- The tarred R31 between Kuruman and Van Zylsrus
- The R380 between Black Rock and Hotazel
- The D3336 road which runs through the project area (linking the R31 and the project site). A portion of this road has been closed.
- The D3340 dirt road which branches off the D3336 road to the south of the site and runs past UMK mine towards the R380
- Various un-tarred farm access roads

CONCLUSION

There are a number of land uses which may be influenced by the proposed project and associated potential environmental impacts. It should however be noted that areas within and surrounding the proposed project site have already been significantly influenced through mining and related infrastructure, road networks, powerlines, Telkom lines, railway networks and grazing activities.

7.4.3 DESCRIPTION OF SPECIFIC ENVIRONMENTAL FEATURES AND INFRASTRUCTURE ON THE SITE

The environmental features in the project area are described in Section 7.4.1 above, however the notable environmental feature is the Ga-Mogara drainage channel located on the eastern boundary of the proposed project area. Infrastructure within and close to the project area is discussed in Section 7.4.2 above. The notable infrastructure within the proposed project area is the R380 and Telkom line that traverses the proposed project site.

7.4.4 ENVIRONMENTAL AND CURRENT LAND USE MAP(S)

The environmental features in the project area are described in Section 7.4.1 above, however the notable environmental feature is the Ga-Mogara drainage channel located on the eastern boundary of the proposed project area. Infrastructure within and close to the project area is discussed in Section 7.4.2 above. The notable infrastructure within the proposed project area is the R380 and Telkom line that traverses the proposed project site.

7.4.5 ENVIRONMENT AND CURRENT LAND USE MAP

A conceptual map showing topographical information as well as land uses on and immediately surrounding the proposed project area is provided in Figure 29 and Figure 30.

Legend

- Proposed Project Area
- Closed/Dormant Mines
- Operating Manganese Mines
- Potential Receptors
- High Urban Density
- Low Urban Density
- Cultivated Land
- Historical Borrow Pits
- Rivers
- Powerline
- Railway
- Roads

0 2 4 Kilometers

Scale: 1:150 000 @ A3

Projection:Transverse Mercator
Datum: Hartebeeshoek, Lo 23

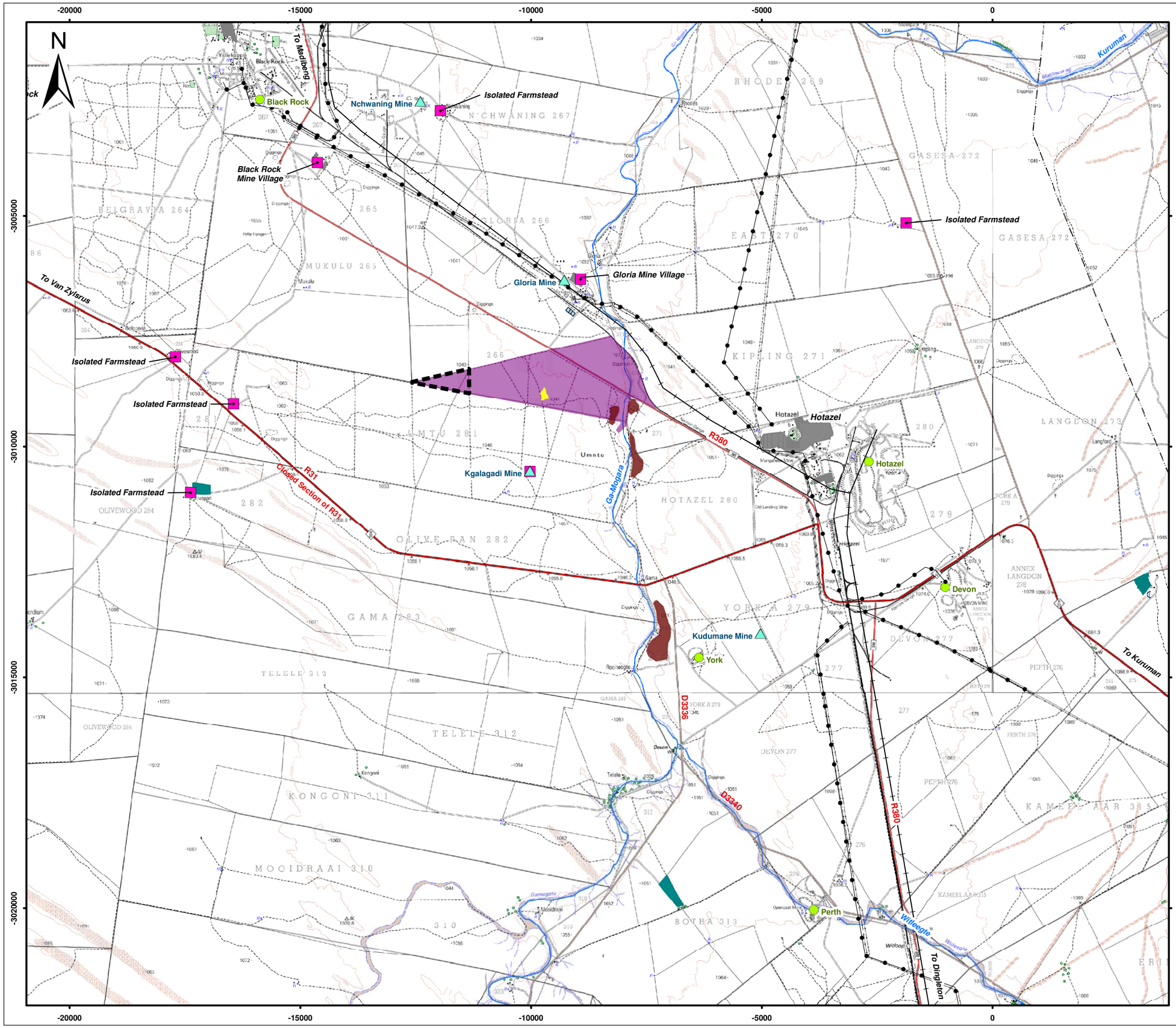
MOKALA MANGANESE (PTY) LTD

Figure 29

Regional Land Use Map

SLR Consulting (Africa) (Pty) Ltd
P O Box 1596, Cramerview, 2060, South Africa
Tel: +27 (11) 467-0945 Fax: +27 (11) 467-0978

720.0912.00001 | October 2015



Scale: 1:80 000 @ A3

Projection:Transverse Mercator
Datum: Hartebeeshoek, Lo 23

MOKALA MANGANESE (PTY) LTD

Figure 30

Local Land Use Map

SLR Consulting (Africa) (Pty) Ltd
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720.0912.00001 | October 2015

7.5 ENVIRONMENTAL IMPACTS AND RISKS OF THE ALTERNATIVES

This section provides a list of potential impacts on environmental and socio-economic aspects that have been identified in respect of each of the main project actions / activities and processes for each of the project phases (Table 3) in terms of the **project alternatives**. A discussion of the negative and positive impacts of the project alternatives is provided in Section 7.7. The ratings for consequence, probability and significance of each of the impacts in the **unmitigated scenario** (which assumes that no consideration is given to the prevention or reduction of environmental and social impacts) are also provided in the table below in accordance with the new DMR report template.

TABLE 47: LIST OF IMPACTS IDENTIFIED FOR THE PROPOSED PROJECT INCLUDING ALTERNATIVES

The assessment ratings provided in this table are for the unmitigated scenario only which assumes that no consideration is given to the prevention or reduction of environmental and social impacts.

Potential impact	Alternative	Project phases	Consequence			Probability	Significance	Degree to which impact		
			Severity	Duration	Spatial scale			Can be reversed	Causes irreplaceable loss of resources	Can be avoided/ Managed/ Mitigated
Site preparation										
Hazardous excavations and infrastructure that can be harmful to people and animals	1 and 2	Construction Operation Decommissioning	H	H	M	H	H	Fully	Possible	Can be managed/mitigated to acceptable levels
Physical destruction of biodiversity			H	H	M	H	H	Partially		
General disturbance of biodiversity			M	H	M	H	H	Partially		
Pollution from emissions to air			H	H	M	H	H	Fully		
Noise pollution			H	H	M	H	M	Fully	Unlikely	
Negative visual impacts			M	H	M	L	M	Fully		
Loss of or damage to heritage/palaeontological resources	1		M	H	L	L	L	Partially	Possible	Can be avoided
	2		M	H	L	M	M	Cannot be reversed if destroyed	Irreplaceable loss	Cannot be avoided, managed or mitigated if destroyed
Positive socio – economic impacts (Economic impact)	1 and 2		H^+	H	H	H	H^+	Fully	Possible	Can be managed/mitigated to acceptable levels
Negative socio – economic impacts (Inward migration)			H	H	M	M	H	Fully		
Change in land use			H	H	M	H	H	Fully		
Earthworks										

Potential impact	Alternative	Project phases	Consequence			Probability	Significance	Degree to which impact		
			Severity	Duration	Spatial scale			Can be reversed	Causes irreplaceable loss of resources	Can be avoided/ Managed/ Mitigated
Hazardous excavations and infrastructure that can be harmful to people and animals	1 and 2	Construction Operation Decommissioning	H	H	M	H	H	Fully	Possible	Can be managed/mitigated to acceptable levels
Loss of soil resources and land capability through pollution			M	H	L	H	M	Fully		
Loss of soil resources and land capability through physical disturbance			H	H	L	H	H	Fully		
Physical destruction of biodiversity			H	H	M	H	H	Partially		
General disturbance of biodiversity			M	H	M	H	H	Partially		
Contamination of surface water resources			H	H	M	M	H	Fully		
Alteration of natural drainage patterns (Loss from containment infrastructure and encroachment to Ga-Mogara)			M	H	M	H	H	Fully		
Alteration of natural drainage patterns (River realignment)		Construction	H	H	M	H	H	Fully		
Contamination of groundwater resources		Construction Operation Decommissioning	H	H	M	H	H	Fully		
Pollution from emissions to air			H	H	M	H	H	Fully		
Noise pollution			H	H	M	H	M	Fully	Unlikely	
Negative visual impacts			M	H	M	L	M	Fully		
Loss of or damage to heritage/palaeontological resources	1		M	H	L	L	L	Partially	Possible	Can be avoided
	2		M	H	L	M	M	Cannot be reversed if destroyed	Irreplaceable loss	Cannot be avoided, managed or mitigated if destroyed
Positive socio – economic impacts (Economic	1 and 2		H^+	H	H	H	H^+	Fully	Possible	Can be

Potential impact	Alternative	Project phases	Consequence			Probability	Significance	Degree to which impact		
			Severity	Duration	Spatial scale			Can be reversed	Causes irreplaceable loss of resources	Can be avoided/ Managed/ Mitigated
impact)										managed/mitigated to acceptable levels
Negative socio – economic impacts (Inward migration)			H	H	M	M	H	Fully		
Change in land use			H	H	M	H	H	Fully		
Civil works										
Hazardous excavations and infrastructure that can be harmful to people and animals	1 and 2	Construction Operation Decommissioning	H	H	M	H	H	Fully	Possible	Can be managed/mitigated to acceptable levels
Loss of soil resources and land capability through pollution			M	H	L	H	M	Fully		
Contamination of surface water resources			H	H	M	M	H	Fully		
Alteration of natural drainage patterns (Loss from containment infrastructure and encroachment to Ga-Mogara)			M	H	M	H	H	Fully		
Alteration of natural drainage patterns (River realignment)		Construction	H	H	M	H	H	Fully		
Contamination of groundwater resources		Construction Operation Decommissioning	H	H	M	H	H	Fully		
Pollution from emissions to air			H	H	M	H	H	Fully		
Noise pollution			H	H	M	H	M	Fully	Unlikely	
Negative visual impacts			M	H	M	L	M	Fully		
Positive socio – economic impacts (Economic impact)			H^+	H	H	H	H^+	Fully	Possible	
Negative socio – economic impacts (Inward migration)			H	H	M	M	H	Fully		
Change in land use			H	H	M	H	H	Fully		
Open pit mining										
Loss and sterilization of mineral resources	1 and 2	Construction	H	H	M	H	H	Fully	Possible	Can be

Potential impact	Alternative	Project phases	Consequence			Probability	Significance	Degree to which impact		
			Severity	Duration	Spatial scale			Can be reversed	Causes irreplaceable loss of resources	Can be avoided/ Managed/ Mitigated
Hazardous excavations, surface subsidence and infrastructure that can be harmful to people and animals		Operation Decommissioning	H	H	M	H	H	Fully		managed/mitigated to acceptable levels
Loss of soil resources and land capability through pollution			M	H	L	H	M	Fully		
Loss of soil resources and land capability through physical disturbance			H	H	L	H	H	Fully		
Physical destruction of biodiversity			H	H	M	H	H	Partially		
General disturbance of biodiversity			M	H	M	H	H	Partially		
Contamination of surface water resources			H	H	M	M	H	Fully		
Alteration of natural drainage patterns (Loss from containment infrastructure and encroachment to Ga-Mogara)			M	H	M	H	H	Fully		
Alteration of natural drainage patterns (River realignment)		Construction	H	H	M	H	H	Fully		
Contamination of groundwater resources		Construction	H	H	M	H	H	Fully		
Reducing groundwater levels and availability (Pit dewatering and abstraction of water from boreholes)	N/A	Operation Decommissioning	H	M	M	M	H	Fully		
Reducing groundwater levels and availability (Pit dewatering)		Operation	H	M	M	M	H	Fully		
Pollution from emissions to air	1 and 2	Construction	H	H	M	H	H	Fully		
Increase in disturbing noise levels		Operation Decommissioning	H	H	M	H	M	Fully	Unlikely	
Blasting related impacts (Air blasts, ground		Operational	H	H	H	M	H	Fully	Possible	

Potential impact	Alternative	Project phases	Consequence			Probability	Significance	Degree to which impact		
			Severity	Duration	Spatial scale			Can be reversed	Causes irreplaceable loss of resources	Can be avoided/ Managed/ Mitigated
vibration and fly rock)										
Negative visual impacts		Construction	M	H	M	L	M	Fully	Unlikely	
Loss of or damage to heritage/palaeontological resources	1	Operation	M	H	L	L	L	Partially	Possible	Can be avoided
	2	Decommissioning	M	H	L	M	M	Cannot be reversed if destroyed	Irreplaceable loss	Cannot be avoided, managed or mitigated if destroyed
Positive socio – economic impacts (Economic impact)	1 and 2		H^+	H	H	H	H^+	Fully	Possible	Can be managed/mitigated to acceptable levels
Negative socio – economic impacts (Inward migration)			H	H	M	M	H	Fully		
Change in land use			H	H	M	H	H	Fully		
Processing plant										
Hazardous excavations and infrastructure that can be harmful to people and animals	1 and 2	Construction Operation Decommissioning	H	H	M	H	H	Fully	Possible	Can be managed/mitigated to acceptable levels
Loss of soil resources and land capability through pollution			M	H	L	H	M	Fully		
Loss of soil resources and land capability through physical disturbance			H	H	L	H	H	Fully		
Physical destruction of biodiversity			H	H	M	H	H	Partially		
General disturbance of biodiversity			M	H	M	H	H	Partially		
Contamination of surface water resources			H	H	M	M	H	Fully		
Alteration of natural drainage patterns (Loss from containment infrastructure)			M	H	M	H	H	Fully		
Contamination of groundwater resources			H	H	M	H	H	Fully		
Pollution from emissions to air			H	H	M	H	H	Fully		

Potential impact	Alternative	Project phases	Consequence			Probability	Significance	Degree to which impact		
			Severity	Duration	Spatial scale			Can be reversed	Causes irreplaceable loss of resources	Can be avoided/ Managed/ Mitigated
Increase in disturbing noise levels			H	H	M	H	M	Fully	Unlikely	
Negative visual impacts			M	H	M	L	M	Fully		
Loss of or damage to heritage/palaeontological resources	1		M	H	L	L	L	Partially	Possible	Can be avoided
	2		M	H	L	M	M	Cannot be reversed if destroyed		Cannot be avoided, managed or mitigated if destroyed
Positive socio – economic impacts (Economic impact)	1 and 2		H^+	H	H	H	H^+	Fully		Can be managed/mitigated to acceptable levels
Negative socio – economic impacts (Inward migration)			H	H	M	M	H	Fully		
Change in land use			H	H	M	H	H	Fully		
Transport systems										
Hazardous excavations and infrastructure that can be harmful to people and animals	1 and 2	Construction Operation Decommissioning	H	H	M	H	H	Fully	Possible	Can be managed/mitigated to acceptable levels
Loss of soil resources and land capability through pollution			M	H	L	H	M	Fully		
Loss of soil resources and land capability through physical disturbance			H	H	L	H	H	Fully		
Physical destruction of biodiversity			H	H	M	H	H	Partially		
General disturbance of biodiversity			M	H	M	H	H	Partially		
Contamination of surface water resources			H	H	M	M	H	Fully		
Alteration of natural drainage patterns (Loss from containment infrastructure and encroachment to Ga-Mogara)			M	H	M	H	H	Fully		
Alteration of natural drainage patterns (River		Construction	H	H	M	H	H	Fully		

Potential impact	Alternative	Project phases	Consequence			Probability	Significance	Degree to which impact		
			Severity	Duration	Spatial scale			Can be reversed	Causes irreplaceable loss of resources	Can be avoided/ Managed/ Mitigated
realignment)										
Contamination of groundwater resources		Construction Operation Decommissioning	H	H	M	H	H	Fully		
Pollution from emissions to air			H	H	M	H	H	Fully		
Noise pollution			H	H	M	H	M	Fully	Unlikely	
Disturbance of roads by project related traffic			H	H	M	M	H	Fully	Possible	
Negative visual impacts			M	H	M	L	M	Fully		
Loss of or damage to heritage/palaeontological resources	1		M	H	L	L	L	Partially		Can be avoided
	2		M	H	L	M	M	Cannot be reversed if destroyed	Irreplaceable loss	Cannot be avoided, managed or mitigated if destroyed
Positive socio – economic impacts (Economic impact)	1 and 2		H^+	H	H	H	H^+	Fully	Possible	Can be managed/mitigated to acceptable levels
Negative socio – economic impacts (Inward migration)			H	H	M	M	H	Fully		
Change in land use			H	H	M	H	H	Fully		
Power supply and use										
Hazardous excavations and infrastructure that can be harmful to people and animals	1 and 2	Construction Operation Decommissioning	H	H	M	H	H	Fully	Possible	Can be managed/mitigated to acceptable levels
Loss of soil resources and land capability through pollution			M	H	L	H	M	Fully		
Loss of soil resources and land capability through physical disturbance			H	H	L	H	H	Fully		
Physical destruction of biodiversity			H	H	M	H	H	Partially		
General disturbance of biodiversity			M	H	M	H	H	Partially		
Contamination of surface water resources			H	H	M	M	H	Fully		

Potential impact	Alternative	Project phases	Consequence			Probability	Significance	Degree to which impact		
			Severity	Duration	Spatial scale			Can be reversed	Causes irreplaceable loss of resources	Can be avoided/ Managed/ Mitigated
Alteration of natural drainage patterns (Loss from containment infrastructure and encroachment to Ga-Mogara)			M	H	M	H	H	Fully		
Alteration of natural drainage patterns (River realignment)		Construction	H	H	M	H	H	Fully		
Contamination of groundwater resources		Construction Operation Decommissioning	H	H	M	H	H	Fully		
Pollution from emissions to air			H	H	M	H	H	Fully		
Noise pollution			H	H	M	H	M	Fully	Unlikely	
Negative visual impacts			M	H	M	L	M	Fully		
Loss of or damage to heritage/palaeontological resources	1		M	H	L	L	L	Partially	Possible	Can be avoided
	2		M	H	L	M	M	Cannot be reversed if destroyed	Irreplaceable loss	Cannot be avoided, managed or mitigated if destroyed
Positive socio – economic impacts (Economic impact)	1 and 2		H^+	H	H	H	H^+	Fully	Possible	Can be managed/mitigated to acceptable levels
Negative socio – economic impacts (Inward migration)			H	H	M	M	H	Fully		
Change in land use			H	H	M	H	H	Fully		
Water supply and use										
Hazardous excavations and infrastructure that can be harmful to people and animals	1 and 2	Construction Operation Decommissioning	H	H	M	H	H	Fully	Possible	Can be managed/mitigated to acceptable levels
Loss of soil resources and land capability through pollution			M	H	L	H	M	Fully		
Loss of soil resources and land capability through physical disturbance			H	H	L	H	H	Fully		

Potential impact	Alternative	Project phases	Consequence			Probability	Significance	Degree to which impact		
			Severity	Duration	Spatial scale			Can be reversed	Causes irreplaceable loss of resources	Can be avoided/ Managed/ Mitigated
Physical destruction of biodiversity			H	H	M	H	H	Partially		
General disturbance of biodiversity			M	H	M	H	H	Partially		
Contamination of surface water resources			H	H	M	M	H	Fully		
Alteration of natural drainage patterns (Loss from containment infrastructure and encroachment to Ga-Mogara)			M	H	M	H	H	Fully		
Alteration of natural drainage patterns (River realignment)		Construction	H	H	M	H	H	Fully		
Contamination of groundwater resources		Construction						Fully		
Lowering of groundwater levels (Only applicable if abstraction from boreholes takes place)	N/A	Operation Decommissioning	H	M	M	M	M	Fully		
Negative visual impacts	1 and 2		M	H	M	L	M	Fully	Unlikely	
Loss of or damage to heritage/palaeontological resources	1		M	H	L	L	L	Partially	Possible	Can be avoided
	2		M	H	L	M	M	Cannot be reversed if destroyed	Irreplaceable loss	Cannot be avoided, managed or mitigated if destroyed
Positive socio – economic impacts (Economic impact)	1 and 2		H^+	H	H	H	H^+	Fully	Possible	Can be managed/mitigated to acceptable levels
Negative socio – economic impacts (Inward migration)			H	H	M	M	H	Fully		
Change in land use			H	H	M	H	H	Fully		
Mineralised waste										
Loss and sterilization of mineral resources	1 and 2	Construction	H	H	M	H	H	Fully	Possible	Can be managed/mitigated
Hazardous excavations and infrastructure that		Operation	H	H	M	H	H	Fully		

Potential impact	Alternative	Project phases	Consequence			Probability	Significance	Degree to which impact		
			Severity	Duration	Spatial scale			Can be reversed	Causes irreplaceable loss of resources	Can be avoided/ Managed/ Mitigated
can be harmful to people and animals		Decommissioning								to acceptable levels
Loss of soil resources and land capability through pollution			M	H	L	H	M	Fully		
Loss of soil resources and land capability through physical disturbance			H	H	L	H	H	Fully		
Physical destruction of biodiversity			H	H	M	H	H	Partially		
General disturbance of biodiversity			M	H	M	H	H	Partially		
Contamination of surface water resources			H	H	M	M	H	Fully		
Alteration of natural drainage patterns (Loss from containment infrastructure and encroachment to Ga-Mogara)			M	H	M	H	H	Fully		
Alteration of natural drainage patterns (River realignment)		Construction	H	H	M	H	H	Fully		
Contamination of groundwater resources		Construction	H	H	M	H	H	Fully		
Pollution from emissions to air		Operation	H	H	M	H	H	Fully		
Noise pollution		Decommissioning	H	H	M	H	M	Fully	Unlikely	
Negative visual impacts			M	H	M	L	M	Fully		
Loss of or damage to heritage/palaeontological resources	1		M	H	L	L	L	Partially	Possible	Can be avoided
	2		M	H	L	M	M	Cannot be reversed if destroyed	Irreplaceable loss	Cannot be avoided, managed or mitigated if destroyed
Positive socio – economic impacts (Economic impact)	1 and 2		H^+	H	H	H	H^+	Fully	Possible	Can be managed/mitigated to acceptable levels
Negative socio – economic impacts (Inward migration)			H	H	M	M	H	Fully		

Potential impact	Alternative	Project phases	Consequence			Probability	Significance	Degree to which impact		
			Severity	Duration	Spatial scale			Can be reversed	Causes irreplaceable loss of resources	Can be avoided/ Managed/ Mitigated
Change in land use			H	H	M	H	H	Fully		
Non-mineralised waste management (general and hazardous)										
Loss of soil resources and land capability through pollution	1 and 2	Construction Operation Decommissioning	M	H	L	H	M	Fully	Possible	Can be managed/mitigated to acceptable levels
Loss of soil resources and land capability through physical disturbance			H	H	L	H	H	Fully		
Physical destruction of biodiversity			H	H	M	H	H	Fully		
General disturbance of biodiversity			M	H	M	H	H	Partially		
Contamination of surface water resources			H	H	M	M	H	Partially		
Alteration of natural drainage patterns (Loss from containment infrastructure and encroachment to Ga-Mogara)			M	H	M	H	H	Fully		
Alteration of natural drainage patterns (River realignment)		Construction	H	H	M	H	H	Fully		
Contamination of groundwater resources		Construction Operation Decommissioning	H	H	M	H	H	Fully		
Pollution from emissions to air			H	H	M	H	H	Fully		
Noise pollution			H	H	M	H	M	Fully	Unlikely	
Negative visual impacts			M	H	M	L	M	Fully		
Loss of or damage to heritage/palaeontological resources	1		M	H	L	L	L	Partially	Possible	Can be avoided
	2		M	H	L	M	M	Cannot be reversed if destroyed	Irreplaceable loss	Cannot be avoided, managed or mitigated if destroyed
Positive socio – economic impacts (Economic impact)	1 and 2		H^+	H	H	H	H^+	Fully	Possible	Can be managed/mitigated to acceptable levels
Negative socio – economic impacts (Inward			H	H	M	M	H	Fully		

Potential impact	Alternative	Project phases	Consequence			Probability	Significance	Degree to which impact		
			Severity	Duration	Spatial scale			Can be reversed	Causes irreplaceable loss of resources	Can be avoided/ Managed/ Mitigated
migration)										
Change in land use			H	H	M	H	H	Fully		
Support services										
Hazardous excavations and infrastructure that can be harmful to people and animals	1 and 2	Construction Operation Decommissioning	H	H	M	H	H	Fully	Possible	Can be managed/mitigated to acceptable levels
Loss of soil resources and land capability through pollution			M	H	L	H	M	Fully		
Loss of soil resources and land capability through physical disturbance			H	H	L	H	H	Fully		
Physical destruction of biodiversity			H	H	M	H	H	Partially		
General disturbance of biodiversity			M	H	M	H	H	Partially		
Contamination of surface water resources			H	H	M	M	H	Fully		
Alteration of natural drainage patterns (Loss from containment infrastructure and encroachment to Ga-Mogara)			M	H	M	H	H	Fully		
Alteration of natural drainage patterns (River realignment)		Construction	H	H	M	H	H	Fully		
Contamination of groundwater resources		Construction Operation Decommissioning	H	H	M	H	H	Fully		
Pollution from emissions to air			H	H	M	H	H	Fully		
Noise pollution			H	H	M	H	M	Fully	Unlikely	
Negative visual impacts			M	H	M	L	M	Fully		
Loss of or damage to heritage/palaeontological resources	1		M	H	L	L	L	Partially	Possible	Can be avoided
	2		M	H	L	M	M	Cannot be reversed if destroyed	Irreplaceable loss	Cannot be avoided, managed or mitigated if destroyed

Potential impact	Alternative	Project phases	Consequence			Probability	Significance	Degree to which impact		
			Severity	Duration	Spatial scale			Can be reversed	Causes irreplaceable loss of resources	Can be avoided/ Managed/ Mitigated
Positive socio – economic impacts (Economic impact)	1 and 2		H^+	H	H	H	H^+	Fully	Possible	Can be managed/mitigated to acceptable levels
Negative socio – economic impacts (Inward migration)			H	H	M	M	H	Fully		
Change in land use			H	H	M	H	H	Fully		
General site management										
Loss of soil resources and land capability through pollution	1 and 2	Construction Operation Decommissioning	M	H	L	H	M	Fully	Possible	Can be managed/mitigated to acceptable levels
Loss of soil resources and land capability through physical disturbance			H	H	L	H	H	Fully		
Physical destruction of biodiversity			H	H	M	H	H	Partially		
General disturbance of biodiversity			M	H	M	H	H	Partially		
Contamination of surface water resources			H	H	M	M	H	Fully		
Alteration of natural drainage patterns (Loss from containment infrastructure and encroachment to Ga-Mogara)			M	H	M	H	H	Fully		
Alteration of natural drainage patterns (River realignment)		Construction	H	H	M	H	H	Fully		
Contamination of groundwater resources		Construction Operation Decommissioning	H	H	M	H	H	Fully		
Pollution from emissions to air			H	H	M	H	H	Fully		
Negative visual impacts			M	H	M	L	M	Fully	Unlikely	
Loss of or damage to heritage/palaeontological resources	1		M	H	L	L	L	Partially	Possible	Can be avoided
	2		M	H	L	M	M	Cannot be reversed if destroyed	Irreplaceable loss	Cannot be avoided, managed or mitigated if destroyed

Potential impact	Alternative	Project phases	Consequence			Probability	Significance	Degree to which impact		
			Severity	Duration	Spatial scale			Can be reversed	Causes irreplaceable loss of resources	Can be avoided/ Managed/ Mitigated
Positive socio – economic impacts (Economic impact)	1 and 2		H^+	H	H	H	H^+	Fully	Possible	Can be managed/mitigated to acceptable levels
Negative socio – economic impacts (Inward migration)			H	H	M	M	H	Fully		
Change in land use			H	H	M	H	H	Fully		
Demolition										
Hazardous excavations and infrastructure that can be harmful to people and animals	1 and 2	Construction Operation Decommissioning	H	H	M	H	H	Fully	Possible	Can be managed/mitigated to acceptable levels
Loss of soil resources and land capability through pollution			M	H	L	H	M	Fully		
Loss of soil resources and land capability through physical disturbance			H	H	L	H	H	Fully		
Physical destruction of biodiversity			H	H	M	H	H	Partially		
General disturbance of biodiversity			M	H	M	H	H	Partially		
Contamination of surface water resources			H	H	M	M	H	Fully		
Alteration of natural drainage patterns (Loss from containment infrastructure and encroachment to Ga-Mogara)			M	H	M	H	H	Fully		
Contamination of groundwater resources			H	H	M	H	H	Fully		
Pollution from emissions to air			H	H	M	H	H	Fully		
Noise pollution			H	H	M	H	M	Fully	Unlikely	
Negative visual impacts			M	H	M	L	M	Fully		
Loss of or damage to heritage/palaeontological resources	1		M	H	L	L	L	Partially	Possible	Can be avoided
	2		M	H	L	M	M	Cannot be reversed if destroyed	Irreplaceable loss	Cannot be avoided, managed or mitigated if

Potential impact	Alternative	Project phases	Consequence			Probability	Significance	Degree to which impact		
			Severity	Duration	Spatial scale			Can be reversed	Causes irreplaceable loss of resources	Can be avoided/ Managed/ Mitigated
										destroyed
Positive socio – economic impacts (Economic impact)	1 and 2		H^+	H	H	H	H^+	Fully	Possible	Can be managed/mitigated to acceptable levels
Negative socio – economic impacts (Inward migration)			H	H	M	M	H	Fully		
Change in land use			H	H	M	H	H	Fully		
Rehabilitation										
Hazardous excavations, surface subsidence and infrastructure that can be harmful to people and animals	1 and 2	Construction Operation Decommissioning	H	H	M	H	H	Fully	Possible	Can be managed/mitigated to acceptable levels
Loss of soil resources and land capability through pollution			M	H	L	H	M	Fully		
Loss of soil resources and land capability through physical disturbance			H	H	L	H	H	Fully		
Physical destruction of biodiversity			H	H	M	H	H	Partially		
General disturbance of biodiversity			M	H	M	H	H	Partially		
Contamination of surface water resources			H	H	M	M	H	Fully		
Alteration of natural drainage patterns (Loss from containment infrastructure and encroachment to Ga-Mogara)			M	H	M	H	H	Fully		
Contamination of groundwater resources			H	H	M	H	H	Fully		
Pollution from emissions to air			H	H	M	H	H	Fully		
Noise pollution			H	H	M	H	M	Fully	Unlikely	
Negative visual impacts			M	H	M	L	M	Fully		
Loss of or damage to heritage/palaeontological resources	1		M	H	L	L	L	Partially	Possible	Can be avoided
	2		M	H	L	M	M	Cannot be	Irreplaceable loss	Cannot be avoided,

Potential impact	Alternative	Project phases	Consequence			Probability	Significance	Degree to which impact		
			Severity	Duration	Spatial scale			Can be reversed	Causes irreplaceable loss of resources	Can be avoided/ Managed/ Mitigated
								reversed if destroyed		managed or mitigated if destroyed
Positive socio – economic impacts (Economic impact)	1 and 2		H^+	H	H	H	H^+	Fully	Possible	Can be managed/mitigated to acceptable levels
Negative socio – economic impacts (Inward migration)			H	H	M	M	H	Fully		
Change in land use			H	H	M	H	H	Fully		
Maintenance and aftercare										
Hazardous excavations and infrastructure that can be harmful to people and animals	1 and 2	Construction Operation Decommissioning Closure	H	H	M	H	H	Fully	Possible	Can be managed/mitigated to acceptable levels
Loss of soil resources and land capability through pollution			M	H	L	H	M	Fully		
Loss of soil resources and land capability through physical disturbance			H	H	L	H	H	Fully		
Physical destruction of biodiversity			H	H	M	H	H	Partially		
General disturbance of biodiversity			M	H	M	H	H	Partially		
Contamination of surface water resources			H	H	M	M	H	Fully		
Alteration of natural drainage patterns (Loss from containment infrastructure and encroachment to Ga-Mogara)			M	H	M	H	H	Fully		
Contamination of groundwater resources			H	H	M	H	H	Fully		
Pollution from emissions to air			H	H	M	H	H	Fully		
Negative visual impacts			M	H	M	L	M	Fully	Unlikely	
Loss of or damage to heritage/palaeontological resources	1		M	H	L	L	L	Partially	Possible	Can be avoided
	2		M	H	L	M	M	Cannot be	Irreplaceable loss	Cannot be avoided,

Potential impact	Alternative	Project phases	Consequence			Probability	Significance	Degree to which impact		
			Severity	Duration	Spatial scale			Can be reversed	Causes irreplaceable loss of resources	Can be avoided/ Managed/ Mitigated
								reversed if destroyed		managed or mitigated if destroyed
Positive socio – economic impacts (Economic impact)	1 and 2		H^+	H	H	H	H^+	Fully	Possible	Can be managed/mitigated to acceptable levels
Negative socio – economic impacts (Inward migration)			H	H	M	M	H	Fully		
Change in land use			H	H	M	H	H	Fully		

7.6 METHODOLOGY USED IN DETERMINING THE SIGNIFICANCE OF ENVIRONMENTAL IMPACTS

The method for the assessment of environmental issues is set out in the Table 48 below. Part A in Table 48 below provides a list of criteria that can be selected in order to rank the severity, duration and spatial scale of an impact. The consequence of the impact is determined by combining the selected criteria ratings allocated for severity, spatial scale and duration in part B of Table 48. The significance of the impact is determined in Part C of Table 48 whereby the consequence determined in part B is combined with the probability of the impact occurring. The interpretation of the impact significance is given in Part D.

This assessment methodology enables the assessment of environmental issues including: cumulative impacts, the severity of impacts (including the nature of impacts and the degree to which impacts may cause irreplaceable loss of resources), the extent of the impacts, the duration and reversibility of impacts, the probability of the impact occurring, and the degree to which the impacts can be mitigated. This assessment method was used to assess impacts associated with all project alternatives.

TABLE 48: CRITERIA FOR ASSESSING IMPACTS

PART A: DEFINITION AND CRITERIA*		
Definition of SIGNIFICANCE		**Significance = consequence x probability**
Definition of CONSEQUENCE		**Consequence is a function of severity, spatial extent and duration**
Criteria for ranking of the SEVERITY of environmental impacts	**H**	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action.
	M	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints.
	L	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	L+	Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	M+	Moderate improvement. Will be within or better than the recommended level. No observed reaction.
	H+	Substantial improvement. Will be within or better than the recommended level. Favourable publicity.
Criteria for ranking the DURATION of impacts	**L**	Quickly reversible. Less than the project life. Short term
	M	Reversible over time. Life of the project. Medium term
	H	Permanent. Beyond closure. Long term.
Criteria for ranking the SPATIAL SCALE of impacts	**L**	Localised - Within the site boundary.
	M	Fairly widespread – Beyond the site boundary. Local
	H	Widespread – Far beyond site boundary. Regional/ national

PART B: DETERMINING CONSEQUENCE

SEVERITY = L

DURATION	Long term	**H**	**Medium**	**Medium**	**Medium**
	Medium term	**M**	**Low**	**Low**	**Medium**
	Short term	**L**	**Low**	**Low**	**Medium**

SEVERITY = M					
DURATION	Long term	**H**	**Medium**	**High**	**High**
	Medium term	**M**	**Medium**	**Medium**	**High**
	Short term	**L**	**Low**	**Medium**	**Medium**
SEVERITY = H					
DURATION	Long term	**H**	**High**	**High**	**High**
	Medium term	**M**	**Medium**	**Medium**	**High**
	Short term	**L**	**Medium**	**Medium**	**High**
			L	**M**	**H**
			Localised Within site boundary Site	Fairly widespread Beyond site boundary Local	Widespread Far beyond site boundary Regional/ national
			SPATIAL SCALE		
PART C: DETERMINING SIGNIFICANCE					
PROBABILITY (of exposure to impacts)	Definite/ Continuous	**H**	**Medium**	**Medium**	**High**
	Possible/ frequent	**M**	**Medium**	**Medium**	**High**
	Unlikely/ seldom	**L**	**Low**	**Low**	**Medium**
			L	**M**	**H**
			CONSEQUENCE		

PART D: INTERPRETATION OF SIGNIFICANCE	
Significance	**Decision guideline**
High	It would influence the decision regardless of any possible mitigation.
Medium	It should have an influence on the decision unless it is mitigated.
Low	It will not have an influence on the decision.

***H = high, M= medium and L= low and + denotes a positive impact.**

7.7 POSITIVE AND NEGATIVE IMPACTS IN TERMS OF SITE LAYOUT ALTERNATIVES

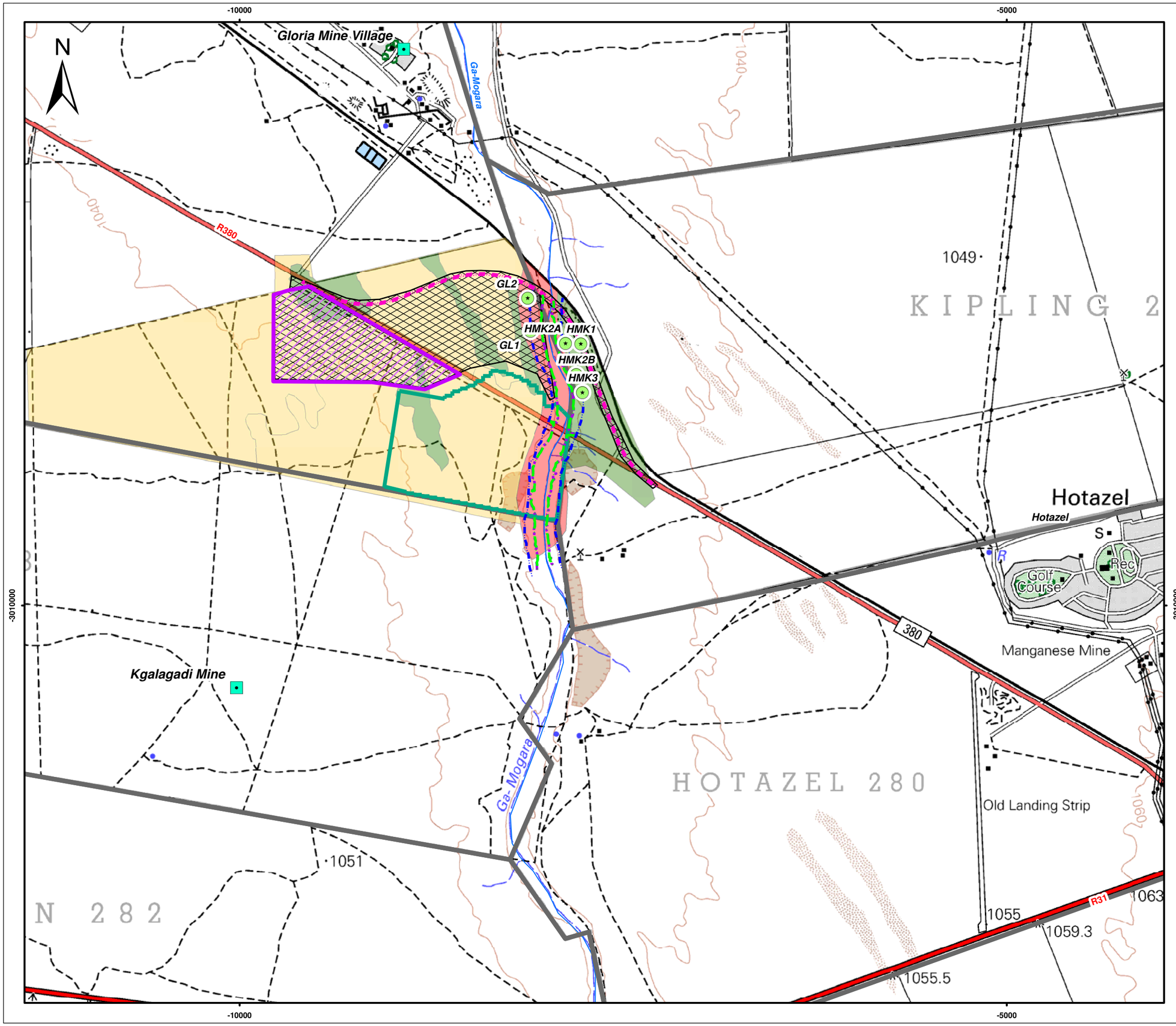
With reference to Section 7.1.3, two site layout alternatives were considered as part of the proposed project. In this regard, Option 1 includes the location of the proposed infrastructure to the south of the existing R380 (Figure 31). Option 2 includes the realignment of the R380 and the location of the proposed infrastructure to the north and south of the current R380 (Figure 31). A basic alternative selection matrix was compiled in order to provide a discussion in terms of the advantages and disadvantages of the site layout options. Table 49 presents the results of the related selection matrix process. The ranking system is a simple two score relative ranking system. For each criterion, a score of one is allocated to the best option and a score of two to the worst. The option with the lowest total score is the preferred option. It is important to note that the discussion around the advantages and disadvantages of the preferred site layout in the table below is also informed by the impacts and risks identified for the site layout options as outlined in Table 47.

TABLE 49: POSITIVE AND NEGATIVE IMPACTS ASSOCIATED WITH SITE LAYOUT ALTERNATIVES

Criteria	Relative ranking		Advantages and disadvantages
	Option 1	Option 2	
Biodiversity (terrestrial and aquatic fauna, flora)	1	2	Option 1 is located in a combination of low and medium sensitive biodiversity areas (*S. mellifera woodland,* Mixed *Vachellia* Savannah and *Vachellia haematoxylon* Savannah vegetation types) as illustrated in Figure 31. Option 2 is located in a combination of high, medium and low biodiversity sensitive areas (*S. mellifera woodland,* Mixed *Vachellia* Savannah, Riverine vegetation and *Vachellia haematoxylon* Savannah vegetation types) as illustrated in Figure 31. It is however important to note that with reference to Table 47, the impacts and risks associated with the physical destruction and general disturbance of biodiversity are considered to be high in the unmitigated scenario for both site layout options. The reason for this is that the open pit is located in the high biodiversity sensitive Riverine vegetation and the disturbance of this area is unavoidable given that the ore body is fixed and as such the sensitive riverine vegetation will be disturbed regardless of the site layout options. Taking the above into consideration, option 1 has a slight advantage when compared to option 2 as it does not disturb the high sensitive Riverine vegetation area, but this vegetation type will still be disturbed due to the location of the ore body.
Heritage resources	1	2	The advantage of option 1 is that it will not require the disturbance of any heritage resources (Figure 31). The disadvantage of site layout option 2 is that it will require the destruction of heritage site HMK1. It is however important to note that heritage site HMK1 is considered to be of low significance from a heritage/cultural perspective and according to the heritage specialist can be destroyed without any permits.
Soils and land capability	1	1	Soil type Clovelley is located within both proposed infrastructure option areas. The related land capability is grazing for both proposed infrastructure options (Terra Africa, April 2015). With reference to Table 47, the impact of the loss of soil resources and land capability is high for both site layout options in the unmitigated scenario. It follows that there are no disadvantages or advantages with either site option when compared together.
Ground water regime and impacts on downstream users	1	1	Both site layout options are underlain by two aquifers, namely a shallow unconfined aquifer comprising Kalahari sands and a deeper fractured aquifer within the Dwyka, Mooidraai and Hotazel formation. No notable geological features were documented at either site layout options. The deeper fractured aquifer might show different characteristics due to potential preferred pathways along dykes and geological contacts. With reference to Table 47 the impact on groundwater resources is high for both site layout options in the unmitigated scenario. It follows that there are no disadvantages or advantages with either site option when

Criteria	Relative ranking		Advantages and disadvantages
	Option 1	Option 2	
			compared together.
Proximity to surface water resources	1	2	The Ga-Mogara drainage channel is located to the east of the proposed project area. Option 1 will not be located within the 1:100 year floodline or within 100m from the Ga-Mogara drainage channel, thereby complying with Regulation 704 (4 June 1999) (Figure 31). In terms of option 2, infrastructure will be located within the 1:100 year floodline and within 100m from the Ga-Mogara drainage channel (Figure 31). It follows that the necessary exemptions will need to be obtained in terms of Regulation 704 (4 June 1999). With reference to Table 47, the alternation of drainage patters for both site layout options is considered to be high without mitigation. The reason for this is that the open pit is will encroach within the 1:100 year floodline and will be within 100m from the Ga-Mogara River and as such encroachment is unavoidable given that the location of the ore body is fixed (Figure 31). Taking the above into consideration, option 1 has a slight advantage when compared to option 2 as it does not encroach onto the Ga-Mogara drainage channel, however encroachment will occur due to the location of the ore body.
Visual impact	1	1	For both site layout options, the proposed plant area is surrounded by existing mining operations to the North, South and South East. It follows that in the context of existing surrounding mining operations both site layout options are not expected to materially influence existing negative visual impacts. It follows that the unmitigated significance of both site layout options is medium (Table 47). No disadvantages or advantages with either site option when compared together.
Proximity to residential areas from a dust and noise perspective	1	1	For both options, the sensitive receptors are the same. Given that both options are located to the north eastern section of the proposed project area, the proximity to residential areas does not differ significantly for there to be a preferred option. No disadvantages or advantages with either site option when compared together.
Sterilization of mineral resources and project viability	2	1	Should Mokala wish to mine underground in the future, Option 1 would sterilise a portion of future mineable resources along the ore body that runs northwest towards the Gloria Mine as it would not be possible to blast beneath the R380. Option 2, allows for the realignment of the R380 and as such underground mining in the future may be a viable option. Further to this, approximately 6 million tons of the ore body extends under the existing R380. The disadvantage of option 1 whereby the R380 was not diverted, the loss of this ore would negatively influence the project viability. If follows that the advantages of Option 2 is that future mineable resources will not be sterilized.

Criteria	Relative ranking		Advantages and disadvantages
	Option 1	Option 2	
Interference with surface infrastructure	2	1	Option 2, will require the realignment of the R380 to allow for the establishment of the proposed infrastructure to the north and south of the current position of the R380. In addition to this, the realignment of the R380 will mean that the existing Telkom line that runs adjacent to the R380 will also need to be realigned. These realignments will require additional negotiations with the relevant departments. It is however important to note, that if the R380 and the Telkom line are not diverted, (Option 1) this infrastructure would be within the blast radius. It follows that this would cause major disruption to existing traffic along R380 as this road would need to be closed during blasting and the blasting activities may damage the surface of the R380 as well as the overhead Telkom lines. Taking the above into consideration the disadvantage of option 2 is that it will take time and cost money to obtain the necessary permits and realign the R380 and Telkom line, however the advantage is that surface infrastructure will not be damaged. While the advantage of option 1 does not require permitting, the disadvantage of option 1 is that surface infrastructure may be damaged.
Change in land use	1	1	For both site layout options, land use will be changed from agricultural to mining. In addition to this the land uses surrounding the proposed project area are the same for both site layout options. It follows that the unmitigated significance of both site layout options is medium (Table 47). No disadvantages or advantages with either site option when compared together.
Economic impact	1	1	The proposed project will contribute towards local, regional and national economies through wages, taxes and profits regardless of the site layout options. It follows that the unmitigated significance of both site layout options is a high positive (Table 47). No disadvantages or advantages with either site option when compared together.
Inward migration	1	1	The proposed project can lead to an influx of job seekers that will place pressure on existing services regardless of the site layout options as this is the nature of mining. It follows that the unmitigated significance of both site layout options is a high (Table 47). No disadvantages or advantages with either site option when compared together.
Space availability	2	1	The disadvantage of Option 1 is that it presents space constraints which limits optimal development options for the placement of infrastructure.
Carbon footprint	2	1	In Option 2 more of the infrastructure is closer to the pit for most of the operational life of mine. This reduces the distances travelled on site which reduces energy requirements and carbon footprint.
Total	**18**	**17**	**Infrastructure layout option 2 is preferred**



Legend

- Alternative Site - Option 1
- Alternative Site - Option 2
- Proposed Open Pit Area
- Farm Boundaries
- Tracks/Paths
- Rivers
- Proposed Road Re-Alignment of R380 (Part of Option 2)
- 100m River Buffer
- 50yr Floodlines
- 100yr Floodlines
- Potential Receptors
- Heritage Sites

Biodiversity Sensitivity

- High
- Moderate
- Low

0 200 400 Meters

Scale: 1:24 000 @ A3

Projection:Transverse Mercator
Datum: Hartebeeshoek, Lo 23

MOKALA MANGANESE (PTY) LTD

Figure 31

Site Layout Alternatives

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710.0912.00001

October 2015

7.8 POSSIBLE MITIGATION MEASURES THAT COULD BE APPLIED AND THE LEVEL OF RESIDUAL RISK

Section 7.3, provides a summary of issues and concerns raised by IAPs as part of the proposed project. This section outlines possible mitigation measures or alternatives that are available to accommodate or address issues and concerns raised by IAPs where relevant. In addition to this, this section will also provide an assessment of the impact or risks associated with the identified possible mitigation measures or alternatives.

TABLE 50: POSSIBLE MITIGATION MEASURES AND ANTICIPATED LEVEL OF RESIDUAL RISK

Issue and concern raised	Possible mitigation measure or alternative to address issue	Impact significance of the possible mitigation measure or alternative before and after mitigation (Section 9)	
		Unmitigated	Mitigated
I am concerned about groundwater availability.	• Due to the nature of mining project that result in dewatering and the abstraction of groundwater, the possible mitigation measures available to manage this impact include: o Conduct groundwater monitoring and implement remedial actions where required. This includes compensation for mine related loss of third party water supply. o This monitoring programme should include third party boreholes.	Low	Low
I am concerned about the impact that the project will have towards groundwater availability.			
My concern about the proposed project is groundwater availability.			
I am concerned about groundwater availability.			
I have boreholes in the area and I am concerned about the impacts that the project will have on existing groundwater levels.			
The Vaal Ga-Mogara pipeline and Kathu are the biggest consumers of Kumba/Sishen water.			
There is a concern that the shallow aquifer is dry. This could be due to the sinkholes upstream at the Kumba Mine. This project will add additional pressure on the existing aquifers which will have an impact on downstream users.			
A major problem in the area is underground water. The river does not flow and aquifers don't get water. In addition, the cumulative impacts by each mine must be calculated. The Kumba Mine is currently the biggest user of groundwater.			
The Ga-Mogara drainage channel has limited surface water run-off. The first aquifer is not replenishing. This has a major impact			

Issue and concern raised	Possible mitigation measure or alternative to address issue	Impact significance of the possible mitigation measure or alternative before and after mitigation (Section 9)	
		Unmitigated	Mitigated
on users as far as Kathu. The proposed project will only add additional pressure.	• Due to the nature of mining project that result in dewatering and the abstraction of groundwater, the possible mitigation measures available to manage this impact include: o Conduct groundwater monitoring and implement remedial actions where required. This includes compensation for mine related loss of third party water supply. o This monitoring programme should include third party boreholes.	Low	Low
Groundwater usage by Mokala will just add more pressure on existing users. More pressure on the Vaal Ga-Mogara pipeline which also affect livestock.			
We would like to know what the cone of depression is for the project taking into account other mines in the area. When considering the other mines in the area, Mokala will cause the existing cone of depression to extend. We are not interested in seeing a site specific cone of depression.			
The groundwater resources in the area are already under pressure. The existing mining companies shift blame where groundwater shortages are concerned. There needs to be a proper way of managing water usage for each mining company in order to assess the cumulative impacts on groundwater.			
I am concerned about the impact that the proposed project will have on existing transport networks.	• Construct safe access points • Educate employees (temporary and permanent) about road safety • Enforce strict vehicle speeds • Upgrade the intersection to the proposed mine which also services the Gloria Mine • Work together with existing mines and relevant authorities to maintain roads • If a person or animal is injured by transport activities an emergency response procedure must be implemented.	High	Medium
If Mokala is intending on mining approximately 1.3 million tonnes of ore per year this means that approximately 300 trucks will be leaving the mine every day. That will require a highway. The existing roads cannot accommodate that number of trucks.			
How much will Mokala contribute to road maintenance? Some mining companies in the area have contributed towards upgrading existing roads. The roads in this area are not designed for heavy vehicles especially trucks.			
I am concerned about housing.	No housing will be established on-site	Low	Low
I am concerned that the proposed project will result in an increase in veld fires.	• Prevention and combatting veld fires though establishment and maintaining of fire breaks and through the education of employees in order to comply with the National Veld and Forest Fire Act	High	Low
The area is well known for veld fires. Will Mokala join other			

Issue and concern raised	Possible mitigation measure or alternative to address issue	Impact significance of the possible mitigation measure or alternative before and after mitigation (Section 9)	
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mining companies in assisting with veld fires?	No. 101 of 1998. • Mokala will work together with surrounding land owners and land users to combat veld fires.		
Has the application for re-zoning of the land been submitted as the current land zoning is agricultural?	• Mokala will submit a re-zoning application to the Joe Morolong Local Municipality in terms of the Northern Cape Planning and Development Act, 1998 (Act No 7 of 1998) or the Spatial Planning and Land Use Management Act No. 16 of 2013, whichever is applicable at the time of submitting the re-zoning application.	Low	Low
When will blasting take place? The law states that blasting should only take place during the day. Mokala should also be aware that there is an existing forum which assists in notifying people of planned blasts. Mitigation measures associated with blasting could disrupt traffic.	• Limit blasting frequency and conduct blasting during daylight hours	High	Medium
The life of mine, being approximately 15 years is a short period for a project with such anticipated impacts, particularly the realignment of the Ga-Mogara drainage channel. We hope that your plan is not to mine, pack up and leave the area dry. Is it really possible to re-establish drainage patterns if soil heaps will be on-site? The impact that the project will have on the river flow must be calculated.	• Obtain the necessary authorisations in terms of the NWA and exemptions in terms of Regulation 704 (4 June 1999) for activities and infrastructure located within 100m or within the 1:100 year floodline of the Ga-Mogara drainage channel • The design of the Ga-Mogara drainage channel must allow for the continuation of natural flow when this occurs • In the event of a flood event, no water will be abstracted from the Ga-Mogara drainage channel • Effective rehabilitation to as close to pre-mining conditions as practically possible.	High	Low
We are concerned that the opencast mine will produce a significant amount of dust especially during blasting. Hotazel is located North East of the proposed project site. Given that the	• Limit disturbed areas • Suppress dust effectively on unpaved roads and at	Medium	Low

Issue and concern raised	Possible mitigation measure or alternative to address issue	Impact significance of the possible mitigation measure or alternative before and after mitigation (Section 9)	
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prevailing wind direction is from the north west, Hotazel will be covered with dust.	material transfer points as required • Monitor pollutants of concern and implement additional mitigation as required • Maintain vehicles and equipment in good working order. • Undertake a carbon footprint assessment.		
Will you determine the carbon footprint of the proposed project? I am aware that it is currently not legislated and thus not mandatory but be aware that it is what the environmental department is moving towards to for future EIA processes.			
This is a dry process. What about Dust suppression?			
What is Mokala's intention regarding the transportation of ore?	Mokala will make use of existing road networks to transport ore to either ports in Durban or Port Elizabeth. As part of the proposed project various alternatives were considered, including the use of rail to transport ore (Section 7.1.4). It is important to note that while road transportation is the preferred option, Mokala will investigate the use of existing load out stations at the Tshipi Borwa Mine, the Kudumane Mine and the Kalagadi Mine as part of the proposed project.	High	Medium
We would prefer if Mokala made use of rail to transport ore as opposed to road.			
Will the proposed mine make use of local labour?	• Employ local people and procure goods and services locally as far as practically possible	High Positive	High Positive
We would like a visual impact assessment to be undertaken for the project. Our concern is lighting at night from the mine.	• Implement effective use of lighting which reduces light spill.	Medium	Low
With reference to the comment above, the primary source of this water is Sishen/Kumba and the source is already strained.	With reference to Section 7.1.4, Mokala investigated the use of groundwater, or sourcing water from the Vaal Ga-Mogara Water Supply Scheme or from neighbouring mines. Sourcing water from groundwater is the preferred option, however based on the outcome of the investigations to date groundwater cannot be the only source of water for the duration of the proposed project. It follows that Mokala will also apply to obtain water from the Vaal Ga-Mogara Water Supply Scheme at such time when groundwater is no longer a reliable	Medium (Only applicable for abstraction from boreholes)	Low (Only applicable for the abstraction of boreholes)
It is strongly advised that Mokala applies to Sedibeng Water to obtain water from the Vaal Ga-Mogara water supply scheme in order to benefit. It was mentioned that one of the water supply alternatives was to source water from neighbouring mines. This will not be possible due to the water shortages in the area.		The project will have no impact on surrounding users if water is obtained from the Vaal Ga-Mogara pipeline. The purpose of the pipeline is to supply water to third parties. If third parties are experiencing water shortages this is a direct	

Issue and concern raised	Possible mitigation measure or alternative to address issue	Impact significance of the possible mitigation measure or alternative before and after mitigation (Section 9)	
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There are many mines requesting access to the Ga-Mogara Pipeline from Sedibeng Water. If Mokala also applies for water from this scheme, more pressure will be placed on the pipeline.	source. Sourcing water from neighbouring mines is not considered to be a viable option, given that this source of water will not be reliable as available water quantities will fluctuate. In addition, neighbouring mines use any water accumulated as part of their mining operations in their existing processes.	impact from Sedibeng Water that has not been able to upgrade the pipeline.	
Assmang undertook a heritage impact assessment during the expansion of the railway bridge. Some stone age tools were found near the Ga-Mogara drainage channel.	• Limit the area of disturbance as far as practically possible • Training of workers about the heritage and cultural sites that may be encountered and about the need to conserve these. • These resources are protected by the National Heritage Resources Act (No 25 of 1999) and may not be affected (demolished, altered, renovated, removed) without approval. In the event that resources are identified, a chance find emergency procedure should be implemented.	Medium	Low
In terms of the water system on-site, will it be a closed loop?	• Develop and implement a stormwater management plan to contain any dirty water and divert clean water away from the site.	High	Low
Please assess what impact the proposed project will have towards the agricultural potential of the project site?	• Limit site clearance to what is absolutely necessary • Develop and implement a soil management plan that addresses soil stripping, stockpiling and use for rehabilitation	High	Medium (Low at closure)
Will there be a biodiversity offset? The report indicated that about 148 ha of natural vegetation would be disturbed as part of the proposed development. It would include realignment of a section of the R380 road and realignment of a section of the Ga-Mogara drainage channel, affecting sensitive areas. Large protected Camel thorn trees (*Acacia (Vachellia) erioloba)* are usually associated with the	• A biodiversity offset is required for the proposed project as more than 1000 protected trees will be removed. Mokala will appoint an independent biodiversity specialist to compile the biodiversity offset in support of the tree removal permit. • Mokala will ensure that no protected trees are	High	Medium

Issue and concern raised	Possible mitigation measure or alternative to address issue	Impact significance of the possible mitigation measure or alternative before and after mitigation (Section 9)	
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riparian vegetation on the banks of the Ga-Mogara River, hence it is anticipated that a large number of protected trees would be destroyed as a result of the proposed activities and that an environmental offset may be required to compensate for the permanent loss of slow growing protected trees.	removed until the necessary tree removal permit has been obtained and the biodiversity offset has been approved by the DAFF.		
A detailed assessment should be undertaken during the EIA phase to provide an accurate estimation of the number of protected trees per size classes, which might be directly affected by the proposed development. Please supply this information to the DAFF (Forestry) as soon as possible.			
Telkom SA SOC Ltd is affected by this proposal. Existing overhead plant is affected between Hotazel and Santoy (Black Rock). If any plant is damaged or must be moved, the cost involved will be repayable. Please note that important overhead route is affected and should be treated as important. On completion of this project, please certify that all requirements as stipulated in this letter have been met. Please note that should any Telkom SA SOC Ltd infrastructure have to be relocated or altered as a result of your activities the cost for such alterations or relocation will be for your account in terms of section 25 of the Electronic Communication Act. This approval is valid for 6 months, after which re-application must be made if the work has not been completed.	• Mokala will ensure that the correct application process is followed in consultation with Telkom • Mokala shall not proceed with any realignment activities without the written approval from Telkom.	Medium	Low

7.9 MOTIVATION WHERE NO ALTERNATIVE SITES WERE CONSIDERED

Not applicable.

7.10 STATEMENT MOTIVATING THE PREFERRED ALTERNATIVE

With reference to Section 7.1, site layout alternatives, water supply and transportation alternatives are were considered as part of the proposed project. A motivation describing the preferred alternatives is provided below.

7.10.1 SITE LAYOUT ALTERNATIVES

With reference to Section 7.1.3, two plant layout alternatives were considered within the eastern section of the proposed project area (refer to Figure 31). Option 1 included the location of the proposed plant to the south of the existing R380. Option 2 included the realignment of the R380 and the location of the proposed plant to the north and south of the current R380. It is however important to note that based on the outcome of the site selection matrix (Table 49), the preferred site layout is option 2 given that option 2 prevents the sterilisation of future mineable resources underlying the R380. In addition to this, if the R380 is not diverted to accommodate the plant layout infrastructure, the R380 may need to be closed periodically during blasting given that the R380 would be within the blasting radius, thereby causing disturbance to existing traffic. In addition to this, option 2 provides the necessary space for optimal development of infrastructure.

7.10.2 WATER SUPPLY ALTERNATIVES

With reference to Section 7.1.4, the preferred water supply alternatives are the use of a combination of on-site groundwater and water from the Vaal Ga-Mogara Water Supply Scheme given that no other reliable water sources are available.

7.10.3 TRANSPORTATION ALTERNATIVES

With reference to Section 7.1.4, three transportation alternatives were considered, these include the following:

- Transportation of ore via road directly to Durban and Port Elizabeth
- Transportation of ore via road to railheads at Lohatla and Glossom from where it would be transported via rail to Durban and Port Elizabeth
- Transportation of ore via road to nearby mines loadout stations.

The preferred option is to transport the ore via road directly to Durban and Port Elizabeth. The use of the railheads at Lohatla and Glossom are currently not an option as these facilities are not equipped to cater for the additional tonnages and the use of loadout stations at nearby mines may only be an option in the near future.