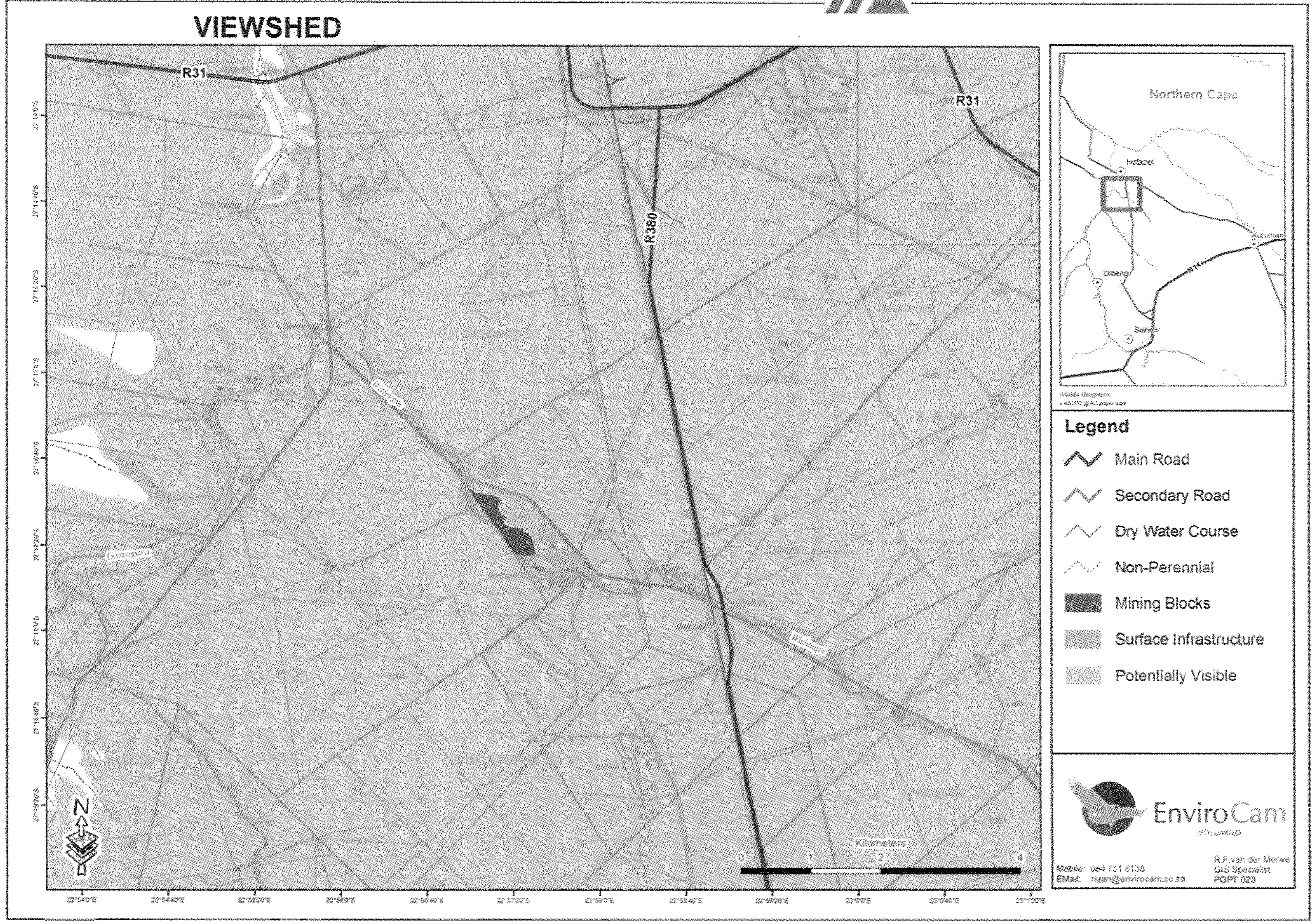

Figure 31 Visual Assessment Observers

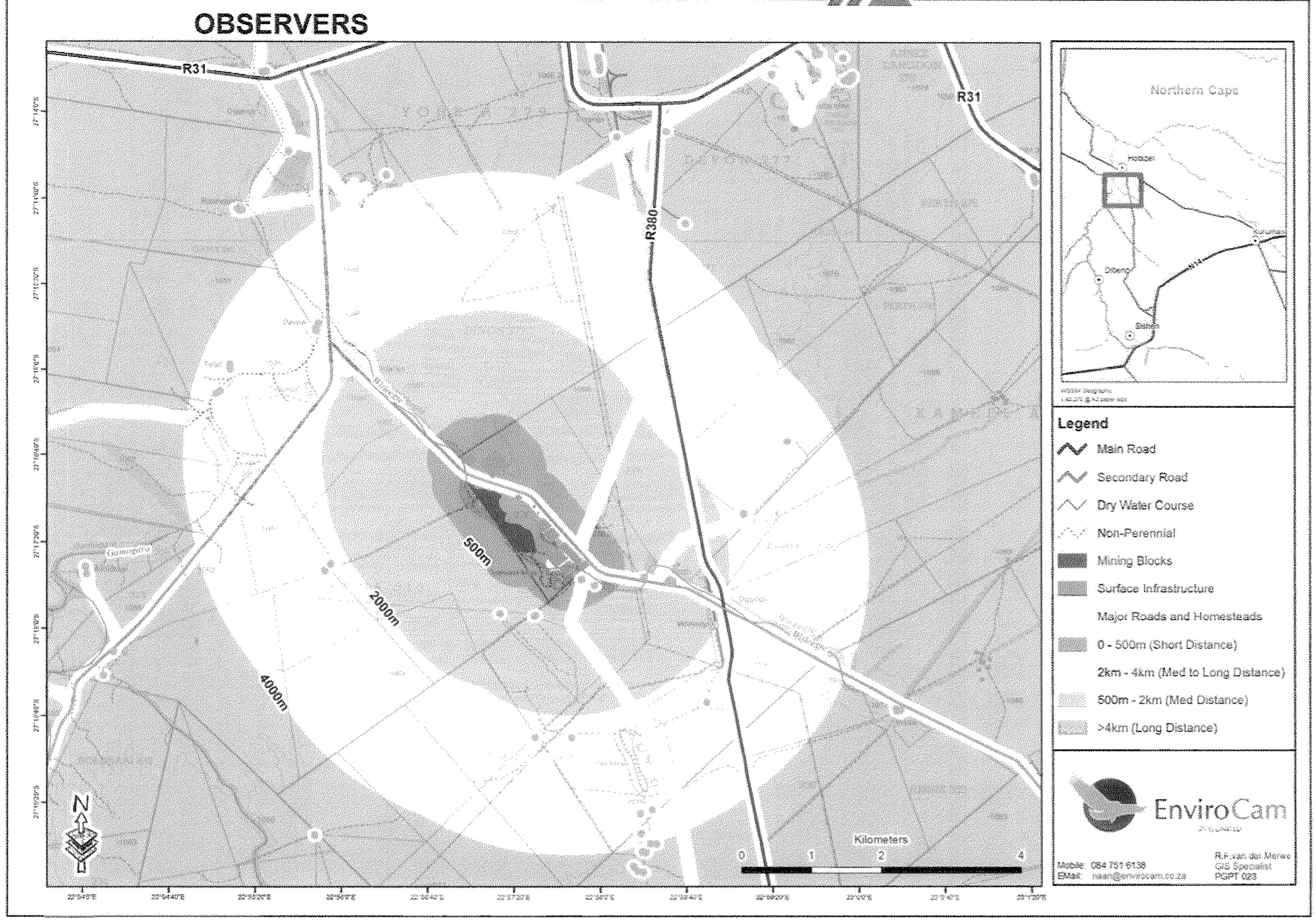

Figure 32 Visual Assessment Observers

From the viewshed analyses (please refer to Figures 31 and 32 and Appendix 9), it is clear that the some sensitive viewer locations (homesteads and motorists limited to secondary roads) are located between the 0 – 500m metres radius from the proposed Sebilo Perth Project. Therefore, the proposed Sebilo Perth Project would be in the foreground of these sensitive views. This results in a high visual exposure of the proposed Sebilo Perth Project from these viewing points.

Table 40 View distance evaluation for proposed Sebilo Perth Project

	High Exposure (significant contribution to visual impact)	Moderate Exposure (moderate contribution to visual impact)	Low Exposure (minimal influence on visual impact)	Insignificant Exposure (negligible influence on visual impact)
Residents	*0 – 500m*	*500m – 2.0 km*	*2.0 - 4.0 km*	*Over 4.0 km*
Tourist	*0 – 500m*	*500m – 2.0 km*	*2.0 – 4.0 km*	*Over 4.0 km*
Motorist	*0 – 500m*	*500m – 2.0 km*	*2.0 – 4.0 km*	*Over 4.0 km*

From the viewshed analyses (Figures 31 and 32 and Appendix 9), it is also clear that the majority of sensitive viewer locations are located within the 500m - 2km and 2km - 4km radius from the proposed Sebilo Perth Project. Therefore, the proposed activity would be in the middle ground and background of these sensitive views depending on the specific range. This results in a moderate visual exposure for the proposed Sebilo Perth Project from these viewing points depending on the range.

1.1.13.3.3 The Visual Absorption Capacity

Visual Absorption Capacity (VAC) signifies the ability of the landscape to accept additional human intervention without serious loss of character and visual quality or value. VAC is founded on the characteristics of the physical environment such as:

1.1.13.3.3.1 Degree of Visual Screening

A degree of visual screening is provided by landforms, vegetation cover and/or structures such as buildings. For example, a high degree of visual screening is present in an area that is mountainous and is covered with a forest compared to an undulating landscape covered in grass.

1.1.13.3.3.2 Terrain variability

Terrain variability reflects the intensity of topographic elevation and diversity in slope variation. A highly variable terrain will be recognised as one with great elevation differences and a diversity of slope variation creating talus slopes, cliffs and valleys. An undulating landscape with a monotonous and repetitive landform will be an example of low terrain variability.

1.1.13.3.3.3 Land Cover

Land cover refers to the perceivable surface of the landscape and the diversity of patterns, colours and textures that are presented by the particular land cover (i.e. urbanised, cultivated, forested, etc).

Areas that have a high visual absorption capacity are able to accept objects easily so that their visual impact is less noticeable. Conversely areas with low visual absorption capacity will suffer a higher visual impact from structures imposed on them.

Viewpoints representative of views experienced by residents, tourists, and motorists through the study area were used for the photographic simulations (please refer to Appendix 9). The before and after simulations illustrated in the appendix show the proposed activity superimposed onto the existing landscape scene. The simulations illustrate the visual absorption potential of the affected landscape when viewed from various sensitive receptor positions within the study area (note that these simulations may vary from the actual impact).

It is apparent from the simulations that the landscape surrounding the proposed operations ability to 'visually absorb' the proposed project is moderate (moderate impact) due to the following:

- The proposed Sebilo Perth Project is situated between relative homogeneous landform types;
- The degree of visual screening is moderate to low due to the relative flat terrain and relative short vegetation cover; and
- The presence of similar mining activities to the south and north of the proposed Sebilo Perth Project will be increase the visual absorption capacity of the surrounding area.

The landscape therefore has a moderate visual absorption capacity and will suffer a moderate visual impact from the proposed activity imposed on it.

Table 41 Visual absorption capacity evaluation

Criteria	High (Low Impact)	Medium (Medium Impact)	Low (High Impact)
Visual Absorption Capacity (VAC)	The ability of the landscape to easily accept visually a particular development because of its diverse landform, vegetation and texture.	The ability of the landscape to less easily accept visually a particular development because of a less diverse landform, texture and vegetation.	The ability of the landscape not to visually accept a proposed development because of a uniform texture, flat slope and limited vegetation cover.

It is also important to consider the effects of lighting when discussing visual intrusion. Operation and security lighting in and around the sites will be visible at night and might contribute to the cumulative effect of lights from the industrial and residential areas.

1.1.13.3.4 Critical Viewpoints

Areas with relative moderate volumes of traffic such as the R31 main road, R380 main road, and various homesteads were regarded as critical view zones against which the visual impact would be evaluated (see Figure 32). Critical views were determined during the field trip and from the 1:50 000 topographical maps.

Viewer groups are a collection of viewers that are involved with similar activities and experience similar views of the proposed activity. Within the receiving environment, specific visual receptors experience different views of the proposed activity. They will be affected due to the alteration of their views and are therefore identified as part of the receiving and affected environment. The visual receptors are grouped according to the similarities in views.

The visual receptors would be affected because of alterations to their views due to the proposed project. In order to determine the sensitivity of these visual receptors a commonly used rating system is utilised (please refer to Appendix 9). This is a generic classification of visual receptors and enables the visual impact specialist to establish a logical and consistent visual receptor sensitivity rating for viewers who are involved in different activities without engaging in extensive public surveys. The visual receptors are discussed below.

1.1.13.3.4.1 Residents

In the case of static views, such as views from buildings, the visual relationship between an activity and the landscape will not change. The cone of vision is relatively wide and the viewer tends to scan back and forth across the landscape. Residents of the affected environment are therefore classified as visual receptors of high sensitivity owing to their sustained visual exposure to the proposed activity as well as their attentive interest towards their living environment.

It is anticipated that the homesteads in the vicinity will be affected negatively. The physical distance between the proposed Sebilo Perth Project and visual receptors (residents) varies from less than 500m to more than 4km. The visual exposure for these different visual receptors would therefore also vary due to distance. The orientation of the homestead and localised vegetation/structure screening around the homestead may reduce the visual impact of the proposed activity. For example the vegetation covers adjacent to the Kongoni Manganese Project Offices are denser and taller that the average vegetation cover found within the study area. This could screen potential views to the proposed activity to an extent (Please refer to Figure 33).

Figure 33 The Kongoni offices (behind trees in the middle ground).

1.1.13.3.4.2 Tourists

Tourists are regarded as visual receptors of exceptionally high sensitivity. Their attention is focused towards the landscape, which they essentially utilise for enjoyment purposes and appreciation of the quality of the landscape.

The R31 main road is used by tourist visiting tourist attraction areas within the Kalahari region (e.g. the Kalahari Gemsbok National Park) and are likely to harbour expectations of an aesthetically pleasing environment, although the existing mining activities in the area (Hotazel, Black Rock, etc.) has already degraded the visual integrity of the surrounding area, especially the area to the north and south of the proposed Sebilo Perth Project.

1.1.13.3.4.3 Motorists

Motorists are generally classified as visual receptors of low sensitivity due to their momentary views and experience of the proposed activity. Under normal conditions, views from a moving vehicle are dynamic as the visual relationship between the activity is constantly changing as well as the visual relationship between the activity and the landscape in which they are seen. The view cone for motorists, particularly drivers, is generally narrower than for static views. Motorists will therefore show low levels of sensitivity as their attention is focused on the road and their exposure to roadside objects is brief.

1.1.14 Socio-economic setting

The socio-economic impact assessment was undertaken by MWA (2012). The complete specialist report is contained in Appendix 10.

1.1.14.1 Demographics

The JTG District Municipality (DM), is the second smallest district in the Northern Cape, occupying only 6% of the Province (27 293 km^2). It has a population density of 6.78 people per square km and the average household density in JTG DM is 1.62 persons per household. The District comprise of three Local Municipalities viz; Gamagara, Ga-Segonyane and Joe Morolong.

The JTG DM has both rural and peri-urban features and comprise of 186 settlements with 80% of these villages are located in Joe Morolong. The largest area of the District Municipality is covered by rural land uses and utilised only for extensive grazing, game farming and mining. All privately owned land is used for cattle, sheep or game farming. The area is well known for good commercial hunting in the winter and game farming is becoming ever more popular. The average size of these farms varies from about 6 000ha in the dry western half to about 2 000ha along the banks of the rivers and to the east.

According to Census 2001, the population of the study area was estimated at 170 659 comprised of 41 269 households. Census 2007 however put the household population at approximately 40 225 suggesting a decline in the population for Ga-Segonyana and Joe Morolong. Gamagara is the only area showing population growth and this can be attributed to employment opportunities created by the mines in the area, while the decline in Joe Morolong and Ga-Segonyana could be a result of HIV-AIDS and out-migration in search of higher- learning and job opportunities. The District expects the decline to continue and predict a 0.29% population growth by 2015.

The population is largely young with approximately 55% under 20 years and over 66% are of the working age. While this may provide the future labour force for the proposed Perth Mine, a significant number (27.6%) of the population in 2001 had no formal education with approximately 1.83% achieving some tertiary education. More details are provided in Appendix 10.

A high number (61%) of the economically active people is said to be unemployed. The majority (80%) of the unemployed are based in the Joe Morolong and Ga-Segonyana Local Municipalities (58%). Gamagara has a higher employment profile (76%) due to the presence of the mines in the area. Poverty is very widespread in the District and a significant number of the population relies on government social grants. Access to municipal services is the biggest challenge in the District. This may be due to inability to pay for basic services, a low professional and knowledge base in the area. The problem is exacerbated by the vastly sparsely populated areas that make provision of infrastructure expensive and highly unattainable.

The provision of adequate sanitation facilities and refuse removal services is essential to mitigate the health risks and possible pollution of water streams of which a noticeable number of people and animals depend on. Hospitals are mainly situated in Kuruman and Ga-Segonyana and a number of clinics and mobile clinics are spread in the area however the services are clearly inadequate and fragmented. Tuberculosis, asbestosis and HIV/AIDS are three diseases, which have been raised as a concern in the area with HIV/AIDS as a main contributor of mortality.

Housing is mostly located on tribal land. A large number of the people (83%) own their homes with only 7% renting. Dwelling types are mostly brick and mortar with Joe Morolong showing a higher number of traditional structures (mud). The JTG District Municipality seems to have the smallest percentage (2%) of informal settlements in the country however this may change as there have been more mining rights awarded in the District Municipality, a consequence of which may be an increase in demand for housing and basic services.

The majority of the people (75.6%) travel by foot in the JTG District Municipality with 13% utilising public transport modes.

Table 42 Municipal Services

Category	Comparison			
	Ga-Segonyana	Gamagara	Joe Morolong	Average (District)
Source of Energy				
Electricity	91%	97%	86%	90%
Candles	8%	2%	12%	9%
Paraffin	1%	-	2%	1%
Access to water				
Piped water inside the dwelling	22%	61%	1%	20%
Piped water inside the yard	23%	36%	1%	16%
Piped water from access point outside the yard	51%	1%	81%	55%
Borehole	1%	1%	13%	6%
Other	2%	1%	1%	3%
Toilet facilities				
Flush toilet (connected to sewerage))system)	2%	70%	1%	16%
Flush toilet (with septic tank)	10%	20%	-	3%
Chemical toilet	1%	-	-	-
Pit latrine with ventilation (vip)	29%	4%	16%	20%
Pit latrines without ventilation	40%	5%	58%	41%
Bucket latrines	1%	1%	-	-
None	16%	-	24%	19%
Refuse Removal				
Removed by local authority at least once a week	20%	91%	-	17%
Communal refuse dump	1%	1%	2%	2%
Own refuse dump	70%	7%	85%	72%
No rubbish disposal	8%	1%	12%	10%

Source: Statssa 2001

1.1.14.2 Economic Activities

1.1.14.2.1 Mining

The main economic activities in the Northern Cape are farming and mining. Mining activities are mainly iron and manganese, with some of the biggest deposits in the world found in the Northern Cape Province. The Sishen iron-ore mine is one of the largest open-cast mines in the world and the iron-ore railway from Sishen to Saldanha is one of the longest iron-ore carriers in the world. The province accounts for some 7% of global diamond exports (by carat), 13% of all zinc and lead exports and more than 25% of the world's manganese exports. Mining giants like De Beers, Kumba Iron Ore, Samancor, and Assmang operate in the Northern Cape. Other important metals and minerals include copper, limestone, gypsum, rose quartz, tiger's eye, mica, verdite and semi-precious stones.

According to the Census 2001 statistics released by Statistics South Africa (StasSA), about 15 478 people were employed in the Northern Cape's Mining and Quarrying sector in 2001 – see Table 43. The Annual Labour Force Survey (also released by StatsSA) indicated this number to be around 20 706. Both these numbers increased by around between 22% and 26% in 2007. A significant increase was observed in mining employment specifically in the JTG District Municipality within this timeframe.

Table 43 Labour Force Statistics – Mining and Quarrying

Mining and Quarrying	2001	2007	% increase	2001	2007	% increase
	Northern Cape			JTG District Municipality		
Census 2001	15 478	N/A	22%	3 819	N/A	51%
Community Survey 2007	N/A	18 898		N/A	5 772	
Annual Labour Force Survey	20 706	26 048	26%	N/A	N/A	

The largest land-based sedimentary manganese deposits of the world are found in the Northern Cape's Kalahari Manganese Field. It accounts for up to 80% of the world's known and commercially mineable manganese reserves. However, South Africa produces only about 15% of world demand in 2009 (Chamber of Mines South African: Facts and Figures 2010). In 2010, South African primary manganese ore production increased by 57% to 7.1 million tons, coinciding with the global economic recovery as well as new projects coming into production.

Miningmx reported that South Africa's manganese sector is geared for large-scale expansion and would add around 15% to global capacity within the next few years. This could mean that the Kalahari Manganese Field could contribute around 30% of world production. Transnet has undertaken to increase, in time, the rail capacity available to the manganese mines from some 5Mtpa to 12Mtpa – more or less the levels of production which will be reached when the new mines get going.

The extent of prospecting and mining activities can be seen in Figure 34. Seven mines, which have been in operation since the seventies have closed in recent years. Currently five mines are operational – Samancor's Wessels and Mamatwan mines, Assmang's N'Chwaning and Gloria mines, and UMK's Manganese Mine. There are currently a number of manganese projects that are between advanced exploration and construction phases belonging to well known mining companies as well as smaller unknown BEE entities. This study has identified around eight of these projects.

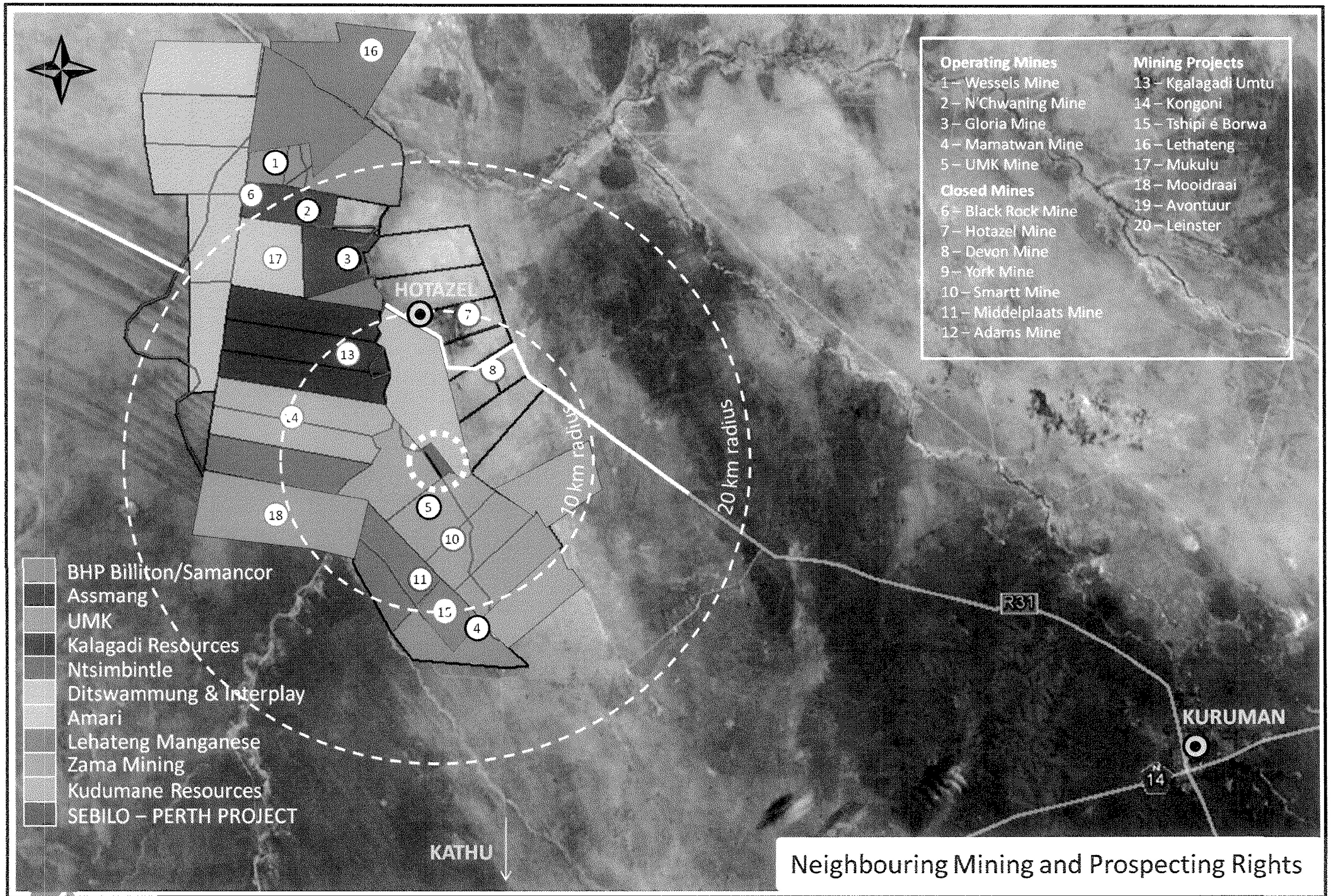

Figure 34 Neighbouring Mines and Prospecting Rights

Employment in manganese mining, which is basically confined to the Kalahari Manganese Field, has grown from 2 000[2] in 2001 to 5 879[3] in 2010 as indicated in Figure 35 below. It is estimated, based on public information and an extrapolation based on production tonnages, that between 2 000 and 4 000 additional jobs could be created within the next five to ten years in a radius of 50 km around the Perth Project. The development of these mines will have a huge impact on housing delivery and other social facilities like schools and clinics.

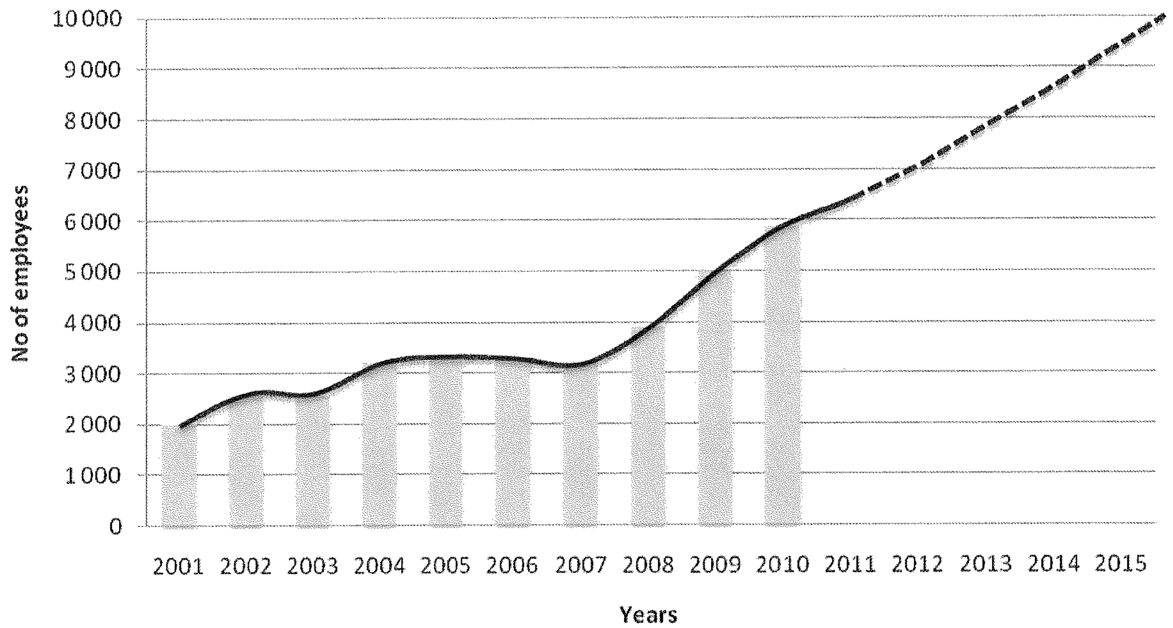

Figure 35 Manganese Employment in South Africa

Considering that the proposed Perth Mine will only employ around 130 permanent employees at full production, the socio-economic impact within the surrounding areas and within the local and district municipalities will be relatively small.

1.1.14.2.2 Other economic activities

Although mining is currently the key economic driver in the JTG District Municipality, the challenge for this sector is its inability to yield sustainable jobs given that the extraction of mineral resources is not sustainable. Diversifying the local economy in the medium to long term is therefore perceived to be of utmost importance. The short-term strategy for the municipality is to broaden and encourage the opportunities presented by a variety of mineral resources present in the area.

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[2] South African mining industry snapshot 2009 (Chamber of Mines)
[3] Chamber of Mines South African: Facts and Figures 2010

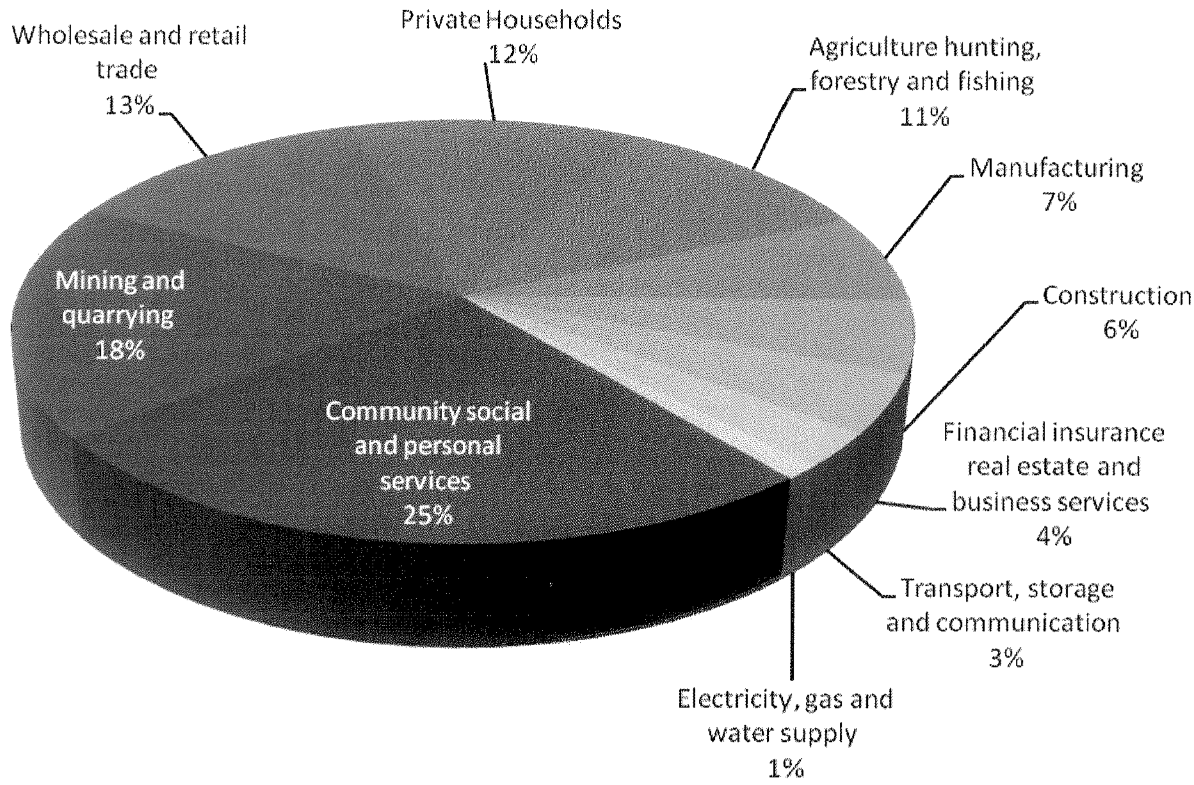


Figure 36 Industries in JTG District Municipality (2001)

According to the Census 2001 community, social and personal services was the main employment sector in the district municipality followed by mining and quarrying and wholesale and retail trade – see Figure 36 above.

While most of the District Municipal growth and development related policy and strategy documents put agriculture as one of the key economic pillars in the area, Figure 36 indicates only 11% of the economically active population are involved in agriculture related activities. This may be due to under-counting in people engaged in subsistence farming particularly in Ga-Segonyana and Joe Morolong. The manufacturing sector is relatively small and mostly mining related. The transport, storage and communication sector within the JTG District Municipality is characterised by a limited available number of transport modes, storage facilities, huge backlogs in communication, and a lack of reliable public transport services. This is the reality despite the fact that Kuruman is an important distribution depot for the surrounding rural areas. Due to the poor road conditions that connect the rural and urban areas, a lack of service provision by the bus and freight transport companies pose a huge problem.

Nature-based tourism (ecotourism) is the prime tourist attraction to the Northern Cape Province and JTG District Municipality. Overall accessibility and remoteness to tourist attractions have proven to be two major limiting factors for tourism growth in the area.

The rural land in the district is used extensively for cattle, sheep, goat and game farming. The area is well known for its good commercial hunting in the winter.

As with other previously peri-urban and rural communities in South Africa, the study area was planned without a long-term vision, is largely dormitory with no local economy, inadequate and lack of infrastructure.

1.1.14.2.3 Land Use Assessment

The largest part of the district area is characterized as rural land and extensively used for grazing, game farming and mining activities. All privately held land is used for cattle, sheep and game farming. The vast mineral wealth of the Northern Cape Province attracted Kumba, Samancor and Assmang into the Province to mine manganese and iron ore.

The town of Hotazel, 10 km north of the Perth Project, is a small community with a population close to 2 500 people. It was founded in 1958 as a mining village for a manganese mine. The area surrounding Hotazel is characterised mainly by current or historical mining activity. This area that was once a commercial agricultural hub has been replaced by manganese mines and prospects. The only remaining commercial agricultural land can be found towards the east of the R380 Hotazel-Kathu road.

Mining took place on the Perth Project area in the seventies. Assmang extracted low-grade manganese ore from the Perth Manganese Mine up until 1978, using both opencast and underground mining activities. The opencast pit covers an area of approximately 9.6 ha and underground mining covers an area of approximately 12.2 ha. Surface infrastructure was demolished during 1992. A Prospecting Right issued on this property was transferred according to section 11 of the Minerals and Petroleum Resources Development Act (Act 28 of 2002) from Assmang Limited to Sebilo Resources (Pty) Ltd during 2009. This allowed Sebilo to conduct prospecting activities towards the south, south-west, west and north-west of the original opencast pit.

The landowner continued with cattle farming, mainly Bonsmaras, on the remaining and largest portion of the farm Perth (2 000 ha in total) which stretches from the dirt road (northern boundary of the open pit) across the R380 road towards the Kuruman R31 road. According to the landowner, the farm is recognized as one of the leading Bonsmara breeders in the area. The landowner further pointed out that the farm Perth is the only remaining commercial agricultural land in the Kalahari Manganese Field (west of the R380).

The landowner and tenant indicated, during a meeting held on 8 March 2012 in Hotazel, that they are planning to plant lusern on the portion where current prospecting activities take place. The idea is then to make use of the water in the pit for irrigation purposes.

Cattle farming also occur on the farm Kaneelaar to the south-east of the farm Perth as well as on the farm Devon towards the north-west. Devon is owned by a mining company but is rented by a local farmer.

There are talks about a solar plant, which may be established on the farm Perth, about a kilometre north of the proposed Perth Project, along the R380 main road. According to the landowners and other sources, UMK, through its subsidiary Transalloys, is planning to invest in solar energy for their mining operation just south of the proposed Perth Mine. UMK also has a company in Switzerland that build solar panels. Should this development go ahead, it is anticipated that the proposed Perth Mine will have no socio-economic impact on the proposed solar development.

1.1.14.3 Batlharo Ba Ga Motlhware Traditional Authority

Traditional Authorities are important institutions that give effect to traditional life and play an essential role in the day-to-day administration of rural communities. The most recognised and important roles of Traditional Authorities are:

- Presiding over customary law courts and maintaining law and order;
- Assisting members of the community in their dealings with the state;
- Lobby government and other agencies for the development of their areas;
- Convening meetings to consult with communities on needs, principles and provide information;
- Making recommendations on land allocation and settlement of land disputes; and
- Protecting cultural values and providing a sense of community in their areas through a communal social frame of reference.

The Batlharo Ba Ga Motlhware Traditional Authority area covers approximately 459 532 km^2 with an estimated population of 37 270 (Census 2001). This Traditional Authority is the biggest Traditional Authority in the JTG District Municipality and straddles both the Ga-Segonyana and Joe Morolong Local Municipalities. The Traditional Leadership and Governance Framework Act of 2003 make provision for women to act as Traditional leaders. Kgosigadi PP Toto is the acting Paramount Chief of the Batlharos and a recognised spokesperson and custodian of the Batlharo Ba Ga Motlhware. She will be officially inaugurated in May 2012. The Kgosigadi PP Toto presides over a number of villages covering Heuningvlei up to Seoding and includes the communities of Tsining. The Kgosigadi has authority over all the Chiefs in the Traditional Authority. These Chiefs represent a cluster of villages according to cultural practices. Below the Chiefs are headsmen/women to assist the chiefs and act as traditional leaders at local level – see Figure 37 below.

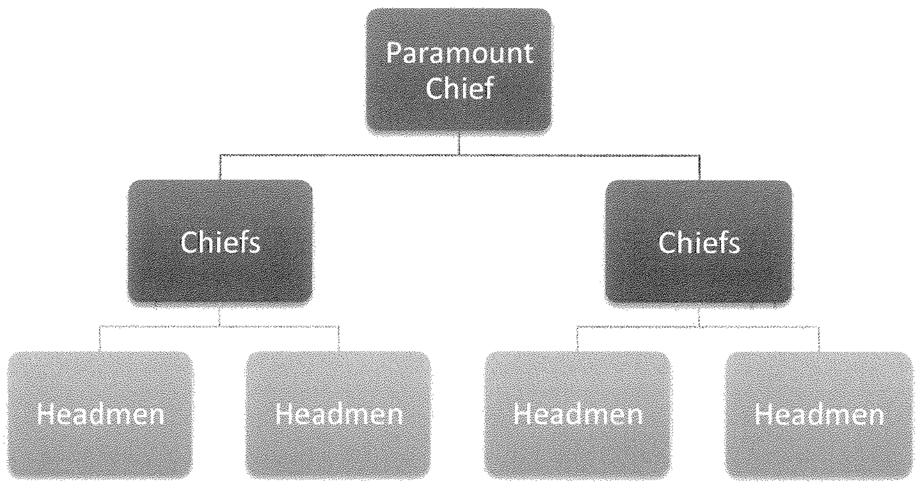


Figure 37 Batlharo Ba Ga Motlhware Traditional Authority Structure

There are currently tensions in the Tsining community over chieftaincy. According to the landowner some of the conflicting parties' instituted a land claim on the land where the proposed Perth Mine will be developed. The Department of Land Affairs has been consulted by the Sebilo Resources representative on these claims and denied any receipt of such claim on Perth farm. The office of the Kgosigadi has also been consulted and has refuted these claims.

Despite the existence of numerous mines in the surrounding areas, the Batlharo claims that there is little evidence of the benefits of mining on their land. According to the Batlharo there are still mud schools built by the community and most of the schools are over-populated with little and inadequate resources. School drop-out rates are alleged to be high resulting in poor literacy and a low skills base that exacerbates the already high poverty levels in the area. A significant number of the people depend on social grants and children are looked after by grandparents because the young leave the area in search for job opportunities. The community claims discriminatory recruitment practices that favour outsiders.

As with many rural areas, there are limited job opportunities and recreation facilities resulting in young people to engaging in undesirable social behaviour such as like excessive drinking and teenage pregnancies.

During the meetings held with the Batlharo, people complained of hardships caused by negligence by the local authority. They allege that in the "old days" the Government used to provide boreholes for the people - now they struggle to get water as the current dispensation no longer provide such services. This situation is aggravated by the drying of water-streams of which mines are blamed.

On a positive front, the Traditional Authority is very excited about the proposed Perth Mine as Sebilo has offered the community a 5% shareholding in the Mine. They believe that Sebilo is the first company to do so and are optimistic about the future and the impact of the proposed Perth Mine on their community. It is anticipated that through the proposed Perth Mine the community will have the much need social facilities like child-care, schools and skills training.

The Ba Ga Motlhware Community Trust has been established and will hold the 5% interest of the shareholding in the Perth Mine and dividends will be paid into this trust account. Sebilo paid for the establishment of this Trust and has already paid R250 000 into the Trust account. It is envisaged that Trust funds will be used to alleviate poverty and accelerate development in the area. A ten-year development plan to be facilitated by independent consultants will guide and coordinate the community development program.

In addition to dividends, specific LED projects, as provided in the Perth Social and Labour Plan, will also be directed towards these communities. Ultimately the Traditional Authority will be responsible for their future and the sustainability thereof beyond mining. The conundrum lies in the ability of the Traditional Authority to invest their dividends towards ensuring a better life while at the same time guaranteeing the long term sustainability and independence of the Traditional Authority.

These photos in Figures 38 and 39 are examples of some of the communities that Sebilo will impact through job creation, community development and dividend payouts

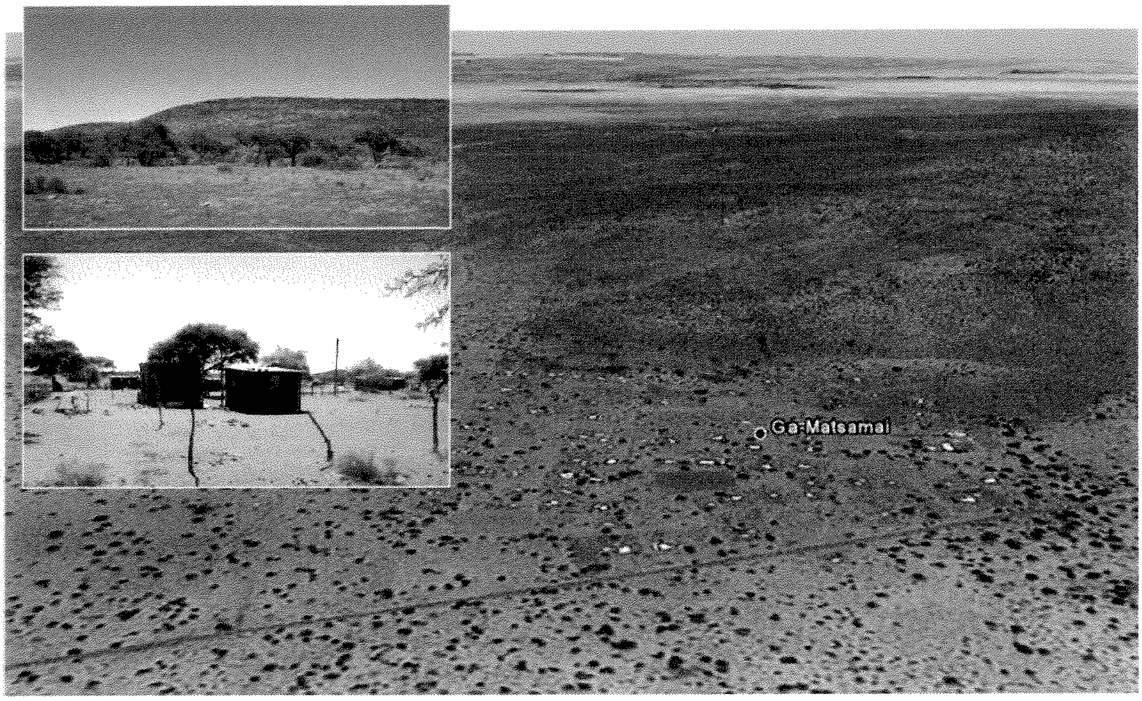


Figure 38 Batlharo Ba Ga Motlhware: A Rural Village

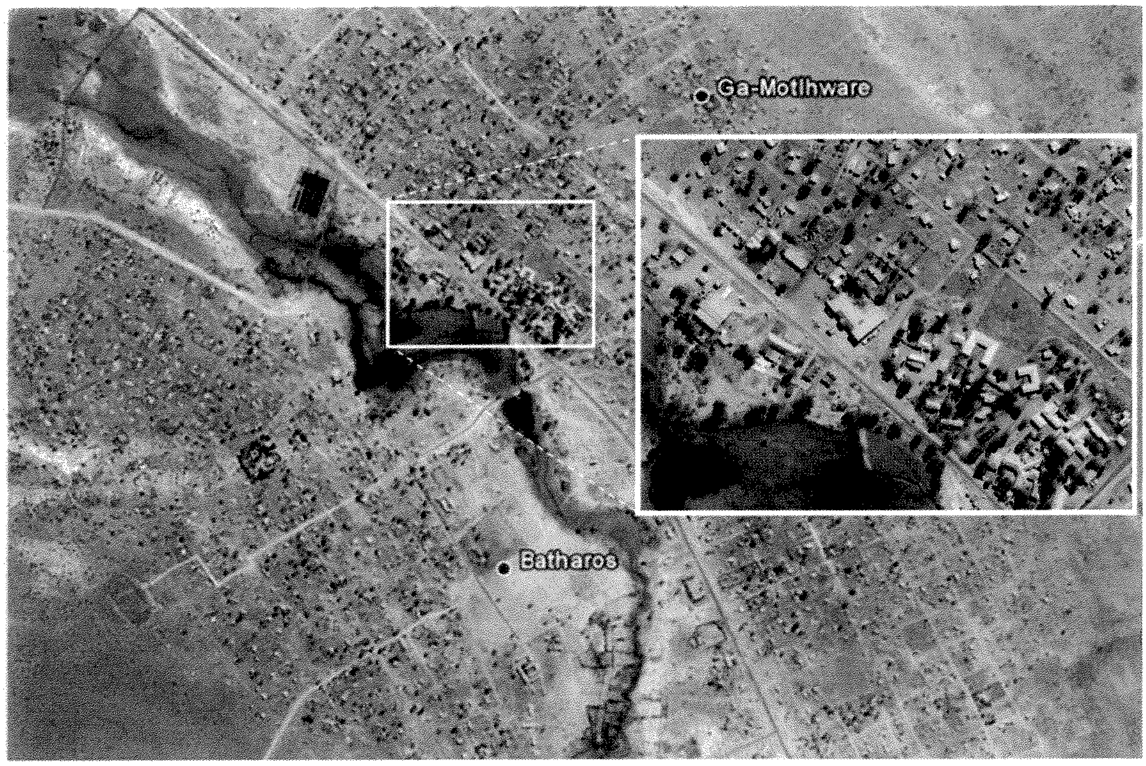


Figure 39 Batlharo Ba Ga Motlhware: A Peri-Urban Village

1.1.15 Cultural heritage setting

The project area falls within farmland and the landscape is of relatively low cultural heritage sensitivity, as it readily adapts to new developments. From a historic built environment perspective, no features of cultural heritage significance were identified, other than farmhouses older than 60 years.

Should any artefact of cultural interest be discovered during mining, the relevant authorities will be notified and the area will be demarcated for further studies.

Farm family graves are situated to the northeast of the proposed mining area, according to information provided by the landowner. The location of these graves will be confirmed prior to the commencement of the construction phase of the project and the area will be clearly demarcated. Sebilo will, in consultation with the landowner, keep mining activities >1km from the graves to minimise impacts.

1.2 Specific environmental features on the site

The following specific environmental features were identified on site, which may require protection, remediation, management or avoidance.

Two sensitive environmental features are present in the vicinity of the project area. These include the riparian zone associated with the Witleegte drainage line and the presence of red data species (Secretary bird and Kori Bustard) and protected trees (*Acacia erioloba and Acacia haematoxylon*). It is however noted that the Witleegte riparian zone has been altered through agriculture and several alien invasive plant species are present in this area.

In addition to these specific sensitive areas, habitat types for rare and endangered species also include rocky outcrops and any habitat type that is topographically or environmentally distinctly dissimilar to the general surrounds. Thus based on the information presented above, sensitive habitats are considered as important topographical and ecological features on the basis of the following criteria:

- Association with riverine or wetland regimes;
- Prime examples of natural vegetation types, particularly those that are under pressure from agriculture or development;
- Habitat associated with endangered or vulnerable plant or animal species;
- Topographical features and habitat that occur naturally in the area;
- Habitat or areas that are considered biodiversity or conservation "hotspots";
- Areas classified as hills or ridges.

It is recommended that areas with specific environmental features are avoided as far as practical. Due to the fact that the Witleegte drainage line flows through the existing historical mining area, it has already been altered by mining. Measures to control stormwater runoff and to preserve soils associated with the riparian zone, is discussed below.

1.3 Map showing the spatial locality

The maps and figures showing the spatial locality of all environmental, cultural/heritage and current land use features identified on site, presented in Section 1.2 above, are as follows:

Table 44 Maps and figures showing the spatial locality of the project

Description	Figure Number
Regional and local setting	Figures 1 and 2
Topographical features of the site	Figure 3
Soil, land use and land capability	Figures 4 - 7
Carrying capacity of the land within the project area	Figures 8 - 10
Bio-diversity (Fauna and Flora)	Figures 11 – 15
Groundwater characteristics	Figures 16 – 20
Geological setting	Figures 21 and 22
Noise and blasting information	Figures 23 - 26
Air quality	Figures 27 – 28
Visual assessment of the area	Figures 29 – 33
Socio-economic assessment for the area	Figures 34 - 39
Surface infrastructure layout plan	Figure 40
Proposed mine plan	Figure 41
Potential surface water diversion works	Figure 44
Proposed storm water control dams	Figure 45

1.4 Confirmation of consultation with IAP

Sebilo undertook a comprehensive programme of consultation with the landowner, Tribal Authorities, communities and other Interested and Affected Parties (IAP). Details regarding this process are presented in Section 7 of this document as well as in Appendix 11. Details regarding the landowner, the person who leases the land and the Tribal Authority are presented in Tables 45 and 46 below.

Table 45 Landowner contact details

	Name	Tel No	Fax No	Address	Email
Land owner	EZ Anthonissen	083 306 6021	053 741 1382	P O Box 117 Hotazel 8490	ebena@absamail.co.za
Land leased to	FH Swanepoel	083 395 6364	053 712 3000	P O Box 2741 Kuruman 8460	fhs@isat.co.za

Table 46 Affected community contact details

	Name	Tel No	Fax No	Address	Email
Batlharo Ba Ga Motlhware	Chief Pelonomi Toto	072 507 2741	NA	NA	Pelo.toto@gmail.com

The local community and Tribal Authority is not the owner of the land. The Department of Rural Development and Land Reform confirmed in writing upon enquiry by Sebilo on 21 February 2012 that, according to their database, there are no restitution claims lodges against Portion 0 and 1 of the farm Perth No 276. The main components of the consultation process were:

- Acceptance of the Mining Right Application by the DMR on 11 November 2011.
- Advertising the project in Diamonds Field Advertiser and the Volksblad on 18 November 2011; in the Kalahari Bullet on 25 November 2011; as well as placing notices on site and on community notice boards.
- A public meeting was held on 5 Desember 2011 in the Hotazel Rec Club to introduce the project to IAP and to provide an opportunity for comment and interaction with the project team.

- A draft Scoping Report was submitted to the DMR for comment on 12 December 2011.
- The draft Scoping Report was made available to the landowner, Tribal Authority and other registered IAP for a 30-day comment period during January 2012.
- One-on-one discussions were held with the landowner as well as the Tribal Authority January 2012 by MWA on behalf of Sebilo.
- A feedback letter was sent via registered mail to the landowner, the Tribal Authority and all registered IAP on 4 April 2012. This letter included an invitation to an Open Day, as summarised below.
- An Open Day was held on 21 April 2012, upon completion of the draft specialist reports, at the Hotazel Rec Club between 9H00 and 14H00. Sebilo provided transport to the Open Day to those who do not have their own transport. A total of 81 community members attended the Open Day (see Appendix 11).
- The landowner indicated that he could not attend the Open Day due to personal reasons. Sebilo organised a separate one-on-one discussion with the landowner after the Open Day to discuss the findings of the specialist studies as well as the way forward with the project.
- The draft EMP will be made available to the landowner, the Tribal Authority as well as registered IAP for a 30-day comment period between 17 May and 20 June 2012. Once comments have been received, the Public Participation Report for the project will be finalised and submitted to the DMR for comment.
- Various telephonic, email and faxed communication took place as part of consultation.

2 ASSESSMENT OF THE POTENTIAL IMPACTS OF MINING

This assessment of the potential impacts of the proposed mining operation on the environment, socio-economic conditions and cultural heritage of the area, was undertaken in terms of Regulation 52(2)(b) of the MPRDA.

2.1 Description of the proposed mining operation

2.1.1 The main mining activities

The proposed mining infrastructure and mining components that will form part of the mining project, are summarised in Table 47 (adapted from Mineral Corporation, 2011). The components listed are shown in Figures 40 and 41, prepared by The Mineral Corporation.

Table 47 Mining-related Components Evaluated

Item	Dimensions	Comment
Main access road	3km	All weather access road to provide safe access. Roads will not be tarred, but will be sealed with Dustaside
Site access roads	5km, 12m wide	For use by secondary support fleet and earthmoving haul trucks
Electricity	11kV Substation	Situated close to the main plant
Electricity	132 kV line	From the main ESKOM supply to the main substation
Electricity	5MVA, 132/11 kV transformer	Situated at the main substation
Potable Water	200 m^3 steel storage tank, mounted 10m above ground	Potable water use will reduce to 48 m^3/d for change house and office use once water from pit is used in mine water balance
Process Water	Mine site PCD: 150 x 150 x 16m	Dam will be lined. Pumped from pit as well as stormwater runoff into settling ponds for use as process water
Process Water	Infrastructure PCD: 30 x 30 x 13m	Dam will be lined. Pumped from pit as well as stormwater runoff into settling ponds for use as process water
Stormwater	Trenches: 1.5m wide, 1m deep Berms: 1.5m high, 1.5m wide	Cutoff trenches and berms around mining area to intercept stormwater runoff
Rail Facility	2km	Rail link spurred off the main Kalahari Rail Facility
Rail Facility	1 150m siding	At termination point of the spur line, train length 1 100m
Rail Facility	Load out facility (Silo) 120 x 92m	Rapid loading of a 104 truck train, carrying 6 650 tonnes of ore. Concrete foundations, 1.1m deep.
Opencast mining	Maximum depth 70m Current extent: 9.6ha No final extent of mining available	Planned from 2013 – 2023.
Decline cluster	3 units of 5 x 6 x 100m	Trucking, man and material and ventilation decline cluster, developed on dip from the open pit highwall
Underground mining	Current extent: 12.2ha No final extent of mining available	Room and pillar operation planned from 2023 - 2026
Exploration drilling	Final number of boreholes not currently available	On-going through the life of mine to identify extensions to the ore body, which may allow further mining beyond 2026.
Topsoil stockpiles	100 x 100 x 1.5m	For future use during rehabilitation at the opencast operations
Explosives	Explosives magazine for 10000kg of emulsion	Stored in two separate fenced-in areas close to the pit. A powder magazine will house high velocity explosives.
Primary crusher	70 x 70m	Crushed material is stockpiled and delivered to processing plant. This area will not be paved.
Ore processing facility	100 x 100m	Includes stockpiles, secondary crusher, screens and lift conveyor to silo. Fines will be slurried to the ultrafines empoundment facility. Concrete foundations, 1.1m deep. Prefab buildings
Ore Stockpile	1.5m high 200m x 200m (4ha)	Situated adjacent to the ore processing facility.
Ultrafines empoundment	20m high 150 x 150m footprint (2.25ha)	Thickener and cyclone underflow pumped to ultrafines facility. Return water will be pumped back to the plant
Waste dump	40m high 300 x 300m footprint (9ha) (Current footprint: 8.3ha)	Waste rock will be backfilled into the pit during final rehabilitation before mine closure

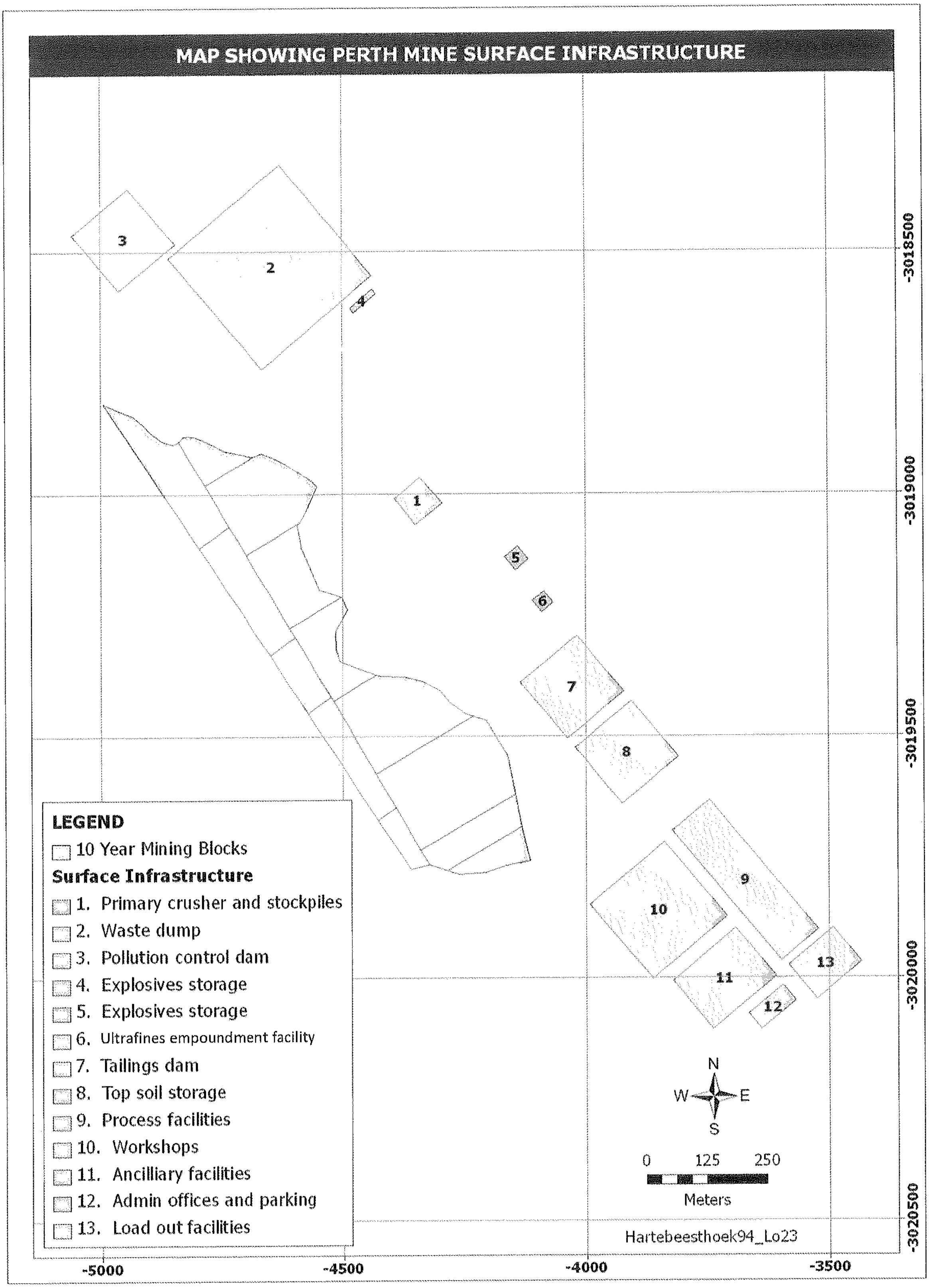


Figure 40 Map showing the surface infrastructure layout plan

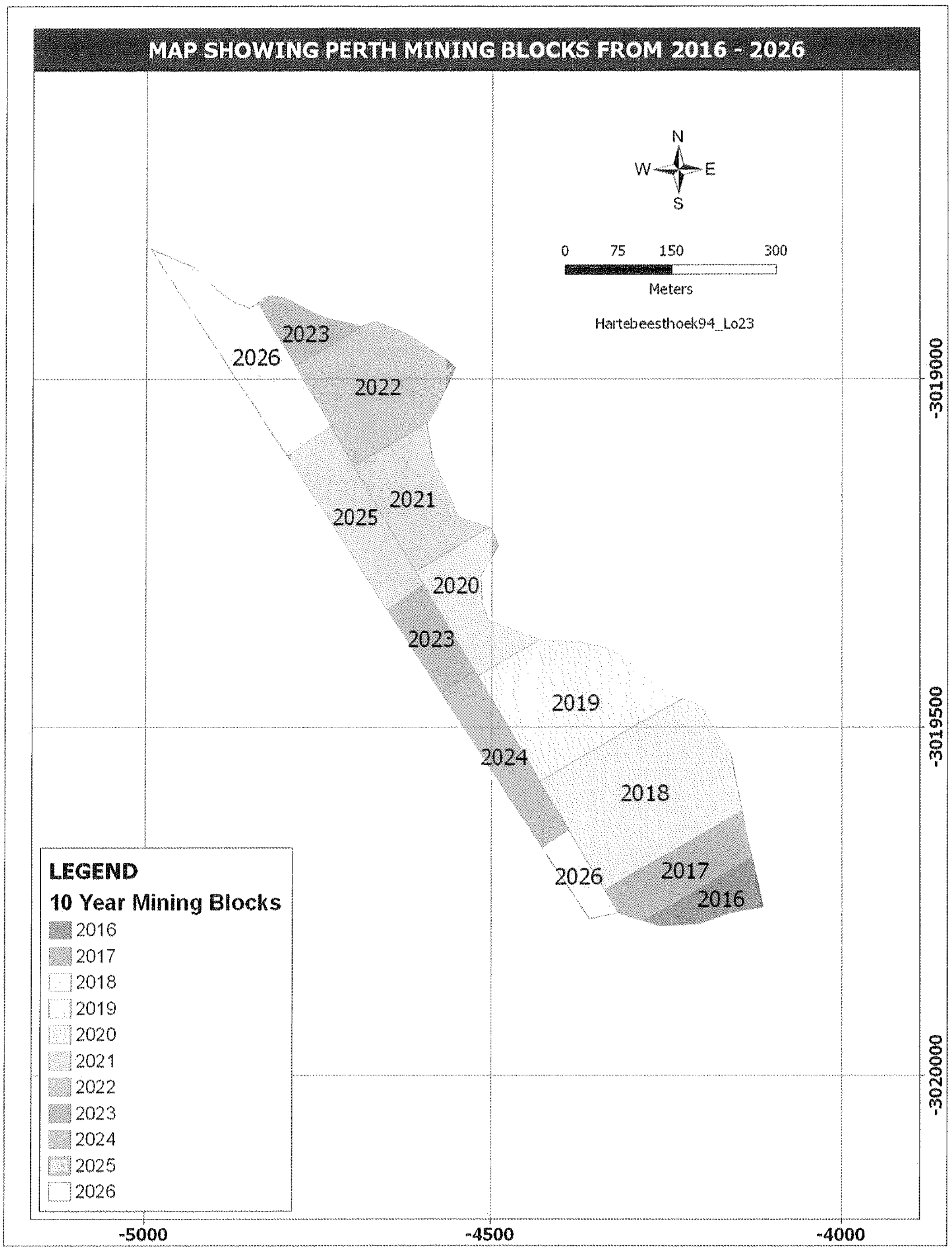


Figure 41 Perth mine plan (2026 – 2026)

2.1.1.1.1 Power supply

At present, there is no existing and available power supply to the site. Electricity will be sourced from local ESKOM infrastructure. The mine reticulation will be provided at 11 kV, with the main substation situated in close proximity to the main plant (Mineral Corporation, 2011). The substation will be within the first level of security access of the mine enabling easy access for maintenance personnel. Application for a 5 MVA supply has been submitted to Eskom. This supply will be required to supply mining, metallurgical plant and infrastructure.

A single Eskom 132 kV line will be brought into the main substation switching yard, from where it will be connected to a 5 MVA, 132/11 kV step-down transformer. The secondary side of the transformer will be connected to the main substation 11 kV switchboard.

The expected full load power requirement is calculated as 3326kVA. This consists of the following loads:

- Metallurgical Plant – 1,435 kVA.
- Mini-substation 1 Main Sub – 100 kVA.
- Mini-substation 2 Road & Rail Small Power – 200 kVA.
- Main Office mini-substation – 250 kVA.
- Ultrafines empoundment facility – 95 kVA.
- Mining Workshops 550V – 200 kVA.
- Mining Offices 400V – 100 kVA.
- Primary Crusher – 945.5 kVA.

2.1.1.1.2 Water supply

All potable water will be supplied through the Vaal Gamagara water scheme via a bulk water meter, managed by Sedibeng Water. The main supply will be routed to a fabricated steel storage tank, holding approximately two days of total mine consumption. The tank mounted 10 m above ground level to enable gravitational feed throughout the mine site. The reticulation throughout the mine site consists of consumers such as the process plant, mining, change house, offices and workshops. Each supply area will be individually metered to enhance control and minimize wastage.

It is estimated that the total mine potable water consumption will be 200 m^3 per day. This estimation is an upfront requirement, until such time as the pit has developed to an extent where it produces enough water for service and process water purposes. In this steady state, potable water demand will reduce to the levels required for change house and office use only. This is estimated at approximately 48 m^3 per day. However, due to the expected higher upfront requirement of water consumption, the application for potable water to Sedibeng Water will be based on the total requirement of 200 m^3 per day.

Two sources of raw water are anticipated. The ground water reporting to the pit is the first source. It is estimated to provide sufficient water for the mine's service and process water requirements. This water will be pumped from the open pit to the settling ponds on surface and subsequently to the storage tanks for process water. The second source is water from the storm water reticulation system. Sebilo will apply for the necessary water use licenses that will be required for the operations from the Department of Water Affairs (DWA).

2.1.1.1.3 Equipment selection

The mine is currently planned to operate with diesel powered equipment. It is recognized that electric mining equipment will have lower operating costs and generally a longer expected working life. So even though electric power will be available at the mine site it is uncertain how secure the supply will be. Thus the current decision to operate diesel powered equipment rather than electrically powered was influenced by the following factors:

- Lower capital cost of diesel powered mining equipment;
- The availability of a secure power supply in the area;
- The relatively short life of mine; and
- Equipment mobility.

The equipment mobility is the key influencing factor. Due to the nature of the resource, which has high and medium grade areas and the requirement of maintaining a constant Run of Mine (RoM) grade, a degree of blending from the open pit operation will be required. To maintain the required blend a number of different benches in different parts of the open pit will be mined at any one point in time.

As a result, it is important that a high degree of equipment mobility is maintained hence the optional use of Front End Loaders (FELs) to supplement the loading performed by the larger hydraulic shovels, which are relatively slow moving.

It should be noted that should the economics of the operation change, the decision to use diesel loading equipment could be reversed.

The mine proposes to operate the following equipment on site:

- Two 5.0 m^3 capacity excavators;
- Three two front end loaders (FEL) also with a 5m^3 capacity for flexibility and management of the various stockpiles. One FEL will be dedicated to uploading the material at the primary crusher for transport to the processing plant. These loading units will have the flexibility to operate at the 10 m proposed bench height as well as loading significant quantities of overburden which will be mined and used for construction and reclamation purposes.
- Rotary drills of the 30 000kg class are recommended for drilling the 165 mm diameter production blast holes.
- One road grader will maintain the roads on the property;
- One water truck to suppress dust on main haul routes;
- One track dozer will be used for typical dozer functions including maintenance of dumps, drill site preparation, road building, ditching, bench repair, shovel cleanup and stockpile dozing.
- A rubber-tired dozer will be used for the majority of the lighter dozer work such as shovel excavator cleanup and road sweeping;
- Diesel pickup trucks will be supplied for the Mine Superintendent, Maintenance Superintendent, Shift Foreman, Blaster, Engineering, Surveyors and the mechanical crew;
- Maintenance support vehicles and equipment will include flat deck trucks, fuel, water and lube trucks for servicing the excavators;
- Miscellaneous units such as personnel carriers, lighting towers, etc.

2.1.1.1.4 Workforce

It is anticipated that approximately 59 people will be initially employed at the operations. Sebilo intends to employ people from local communities at the operations. The number of job opportunities will increase to around 125 at full production, as detailed in Table 48. It should be noted that the only outsourced activity envisioned at present, is the removal of domestic and hazardous waste from site.

No personnel will live on site during the mining project.

Table 48 Proposed Workforce Build-up

Employment Levels		Forecast										
		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
F	Top management	0	0	0	0	0	0	0	0	0	0	0
E	Senior management	1	1	2	2	2	2	2	2	2	2	2
D	Middle management	5	8	13	13	13	13	13	13	13	13	13
C	Junior management	10	13	19	23	23	23	23	23	23	23	23
B	Semi-skilled	37	40	58	71	71	71	71	71	71	71	71
A	Unskilled	6	6	10	16	16	16	16	16	16	16	16
Total Permanent Employees		**59**	**68**	**102**	**125**	**125**	**125**	**125**	**125**	**125**	**125**	**125**

2.1.1.1.5 Rehabilitation

Rehabilitation will commence some three years after the commencement of the ore mining operation and its advance will match the depletion rate of the open pit. Sebilo has already made financial provision for the existing mining footprint. The final quantum for rehabilitation will include all aspects of mining, as discussed above.

2.1.2 Plan of the main activities

The surface layout for the project is shown in the map in Figure 40. The mine plan for the proposed opencast and underground mining operations is shown in the map in Figure 41.

2.1.3 Description of mining phases

2.1.3.1 Construction Phase

The construction phase of the project is projected to commence in February 2013 and be completed within 24 months by February 2015. These timeframes are dependent on the assumption that the mining right and associated environmental permits and water use licenses will be issued by the end of 2012.

The following activities will take place during the construction phase of the proposed project:

- Construction of the access roads and temporary services.
- Stripping and stockpiling of topsoil.
- Construction of the rail siding and rail connection to the main line, if required.
- Dewatering of the historical opencast pit and underground workings.
- Construction of a surface water diversion of the Witleegte drainage line, if required.
- Construction of the surface water containment works.
- Construction of processing plant, workshops and associated stores.

- Construction of the office and parking facilities.
- Construction of the waste rock stockpile and ultrafines empoundment facility.

2.1.3.1.1 Construction of access roads and temporary services

Approximately 6.2 km (10m wide) of all weather access road will need to be constructed to provide safe access to the mine site.

In addition, 2.7km (25m wide) of internal haul roads and 1.9 km (16m wide) of mining haul roads will be required on the site. These roads are specifically required for use by the secondary support fleets and earthmoving haul trucks. The design needs to cater for loads associated with product haulage and stores delivery truck loads.

Sebilo will be responsible for the construction and maintenance of these access roads on a continuous basis.

The project site is currently unserviced and following temporary services will be provided during construction:

- Chemical toilets will be made available on site for ablutions. These toilets will be serviced, as required, by a contractor.
- Waste skips will be used for waste collection and any domestic or hazardous waste will be removed from site to a licensed waste disposal facility by a contractor. Waste will be separated at source.

2.1.3.1.2 Soil Stripping Plan

The mine infrastructure footprint, as indicated in Figure 40, will be cleared. This is necessary to prepare the area for construction of the various components of mining. Vegetation will be cleared and the surface layer of soil will be stripped according to the Soil Stripping Plan below. The topsoil will be stockpiled for later use in landscaping during rehabilitation of the mining area. Only limited earthworks, with very little cut-and-fill, is envisaged to level the mining area in preparation for construction.

The term topsoil refers to the A and B-horizons of the soil profile as defined in the Taxonomic Soil Classification system for South Africa. The A-horizon comprises the upper part (0-300 mm) of the soil profile and the B-horizon from 300 mm up to the stripping depth specified per soil type indicated in Figure 43. The topsoil and A- and B-horizons are further described in Appendix 1 in terms of soil stripping, stockpiling and replacing.

Stripping, stockpiling and replacing of topsoil has a very high impact on soil, land capability and land use and the procedures followed during execution of these actions directly influences the post-mining land capability and consequently determines the degree of deterioration from pre-mining to post-mining land capability (Rehab Green, 2012). It also directly determines the possible post-mining land uses.

Stripping and stockpiling of topsoil, shaping of spoils and replacing of topsoil should therefore take place according to a plan, which should be well managed and progressively adapted according to circumstances. The following should be considered:

- **Prevent stripping and mixing of high quality topsoil (A and B-horizons) with low quality underlying material to ensure sufficient volumes of high quality soil for rehabilitation.** The quality of soil earmarked for rehabilitation purposes significantly deteriorates when the high quality topsoil is mixed with the underlying poorer quality material (clay layers, calcrete, plinthite, weathered rock etc). This results in significant deterioration in the quality of soil physical and chemical properties and a decline in soil fertility necessary for re-vegetation. The deterioration in soil quality also significantly increases the susceptibility of rehabilitated soils for erosion and seal and crust formation.

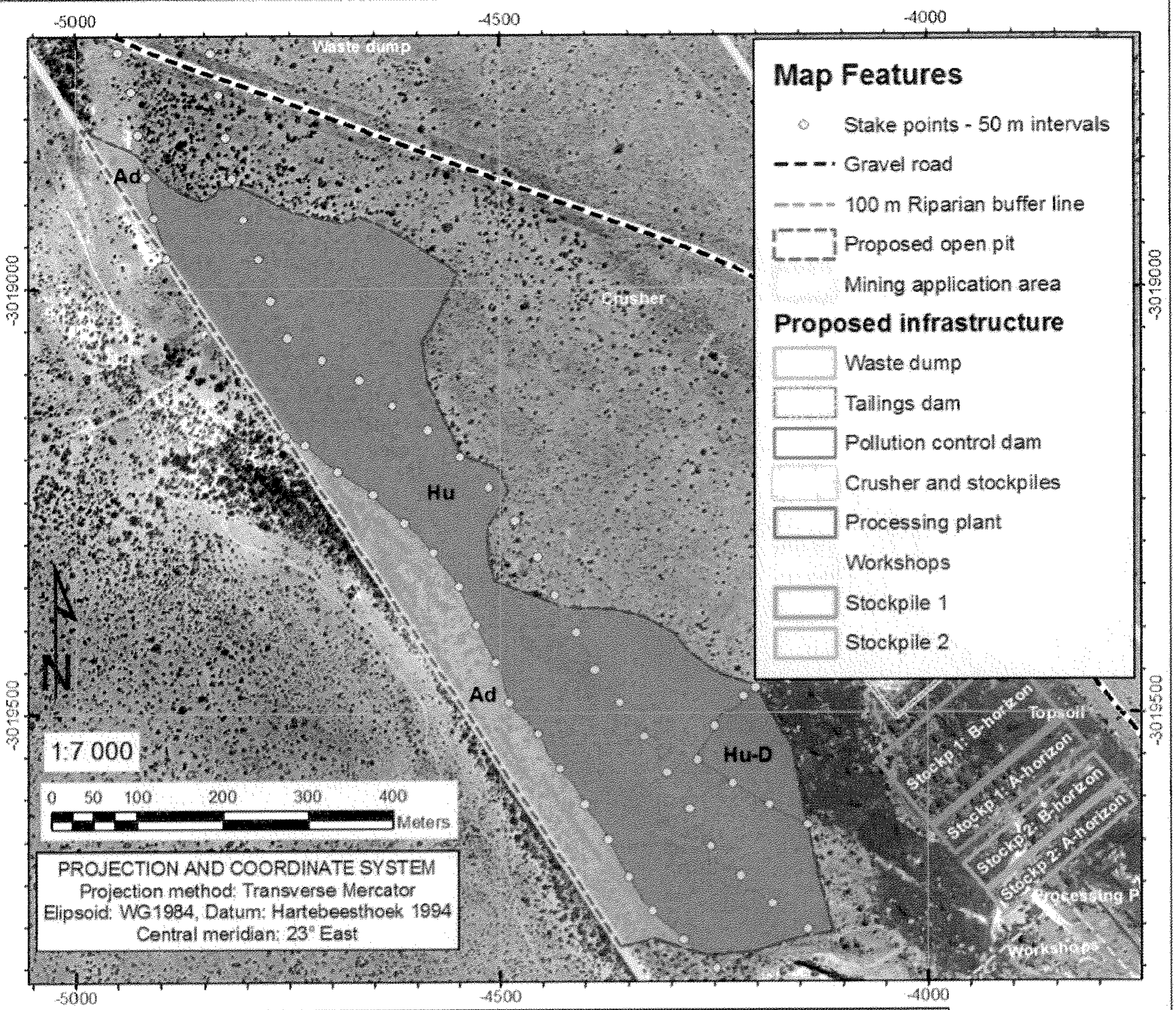
- **Separate stockpiling of different soil types to obtain the highest post-mining land capability**. Topsoil quality or potential is not just limited to the grade of soil generally referred to as topsoil but can vary from very high to low due to various properties. Soil properties of different soil types can vary substantial e.g. the clay content of red and yellow brown soils often differ with up tot 20% within the same field. Mixing of different soil types result in rapid changes in soil properties and characteristics such as texture, infiltration rates and water holding capacity over short distances after replacement, which will definitely adversely affect the post-mining land capability.
- **Separate stripping, stockpiling and replacing of soil horizons (A and B-horizon) in the original natural sequence to obtain the highest post-mining soil potential for re-vegetation**. The higher soil fertility of the A-horizon, especially phosphorus and carbon contents, declines significantly when it is mixed with the B-horizon resulting poorer re-vegetation success. It also increases the susceptibility to compaction and hard setting. The A-horizons also serves as a seed source, which will enhance the re-establishing of natural species. The A and B-horizons should be stripped and stockpiled separately and replaced with the A-horizon overlying the B-horizon.

Contrary to the general perception, separate stockpiling of different soil types and horizons does not have significant cost implication for the mine and only requires planning and continuing management. It is therefore crucial to strip according to guidelines and depths as described in the following sections. The soil horizons and properties influencing stripping and stockpiling procedures are discussed in Appendix 1.

During the construction phase, the erection of mining infrastructure will have impacts on the soil, land capability and land use during the construction phase. The following procures for topsoil stripping and handling during the operational phase should be followed:

- ***Buildings and conveyers***. All excess topsoil, which might be excavated for the foundations of these structures should be stored for later rehabilitation.
- ***Sidings, haul roads and ore stockpiles***. Soil pollution should be prevented at all times. Wherever material with a potential polluting ability will be dumped and handled, the footprint should be covered with at least 300 mm subsoil or soft overburden material (calcrete can be used) and the edges should be elevated (berm) to prevent pollution beyond the footprint.
- ***Ultrafines and waste dumps***. At least 1000 mm of topsoil should be removed and stored for later rehabilitation. Borrow pits may not be made on a later stage in order to get topsoil for rehabilitation of the dump. The footprint should be compacted, it should be free draining and all seepage should be channeled to pollution control dams.
- ***Pollution control dams***. The A-horizon (0-300 mm) and B-horizon of the topsoil should be stripped and stored separately for later rehabilitation. Materials with a potential polluting ability such as most ores may not be used to stabilized the base or wall embankments of the dam (calcrete can be used). Construction and management of the pollution control dams are discussed in more detail in Section 2.1.3.1.3 below.

The criteria for soil stripping and replacing within the open pit areas are summarised in Table 49 and in Figure 43 for the various soil types.



Legend: Pre-mining stripping depths, soil volumes, post-mining replacing depths and land capability

	Pre-mining					Post-mining		
Soil group and stockpile no.	Soil Types	*Strip depth (m)	Area (ha)	Area (%)	Soil volume (m³)	Replacing Depth (m)	Replacing Area (ha)	Land capability
Stockpile 1 (Red, well-drained, Aeolian sand)	Hu	Total sand layer	18.17	77.07	436080 (2.4 m depth)	Total original sand layer	19.19	Grazing
	Hu-D	Total sand layer	1.02	4.34	24480 (2.4 m depth)			
		TOTAL	**19.19**	**81.41**	**460560**			
Stockpile 2 (Pale, yellowish brown, calcareous sand in riparian zone)	Ad	1.0	4.39	18.59	43900	1.0	4.39	Riparian
		TOTAL	**4.39**	**18.59**	**43900**			
		Grand Total	**23.58**	**100.00**	**504460**		**23.58**	

*The soils were assessed up to a depth of 2.4 m. However the total sand layer up to the calcrete layer should be stripped and stockpiled. The calcrete and topsoil layer should be replaced in the same sequence. No soil may be pushed into the pit to get rid of.

Figure 43 Soil stripping and stockpile guide

Table 49 Criteria for soil stripping & replacing within open pit areas

Legend: Pre-mining stripping depths, soil volumes, post-mining replacing depths and land capability								
	Pre-mining					Post-mining		
						Replacing		
Soil group and stockpile no.	Soil Types	*Strip depth (m)	Area (ha)	Area (%)	Soil volume (m³)	Depth (m)	Area (ha)	Land capability
Stockpile 1 (Red, well-drained, Aeolian sand)	Hu	Total sand layer	18.17	77.07	436080 (2.4 m depth)	Total original sand layer	19.19	Grazing
	Hu-D	Total sand layer	1.02	4.34	24480 (2.4 m depth)			
	TOTAL		19.19	81.41	460560			
Stockpile 2 (Pale, yellowish brown, calcareous sand in riparian zone)	Ad	1.0	4.39	18.59	43900	1.0	4.39	Riparian
	TOTAL		4.39	18.59	43900			
Grand Total			23.58	100.00	504460		23.58	
*The soils were assessed up to a depth of 2.4 m. However the total sand layer up to the calcrete layer should be stripped and stockpiled. The calcrete and topsoil layer should be replaced in the same sequence. No soil may be pushed into the pit to get rid of.								

2.1.3.1.3 Construction of the rail siding and rail connection

A rail link is required to the main rail network for the transport of ore to Durban or Port Elizabeth. This link will consist of a straight line of rail approximately 3.2km (6m wide) in length spurred off from the main line. At the termination point of the spur line a siding will be constructed approximately 1150mm in length, based on a train length of 1100m. A silo is to be constructed over the siding at the entrance to the mine site to facilitate the rapid loading of the 104-truck train.

It is anticipated that loading will be carried out utilising Transnet locomotives.

Loading of the 104-truck train, carrying 6650 tonnes of ore, will be done over 3 hours or longer. The Transnet locomotives will move the train at creep speed (0.35 m/sec) through the loading station. Provision is made for the train to stop twice during the loading process for the silo to be re-filled. This loading procedure will reduce the loadable capacity of the silo to 2,000 tonnes and the capacity of the conveyor from the reclaiming system of the stockpile to the silo to 2,000 tonnes per hour. The train and locomotives will not be separated during the loading process, which eliminates the necessity of brake tests of the loaded train. The loading station will also be able to load each truck with 63 tonnes of ore evenly and within the limits set by Transnet for the axle loads.

It is assumed that approximately 7 trains will be loaded per month.

2.1.3.1.4 Pit Dewatering Plan

The pit dewatering plan was developed by Epoch Resources (2012), the details of which are presented in Appendix 4.

Removal of the accumulated water in the existing open pit is required in order to allow access to the open pit such that mining can recommence. The removal of this water from the old workings is crucial to the mining project and will determine the reserves available for mining as well as the access point to the underground ore body.

2.1.3.1.4.1 Volume and Quality of Open Pit Water

It is estimated by the owners of the mine that approximately 114 million litres of water is present in the old mine workings. The quality of the water is poor with Total Dissolved Solids (TDS) concentration in excess of 8000 mg/l. The dominant cations and anions in the water are chloride (Cl), Calcium (Ca), Magnesium (Mg), Fluoride (F), Sodium (Na) and Nitrogen (N). Acid-base accounting undertaken on the ore and waste rock (see Section 1.1.8.6) show that excess neutralising capacity exists, with no threat for acidification and generation of Acid Mine Drainage (AMD). The pH of the pit water is 7.9, which is typical of the BIF geology.

2.1.3.1.4.2 Water Treatment Plant

It is proposed that water would be pumped from the open pit to a treatment plant located on or adjacent to the plant terrace. The dewatering of the open pit will precede the commencement of mining and processing operations, implying that the water would have to be treated to a standard suitable for release to the environment or for local re-use.

2.1.3.1.4.3 Water Treatment Process

The water treatment process is described in Appendix 4 and will include pre-treatment, membrane filtration and post treatment processes. Key features of the proposed treatment plant are as follows:

- The membranes are high recovery membranes suitable for the type of waters found within the pit and are designed to minimise brine generation by increasing the recovery of water to approximately 98%. By comparison, conventional membrane technologies would recover approximately 75 % of the water treated, thereby generating significantly larger volumes of brine.
- The chemicals/ reagents utilized within the treatment plant have been specially formulated for the unique manner in which the treatment plant operates and are commonly referred to as GRAS (generally regarded as safe).
- The waste stream consisting of the brine is approximately 2% of the total volume treated and is the smallest brine stream produced compared to conventional processes that generate a 25% brine stream that has to be dealt with resulting in larger evaporation dams and cost to implement.

The treatment process is flexible both in terms of the rate that water can be treated and in the quality of water that can be produced. The size of the water treatment plant that would be installed will depend on the time allowable for the dewatering of the pit and the re-establishment of mining operations. The estimated time required for dewatering of the pit is as follows:

- 15.6 months at a treatment rate of $10m^3$/hr and 24 hr/day
- 6.3 months at a treatment rate of $25m^3$/hr and 24 hr/day
- 3.1 months at a treatment rate of $50m^3$/hr and 24 hr/day

2.1.3.1.4.4 Water Treatment Plant Infrastructure

It is expected that the water treatment plant would be located on or adjacent to the process plant terrace on an area of 20m by 30m, as shown in Figure 44 below. The plant would be erected on a 150mm thick reinforced concrete slab. Infrastructure required to support the installation and operation of the plant is expected to include:

- The dewatering pumps and pipeline required to pump the water from the pit to the treatment plant.
- A receiving water tank to be supplied as part of the water treatment plant into which pit water will be pumped and from which the water treatment plant will be supplied.
- Supply of power to the water treatment plant (estimated 300kW) and pit dewatering pump station.

The concentrate (brine) discharge water from the treatment plant will be pumped to an evaporation dam no more than 100m away from the plant. The treated compliant water will be discharged from the plant to a holding tank situated next to the treatment plant for discharge to the environment by overflow or for reuse.

2.1.3.1.4.5 Water Treatment Options

The proposed water treatment technology is flexible in that it can vary the quality of water produced depending on the requirements at the time. Variations in the quality of water will impact on the cost of water treatment as well as the rate of brine production.

The production of industrial quality water would be approximately 10% to 20% cheaper to produce than producing potable quality water due to reductions in reagent consumptions for the treatment of the water within the pre-treatment stage and solids reduction between stages within the treatment.

The production of industrial quality water will result in a reduction in the volume of brine produced of by approximately 20%, as only the concentration of contaminants that exceed the allowable limits for discharge will be removed to provide an environmentally acceptable discharge water quality. Excess contaminants would be discharged as a brine and be disposed of to the evaporation dam.

Should there be a need to supply potable water to the site this would be done by treating the required quantity of water and pumping it to a separate water tank or dam for use as required.

While the volume of brine produced can be reduced by producing water to a lower quality specification, it is unlikely that the generation of brine could be eliminated completely.

2.1.3.1.4.6 Brine Disposal

Brine from the water treatment plant will be pumped to an HDPE lined pond where it will be allowed to evaporate. The pond has been sized based on two considerations (as detailed in Appendix 4), namely:

- The surface area required to ensure that the rate of evaporation from the pond matches the rate of brine disposal.
- The storage capacity required to contain all of the brine expected to be produced by the treatment of the specified volume of water.

Based on the understanding that the treatment of water will cease after the dewatering of the pit is complete, it is considered appropriate to size the pond to store the entire production of brine. This will require the establishment of a pond with a storage capacity of:

- 2 850m^3 at a treatment efficiency of 97.5%
- 5 700m^3 at a treatment efficiency of 95.0%
- 11 400m^3 at a treatment efficiency of 100%

It is recommended that a pond with a storage capacity of between 2 850 and 5 700m^3 be constructed to allow for lower than expected efficiencies or the treatment of additional water if required. The brine pond is expected to comprise:

- An excavated pond, with the excavated material shaped and compacted to form a perimeter wall to the pond to achieve the required storage capacity and isolate the pond from the surrounding surface water environment.
- A liner to the inside face of the excavated pond and wall anchored into an earth filled trench on the crest of the wall and comprising:
    - Shaping, compaction and removal of stones from the basin of the pond
    - A heavy duty geofabric protective layer
    - 1.5mm HDPE liner or similar approved
- Safety ropes and anchor blocks installed at no greater than 25m centres to the perimeter of the pond.
- A 6 strand barbed wire perimeter fence and warning signage.

2.1.3.1.4.7 Installation of Water Treatment Infrastructure

The timeline for the installation of the water treatment plant and related infrastructure will be dictated by the time allowed for dewatering of the pit as well as the time required for:

- Installation of the water treatment plant itself (2 months) and the construction of the required terrace and concrete foundation (1 month).
- Installation of the pit dewatering pump station and pipeline (2 months).
- Construction of the brine pond (2 months).

2.1.3.1.5 Surface Water Diversion

The information presented in this section was prepared by Epoch Resources (2012), as detailed in Appendix 4. The proposed open pit mine and surface infrastructure will impact on the Witleegte drainage line, as shown in Figure 15. While the river is perennial and flows only in the event of significant rainfall events, the likelihood exists that the stream may have to be diverted around the pit during the construction phase of the project, based on:

- The proposed plant layout encroaches on the river.
- The waste dump straddles the river.
- The existing open pit has been mined through the river.
- The proposed extensions of the open pit to the north and west will encroach on the river.

The diversion would be required both to protect the mining operations in the pit and in the proposed decline shafts to ensure access to the underground resources.

2.1.3.1.5.1 Options for Diversion of Witleegte Drainage Line

The estimated flow rates and flood volumes expected to be experienced at the mine are discussed in Section 1.1.7.

Surface water runoff reporting to the open pit would by definition be classified as contaminated and would probably have to be treated before it could be released into the environment. This is likely to be costly and delay the resumption of mining significantly. If the underground workings are flooded there would probably be significant damage to underground infrastructure

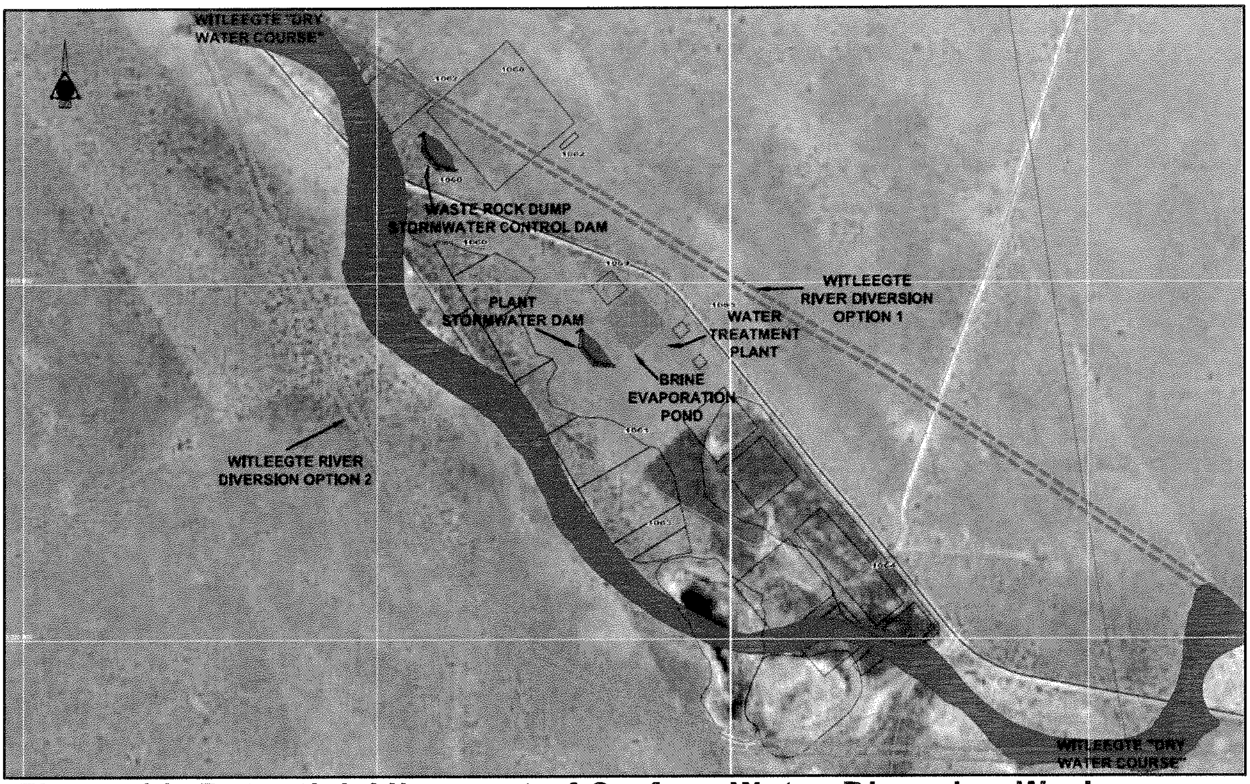


Figure 44 Potential Alignment of Surface Water Diversion Works

In view of the potential problems expected to be associated with flooding of the pit, three options have been considered for preventing surface water inflows to the pit. These options are shown in Figure 44 and are described in summary as follows:

- **Option 1.** The Witleegte is diverted the north and east of the mine site. This would require the installation of substantial culverts under the road crossing to the north of the site. The advantage of this option is that it does not encroach on the ore reserves to the west. It does however affect the surface rights owners to the east.
- **Option 2.** The Witleegte is diverted to the south and west of the site. There should not be any road crossings associated with this option but it may interfere with westward expansions of the open pit or the underground workings. This option will be opposed by the mineral rights holders to the west (UMK operations).
- **Option 3.** The Witleegte is maintained on, or as close as possible, to its natural alignment. This option has the advantage of minimising the impacts on the adjacent landowners but would require:
    - A short-term diversion while the river area is mined, followed by the re-establishment on its original as the pit is backfilled.
    - Relocation of the drainage line to the west of the proposed open pit expansion slightly westward or its temporary diversion and eventual re-established on its original alignment as backfilling of the pit is completed.
    - Relocation of the plant site slightly to the north from its currently proposed position.
    - Integration of the diversion, backfilling and drainage line re-establishment into the sequencing of the mining operations.

None of these solutions can be seen in isolation and would require detailed planning and design in conjunction with the mine and plant design as well as consultation with the adjacent landowners.

2.1.3.1.5.2 Preferred Option for Surface Water Diversion

Based on the information available at the time of compiling this report, Option 3 as outlined above, is the preferred option for preventing surface water inflows to the open pit. This is because:

- Surface and mineral rights holders have indicated that they would oppose the diversion of the river around the site.
- The preliminary estimates of costs associated with the surface water diversions (Options 1 and 2) are considered to be unaffordable for a project on the scale of the proposed mine.

The pre-feasibility stage mine design of the project is therefore expected to focus on the development, permitting and implementation of Option 3 with specific reference to confirmation of the expected peak flow rates and volumes from the catchment based on a detailed catchment study to determine whether there are any potential upstream attenuation or control structures that would affect the stream flows. The design of the works would have to be carried in conjunction with the mine planning process to ensure that the drainage line can be reinstated and also that the decline portals can be protected in the long term.

While the scale of the diversion works are expected to be significant, it is expected that if it is properly planned and executed, the required works can be incorporated into the mining and backfilling operations at very little additional overall cost to the mine.

The diversion works to the west of the proposed open pit expansion would also require:

- The approval of the surface and mineral rights holders to the west.
- Confirmation that the works do not pose any risk to the high wall stability in the open pit or to the proposed underground workings to be accessed via the decline portals.

2.1.3.1.6 Surface Water Containment

In terms of the requirements of GN704 the mine will be required to contain runoff from all disturbed areas on their property. Based on the currently proposed surface layout, it is suggested that this be accomplished by the construction of:

- A plant storm water control dam.
- A waste rock dump storm water control dam.

2.1.3.1.6.1 Location Surface Water Containment Works

Suggested locations for both of these dams are shown in Figure 45 below. The reasons for their suggested placement are as follows:

- The site is elongated and is bisected by a road, which would complicate the direction of all surface water runoff to a single location.
- The waste rock dump storm water control dam is located such that it can collect all surface water runoff from the area north east of the road bisecting the mine site. If no development or surface disturbance takes place on that side of the road the need for the dam would fall away.
- The plant storm water control dam is located such that it can collect runoff from the entire

area south and west of the road, including potential spillages from the water treatment works, brine pond and ultrafines storage facility.

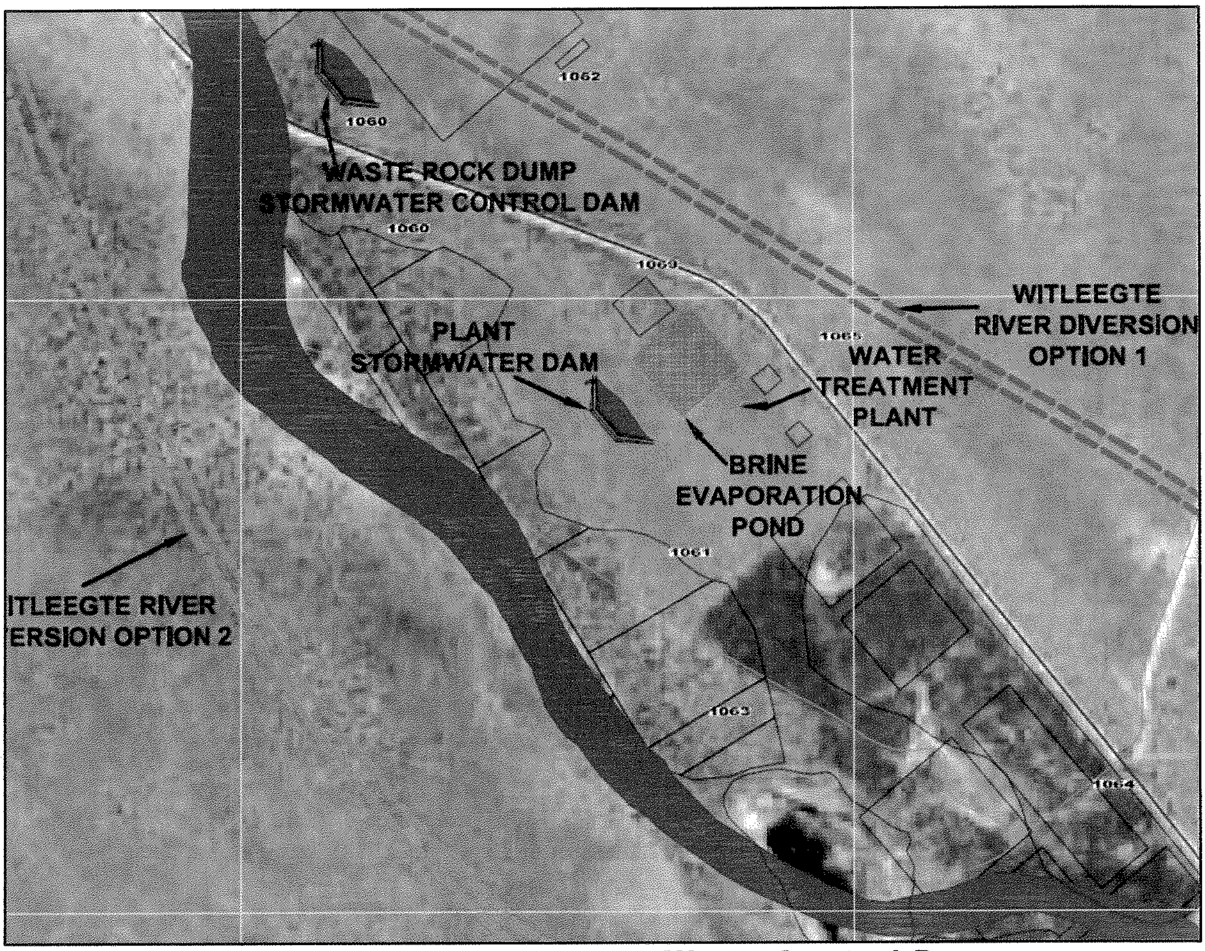


Figure 45 Proposed Location of Storm Water Control Dams

In addition to the stormwater control works shown, it is expected that the control of surface water flows on the site will require the construction of diversion and containment channels to:

- Divert runoff away from areas affected by mining and associated operations.
- Ensure that runoff from disturbed areas is directed towards the stormwater control dams.

It is expected that the site topography will be used so as to minimise the scale of such channels. All channels constructed should be wide and flat and be designed as permanent features so as to minimise the amount of work required at closure.

2.1.3.1.6.2 Sizing of Surface Water Containment Works

The required storage and spillway capacities for the respective catchments are summarised in Table 50 and have been determined based on Rational Method calculations of runoff from their respective areas as well as evaluation of variations in rainfall depth as a function of recurrence interval and event duration as shown in Appendix 4. The dams have been sized to contain runoff associated with an event of approximately 150mm which equates to:

- An event with recurrence interval of 200 years, duration of 1 day and a probability of occurrence in the 15 year life of mine of 7% (i.e. 147.5mm)
- An event with recurrence interval of 20 years, duration of 7 days and a probability of

occurrence in the 15 year life of mine of 54% (160mm).

Table 50 Stormwater Containment Dams and Spillways

Name of Dam	Catchment Area (m^2)	Rational Method Runoff Coefficient	Design Storage Volume (m^3)	Peak Flow Rate / Spillway Capacity (m^3/s)
Plant Storm Water Control Dam	409 000	0.65	40 000	6.44
Waste Rock Dum Storm Water Control Dam	121 000	0.42	8 000	1.31

2.1.3.1.6.3 Construction of Surface Water Containment Works

The methods applied to the construction of the surface water containment works should be dictated by the nature of available construction materials and the low rainfall climate. Due to the anticipated shortages of water in the area, it is expected that any runoff accumulating in the dams would quickly be recovered for use in the processing plant. Dams are therefore expected to comprise excavated storage compartments with excavated material used to construct low flat dam walls to the down grade side of the excavation so as to optimise the available storage capacity.

It is not expected that the dams would be lined as they will probably require frequent cleaning of eroded and windblown sand. This, together with the very low rainfall in the area would make lining unnecessary unless the dams were expected to receive particularly bad quality water. All seepage flows from the dams are expected to report to the open pit from where they can be retrieved, treated and reused or released as necessary.

2.1.3.1.7 Construction of the processing plant, workshops and associated stores

A primary crushing area, workshops, admin offices, ancillary facilities, processing plant and loading facility will be constructed at the site, as indicated in Figure 40.

Construction of the facilities will include limited cut-and-fill earthworks, excavation of foundations and erection of concrete and steel structures. A security fence will be erected around the infrastructure and lighting will be fitted, as required. The workshop are will include an oil trap and the fuel storage area will be adequately bunded.

The surface water works are expected to require a combination of pollution containment, surface water diversion and abstraction and treatment facilities comprising (Epoch 2012):

- A Pollution Control Dam (PCD) sized to contain runoff from the plant area
- A surface water diversion and containment works to manage flows associated with the Witleegte perennial stream
    - Pit dewatering and treatment infrastructure expected to include:
    - A pumping station in the open pit
    - A water treatment plant

- A lined storage facility to store brine residues associated with the water treatment process

The surface water containment works are discussed in more detail in Section 2.1.3.1.3.

The total disturbed area will be approximately 50 ha in area, within the total area of the mining right application of 159.6ha.

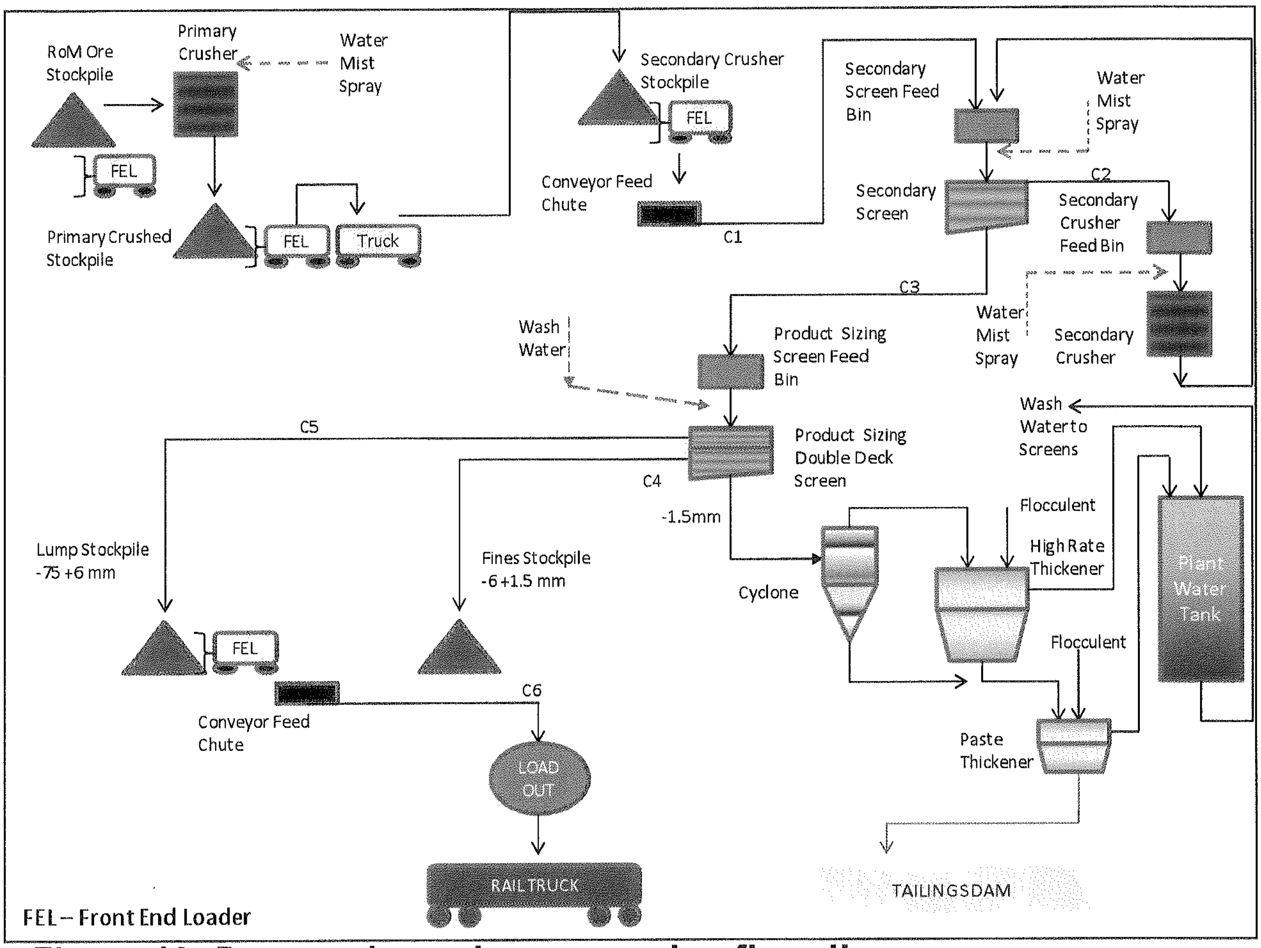


Figure 46 Proposed on-mine processing flow diagram

2.1.3.1.8 Construction of the offices and parking facilities

The location of the offices and parking facilities, is shown in Figure 40.

2.1.3.1.9 Construction of waste rock stockpile

Once mining and processing commences, a waste rock dump and ultrafines storage facility will be constructed.

2.1.3.2 Operational Phase

The following activities will be undertaken during the operational phase of mining:

- Opencast mining operations
- Underground mining operations
- Topsoil management
- Explosives handling
- Hauling and processing of ore
- Dust suppression
- Disposal of mining waste on either the waste rock dump or the ultrafines storage facility
- Controlling water through the mine water balance

2.1.3.2.1 Opencast mining operations

Opencast mining is expected to commence in 2016 within the existing opencast pit area (see Figure 41). Mining will continue in a north-westerly direction up to the year 2023. Mining blocks will be concurrently rehabilitated as mining progresses with the roll-over method of mining. This involves systematically backfilling mined out areas with overburden material, the replacement of topsoil over backfilled areas and the re-instatement of vegetation.

The existing pit will be used as a stormwater control dam and as such will not be rehabilitated until mine closure.

The pit limit and depth is sensitive to operating costs, pit slope assumptions, metal prices and processing recovery. The resource is therefore split between surface and underground mining operations, but may vary as the mine develops. Currently the pit bottom is set at 70mbs, based on the average best economic stripping ratio. This could however change going forward resulting in surface operations being reduced while the underground operations could be brought forward.

The current mine plan aims to produce ore at a rate of between 0.14 and 0.5 million tonnes of ore per year from the opencast operations.

2.1.3.2.2 Underground mining operations

Underground mining will commence in 2023 along the central western boundary of the mine plan (see Figure 41). Mining will continue in a north-westerly and south-easterly direction until 2026, when mining will be completed.

Access to the underground operations will be via a decline cluster from the opencast pit highwall, consisting of a trucking decline, man and material way and a ventilation intake. These declines are to be developed on apparent dip (approx. 9^0) from a high-wall in the central open pit area.

The declines will be developed in the lower ore body. The maximum height of the declines is 6m, matching the maximum capability of typical underground mining equipment.

The planned output of the decline cluster is 0.5 million ore tonnes per annum.

Within the lower ore body, the target for the underground mining operation will be the high grade zone which has a height of 6m. A mechanised mining method, a room and pillar operation, will be used. Pillars 6m by 6m will be left for the purposes of support while 8m rooms are mined. This will give a planned extraction of 80% (20% pillar loss) of the identified resource.

The ore will be broken by means of drill and blast methods. Mechanised electrically powered drill rigs will drill horizontal holes into the faces. These are then filled with ammonium nitrate based explosives and blasted to minimise the generation of fines.

No ventilation shafts will be required during operations. Ventilation will be implemented from the decline shaft with a 200 kW exhaust fan.

2.1.3.2.3 Topsoil management

In practice, even with optimal rehabilitation procedures applied, deterioration from pre-mining to post-mining land capability is unavoidable. It is therefore crucial to follow the proposed rehabilitation procedures precisely in order to prevent degradation of soil characteristics and to re-establish the highest possible post-mining land capability.

The following stripping, stockpiling and replacing procedures needs to be executed precisely:

- Two different soil types occur in the proposed open pit area that needs to be stripped and stockpiled separately. The extent and location of the soil types that should be stripped and stockpiled separately is highlighted in green (soil types Hu and Hu-D) and blue (Soil type Ad) in Figure 43. Soil types Hu and Hu-D are similar but soil type Hu-D are covered with a thin layer of ore and small dumps of waste rock and need to be cleaned thoroughly before soil stripping commences.
- The boundaries of the soil types that should be stripped at different depths and/or stockpiled separately, as shown in Figure 43, should be surveyed and staked at 50 m intervals before any soil stripping commences. This can be done by the surveyor or soil specialist. The stake points are shown in Figure 43 as yellow dots at intervals of 50 m and the coordinates are provided in Appendix 1.
- The two proposed topsoil stockpiles, consisting each of a section for the A and B-horizon is outlined in green and blue in Figure 43. These stockpile positions or alternative positions, needs to be surveyed and staked by the mine surveyor. The most suitable stockpile positions should be determined by the mining engineer considering the mining block sequence of the mine plan.
- The A and B-horizon should be stripped and stockpiled separately as specified in the guidelines for the rehabilitation of mined land (Chamber of Mines of South Africa, 2007). The A and B-horizon sections should be marked with a signboard. The size of the stockpiles should be based on the soil volume per stockpile as indicated in Figure 43 and no height restriction is proposed.
- All soil material above the calcrete layer has to be stockpiled or directly replaced at a backfilled section. Due to the thickness of the soil layer and large quantities of soil it will be necessary to implement a rollover mining method, which implies that rehabilitation takes place concurrently with the mining process.
- Before topsoil can be replaced, the pit should be backfilled to an elevation similar to the pre-mining topography in order to ensure a continuation of the pre-mining surface drainage pattern. The backfilled surface should be surveyed by a surveyor in order to ensure that it has the correct elevation and slopes, and are free draining. A non-free draining surface results in local depressions of periodically saturated zones and increased percolation which usually leads to localised subsidence of underlying spoil material. Slopes of the spoil surface should therefore be similar to the pre-mining surface and should change gradually since abrupt changes in slope gradient increase the susceptibility for erosion initiation.
- The backfilled surface should first be replaced with soil of the B-horizons. Care should be taken to tip enough soil per square unit to reinstate the total required B-horizon thickness at once. The dumped soil heaps should thus only be levelled to reach the required horizon/soil thickness. This will prevent compaction in the lower profile, which can not be alleviated

afterwards. Spreading of soil over far distances and repeated traversing should be avoided. Caterpillar tracked equipment is preferred to use for levelling of the B-horizons due to the large quantities of soil that needs to be handled and less compaction caused by these tracks. Bowl scrapers cause enormous compaction and may not be used.

- When the roll-over mining system kicks in and the point is reached where soils are stripped and directly replaced, without stockpiling, the following method should be implemented. The A-horizon of one mining strip should be stored at the final mining strip and the B-horizon should be tipped and levelled on the area to be rehabilitated (properly levelled spoil surface). The A-horizon of the next mining strip should then be tipped and levelled on top of the replaced B-horizon and the roll-over system can continue like this. The stored A-horizon of the first mining strip should then be replaced on the B-horizon of the last mining strip.
- After the B-horizon is replaced, the surface should be loosened to a depth of approximately 300 mm with normal agricultural equipment, preferably a multiple teeth implement. This is very important to prevent a compacted layer between the A and B-horizons which will be similar to a plough sole which dramatically reduces the effective soil depth and restrict root development.
- The A-horizon should then be tipped systematically over the loosened B-horizons surface and spread evenly. Replacing the A-horizon involves much smaller quantities of soil and a combination of a lighter dozer and grader should be used. Graders have the ability to create a more even surface with less traversing than a dozer, without creating too much compaction.
- The replaced topsoil thickness should progressively be monitored during replacement to verify if it is similar to the replacing depth provided in Figure 6 and to prevent that shortages of topsoil are not encountered.
- The soil fertility status should be determined by soil chemical analysis after levelling (before seeding/re-vegetation), and soil amelioration should be done accordingly as recommended by a soil specialist, in order to correct the pH and nutrition status before re-vegetation.
- The rehabilitated sections should be re-vegetated with a grass mixture dominated by local climax species in early summer to stabilize the soil.
- A short term fertilizer program should be based on the soil chemical status after the first year in order to maintain the fertility status for 2 to 3 years after rehabilitation until the area can be declared as self sustaining.

The soil types that should be stripped and stockpiled either separately or together are shown in Figure 43. The figure includes a table that shows the stripping depths, the areas and percentages as well as the total soil volume per soil type based on the stripping depth. It also shows the replacing depth (topsoil thickness) and post-mining land capability class. This was determined by calculating the total soil volume per soil group (stockpile), divided by the original area, which was stripped. This implies that if more than one soil type, which were stripped at different depths, are stockpiled together, it will be replaced at one average depth. It further shows the stake points on soil boundaries at 50 m intervals.

2.1.3.2.4 Explosives handling

The mine explosives will be stored in two separate areas close to the open pit. The explosives plant office and garage, ammonium nitrate silos and emulsion tank will be stored within a fenced compound to be located in accordance with the legal requirements.

The storage facility will accommodate up to 10 000 kg of emulsion. A powder magazine will house all high velocity explosives. The magazine will be bullet proof, fire resistant, theft-resistant, weatherproof, well ventilated, and conform to standards set by the South African mining regulations.

2.1.3.2.5 Hauling and processing of ore

Ore will be crushed and screened at the processing plant. A total of 500 000 tonnes of RoM ore will be crushed and screened per year. This is equivalent to 222 222 m^3/a. The plant will be operated on one 9-hour shift per day. The following key equipment will form part of the plant:

- Primary crusher
- Secondary crusher
- Front-end Loader
- High rate thickener
- Paste thickener
- Secondary screen
- Double-deck screen
- Cyclones
- Flocculant tank
- Plant water tank

The Run of Mine (RoM) stockpile is indicated on Figure 40. The stockpile is expected to cover an area of 30 x 30m, 12m high. On average 0.01 million tonnes of ore will be stockpiled.

Trucks in the 40t class are well suited to the haul and operating conditions that will be encountered at the mine. These trucks can be fully loaded by the loaders in 3 to 4 passes. Four trucks will be required in the initial production period with this increasing to 11 once steady state RoM production has been achieved.

The ore will be hauled to the primary crusher located at the southern end of the proposed new open pit. The ore is tipped and then uplifted by a FEL for feeding into the crusher. The crushed material is stockpiled and loaded by the FEL into a dedicated dump truck, which in turn delivers the crushed material to the main processing plant stockpiles located at the central complex.

The ore will be picked up from the post primary crusher stockpiles via FEL feeding a conveyor. The ore is then screened into different size factions in a wet screening plant on surface. The different size fractions are sampled and are stockpiled into different stockpiles according to grade and size. From these stockpiles the trains are loaded according to the customer's requirements in terms of size and grade.

The following fleet will be maintained on site:

Item	Fleet
Earthmoving	2
Excavators	1
40t dump trucks	11
Drill rigs	3
FEL	1
Ancillary	1
Water cart	1
Grader	1
Dozer	1
TLB	1
Service truck	1
Fuel bowser	1
Explosives truck	1
Mobile crane	1
Lighting plant	1
Pick-up trucks (bakkies)	4
Generator sets	1
Personnel carrier	1
TOTAL	**34**

2.1.3.2.6 Dust suppression

Dust suppression will be undertaken by operating a wet screening processing plant and by using water tankers to keep the haul and other mining roads wet. For this purpose, a 20 000 litre tanker will be kept on site for dust suppression. Water for dust suppression will be obtained from the water treatment plant or from water contained inside the mining operations.

2.1.3.2.7 Disposal of mining waste on the waste rock dump or ultrafines empoundment

During the ramp-up phase of mining, overburden will be produced at rates of between 0.2 and 1 million tonnes per year. During full opencast production, just over 3 million tonnes of overburden material will be produced per year. Most of this material will be backfilled into the pit as mining progresses as part of the roll-over method of mining. Overburden material may however be stored on the waste rock dump, as indicated in Figure 40, as and if required during mining. The waste rock stockpile is expected to have a footprint of 300 x 300m at a height of 31m, which is equivalent to 2.8 million m^3 of waste rock. It is however unlikely that this volume of waste material will be stored on site, as most of the waste will be backfilled into the pit.

The ultrafines empoundment facility will have a footprint area of 150 x 150m and a height of 6m. Some 0.12 million m^3 of fine material can be stored on the facility.

2.1.3.2.8 Mine Water Balance

The design and planning of the mining and processing operations are currently in the early stages of development, which make it impossible to develop a detailed mine water balance. It can be stated however that:

- The use of surface water runoff is unlikely to contribute significantly to the mine water requirements.
- Little if any groundwater inflows are expected to the open pit and underground workings which are also not expected to contribute significantly to the mine water requirements.
- The treatment of accumulated water in the pit would have to be completed before operations in the pit or plant commence. Unless a large dam is constructed to store this water it would also not contribute to the mine's operating water requirements, as the water would be discharged to the catchment after treatment.

It is probable therefore that all the mine's water requirements would have to be sourced externally. Large water uses on the mine are expected to include:

- The process plant and associated disposal of fine material.
- Dust suppression in the open pit and haul roads to the plant and waste dump.

In this regard, water will be bought from commercial services, like the Vaal-Gamagara Water Supply Scheme.

2.1.3.3 Decommissioning and Closure

During decommissioning and closure, mining operations will cease and the focus will be placed on final rehabilitation of the mining area. The following specific activities will be undertaken.

2.1.3.3.1 Topsoil management

The post-mining land capability class will mainly be determined by the soil type and the thickness of the soil layer placed back on the spoil surface. Other factors and characteristics that might influence the post-mining land capability is slope, compaction and reduction of soil quality due to contamination of soils by subsoil, soft overburden or spoil material.

A post-mining land capability assessment needs to be done progressively (annually) during the operational phase by a soil specialist by means of auger observations at a density of 100 x 100m. This is required to evaluate the rehabilitation procedures and to verify that the topsoil thickness is similar to the replacing depths provided in Table 43. A final post-mining land capability map needs to be compiled and should be submitted for closure purposes.

The following procedures for topsoil stripping and handling during the decommissioning phase should be followed:

- ***Remaining mined areas***. All remaining mined areas will be rehabilitated.
- ***Buildings and conveyers***. The footprint should be thoroughly cleaned and all building ruble and waste material should be removed. The footprint should be loosened by ripping actions. The topsoil should be ameliorated according to soil analyses and the footprint should then be re-vegetated with a grass mixture dominated by local climax species.
- ***Sidings, haul roads and ore stockpiles***. The footprint should be thoroughly cleaned and all ore and subsoil material should be removed to a suitable disposal facility. The footprint should be loosened by ripping actions. The topsoil should be ameliorated according to soil analyses and the footprint should then be re-vegetated with a grass mixture dominated by local climax species.
- ***Pollution control dams***. The footprint should be thoroughly cleaned from slurry and loosened by ripping actions before the subsoil, and then topsoil are replaced. The topsoil should be ameliorated according to soil analyses and the footprint should then be re-vegetated with a grass mixture dominated by local climax species.

2.1.3.3.1.1 Requirements for successful rehabilitation

In order to guarantee successful rehabilitation, the procedures in section 6 need to be executed and the following is required:

- Soil boundaries of soil types that should be stripped and stockpiled separately should be staked at 50 m intervals before any soil stripping commences.
- Soil types should be stripped at stripping depths as specified on Figure 43 and Table 49.
- Topsoil should be stockpiled on 2 stockpiles as specified on Figure 43 to accommodate 2 soil groups namely red aeolian sand of undulating dunes and pale, yellowish brown, calcareous sand of the riparian zone. Each stockpile should consist of separate sections for the A and B-horizons.
- The spoils should be leveled to a free draining surface, similar to the pre-mining topography, before topsoil is replaced during rehabilitation.
- Topsoil should be replaced evenly over spoils during rehabilitation at depths as specified in Figure 43 and Table 49.

- The A and B-horizons should be reconstructed in the original sequence as specified.
- The replaced topsoil should be ameliorated according to soil analysis before seeding and re-vegetation take place.
- Rehabilitated areas should be re-vegetated as soon as possible with a grass mixture dominated by local climax species in order to stabilize the soils.
- Soil erosion on the rehabilitated areas should be monitored and remediate if necessary until the area can be declared as stabilized and self sustaining.
- A post-mining soil depth and land capability evaluation should be done by a soil specialist registered at the Council for Natural Scientific Professions (SACNASP). A post-mining land capability map should be compiled and submitted for closure purposes.

2.1.3.3.2 Water Treatment Plant

Based on the information available it is not expected that there would be a significant ingress of groundwater into the open pit post closure. It is therefore unlikely that the water treatment plant would be operational in the long term unless there were significant inflows of surface water into the open pit. It is therefore expected that at some stage during the operation of the mine the water treatment and associated infrastructure would be removed from site and that pipe supports and foundations would be demolished and disposed of to a designated waste disposal area. The water treatment plant itself would be sold or returned to its owner depending on how it was acquired and pit dewatering pumps and pipelines would either be sold or put to some other use on the mine.

It is expected that the water in the brine pond would be left to evaporate. At closure the pond would be filled with selected waste or fines to create a domed landform, which could then be rehabilitated by covering with soil and topsoil and the establishment of vegetation to form a sustainable free draining landform.

2.1.3.3.3 Stormwater Containment Works

At closure all accumulated silt and fines washed down from the plant should be removed from the dams and deposited to the ultrafines empoundment facility. Once clean, the dams should be left intact so as to serve the post closure land use.

2.1.4 Listed activities (in terms of the NEMA EIA regulations)

The following listed activities, in terms of section 24(2)(a) and (d) of NEMA, may be applicable to Perth Mine:

- Activity 7: Mining as provided for in the MPRDA (Act 28 of 2002), as amended in respect of such permits and rights. The competent authority for this part of the schedule is the Minister or an organ of state with delegated powers in terms of section 42(1) of the MPRDA, as amended.
- Activity 8: In relation to permits and rights granted under Activity 7 above, or any other right granted in terms of previous mineral legislation, the undertaking of any mining related activity or operation within an exploration, production or mining area, as defined in terms of section 1 of the MPRDA (Act 28 of 2002).

For the purpose of this application, it is assumed that the DMR will be the competent authority.

2.2 Identification of potential impacts

2.2.1 Potential impacts per activity and listed activities

2.2.1.1 Soil, land use and land capacbility impact assessment

The construction of mining related infrastructure such as a waste rock dump, ultrafines empoundment, pollution control dams, crusher, processing plant, topsoil stockpile, workshop, offices, explosives magazines and a load out and ancillary facility will have impacts on soil, land capability and land use during the construction phase. Minor soil disturbances will take place during the construction phase and a principal to store all excavated soil, to be used for rehabilitation, should be followed. The impacts are summarized in Table 10.

Stripping and stockpiling of topsoil within the proposed open pit footprint will take place during the operational phase. A rollover mining method will be implemented and backfilling, leveling of spoil and soft overburden material and replacing of topsoil will commence during the operational phase . The impact assessment and ranking are summarized in Table 11.

At the end of the operational phase all impacts on soil, land capability and land use should have taken place. Areas not rehabilitated during the operational phase should be rehabilitated by which all impact should be mitigated as far as possible.

The proposed mine plan was evaluated to identify possible impacts or conflicts by proposed infrastructure in terms of soils, land capability and land uses. The following issues were identified:

- The existing mine plan does not indicate dedicated topsoil stockpiles for different soil types and soil horizons. This issue was addressed and dedicated stockpiles for different soil types and horizons is proposed on Figure 43 and should be incorporated in the mine plan.
- The proposed open pit includes sections of the riparian zone. The riparian zone was accurately delineated based on soil properties, topography and vegetation indicators. Stake points were generated at 50 m intervals on the eastern riparian edge as well as a 100 m buffer line as shown in Figure 43. The coordinates of the stake points are provided in Appendix 1. The extent of riparian zone within the proposed open pit is shown in Figure 43.
- The most northern proposed pollution control dam is situated on the edge of a dune with a slope of 14%. This locality might need to be re-evaluated.
- Various proposed infrastructure is located on the existing waste rock dump. It was indicated by the mine that the footprints of these planned structures would be removed before structures are erected.

2.2.1.1.1 Construction phase

1. Nature of impact – Erection of removable structures such as a processing plant, offices, crusher , workshop and loading facilities								
Impact No	Receptor	Impact and result	Magnitude	Scale	Duration	Probability	Significance calculation	Mitigation
1	Soil	Excavation of soil for foundations of structures will result in: Disturbance of natural soil horizon sequences.	The magnitude will be very high because the upper part of the soil profile of the entire footprint of the facility will be disturbed for the lifespan of the structure. (Very high - 10)	The impact will be confined to the footprint of the proposed structures. (site only - 1)	The impact will be of long term nature and will remain for the lifespan of the structure. (Long term - 4)	The impact will definitely occur. (Definite – 5)	(10+1+4)x5= 75 Significance = High	All excavated topsoil will be stored to be used for rehabilitation during the decommissioning phase. Topsoil and underlying material will be stripped and stored separately as described in section 6.1-6.3. The significance after mitigation can be low depending on how precise the procedures in section 6 are executed.
2	Soil	The structure covering the soil surface completely will result in: Loss of the natural functioning of the soil as a growth medium and habitat for fauna and flora	The magnitude on the natural functioning of the soil as a growth medium and habitat for fauna and flora will be very high because structures will cover the surface completely. (Very high - 10)	The impact will be confined to the footprint of the proposed structures (site only - 1)	The impact will be of long term nature and will remain for the lifespan of the structure. (Long term - 4)	The impact will definitely occur. (Definite – 5)	(10+1+4)x5= 75 Significance = High	The structures will be demolished and the footprints thoroughly cleaned as soon as the structure served its purpose. The footprint will be rehabilitated by replacing the stored subsoil and topsoil in the original sequence The soil fertility will be ameliorated according to soil analysis after replacing and leveling (before seeding/re-vegetation). Re-vegetation of the footprint with a grass mixture dominated by local climax species. The environmental consequence after mitigation can be low depending on how precise the procedures in section 6 were executed.

3	Soil	Loss of original soil fertility.	The magnitude on soil fertility will be low although covering the soil surface will hamper the natural replenishing and recycling of nutrients via fauna and flora. (Low - 4)	The impact will be confined to the footprint of the proposed structures. (site only - 1)	The impact will be of long term nature and will remain for the lifespan of the structure. (Long term - 4)	The impact will definitely occur. (Definite – 5)	(4+1+4)x5=45 Significance = Moderate	Soil amelioration will be done after replacement of the topsoil according to soil analyses and the soil fertility will be maintained by an annual fertilizing program until the area can be declared as self sustaining. The environmental consequence after mitigation will be low.
4	Land capability	The original land capability classified as grazing potential will cease completely until the structures are demolished and the footprints are rehabilitated.	The magnitude of the impact will be very high because the original land capability will cease completely for the entire lifespan of the structure until rehabilitation takes place. (Very high - 10)	The impact will be confined to the footprint of the proposed structures. (site only - 1)	The impact will be of long term nature and will remain for the lifespan of the structure. (Long term - 4)	The impact will definitely occur. (Definite – 5)	(10+1+4)x5= 75 Significance = High	Stripping, storing and replacing of topsoil as described in section 6.1- and 6.3. Soil amelioration will be done after replacement of the topsoil according to soil analyses and soil fertility will be maintained by means of an annual fertilizer program until self sustaining. The environmental consequence after mitigation can be low depending on how precise the procedures in section 6 were executed.
5	Land use	The current possible land uses will cease completely until the structures are demolished and the footprints rehabilitated.	The magnitude of the impact will be very high because the current possible land uses will cease completely for the entire lifespan of the facility until rehabilitation takes place. (Very high - 10	The impact will be confined to the footprint of the proposed structures. (site only - 1)	The impact will be of long term nature and will remain for the lifespan of the facility. (Long term - 4)	The impact will definitely occur. (Definite – 5)	(10+1+4)x5= 75 Significance = High	Stripping, stockpiling and replacing of topsoil as described in section 6.1- 6.3. Soil amelioration will be done after replacement of the topsoil according to soil analyses and soil fertility will be maintained by means of an annual fertilizer program until self sustaining. Re-vegetation of the area with local climax grass species. The environmental consequence after mitigation can be low depending on how precise the procedures in section 6 were executed.

2.2.1.1.2 Operational phase

1. Nature of impact – Stripping and stockpiling of topsoil at the footprint of the proposed open pit

Impact No	Receptor	Impact and result	Magnitude	Scale	Duration	Probability	Significance calculation	Mitigation
1	Soil	Stripping of topsoil will result in: Loss of the original spatial distribution of soil types and soil horizon sequences.	The magnitude will be very high because the soil horizon sequences and physical properties at the entire footprint of the open pit will be disturbed. (Very high - 10)	The impact will be confined to the footprint of the open pits. (site only - 1)	The impact will be of long term nature and will start when topsoil is stripped during the operational phase and will remain until rehabilitation takes place by which the impact will be alleviated to some extent depending on quality of rehabilitation. (Long term - 4)	The impact will definitely occur. (Definite - 5)	(10+1+4) x5 =75 Significance = High	Topsoil will be stripped, stockpiled and replaced based on soil types and depths as shown in Figure 6 and Table 9 and as described in section 6.1-6.3 The original soil horizon sequences will be reconstructed as far as possible by stripping and stockpiling the A and B-horizons separately and by replacing it in the same sequence. The significance after mitigation can be lower depending on how precise the procedures in section 6 are executed.
2	Soil	Loss of original effective soil depth and soil volume.	The magnitude on effective soil depth and volume will be very high because the total stripped area will basically have no effective soil depth until rehabilitation takes place. (Very high - 10)	The impact will be confined to the footprint of the open pits. (site only - 1)	The impact will be of medium to long term nature and will start when topsoil is stripped during the operational phase and will remain until rehabilitation takes place during either the operational or decommissioning phase. (Medium term - 3)	The impact will definitely occur. (Definite - 5)	(10+1+3) x5 =70 Significance = Moderate	The footprint of the opencast and areas to be stripped will be contained as far as possible. The topsoil will be replaced at depths fairly similar to pre-mining conditions as described in section 6.1-6.3 and Table 9. The significance after mitigation can be lower depending on how precise the procedures in section 6 are executed.
3	Soil	Loss of original topography and drainage pattern	The magnitude will be high because the original topography and surface drainage pattern will remain completely changed	The impact will be confined to the footprint of the open pits.	The impact will be of medium to long term nature and will start when topsoil is stripped during the operational phase and	The impact will definitely occur.		The open pit will be backfilled similar to the original elevation and topography. The spoil surface will be shaped to ensure a free draining surface and a continuation of the pre-mining

			until the open pits are backfilled and rehabilitated. (High - 8)	(site only - 1)	will remain until rehabilitation takes place during either the operational or decommissioning phase. (Medium term - 3)	(Definite - 5)	(8+1+3)x5=60 Significance = Moderate	surface drainage pattern. Replacing of topsoil as described in section 6.1-6.3. The environmental consequence after mitigation can be low depending on how precise the procedures in section 6 were executed.
4	Soil	Loss of original soil fertility.	The magnitude on soil fertility will be low although stripping and stockpiling of soil will hamper the natural replenishing and recycling of nutrients via fauna and flora. (Low - 4)	The impact will be confined to the footprint of the open pits. (site only - 1)	The impact will be of medium to long term nature and will start when topsoil is stripped during the operational phase and will remain until rehabilitation takes place during either the operational or decommissioning phase. (Medium term - 3)	The impact will definitely occur. (Definite - 5)	(4+1+3)x5=40 Significance = Moderate	Soil amelioration will be done after replacement of the topsoil according to soil analyses and the soil fertility will be maintained by an annual fertilizing program until the area can be declared as self sustaining. The environmental consequence after mitigation will be low.
5	Land capability	The original land capability classified as grazing will cease completely until the open pits are backfilled and rehabilitated.	The magnitude of the impact will be very high because the original land capability will cease completely until the open pits are backfilled and rehabilitated.	The impact will be confined to the footprint of the open pits.	The impact will be of medium to long term nature and will start when topsoil is stripped during the operational phase and will remain until rehabilitation takes place during either the operational or decommissioning phase.	The impact will definitely occur.	(10+1+4)x5 =75	Topsoil will be stripped and stockpiled per soil type and at depths as shown in Figure 6 and as described in section 6.1-6.3. The open pit will be backfilled similar to the original elevation and topography. The spoil surface will be shaped to ensure a free draining surface and a continuation of the pre-mining surface drainage pattern. The topsoil will be replaced at depths fairly similar to pre-mining conditions as described in section 6.1-6.3 and Table 9. Soil amelioration will be done after replacement of the topsoil according to soil analyses and soil fertility will be maintained by means of an annual fertilizer program.

			(Very high - 10)	(site only - 1)	(Medium to long term - 4)	(Definite - 5)	Significance = High	The environmental consequence after mitigation can be low depending on how precise the procedures in section 6 were executed.
6	Land use	The current possible land uses will cease completely until the open pits are backfilled and rehabilitated.	The magnitude of the impact will be very high because the current possible land uses will cease completely until the open pits are backfilled and rehabilitated. (Very high - 10)	The impact will be confined to the footprint of the open pits. (site only - 1)	The impact will be of medium to long term nature and will start when topsoil is stripped during the operational phase and will remain until rehabilitation takes place during either the operational or decommissioning phase. (Medium to long term - 4)	The impact will definitely occur. (Definite - 5)	(10+1+4)x5 =75 Significance = High	Topsoil will be stripped at depths and per soil type as shown in Figure 6 and Table 9 and as described in section 6.1-6.3. The open pit will be backfilled similar to the original elevation and topography. The spoil surface will be shaped to ensure a free draining surface and a continuation of the pre-mining surface drainage pattern. The topsoil will be replaced at depths fairly similar to pre-mining conditions as described in section 6.1-6.3 and Table 9. Soil amelioration will be done after replacement of the topsoil according to soil analyses and soil fertility will be maintained by means of an annual fertilizer program. The environmental consequence after mitigation can be low depending on how precise the procedures in section 6 were executed.

2.2.1.1.3 Decommissioning and closure phase

2. Nature of impact – Natural soils covered by stockpiles and dumps (topsoil, subsoil, soft overburden, hard overburden and waste)								
7	Soil	Severe soil compaction by the weight of dumped material.	The magnitude of the impact will be medium because the natural soil physical status will be altered negatively. (Moderate - 6)	The impact will be confined to the footprint of the dumps and stockpiles. (site only - 1)	The impacts will be of medium to long term nature and will commence during the operational phase and will remain until the stockpiles and dumps are removed which will probably be during the decommissioning phase. (Medium to long term - 4)	The impact will definitely occur. (Definite - 5)	(6+1+4)x5=55 Significance = Moderate	Alleviation of compaction at the footprint of dumps and stockpiles after removal by ripping actions. The environmental consequence after mitigation can be low depending on how precise the procedures in section 6 were executed.
8	Land capability	Covering the natural soil surface with dumps and stockpiles will cause the land capability to cease completely.	The magnitude of the impact will be very high because the land capability will cease completely until the stockpiles and dumps are removed. (High - 10)	The impact will be confined to the footprint of dumps and stockpiles. (site only - 1)	The impacts will be of medium to long term nature and will commence during the operational phase and will remain until the stockpiles and dumps are removed which will probably be during the decommissioning phase. (Medium to long term - 4)	The impact will definitely occur at the footprint of any dump or stockpile. (Definite - 5)	(10+1+4)x5 =75 Significance = High	All stockpiles will be removed during the rehabilitation process. Alleviation of compaction at the footprint of dumps/stockpiles by ripping actions. Amelioration of topsoil according to soil analysis. Re-vegetations with grass mixture dominated by local climax species. Annual maintenance of soil fertility by fertilizer applications. The environmental consequence after mitigation can be low depending on how precise the procedures in section 6 were executed.
9	Land use	Covering the natural soil surface with dumps and stockpiles will cause all possible land uses to cease completely.	The magnitude of the impact will be very high because all possible land uses will cease completely until the stockpiles and dumps are removed.	The impact will be confined to the footprint of the dumps and stockpiles.	The impacts will be of long term nature and will commence during the operational phase and will remain until the stockpiles and dumps are removed which will probably be during the	The impact will definitely occur at the footprint of any dump or stockpile.	The impact will definitely occur at the footprint on any dump or stockpile.	All stockpiles will be removed during the rehabilitation process. Alleviation of compaction at the footprint of dumps/stockpiles by ripping actions. Amelioration of topsoil according to soil analysis. Re-vegetation with a grass mixture dominated by local climax speicies.

			(High - 10)	(site only - 1)	decommissioning phase. (Medium to long term - 4)	(Definite - 5)	(10+1+4)x5= 75 Significance = High	Annual maintenance of soil fertility by fertilizer applications. The environmental consequence after mitigation can be low depending on how precise the procedures in section 6 were executed.

2.2.1.2 Biodiversity impact assessment

The study area is located in the relatively untransformed Northern Cape Province of South Africa. On a regional scale, the Kathu Bushveld regional vegetation community is listed as Least Threatened and 98.8% remains untransformed. That being said, significant developments have been proposed for the Northern Cape in general as well as the region in which the study area is located. Proposed developments include Photovoltaic Plants (solar energy), transmission power lines and mining developments. On an EIA level, these projects are usually treated singly and consequently the impact assessments seldom consider the cumulative effects of all of these proposed land transformations.

In addition, the study area is untransformed and well connected; the effects of habitat transformation and fragmentation (loss of connectivity, edge effects etc.) are likely insignificant in the region of the study area (except for the developed areas such as the town of Hotazel). It is therefore considered highly likely that at least two red data animals will be present in the study area (Secretarybird and Kori Bustard) and at least moderately likely, that at least another nineteen species will occur. Species such as the Black-footed Cat are poorly known and the potential impacts of the proposed project on these species are difficult to predict.

Two protected tree species may occur within the study area, namely *Acacia erioloba* and *Acacia haematoxylon.* These trees may not be removed without obtaining the necessary permitting. Indigenous vegetation is threatened by alien invasive species, especially within the riparian zone of the Witleegte drainage line.

2.2.1.3 Surface water impact assessment

The following impacts on surface water was identified during this assessment:

- Dewatering of the existing flooded pit and underground workings. It is estimated that approximately 114 million litres of poor quality water is present in the old mine workings. This water will be pumped from the old mine workings, treated and re-used in the mining operations or elsewhere or discharged to the environment.
- Construction of brine ponds associated with the water treatment plant. The brine will be pumped to an HDPE lined pond, where it will be allowed to evaporate. The size of the brine pond will be determined by the treatment efficiency of the water treatment plant. The recommended storage capacity of the brine pond is 2850 – 5700 m^3. There is a risk of leakage of poor quality brine from the pond into the surface water environment. This is mitigated on the basis that the brine pond will be lined with a heavy duty geofabric as a protective layer and a 1.5mm HDPE liner. The brine pond will further be fenced in and the necessary warning signage will be erected.
- The proposed opencast pit and the associated surface infrastructure will impact on the Witleegte drainage line. The natural course of the drainage line is through the mining area, but the stream has already been impacted by historical mining activities. While the river is perennial and flows only in the event of significant rainfall, stormwater runoff in the stream may result in flooding of the mining area. Due to the fact that the operations are situated at the bottom of the catchment, significant volumes of water can flood the mining area in the event of a high rainfall event. Surface water runoff reporting to the open pit would be considered contaminated and will have to be treated before it could be released to the environment. Flooding is likely to be costly and would delay the resumption of mining significantly. If the underground workings are flooded, there would probably be significant damage to underground infrastructure. In order to mitigate this impact, three surface water diversion options are recommended.
- Two storm water control dams will be constructed at the operations, namely at the plant and at the waste rock dump. The design storage volumes of these facilities are 40 000m^3 and

8000 m^3 respectively. It is not expected that the dams would be lined, as they will probably require frequent cleaning of eroded and windblown sand. This, together with the very low rainfall in the area would make lining of the dams unnecessary unless the dams were expected to receive particularly bad quality water. All seepage from these dams are expected to report to the pit, from where it can be managed as part of the mine water balance.

- The quantities of water required to operate the mine and the water treatment plant, must be confirmed, based on a more detailed mining and processing plan, in order to secure a reliable source of process water supply. The mine water balance should also be based on feasibility level designs for the waste rock dump and ultrafines empoundment facility.

2.2.1.4 Groundwater impact assessment

2.2.1.4.1 Construction phase

During the construction phase the historic mine area will be dewatered. It is expected that the mine area will be completely dewatered. Depth to groundwater level in the area as measured in the hydrocensus and the newly drilled monitoring boreholes range around 27 to 32 mbgl. The water level in the opencast pit is thus expected to be lowered below the surrounding regional groundwater level leading to groundwater inflows into the pit area from the surrounding aquifers.

The groundwater that seeps into the open pit from the surrounding aquifers will have to be pumped from the mining area in order to ensure a dry working environment. This will lead to localised dewatering of the aquifers surrounding the historic mining area. Groundwater inflow rates are not expected to exceed 10 m^3/day. The zone of influence of the drawdown cone is calculated using Sichardt's equation:

$R_i = 3000 D_0 \sqrt{k}$

where:

R_i = radius of the zone of influence;

D_0 = maximum drawdown in groundwater level of 72 m (assume 100 m deep historic mining that have to be dewatered and a regional groundwater level of 28 mbgl); and

K = aquifer hydraulic conductivity (using a minimum hydraulic conductivity of 0.001 m/day for the non-fractured host rock and a maximum hydraulic conductivity of 0.021 m/day for individual fractures it is calculated to be between 1.16E-8 and 2.43E-7 m/sec for the fractured rock aquifer).

Thus, it can be calculated that the maximum zone of influence in the general competent rock using a hydraulic conductivity of 2.43E-7 m/sec is around 110 m. Based on this it can be said that none of the privately owned boreholes will be impacted by the mine dewatering.

Surface construction of the waste rock and ultrafines empoundment, settling and evaporation ponds, pollution control dams, haul roads and offices will not breach the groundwater level and is therefore not expected to have any notable impact on the groundwater levels.

In general it can be said that the impacts during the construction phase will be small.

2.2.1.4.2 Operational phase

2.2.1.4.2.1 Groundwater level drawdown and the zone of influence

The mine floor elevations are below the general groundwater level thus causing groundwater inflows into the mining areas from the surrounding aquifers during operations. The mining areas will have to be actively dewatered to ensure a safe working environment. Pumping groundwater that seeps into the mine area to surface will cause dewatering of the surrounding aquifers and an associated decrease in groundwater level within the zone of influence of the dewatering cones.

The zone of influence of the dewatering cone depends on several factors including the depth of mining below the regional groundwater level, recharge from rainfall to the aquifers, vertical infiltration of the recharging water, the size of the mining area, the aquifer transmissivity, and aquifer storativity amongst others. An analytical calculation of the theoretical zone of influence is again done using Sichardt's equation:

$R_i = 3000 D_0 \sqrt{k}$

where:

R_i = radius of the zone of influence;

D_0 = maximum drawdown in groundwater level (assume 100 m deep excavations to the deepest point of the LMO seam and average groundwater levels of 28 mbgl – thus 72 m available drawdown); and

K = aquifer hydraulic conductivity (using a minimum hydraulic conductivity of 0.001 m/day for the non-fractured host rock and a maximum hydraulic conductivity of 0.021 m/day for individual fractures it is calculated to be between 1.16E-8 and 2.43E-7 m/sec for the fractured rock aquifer).

Thus, it can be calculated that the maximum zone of influence in the general competent rock using a hydraulic conductivity of 1.16E-8 m/sec is around 25 m. The calculated zone of influence in the individual groundwater bearing fractures with hydraulic conductivities of up to 2.43 m/sec range up to 110 m from the mining area.

Sichardt's equation is widely acknowledged to under estimate the zone of influence somewhat. Therefore, a value of 200 m is assumed to be conservative. The zone of influence is indicated on Figure 47 Based on this calculation and Figure 47, it can be said that none of the privately owned boreholes will be impacted by the mine dewatering.

Please note that the Witleegte stream has non-perennial flows. Therefore, even though the channel represents a topographical low, it is considered that the drawdown cone can develop to the opposite side of the topographical depression due to a combination of:

- The depth of the mining and groundwater level in the area;
- The apparent poor hydraulic connection between the stream and the underlying aquifer due to the very low hydraulic conductivity of the rock material; and
- The non-perennial nature of the stream.

2.2.1.4.2.2 Water inflows into the mining area

Three components of inflow need to be considered for dewatering of the open pit area:

- Direct rainfall onto the open pit;
- Recharge into the rehabilitated areas (shown by Hodgson & Krantz to be around 8 % of MAR); and
- Inflow of groundwater from adjacent aquifers.

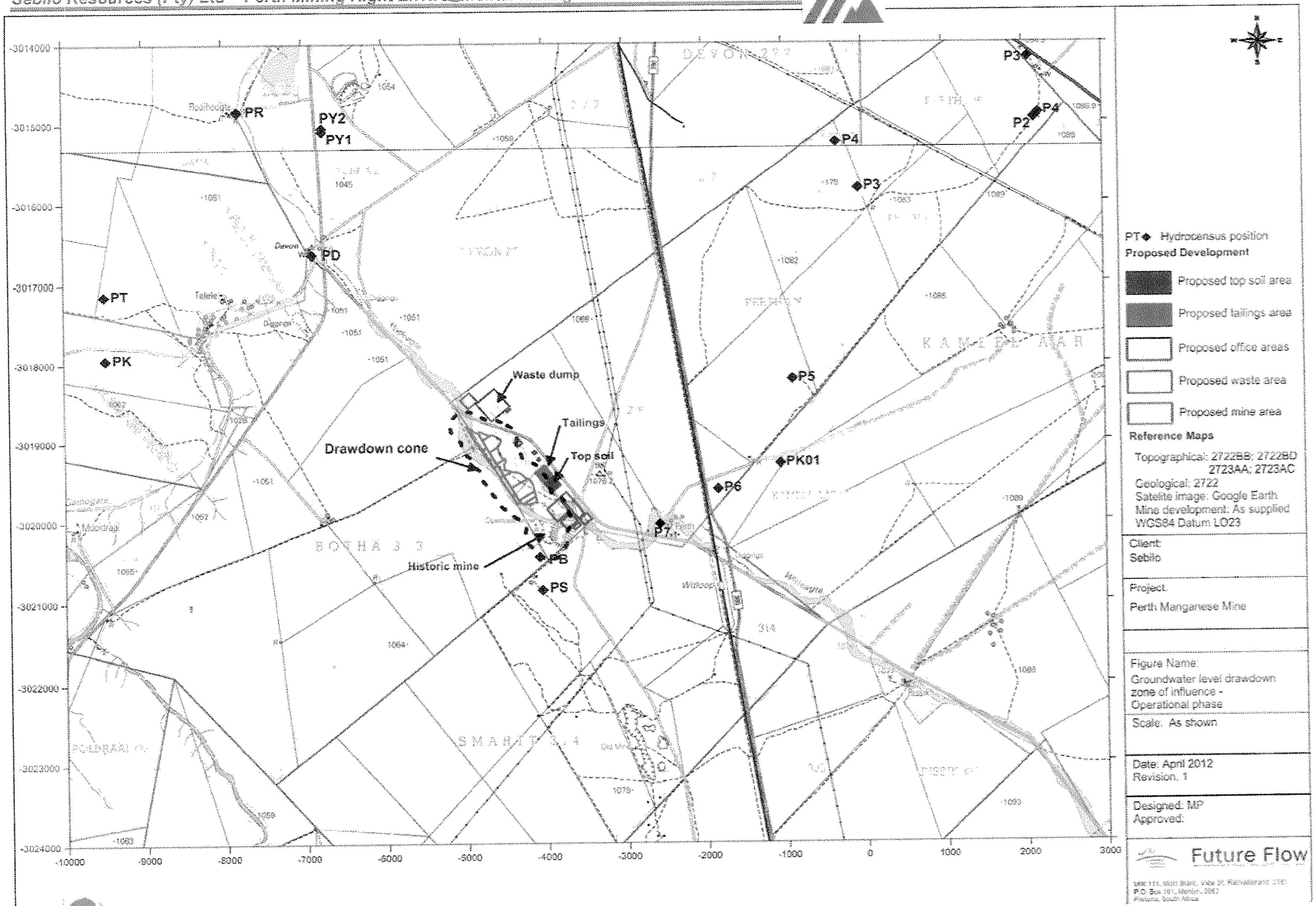


Figure 47 Groundwater drawdown during operations

In order to calculate the theoretical rainfall recharge volumes that have to be dewatered to ensure effective dewatering of the mining area it is necessary to quantify:

- The surface area where recharge can take place:
    - Open pit - the full extent of the annual open pit is taken into account;
- Average annual rainfall – 350 mm; and
- Percentage recharge from rainfall into the open pit: - 100 %.

The average daily dewatering capacity required to remove direct recharge from rainfall onto the pit is summarised in Table 51. The calculated direct rainfall onto the pit area range between 7 and 63 m^3/day depending on the size of the open pit. Do note that these listed values are only annual average values. In reality the rainy season occurs between October and April with little rainfall occurring during the dry season. Therefore, direct rainfall into the pit during the rainy season will be higher than the values shown in Table 51. The direct rainfall into the pit could possibly as high as 150 m^3/day during January 2018 when the open pit area is at its largest with a total combined area of 65 760 m^2 for the pits opened during 2016, 2017, and 2018 (keep in mind that rehabilitation only begins three years after mining started). January is also the month with the highest average rainfall at 70 mm.

Table 51 Calciuated mine seepage rates

Year	Pit area (m^2)	Under ground area (m^2)	Pit depth (m)	Under ground depth (m)	Groundwater inflows (m^3/day)			Re charge in flows (m^3/d)	Total groundwater inflows (m^3/day)			Direct rain fall (m^3/d)	Recharge onto rehab areas (m^3/day)	Total mine inflows (m^3/day)		
					Min	Ave	Max		Min	Ave	Max			Min	Ave	Max
2015	Construction	No under ground mining	35	No under ground mining	4	10	23	0.03	4	10	23	Con Struc tion	No rehab yet	4	10	23
2016	7 640		40		7	17	40	0.03	7	17	40	7	No rehab yet	14	24	47
2017	13 610		40		7	17	40	0.03	7	17	40	20	No rehab yet	27	37	60
2018	44 510		40		7	17	40	0.03	7	17	40	63	1	71	80	104
2019	32 800		67		22	54	130	0.03	22	54	130	31	2	56	87	163
2020	14 830		67		22	54	130	0.03	22	54	130	14	5	42	73	149
2021	18 790		82.47		31	75	182	0.03	31	75	182	18	8	57	101	207
2022	28 270		84.38		32	78	188	0.03	32	78	188	27	9	68	114	224
2023	7 150	8690	No open pit mining	90	36	86	207	0.03	36	86	207	7	10	53	103	224
2024	No open pit mining	13790		90	36	86	207	0.03	36	86	207	7	12	55	105	226
2025		18550		90	36	86	207	0.03	36	86	207	7	13	55	105	227
2026		28090		100	41	99	240	0.03	41	99	240	7	13	61	119	260

m = metres

m/sec = metres per second

m^3/day = cubic metres per day

The average direct rainfall will be balanced by evaporation that will also influence the required dewatering volumes and the numbers calculated here could be seen as a worst-case scenario.

Recharge onto rehabilitated areas have been characterised to be around 8 % of mean annual rainfall by Hodgson & Krantz (1998). The mine works plan indicates that continuous rehabilitation of the opencast areas will take place during the life of mine. However, the mine works plan also state that rehabilitation will only start 3 years after the ore mining operation started. Thus, it can be assumed that rehabilitation will start around 2018.

For the purpose of this study it is assumed that each year from 2018 onwards one year's worth of mining area will be rehabilitated. Thus, during 2018 the total area mined during 2015 will be rehabilitated and so forth.

The calculated recharge volumes into the rehabilitated areas are summarised in Table 51. It should be noted that these calculated values represent the worst-case scenario as a notable portion of the recharging rainwater will be retained within the rehabilitated material (possibly up to 20 %) thus decreasing the dewatering requirement. The water retained within the rehabilitated material will lead to a rising water level in the rehabilitated material.

An important point to note is that although a portion of the recharging water will be retained in the rehabilitated material the depth to mine pit floor will increase over time as the mining continues towards the west. This will allow for the rainwater that recharge into the rehabilitated material to run under gravity along the pit floor towards the topographically lowest point in the excavations, which would be represented by the latest active mining area. The recharged water will converge and accumulate at the lowest excavated point from where it can be dewatered.

Thus, it can be said that the final volume of water that enters the mining area through recharge onto the rehabilitated material, and that will have to be dewatered, will be somewhat lower than the theoretical maximum values calculated here and summarised in Table 51.

In order to conceptually quantify the groundwater inflows into the pit area the "equivalent well approach" is used. This approach is commonly used to estimate the inflows into opencast mine workings. The approach assumes that dewatering of the excavation is approximated by the use of an imaginary borehole, fully penetrating the entire saturated thickness of the aquifer. Water is abstracted at a uniform rate to maintain the groundwater level in the aquifer below the level of the excavation. The excavation itself is assumed to represent a large diameter well.

Theoretical groundwater inflow volumes are calculated using the "modified Dupuit equation":

$$Q = \pi k(H^2-h^2)/(\ln R/r)$$

where:

Q = the inflow volume;

k = the hydraulic conductivity (calculated to be between 1.16E-8 and 2.43E-7 m/sec for the fractured rock aquifer);

H = the hydraulic head above the final pit floor at distance R (taking into consideration the pit depth for each year, and an average depth to the regional groundwater level of 28 m);

h = hydraulic head above the final pit floor at distance r (equal to 0 m under the assumption that the water level will be drawn down the final pit floor level);

r = the radius of the imaginary borehole required to simulate the areal extent of the mining area (calculated based on the total proposed Perth mining area of 236 300 m^2 to be approximately 275 m); and

R = the radial extent of drawdown (m) or distance to negligible drawdown based on Sichardt's equation – (calculated to be 200 m from the edge of the mine area).

The Dupuit equation represents the steady state volume of water leaking into the workings as a result of the change in hydraulic gradient within the infinitely extending aquifer. It does not include the effect of recharge or boundary barriers.

The effect of recharge is calculated using the equation:

$$Q_{recharge} = \pi R^2 \rho$$

where:

Q = Pit inflow due to recharge (m/sec);

R = radial extent of the drawdown cone based on the Sichardt equation (calculated at 200 m from the edge of the mine area); and

ρ = recharge rate to the aquifer (at 2 % of 350 mm MAR calculated to be 2.22E-10 m/sec).

The theoretical groundwater inflow volumes at different average hydraulic conductivities for the surrounding rock material are summarised in Table 51. The hydraulic conductivities are calculated from the aquifer transmissivities obtained from pump testing using the equation:

$$T = k \times d$$

where:

T = transmissivity as calculated from aquifer test data (m^2/day)

k = hydraulic conductivity; and

d = the saturated thickness of the rock material that is drained. This varies depending on the depth of the pit floor beneath the regional groundwater level

As discussed previously the transmissivity of the rock material range between an expected minimum of 0.1 m^2/day for the competent, non-fractured host rock, and a maximum of 0.58 m^2/day for individual fractures. The absolute distribution of this range of transmissivities around and within the mine area is not known. Therefore a range of inflows are calculated using minimum, average, and maximum theoretical average transmissivities to obtain a better understanding of the potential inflow volumes. It has to be noted that the calculated values are in effect steady state calculated values and does not take into consideration transient state conditions as a 3D numerical flow model would.

From Table 51 it can be seen that using average hydraulic conductivities the groundwater inflow volumes into the pit area range between 10 and 120 m^3/day over the life of mine. As expected, the inflow volumes are initially relatively low and then increase over time due to:

- The increasing size of the mined-out area which increase the wall space through which seepage from the surrounding aquifers into the mine area increase;
- The increasing depth of the pit floor elevation below the regional groundwater level. Following the Darcy Equation this increases the groundwater flow gradient which leads to increased inflows; and
- Increased recharge into the rehabilitated material (approximately 8 % of MAR) compared to that of the natural, pre-mined area (effectively approximately 1 to 3 % of MAR)

At the end of the life of mine, when the mined out area is the largest, the rehabilitated area is the largest, and the pit floor is the deepest below the regional groundwater levels, groundwater inflows are expected to be 120 m^3/day when using the average hydraulic conductivity values.

It has to be pointed out that recharge from rainfall (directly into the pit and into the rehabilitated material) will not be a constant value as shown in Table 51 where annual rainfall is averaged for daily values. In reality the rainy season occurs between October and April with little rainfall occurring during the dry season. Therefore, direct rainfall into the pit during the rainy season will be higher than the values shown in Table 51. The direct rainfall into the pit could possibly as high as 150 m^3/day during January 2018 when the open pit is at its largest with a total combined area of 65 760 m^2 for the pits opened during 2016, 2017, and 2018 (keep in mind that rehabilitation only begins three years after mining started). January is also the month with the highest average rainfall at 70 mm.

2.2.1.4.2.3 Groundwater contamination

Groundwater flows around the mining area, within the zone of influence of the mine dewatering cone, will be directed towards the mine area. Water will be pumped from the pit to surface water management structures and therefore very little to no contamination is expected to reach the surrounding aquifers from the opencast pit area.

The waste, topsoil, and ultrafines empoundment facility are located mostly outside the zone of influence of the drawdown cone around the mining area. Therefore, it can be said that any contamination from these sources will not necessarily be drawn towards the mining area and could leave the mine area.

The detail designs of the waste, fines, and top soil storage facilities are not currently known. The sandy gravel that overlies the area around the proposed mine inherently has a relatively high hydraulic conductivity compared to the competent rock and can have a conductivity in the order of 1 to 5 m/day. This could lead to significant contaminant migration away from surface infrastructure should there be vertical seepage from these infrastructure towards the underlying sandy gravel. It is assumed that the sandy gravel will be excavated (average thickness of 5.6 m), or sealed off using a synthetic liner and leakage detection system, especially at the ultrafines empoundment and waste rock dump, which will prevent contamination of the underlying aquifers.

2.2.1.4.3 Decommissioning phase

2.2.1.4.3.1 Groundwater level recovery

Mine dewatering will stop during the decommissioning phase and the groundwater level in the aquifers surrounding the mine will start to recover as the water level in the mined-out area rises. However, it is considered that during the time span of the decommissioning phase (assumed to be less than 6 months) there will be little measurable rise in the water levels due to the fact that the underground area will require a large volume to be flooded.

2.2.1.4.3.2 Contamination of the surrounding aquifers

Groundwater flows around the mining area, within the zone of influence of the mine dewatering cone, will remain directed towards the mine area even though mine dewatering has stopped. This is due to the fact that the decommissioning phase is not expected to last more than 6 months which is not sufficient time for the water level in the pit area to recover significantly.

The waste, topsoil, and ultrafine empoundment facilities are located mostly outside the zone of influence of the drawdown cone around the mining area. Therefore, it can be said that any contamination from these sources will not necessarily be drawn towards the mining area and could leave the mine area.

2.2.1.4.4 Long term post-operational phase

2.2.1.4.4.1 Recovery of groundwater levels

The water level in the pit area is expected to rise once mine dewatering stop. The rate of rise of the groundwater will be dependent on:

- Recharge into the rehabilitated material can be assumed to be around 8 to 10 % of mean annual rainfall (Hodgson & Krantz 1998);
- There will be inflows into the pit from the surrounding aquifers. The inflow rate will depend to a large extend on the groundwater flow gradient between the surrounding aquifers and the water level in the rehabilitated material;

- There will be little to no impact from evaporation on the rising water level other than removal of recharging water before it reaches the saturated zone; and
- The volume of space to be filled:
    - Pore volume in the rehabilitated opencast area (shown to be in the order of 20 % of the total volume of rehabilitated material); and
    - Open void space in the underground mine

As described above the water inflows into the rehabilitated pit will depend on groundwater inflows from the surrounding aquifers as well as rainfall recharge. Rainfall recharge can be assumed to be 8 % of the mean annual rainfall (Hodgson & Krantz, 1998). The total opencast pit area is measured to be approximately 167 000 m^2. Using the average annual rainfall of 350 mm, it can be calculated that 4 676 m^3 of water will enter the rehabilitated material on an annual basis. This equates to a daily average of approximately 13 m^3/day.

Average inflows from the surrounding aquifers were calculated to be around 10 to 120 m^3/day. The inflows are partly controlled by the groundwater flow gradient with increasing flow associated with higher flow gradients. The inflows will reduce over time as the water level in the pit area rise and the flow gradient decreases due to the reduced vertical difference between the surrounding regional groundwater levels and the water level in the pit. For the purpose of this discussion an average of 100 m^3/day is used.

These inflows from the surrounding aquifers can of course vary depending on the actual average hydraulic conductivity as listed in Table 51. Using the minimum aquifer hydraulic conductivity inflows range between 5 and 65 m^3/day (average 45 m^3/day) and using the maximum hydraulic conductivity yields inflows ranging between 25 and 260 m^3/day (average 165 m^3/day).

Based on the above it can be calculated that average daily groundwater inflows of approximately 115 m^3/day can be expected into the rehabilitated material. Incorporating the range of average minimum and maximum hydraulic conductivities it is estimated that inflow could have a minimum of around 60 m^3/day and a maximum of 180 m^3/day.

Using an average porosity of 20 % of the rehabilitated material, the pit area of 167 000 m^3, an average mining depth of 69 m, and an average depth to groundwater regional groundwater level of 28 m as calculated from the exploration drilling database it can be calculated that 1.42 Mm^3 of void space has to be filled in the rehabilitated opencast area before the regional groundwater level is reached.

The underground mine area measures 68 800 m^2. The seam thickness in the underground area is calculated to be average 12 m. This is calculated based on the apparent thickness, and does not take into consideration the dip of the ore body. The Mine Works Program indicates a mineable resource of 6 m. Using the total underground area of 68 800 m^2, the mining height (6 m), and a void ratio of 70 %, it is calculated that the underground area will require approximately 289 000 m^3 of water to be submerged.

Thus, it can be calculated that the combined underground void and rehabilitated material void space require approximately 1.7 Mm^3 of water to become submerged.

Using the groundwater inflow rates and void space it is calculated that recovery of the groundwater levels to the level of the regional groundwater level (28 mbgl) will take approximately 40 years using average inflows from surrounding aquifers. Applying the maximum and minimum groundwater inflows (based on minimum and maximum aquifer hydraulic conductivities) it is shown that this time line for groundwater level recovery has a range of a maximum of 75 years, and a minimum of 25 years.

Taking into the consideration the current water level in the historic mine it is considered that the maximum timeline of 75 years are unrealistic and a timeline somewhere between the average of 40 years, and the minimum of 25 years, for the mine to become submerged is possibly a good reflection of site specific conditions.

2.2.1.4.4.2 Contamination of the surrounding aquifers

The groundwater level in the rehabilitated material of the opencast pit will recover to near pre-development levels around 30 to 40 years after closure. The rising water level will allow near natural groundwater flow directions to be re-established. This will allow contamination to migrate away from the mine area in a down gradient direction.

The waste, topsoil, and ultrafines empoundment facilities are located mostly outside the zone of influence of the drawdown cone around the mining area. Therefore, it can be said that any contamination from these sources will not necessarily be drawn towards the mining area and could leave the mine area. As the groundwater flow patterns are re-established through rising water levels in the rehabilitated area the plume will migrate from the mine in a down gradient direction, towards the west where the Witleegte stream channel forms a topographical low. Once the contamination accumulates here, the migration direction will change towards the northwest, along the stream channel, as shown in Figure 48.

Contaminant migration from the mining area through the fractured rock aquifer will be limited. It is not expected that the plume will extend more than 700 to 1 000 m from the mining areas.

The detail design and closure management plans of the waste, fines, and top soil storage facilities are not currently known. The sandy gravel that overlies the area around the proposed mine inherently has a relatively high hydraulic conductivity compared to the competent rock and can have a conductivity in the order of 1 to 5 m/day. This could lead to significant contaminant migration away from surface infrastructure should there be vertical seepage from these infrastructure towards the underlying sandy gravel. It is assumed that the sandy gravel will be excavated (average thickness of 5.6 m), or sealed off using a synthetic liner and leakage detection system, especially at the ultrafines empoundment and waste facilities, which will prevent contamination of the underlying aquifers.

It is assumed that the ultrafines and waste facilities will be sloped, capped, and vegetated in order to reduce oxygenation and rainfall recharge into the facilities. In the long term this will reduce the vertical seepage from the facilities towards the underlying sandy gravel and fractured rock aquifers.

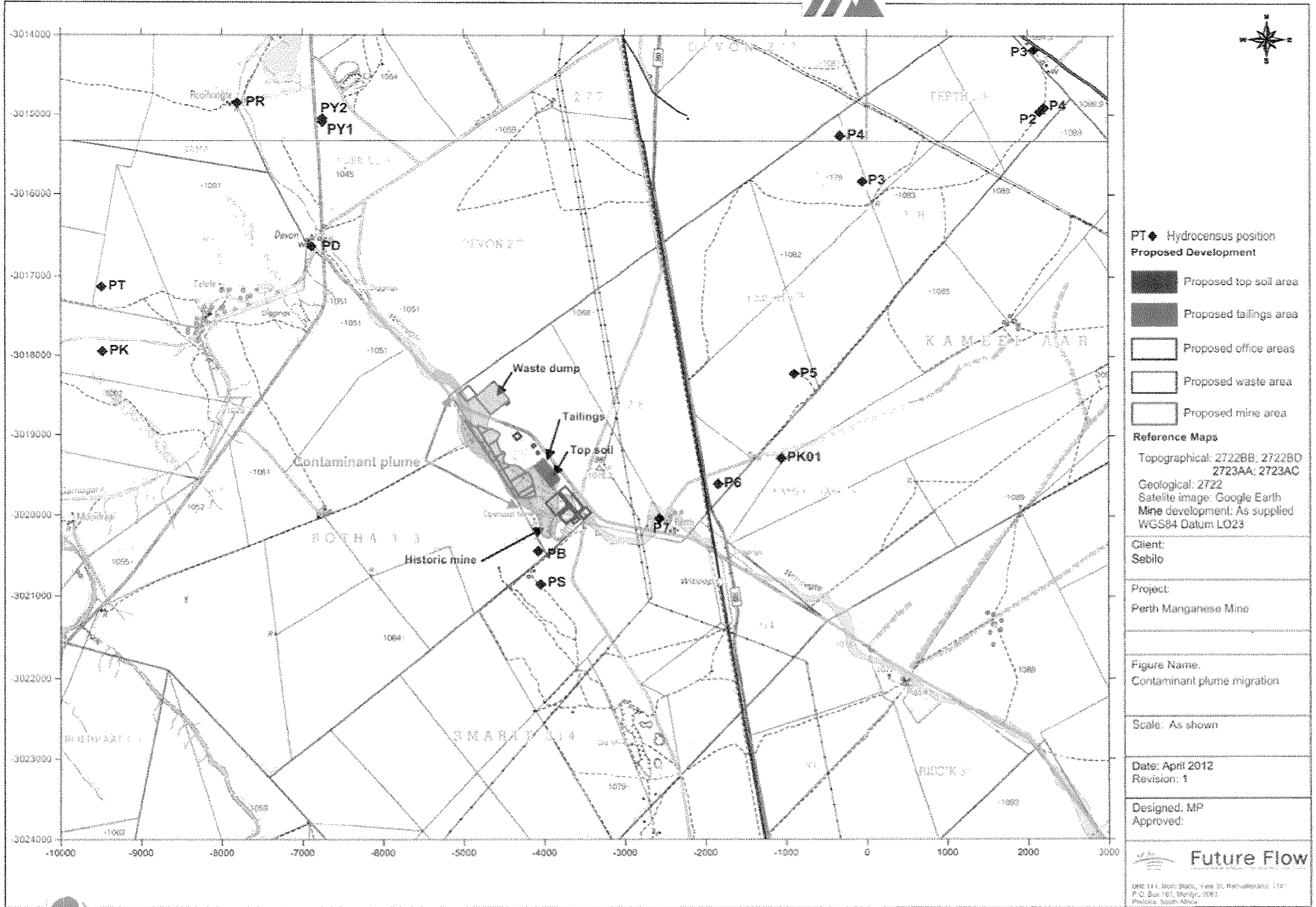


Figure 48 Contaminant plume migration

2.2.1.4.4.3 Decant potential

The groundwater level in the rehabilitated material will recover within around 30 to 40 years after closure. The natural groundwater levels in the mining area are relatively deep below surface at 28 mbgl on average (ranging between 14.60 and 36.70 mbgl).

At no point is the floor elevation of the underground mine above the topographical levels around the perimeter of the opencast area. Therefore, no decant directly from the underground mine is expected.

Decant from the rehabilitated opencast area is more difficult to evaluate. The natural groundwater level in the vicinity of the area is on average around 28 mbgl as discussed previously in this report. Because of the elevated recharge into the rehabilitated material, and the increased transmissivities and storage capacities compared to the surrounding natural, un-mined areas it is possible that the groundwater level can continue to rise in the rehabilitated area after the elevation of the surrounding regional groundwater level has been reached.

It is calculated that under ideal conditions the water level in the rehabilitated material can reach surface around 10 to 15 years after the regional groundwater level was reached, thus around 40 to 55 years after mine closure. Once the water reaches surface elevation, decant onto surface could occur. However, the rate of rise of the water level, as well as the decant potential will be reduced by:

- Once the water level in the rehabilitated area rise above the regional groundwater level (saturated zone), the water pressure in the rehabilitated area will start to force the water out of the rehabilitated pit area, and into the surrounding un-mined, unsaturated rock material. The portion of the water in the rehabilitated material that will be lost in this way, and thus the extent to which the rate of rise of the water level in the rehabilitated material is reduced depends on the transmissivity and storage capacity of the un-mined rock material;
- Once near surface elevations are reached (from 10 mbgl and shallower) water will seep into the surrounding sandy gravels. These gravels have a higher transmissivity and storage capacity than the competent, fractured rock aquifer. Therefor the reduction in the rate of rise of the water level will be reduced further; and
- The relatively high evaporation that characterise the climate in the area will further reduce the rate of rise.

Overall, there is a possibility that surface decant will occur. However, the probability of decant occurring it is currently unsure and it is recommended that on completion of the mine operations a monitoring borehole be installed at the north-western corner of the rehabilitated opencast area at coordinates:

4 980 E; -3 018 700 S.

This borehole will serve to monitor the rate of rise, and quality, of the water in the rehabilitated material. The borehole will serve as an early warning system for potential decant. The water quality data can also be used to determine the decant water quality and the impacts on the surrounding environment.

It should be noted that in the event that the water level in the rehabilitated material rise to the reach the elevation of the sandy gravel it is possible that a dispersed seepage front will develop somewhere down gradient from the mine, in the area between the Witleegte stream and the mine area. It is recommended that should the water level in the proposed monitoring borehole reach the sandy gravel lithologies active monitoring of the area between the mine and the stream be implemented to monitor for any shallow, poor quality seepage daylighting from the sandy gravel.

2.2.1.5 Noise impact assessment

Noise or sound is part of our daily exposure to different sources which is part of daily living and some of the sounds which may be intrusive such as traffic noise forms part of the ambient noise which people get accustomed to without noticing the higher sound levels.

Any person in the workplace and at home is exposed to the following noise levels on a daily basis as illustrated in Appendix 6. Two aspects are however important when considering potential noise impacts of a project, namely:

- The increase in the noise level, and;
- The overall noise level produced

The traffic noise (traffic on the gravel roads), farming activity noise, railway noise, ventilation fan noise, conveyor noise makes up the prevailing ambient noise in the vicinity of the study area. The prevailing noise level may change according to the season of the year when farming activities such as ploughing and harvesting becomes the pre-dominant contributor to the higher noise levels.

There will be an upward shift in the immediate prevailing noise level and to a lesser degree further away from the mine. In terms of noise increases, people exposed to an increase of 2 dBA or less would not notice the difference. Some people exposed to increases of 3-4 dBA will notice the increase in noise level, although the increase would not be considered serious. Noise increases of 5dBA and above are very noticeable and, if these are frequent incidents or continuous in nature, could represent a significant disturbance.

The prevailing winds and the temperature will play an important role in how the noise from the existing mine operations (traffic, conveyor, mine ventilation fan, other existing mine activities) will be experienced by the people in the vicinity of the mine activities.

There will be an increase in noise levels during the construction phase of the project due to earthmoving activities and traffic to and from the proposed opencast and shaft area. This will however be temporarily and the existing gravel road to the abutting UMK-mine will be used. During the operational phase of the mine, noise will be more permanent but to the same extend as what is experienced currently with the abutting mining activities. There is however no residential areas within 1750m of the proposed mine.

For example, the prevailing noise level at the existing plant east of the mine along the R380 road is 56.6dBA. The noise level at 900m from such a plant, should a similar plant be erected at the Sebilo Perth site, will be 44.5dBA. This calculation is based on the noise reduction of 6.0dB per doubling of the distance from the plant. The mining activities at the abutting opencast mine was hardly audible because of the distance, topography and vegetation, which are important factors in noise propagation.

The projected noise contours during mining activities are illustrated in Figure 49. The projected noise level at 800m from the open cast pit activities will be 56.0dBA when all the equipment is working at one time in one area. There will however be a further reduction of 7.0dBA when the activities take place below ground level. The yellow contour represents the 43,0dBA and the green contour represents the 35.0dBA noise levels.

The noise contour at the proposed underground mining shaft is given in Figure 50. This will be a point noise source and the noise level at the shaft will be 85.0dBA and at the red contour the calculated noise level will be between 56.0dBA, yellow contour 43.0dBA and green contour 35.0dBA.

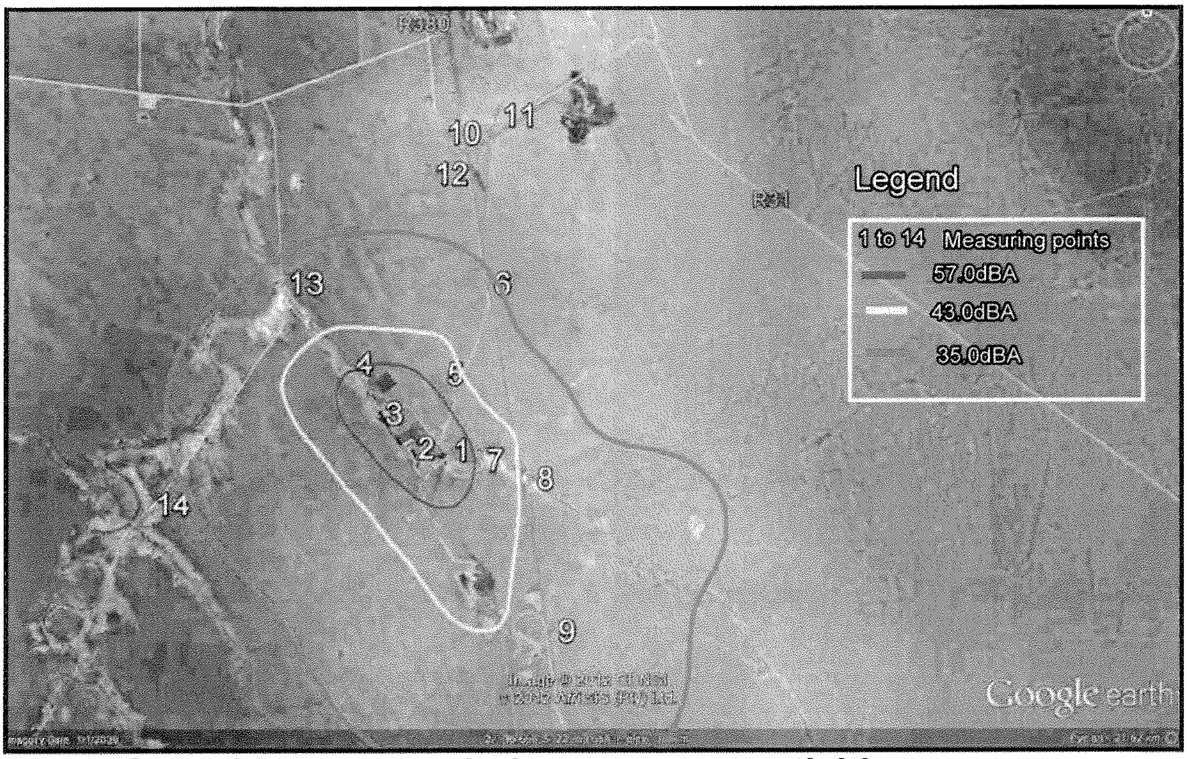


Figure 49 Noise contours during open cast activities

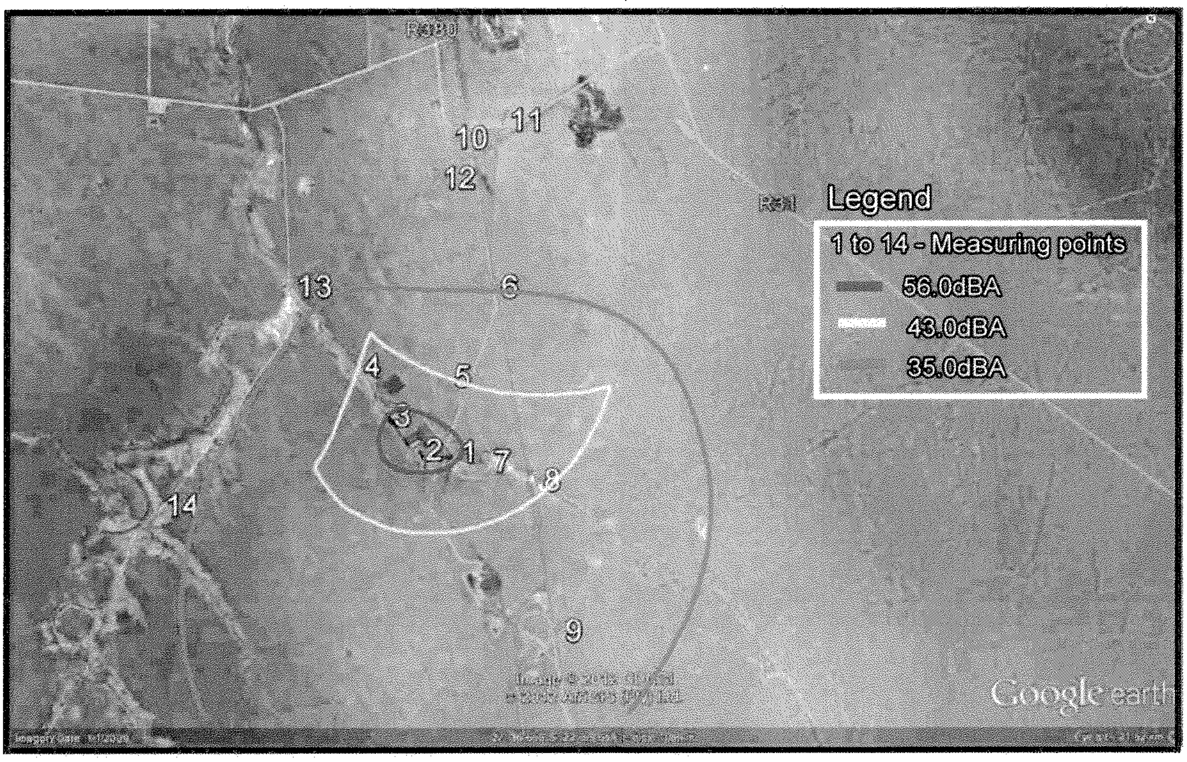


Figure 50 Noise contours for the proposed shaft area.

The air blast contour is given in Figure 50. The red contour is 85dB, the yellow contour 77.0dB and the green contour 61.0dB.

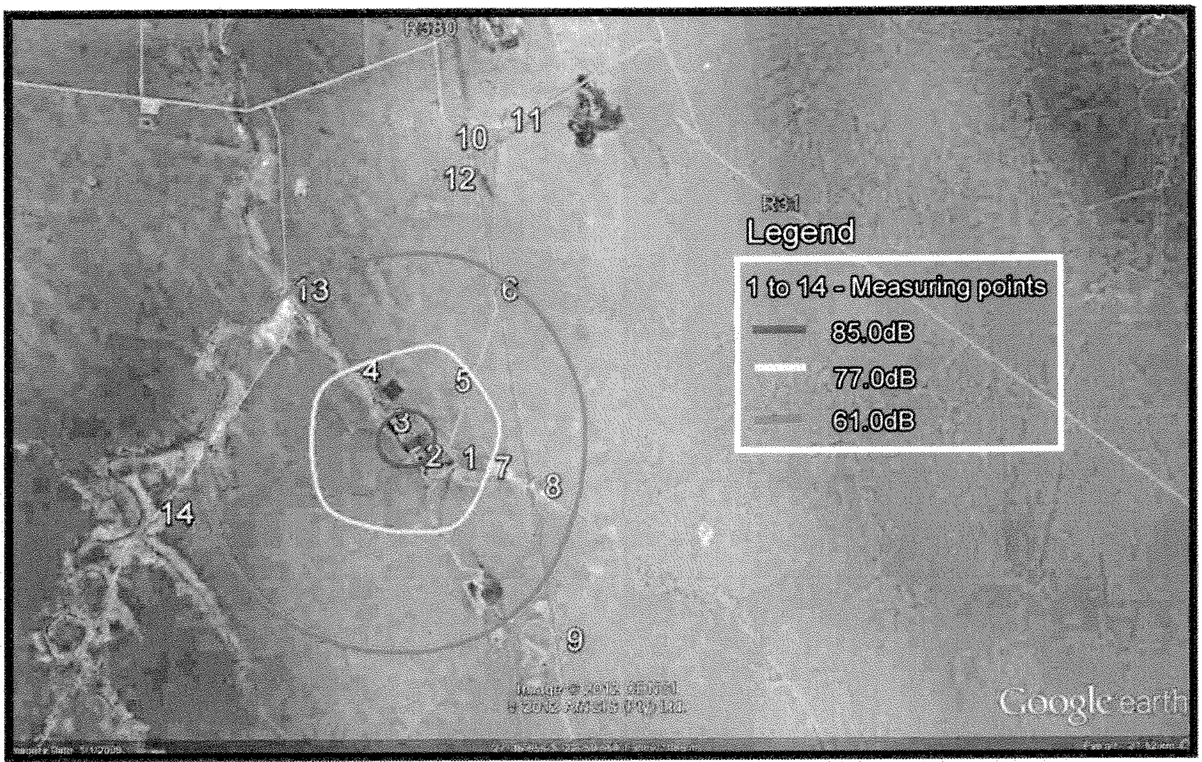


Figure 50 Air blast noise contour at the open cast pit.

The information presented above suggests that the prevailing ambient noise levels in the vicinity of the proposed opencast mine will be exceeded for the duration of the blast only after which the prevailing ambient noise level will be maintained.

2.2.1.6 Blasting impact assessment

The site is so remote that vibration and airblast concerns would seem only to apply to the premises of the mining operation.

The following remarks are relevant purely to environmental impacts, which might arise, and are in addition to the normal mandatory steps required by law for safety.

- Prior to any blast, a survey should be conducted to determine all properties within 500m of any part of the blast. The condition of these properties needs to be recorded and signed off by any persons who might later claim against blasting damage. Such persons should be warned of the blasting time and any concerns discussed.
- If there are any structures within 1000m, discussions should be held to ascertain whether there might be any claims arising from blasting. Vibration/ Airblast readings should be undertaken in order to support such discussions. If it is apparent that monitoring will be wise, two seismographs should be operated at the mine by persons competent to do so, both so that there is a backup if one instrument is down, but also that more than one place can be monitored for each blast.
- The location of the seismographs must be accurately recorded, and the fixation of the sensors in the ground or to structures must be appropriate to the conditions and expected vibration amplitude. Fixation method must be recorded.

- Blasting records indicating the exact location of every blasthole, and the explosive mass delivered into it, as well as the timing layout, must be archived together with complete seismograph records (i.e. raw data files and printouts of vibration traces).

2.2.1.7 Air quality impact assessment

Dispersion modelling was undertaken using the US-EPA approved Aermod Dispersion Model. The air quality impact assessment methodology is discussed in detail in Appendix 8. The emissions inventory presented in Section 1.1.12.5 was used as input for the modelling runs. The results are presented below.

2.2.1.7.1 Construction Phase

During the construction assessment phase it is expected that, the main sources of impact will result due to the construction of access haul roads, the plant area and the clearing of the existing face with open pit mining. These predicted impacts cannot accurately be quantified, primarily due to the lack of information related to scheduling and positioning of construction related activities on a day to day basis. A qualitative description of the impacts has been provided. This will involve the identification of possible sources of emissions and the provision of details related to their impacts.

Construction is commonly of a temporary nature with a definite beginning and end. Construction usually consists of a series of different operations, each with its own duration and potential for dust generation. Dust emission will vary from day to day depending on the phase of construction, the level of activity, and the prevailing meteorological conditions (USEPA, 1996).

The following possible sources of fugitive dust have been identified as activities which could potentially generate dust during construction operations at the mine:

1. Product Transport
   - Scraping;
   - Debris handling;
   - Debris stockpiles; and
   - Truck transport and dumping of debris.
2. Concentrator Plant and Rail Loading
   - Clearing of area for infrastructure;
   - Debris handling;
   - Debris stockpiles; and
   - Truck transport and dumping of debris.
3. Opencast Mining
   - Removal of overburden; and
   - Haul Roads (scraping etc).

2.2.1.7.1.1 Creation and Grading of Access Roads

Access roads are constructed by the removal of overlying topsoil, whereby the exposed surface is graded to provide a smooth compacted surface for vehicles to drive on. Material removed is often stored in temporary piles close to the road edge, which allows for easy access once the road is no longer in use, whereby the material stored in these piles can be re-covered for rehabilitation purposes. Often however, these unused haul roads are left as is in the event that sections of them could be reused at a later stage.

A large amount of dust emissions are generated by vehicle traffic over these temporary unpaved roads (USEPA, 1996). Substantial secondary emissions may be emitted from material moved out from the site during grading and deposited adjacent to roads (USEPA, 1996). Passing traffic can thus re-suspend the deposited material. To avoid these impacts material storage piles deposited adjacent to the road edge should be vegetated, with watering of the pile prior to the establishment of sufficient vegetation cover. Piles deposited on the verges during continued grading along these routes should also be treated using wet or chemical suppressants depending on the nature and extent of their impacts.

A positive correlation exists between the amount of dust generated (during vehicle entrainment) and the silt content of the soil as well as the speed and size of construction vehicles. Additionally, the higher the moisture content of the soil the lower the amount of dust generated.

The periodic watering of these road sections will aid in the reduction of dust generated from these sources. Cognisance should be taken to increase the watering rate during high wind days and during the summer months when the rate of evaporation increases.

2.2.1.7.1.2 Preparation for the construction of the plant and supporting infrastructure.

Removal of material usually takes place with a bulldozer, extracted material is then stored in piles for later use during rehabilitation procedures. Fugitive dust is generated during the extraction and removal of overlying material, as well as from wind blown dust generated from cleared land and exposed material stockpiles. Dust problems can also be generated during the transportation of the extracted material, usually by truck, to the stock piles. This dust can take the form of entrainment from the vehicle itself or due to dust blown from the back of the trucks during transportation.

To avoid the generation of unnecessary dust, material drop height should be reduced and material storage piles should be protected from wind erosion. This can take the form of wind breaks, water sprays or vegetation of piles. All stockpiles should be damped down, especially during dry weather.

It should be noted that emissions generated by wind are also dependent on the frequency of disturbance of the erodable surface. Each time material is added to or removed from a storage pile or surface, the potential for erosion by wind is restored. Any crusting of the surface binds the erodable material (USEPA, 1996). Dust created during the transportation can be limited by watering the road sections that are being used and by either wetting the material being transported or covering the back of the trucks, to limit the wind blown dust from the load.

2.2.1.7.1.3 Preparation of the open pit mining areas

Open pit mining usually starts with the set up of the initial box cut, as there has been previous mining activities, this will mainly involve opening and clearing the mine face. This will involve the removal of topsoil, and overburden by front end loader with the drilling and blasting of the overlying rock required in order to gain access to the mineral bearing ore. Bulldozing, drilling and blasting operations can result in the liberation of significant quantities of dust to atmosphere.

Dust liberated during bulldozing activity can be reduced by increasing the moisture content of the material being removed. An attempt should be made to coincide blasting operations with winds blowing away from the communities directly south of the site, as well as periods when poor atmospheric dispersion are expected i.e. early morning and late evening.

The removed topsoil will have to be transported to a designated collection point from where it can be recovered later during site rehabilitation. The removal of this material for storage should be done along designated haul roads which are properly maintained (watering), to reduce the amount of vehicle entrained dust which can be kicked up during these activities. Likewise, waste rock removed from the pit will have to be discarded at a dedicated waste rock pile. In addition to the use of dedicated, treated haul roads, the material transported can be wet or covered to limit the wind blown dust being released from the load.

2.2.1.7.1.4 Overview of potential Impacts

The following components of the environment may be impacted upon during the construction phase:

- ambient air quality;
- local residents and neighbouring communities;
- employees;
- the aesthetic environment; and
- possibly fauna and flora

The impact on air quality and air pollution of fugitive dust is dependent on the quantity and drift potential of the dust particles (USEPA, 1996). Large particles settle out near the source causing a local nuisance problem. Fine particles can be dispersed over much greater distances. Fugitive dust may have significant adverse impacts such as reduced visibility, soiling of buildings and materials, reduced growth and production in vegetation and may affect sensitive areas and aesthetics. Fugitive dust can also adversely affect human health. It is important to note that impacts will be of a temporary nature, only occurring during the construction period.

2.2.1.7.2 Operational Phase

This section will aim to deal with the potential air quality impacts which could result due to the proposed operations. Details regarding the source characteristics will be obtained from site layout plans and process specific information provided and a questionnaire filled in by the client. The sources likely to be included in this assessment can be categorised as follows:

- Material Processing (Crushing and Screening, Storage Piles);
- Opencast mining (Drilling and Blasting, Tipping, Bulldozing)
- Underground mining operations; and
- Product Transport (Haul Road and Rail)

Table 52 indicating maximum predicted onsite concentrations

	24 Hour (μg/m³)	Annual (μg/m³)
All Operations	55.98	12.59
National Standard	120	50

Note: Onsite concentrations are determined based on the maximum predicted concentration. The South African Air Quality Standards are based on a site boundary figure and not necessarily on a maximum predicted figure

Figure 51 provides an indication of the impacts proposed for all operations on site, this is a cumulative impact to determine the overall potential impact. For the 24 hour averaging period the maximum predicted concentration is 55.98 μg/m³ at the source, and a predicted impact of 53.00 μg/m³ at the edge of the mine lease area, this is just below the National Standard set at 120 μg/m³. Figure 52 provide the predicted concentrations over an annual averaging period, where the National Standard is set at 50 μg/m³ with the maximum predicted concentration being 12.59 μg/m³, and a maximum offsite concentration of 12.10, as indicated in Table. These results are based on a mitigation plan, which is currently being proposed by the mine. These mitigation measures include:

- Conveyor Transfer Points - Dust suppression at PRC and PF using sprays. Wet screening also employed estimated efficiency 80%
- Tipping - Mist spray at silo conveyor loading point estimated efficiency of 80%
- Tipping - Wet suppression using impact sprinklers 70%
- Haul loading - Impact sprinklers 70%
- Rail Loading - Water misting at conveyor loading point estimated efficiency of 80%
- Haul Trucks - Watering down truck 70%
- Drilling - Dust collectors 80% efficient

By including these measures into the design and implementation of the mine plan, the dust levels on site are predicted to be below the South African Standards.

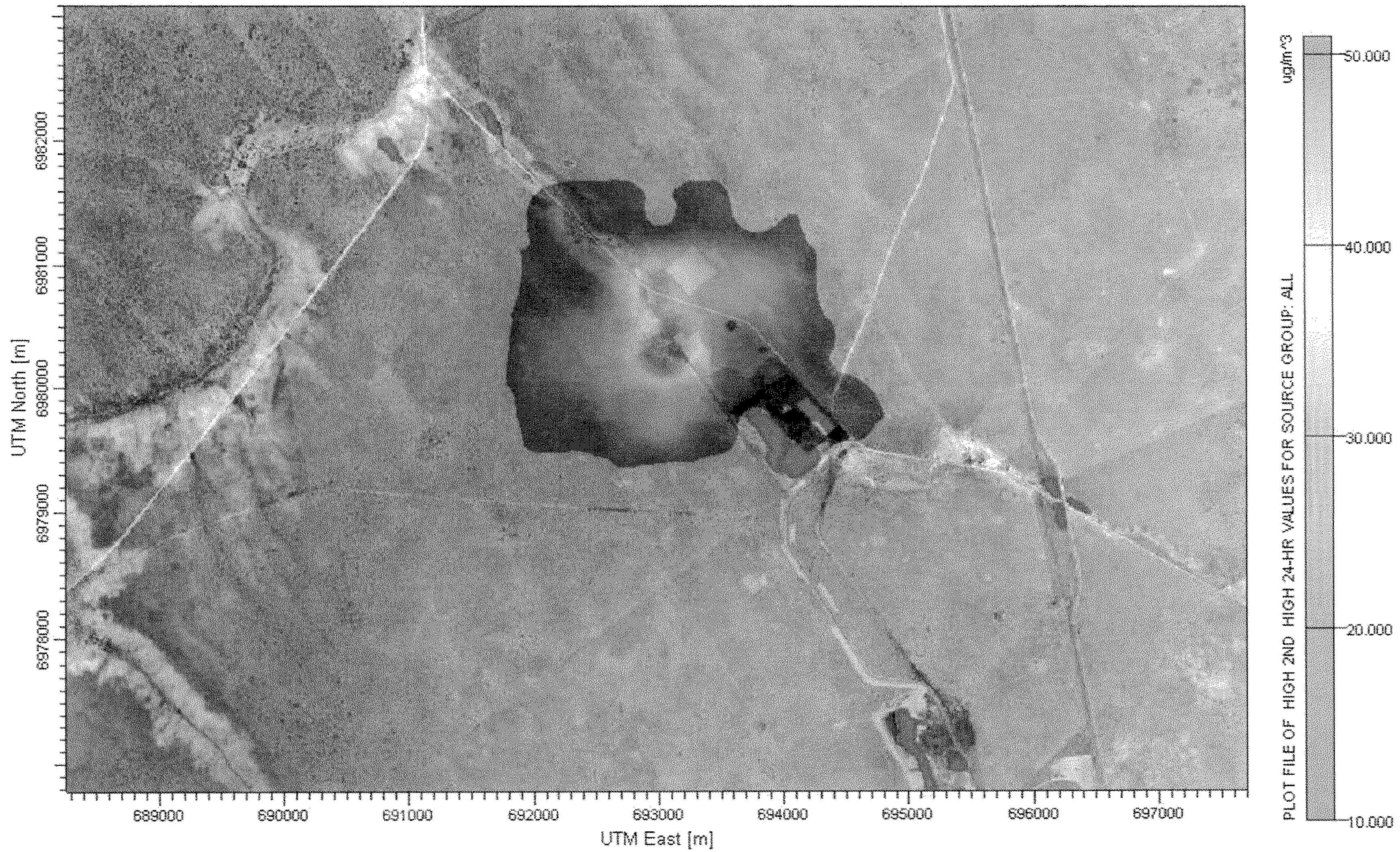


Figure 51 Predicted impacts associated with all operations for a 24-hour averaging period

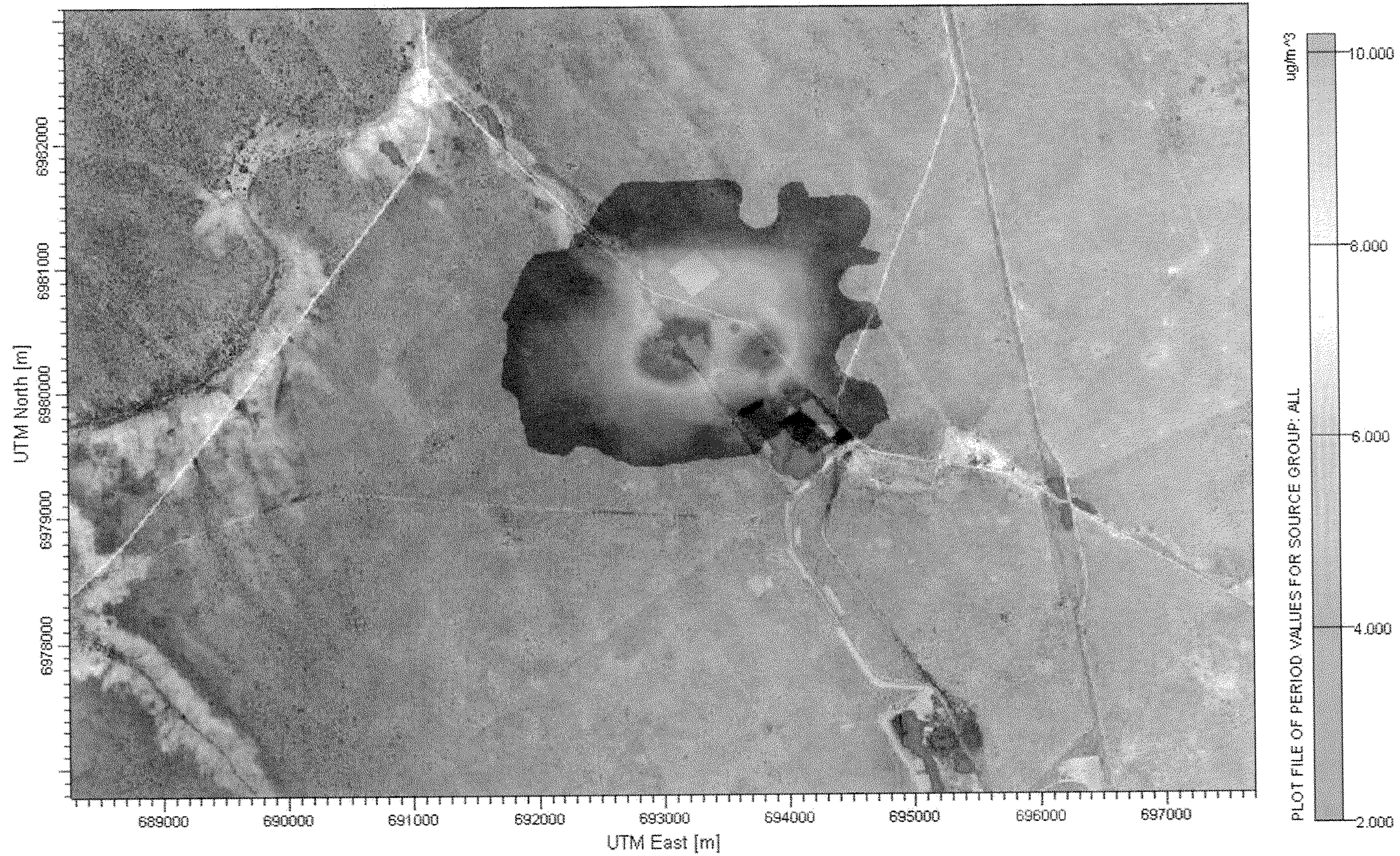


Figure 52 Predicted impacts associated with all operations for an annual averaging period

2.2.1.7.3 Decommissioning Phase

The decommissioning phase is associated with activities related to the demolition of infrastructure and the rehabilitation of disturbed areas. The total rehabilitation will ensure that the total area will be a free draining covered with topsoil and grassed. The following activities are associated with the decommissioning phase (US-EPA, 1996):

- Existing buildings and structures demolished, rubble removed and the area levelled;
- Remaining exposed excavated areas filled and levelled using overburden recovered from stockpiles;
- Stockpiles and ultrafines impoundments to be smoothed and contoured;
- Topsoil replaced using topsoil recovered from stockpiles; and
- Land and permanent waste piles prepared for revegetation.

Possible sources of fugitive dust emission during the closure and post-closure phase include:

- Smoothing of stockpiles by bulldozer;
- Grading of sites;
- Transport and dumping of overburden for filling;
- Infrastructure demolition;
- Infrastructure rubble piles;
- Transport and dumping of building rubble;
- Transport and dumping of topsoil; and
- Preparation of soil for revegetation – ploughing and addition of fertiliser, compost etc.

Exposed soil is often prone to erosion by water. The erodability of soil depends on the amount of rainfall and its intensity, soil type and structure, slope of the terrain and the amount of vegetation cover (Brady, 1974). Revegetation of exposed areas for long-term dust and water erosion control is commonly used and is the most cost-effective option. Plant roots bind the soil, and vegetation cover breaks the impact of falling raindrops, thus preventing wind and water erosion. Plants used for revegetation should be indigenous to the area, hardy, fast-growing, nitrogen-fixing, provide high plant cover, be adapted to growing on exposed and disturbed soil (pioneer plants) and should easily be propagated by seed or cuttings.

2.2.1.8 Visual impact assessment

Visual impact is defined as the significance and intensity of changes to visual quality of the area resulting from an activity or change in land use that may occur in the landscape.

Significance and intensity are measures of the response of viewers to the changes that occur. It represents the interaction between humans and the landscape changes that they observe. The response to visible changes in the landscape may vary significantly between individuals.

Perception results from the combination of the extent to which the activity is visible (level of visibility) and the response of individuals to what they see. A major influence on the perception of people in relation to the activity will be the visual character and quality of the landscape in which they would be located. Natural areas are renowned for their high visual quality. The proposed Sebilo Perth Project and associated landscape features may be seen as a negative impact on these areas of high visual quality, as shown in Figure 53.

The potential visual impact of the proposed activity will primarily result from changes to the visual character of the area within the viewshed. The nature of these changes will depend on measurable factors such as viewing distance, the visual absorption capacity of the surrounding landscape and the scale of the surrounding environment and landform. Other factors are subjective, such as the visual perception of people viewing the activity.

2.2.1.8.1 *Intensity of Visual Impact*

The intensity of visual impact is determined using the viewshed, viewing distance, visual absorption capability and the viewer sensitivity criteria. Additionally, the visual impact index (please refer to Figure 53) predicts the visual impact taking in consideration the identified observers or sensitive receptors and the viewshed.

Table 52 below summarises the results of the criteria used to determine the intensity of the visual impact. These results are based on worst-case scenarios when the impacts of all aspects are taken together.

Table 52 Intensity evaluation for proposed Sebilo Perth Project

	Quality of Visual Resource	Viewshed	Visual Distance	VAC	Sensitivity	Visual Impact (Intensity)
Prior to construction						
Operational Phase Assuming mitigation is successful)	*Low*	*High*	*High to Low (High to Low Impact)*	*Moderate (Moderate Impact)*	*High to Low*	*Low - Moderate*

The results as shown above, indicates that the intensity of visual impact associated with the proposed Sebilo Perth Project, will be Low - Moderate assuming that mitigation measures are successful.

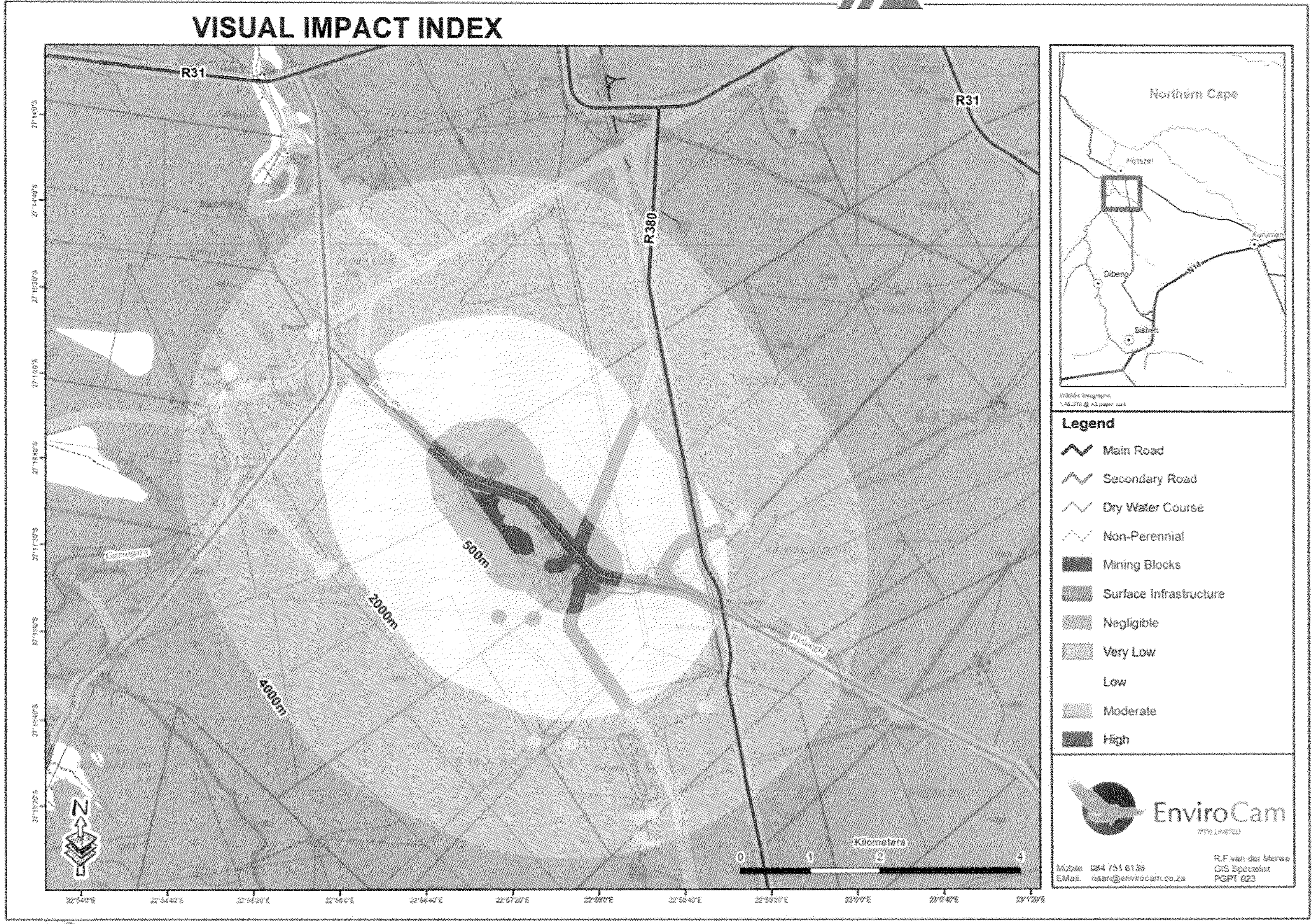


Figure 53 Visual impact index

Table 53 Visual impact significance evaluation

Criteria	View from Homesteads		View From R380 Main Road		View from R31 Main Road	
	Without mitigation	With mitigation	Without mitigation	With mitigation	Without mitigation	With mitigation
Extent	Local (2)	Local (2)	Local (2)	Local (2)	Local (2)	Local (2)
Duration	Long term (3)	Long term (3)	Long term (3)	Long term (3)	Long term (3)	Long term (3)
Intensity	Low – Medium (1)&(3)	Low (1)	Low – Medium (1) & (3)	Low (1)	Negligible (0)	Negligible (0)
Probability	Definite (4)	Highly Probable (3)	Probable (2)	Probable (2)	Improbable (1)	Improbable (1)
Rating	10 & 12	8	8 & 10	8	6	6
Significance	Low- Medium	Low	Low	Low	Low	Low
Status of Impact	Negative	Negative	Negative	Negative	Negative	Negative
Nature of Cumulative impact	It is anticipated that the proposed project would have an overall negative visual influence within the region and increase the current degraded visual appeal of the surrounding area/land use. Therefore the proposed project would result in a negative cumulative impact increasing the visual impact from the surrounding mining/degraded areas. Although concurrent rehabilitation will degrease the cumulative impact.					
Degree to which impact can be reversed	Partially Reversible					
Degree to which impact may cause irreplaceable loss of resources	Low					
Degree to which impact can be mitigated	Medium					

2.2.1.8.2 Significance of Visual Impact

When the intensity of impact is qualified, the significance of the impact can be predicted taking into account core criteria such as the extent and duration of the proposed activity (please refer to Appendix 9).

Visual receptors in various homesteads in the surround area of proposed Sebilo Perth Project are classified as highly sensitive owing to their sustained visual exposure to the proposed activity as well as their attentive interest towards their living environment. Their close proximity (<500 - >4km), the proposed physical dimensions of the proposed Sebilo Perth Project , the ability of the landscape to moderately visually accept the development (VAC) and the presence of visual degraded surrounding areas would result in a Low - Moderate Intensity visual impact. This, in conjunction with the fact that the proposed Sebilo Perth Project would be of local extent and long term duration (please refer Appendix 9) would exert a Low - Medium Negative Significant (without mitigation) visual impact for the homestead visual receptors. The visual impact of the proposed Sebilo Perth Project would therefore alter the affected environment but natural, cultural and social functions and processes would continue, albeit in a modified way. Mitigation measures as suggested in section 7 of this report are therefore essential to reduce the Low - Medium Negative Significance to Low Negative Significance from these views.

The Intensity of the visual impact from views associated with the R31 and R380 main roads visual receptors were determined as Low due to the their low to high sensitivity (motorist and tourist), proximity (500m - 2km and 2 - 4km), proposed physical dimensions of the proposed Sebilo Perth Project, the ability of the landscape to moderately visually accept the development (VAC) and the presence of visual degraded surrounding areas (mining activities). It is anticipated that the visual impact would be negative from these views and would exert a Low Negative Significant (with and without mitigation) impact due to the fact that it is of local extent and long term duration (Appendix 9).

2.2.1.9 Socio-economic impact assessment

2.2.1.9.1 Introduction

This section outlines potential impacts on the community and their socio-economic and natural environment, which may be caused by the commencement of mining operations. The social impacts of the proposed mine, relate to people, issues, perceptions and emotive data, and as such is often more difficult to quantify than the bio-physical components.

The stakeholders who are most likely to be influenced directly or indirectly by the construction of the mine are the landowner, members of the surrounding communities in the immediate vicinity of the proposed footprint; more directly those located in the immediate zone surrounding the footprint; and indirectly those community members in the outlying areas further away. Potential socio-economic, environmental and personal impacts were identified and evaluated, and will be discussed below. Probable impacts are derived from desktop study analysis, consultation with role-players and past experiences in mining operations, mine closures and poverty stricken communities.

This Socio-economic Impact Assessment forms the baseline for the quantification and assessment of the social-economic impacts most likely to result from the establishment of the Perth Mine, and contains recommendations on mitigations and management measures that should be implemented in order to minimise or avoid potential, adverse social impacts.

2.2.1.9.2 General Impacts

The proposed Perth Mine, once operational, may have mainly positive and some negative impacts on both local and sending communities. These impacts may however be minimal considering the broader impact of manganese mining activities within the region. The proposed Mine could however contribute positively to the economy and social stability of the area through job creation, support of local suppliers, creation of secondary industries, support of the Local Municipalities and funding of community projects and social services. According to Sebilo labour will, as far as is practically possible, be recruited from the Joe Morolong and Ga-Segonyana areas. At an average basic minimum salary of R 5 000 per month, it is estimated that these permanent workers (±130) could earn collectively more than R 10 million per annum. While wage flows are one of the key indicators of economic benefit to the community, it is the retention of these wage flows that in fact constitutes the net economic impact. Considering four to six people being directly dependent on every worker, the influence becomes of great importance. Apart from the permanent, directly created job opportunities there may be scope for other entrepreneurial jobs. The labour contingent during construction may also add to the economy of the area. During construction and during the life of the mine, contractors and service industries in the region may benefit from the mining activities. This could have a knock-on effect on suppliers of goods and services in other areas of the country.

Mining is capital intensive and have huge spending power that can contribute immensely to the economy of the area. Procurement spend is considered as a critical factor in the creation of SMME's and local industries.

The proposed Mine's regulatory costs could provide the Government with additional capacity to provide infrastructure and services to the community. These contributions are important not only in developing the national economy, but in the indirect benefit that taxes bring. Perth's contribution to government can include amongst others royalties, corporate taxation, skills levies, UIF, and VAT payments made through mine procurement and through discretionary spending by mine employees. Other contributions include utility payments such as water, electricity and telecommunications services.

It is assumed that the main impact could be job creation with trickle down effects like:

- Co-financing of social infrastructure like roads;
- Poverty alleviation through CSI and SLP allocation (Local Economic Development Programme);
- Opportunities to acquire and build industry related skills base;
- Support of education and school development programs;
- Attracting and creating a skill base in the area; and
- Promoting home-ownership and better lifestyles.

Mining is commonly viewed by society as a dirty business, causing both environmental damage and social disruption. With a new mine there may be an increase in the influx of job seekers to the local and surrounding areas, increased crime levels, overcrowding, informal housing settlements increased unemployment rates, pollution, environmental degradation and the potential spread of communicable diseases, such as HIV/AIDS and Tuberculosis.

Specific negative impacts that the proposed Perth Mine may contribute to, within the broader mine development of the area, include:

- Possible influx of migrants in search of job opportunities;
- Possible growth of informal settlements;

- Possible increase in HIV/AIDS;
- Possible increase in mining related illness; and
- Pressure on infrastructure like water, electricity and roads.

Negative impacts that the proposed Perth Mine may have are focussed mainly on the farm Perth. It is anticipated that farming activities on the farm Perth could be impacted due to reduced gracing and agricultural land. Other impacts on the farm are elaborated below.

Below are specific impacts that are predicted during the various stages of the mining life cycle.

2.2.1.9.3 Predicted Impacts during the Construction Phase

The construction phase of the proposed Perth Mine is expected to start in 2013 and continue until 2014.

2.2.1.9.3.1 Creation of Employment Opportunities

An independent contractor will be used for the construction of the proposed Perth Mine. This contracting company will be responsible for the temporary employment of construction workers during this phase. Sebilo has indicated in its Social and Labour Pan that labour will be sourced from local communities where possible. It is anticipated that the establishment of the mine during construction will create temporary employment opportunities. There may also be possible indirect job opportunities arising from the construction phase as a result of employees' spending power and additional services needed.

The number of temporary job opportunities could mean this impact will have a moderately positive significance.

The landowner is concerned that an influx of people especially during construction could pose a security and theft risk on the farm Perth as well as having a negative environmental impact through oil spills and dumping of rubbish.

2.2.1.9.3.2 Loss of Agricultural Productivity

The landowner and tenant indicated that they are planning to plant lusern on the portion where future mining activities may take place. Their idea is to make use of the water in the pit for irrigation purposes. Commencement with construction of the proposed mine could have a direct impact on these planned farming activities.

2.2.1.9.4 Predicted Impact during the Operational Phase

The operational phase of the proposed Perth Mine is expected to start in 2013 with pre-stripping and production in 2015.

2.2.1.9.4.1 The creation of employment opportunities

The Perth Project would provide approximately 130 permanent employment opportunities during the operational phase (this exclude contractors and sub-contractors).

The majority of businesses are reliant on mining, retail being the big benefactor. Employed workers are likely to use their money to improve their homes and pay school fees for their children leading to better lifestyles for the local people. This could contribute to greater economic growth and allowing better development of the towns and surrounding areas.

2.2.1.9.4.2 Community Development

2.2.1.9.4.2.1 SLP Allocation

Sebilo has committed to contribute to the improvement of lives in the surrounding communities through three LED projects viz:

- Manyiding School renovation;
- Joe Morolong livestock Farming; and
- 'Provision of Sanitation in Joe Morolong.

In addition to community support, the SLP makes provision for Human Resource Development, the outcome of which could see an increase in a literate and skilled labour force. Recruitment practices will also contribute to the empowerment of women as per Government's employment equity regulations.

2.2.1.9.4.2.2 Batlharo Ba Ga Motlhware Community Trust

The Batlharo Ba Ga Motlhware has a 5% shareholding in the Perth Project. The dividends from the Perth Project will be utilised for the upliftment of the community through the development of social infrastructure like building and renovations of schools, child-care facilities, entrepreneurial development and capacity building for the Traditional Authority. The financing and development of infrastructure and economic sector will be preceded by a ten year coherent development plan that will guide and coordinate the developments.

2.2.1.9.4.3 CSI

It is anticipated that the proposed Perth Mine will have a small discretionary fund to support short-term projects like sport development and bursaries for the locals.

2.2.1.9.4.4 The loss of and impact on agriculture activities

Borehole water, that provides drinking water to the cattle, could be affected as the current pit has to be dewatered so that mining can commence. Lowering the water levels in the pit could have an effect on the water table and hence on the surrounding boreholes.

Subsistence farmers in the surrounding communities are of the opinion that mining activities pollute water-streams depriving them of essential resource for their livestock and for humans as there are still people dependent on water from the water-stream for human consumption.

Blasting in the open pit could generate dust which, if settling on the cattle farm, may impact grazing quality and quantity. Blasting is also known to create distress in animals and may impact on the breeding process of cattle.

Other concerns by the landowner and again, which are general accepted impacts resulting from mining are:

- Theft;
- Increased traffic;
- Quality of roads;
- Oil spills; and
- Garbage.

2.2.1.9.4.5 Impact on traditional communities

During consultations with the Traditional Authority and Municipality the following claims were made and specific concerns were noted in terms of the proposed mine development:

- Most mines bring in own workers from outside the local areas;
- Locals are overlooked for employment opportunities due to lack of necessary skills and expertise;
- Areas like Kathu have reached their capacity and potential for growth which means migrants could flock to areas like Ga-Segonyane and Joe Morolong. Increase in population in areas like the Batlharo could result in a demand for housing and the mushrooming of informal settlements
- Most migrants are skilled and professionals creating a class structure resulting in resentment and tensions with the locals;
- Schools and child-care facilities are already full in the Batlharo area;
- Increase in child-trafficking in the informal settlements;
- Dilution and marginalisation of local languages and cultural practises;
- Men leave women and children with very little remittance back home;
- Teenagers vulnerable to moral degradation (sugar daddy syndrome);
- Increase in teenage pregnancies and related diseases like HIV/AIDS and STDs;
- Increase in unemployment rate as not all job-seekers are successful and some decide to stay in the area;
- Increase in drinking and substance abuse;
- Infiltration of Somali and Pakistani traders' threatening xenophobia attacks;
- Increased traffic volumes (busses ferrying employees and transporting commodities;
- Increase in road accidents related to trucks (that transport manganese); and
- Pot-holes created by these trucks.

2.2.1.9.5 Predicted Impacts during the Decommissioning and Closure Phase

Mine closure is the period when mining activities cease and the final decommissioning and mine reclamation are being finalised. It is therefore defined as the process leading to the issue of a closure certificate (Minerals and Petroleum Resources Development Act, 2002, Section 43). A Mine Closure Plan details how the Mine will close the mine site and return the surrounding land, as closely as possible, to its pre-mining state– this is expected for Perth by the year 2026.

In general, a mine can be seen as a labour-intensive catalyst for the provision of bulk services in rural areas. It often provides or supports social services and infrastructure. The multiplier effect of a mine proves to be significant as it increases the magnitude of the contribution to local economic development. The direct social benefits accumulate over the life of the mine as a result, and this ultimately create a dependency. The most pertinent form of dependency is created when local and regional economies become dependent on income and employment multipliers generated by a mine. Unfortunately, mining operations have finite and relatively short life spans, which cannot sustain this dependency. Once a mine closes, the social impacts on employee households, communities and regions are usually severe and leave thousands of people impoverished. For example, mine workers may be homeowners, with children attending school and may be part and parcel of the local society. The social fabric of the community may be disrupted with mine closure as households may not be able to afford municipal services, school fees, insurance, food and any other items critical for household survival.

Mine closure is often very traumatic for both mineworkers and their dependents and can often cause severe psychological impacts on those affected. The main impacts associated with mine closure are generally a loss in workers' sense of belonging and demotivation. These impacts often lead to social disruption in households and communities, which can often be associated with escalation in crime rates and abuse, alcoholism and other substance abuse.

Health related issues in both the workforce and surrounding mine communities can often have a negative impact socially. Employees and the surrounding communities could suffer from mining related illnesses and these can cause strains on households as the little money coming in is used on medication and remedies to cure these problems.

Mines generally offer several benefits to its employees including medical aid, a housing allowance, bonuses and car allowances. Once a mine closes and employees lose their jobs, these benefits will no longer be available to employees and their dependants.

In the case of the proposed Perth Mine the magnitude of these typical impacts may be minimal as the proposed mine's labour force will only be a fraction of the broader area's mining workers - an effective loss of between 1% and 5% of the mineworkers in the District Municipality.

Some local businesses that supply the proposed Perth Mine directly may be impacted by mine closure if they are dependent on the mine's existence or have the mine as a major client. There may be also other businesses that provide services to mineworkers and their dependants, such as taxi transport, shops, and other SMMEs that may be impacted to a certain extent.

It is anticipated that the future closure of the proposed Perth Mine will have a minimal impact on the property market as well as schools in the neighbouring towns.

2.2.1.9.5.1 Sustainability

The biggest challenge and possible future impact of the proposed Perth Mine could be in terms of dependency and the ultimate sustainability of those communities that the mine will support. As indicated earlier, the Batlharo communities, as a shareholder of Sebilo, will earn dividends annually and be on the receiving end of large scale LED projects. These dividend flows and upliftment projects will have a positive impact in the short to medium term. However, once the life of the Perth Mine comes to an end, the money flows and contributions to the Batlharo will end. The worst case scenario is that, assuming that the Batlharo will have no other shareholding in mining ventures, the Traditional Authority may have become dependent on mining and that the impact will be disastrous for the community.

For this reason, a 10 year development plan will be developed for the Batlharo to assist in the sustainable development of the rural communities. It must be also noted that the issue of dependency or life after mining have not been raised during the consultations with the traditional authority nor the municipality.

2.2.1.9.6 Impact Rating for all Phases

For the activities detailed and outlined above, the evaluation criteria tabulated and listed below was applied in assessing the impacts associated with the proposed mining operation.

Explanation of **probability** of impact occurrence

Probability of impact occurrence	Explanation of probability
Very low (VL)	<20% sure of particular fact or likelihood of impact occurring.
Low (L)	20 to 39% sure of particular fact or likelihood of impact occurring.
Moderate (M)	40 to 59% sure of particular fact or likelihood of impact occurring.
High (H)	60 to 79% sure of particular fact or likelihood of impact occurring.
Very high (VH)	80 to 99% sure of particular fact or likelihood of impact occurring.
Definite (D)	100% sure of particular fact or likelihood of impact occurring.

Explanation of **extent** of impact

Extent of impact	Explanation of extent
Site specific (SSP)	Direct and indirect impacts limited to site of impact only.
Local (L)	Direct and indirect impacts affecting environmental elements within the Hotazel area.
Regional (R)	Direct and indirect impacts affecting environmental elements within Northern Cape Province.
National (N)	Direct and indirect impacts affecting environmental elements on a national level.
Global (G)	Direct and indirect impacts affecting environmental elements on a global level.

Explanation of **duration** of impact

Duration of impact	Explanation of duration
Very short (VS)	Less than 1 year
Short (S)	1 to 5 years
Medium (M)	6 to 12 years
Long (L)	13 to 50 years
Very long (VL)	Longer than 50 years
Permanent (P)	Permanent

Explanation of impact **significance**

Impact significance	Explanation of significance
No impact (NI)	There would be no impact at all - not even a very low impact on the system or any of its parts.
Very low (VL)	Impact would be negligible. In the case of negative impacts, almost no mitigation and/or remedial activity will be needed, and any minor steps which might be needed would be easy, cheap and simple. In the case of positive impacts, alternative means would almost all likely to be better, in one or a number of ways, than this means of achieving the benefit.
Low (L)	Impact would be of a low order and with little real effect. In the case of negative impacts, mitigation and/or remedial activity would be either easily achieved or little would be required, or both. In case of positive impacts, alternative means for achieving this benefit would likely be easier, cheaper, more effective, less time-consuming, or some combination of these.
Moderate significance (MS)	Impact would be real but not substantial within the bounds of those which could occur. In the case of negative impacts, mitigation and/or remedial activity would be both feasible and fairly easily possible. In the case of positive impacts, other means of achieving these benefits would be about equal in time, cost and effort.
High significance (HS)	Impacts of a substantial order. In the case of negative impacts, mitigation and/or remedial activity would be feasible but difficult, expensive, time-consuming or some combination of these. In the case of positive impacts, other means of achieving this benefit would be feasible, but these would be more difficult, expensive, time-consuming or some combination of these.
Very high significance (VHS)	Of the highest order possible within the bounds of impacts which could occur. In the case of negative impacts, there would be no possible mitigation and/or remedial activity to offset the impact at the spatial or time scale for which it was predicted. In the case of positive impacts, there is no real alternative to achieving the benefit.

2.2.1.9.7 Socio-economic impact assessment significant ratings for all phases of mining

Type of Impact	Impact	Area/ Activity	Probability of Occurrence	Extent of impact	Duration of impact	Impact significance
Positive	Employment opportunities	Construction	Definite	Local & Regional	Short	High
Positive		Production	Definite	Local & Regional	Medium	Moderate
Negative	Loss of agricultural productivity including impact on cattle drinking water (Farm Perth)	Construction Production	Moderate*	Local	Medium	Moderate
Negative	Influx of job seekers, including growth in informal settlements		Low	Local	Medium	Low
Negative	Nuisance related to construction activities (increase in traffic, crime, blasting, oil spills, etc.)		Moderate	Local	Medium	Low
Positive	Establish and develop SMMEs (including procurement opportunities for existing suppliers)	Production	Definite	Local & Regional	Short	Low
Positive	Community assistance and poverty alleviation through Local Economic Development and Corporate Social Investment		Definite	Local & Regional	Short	Low
Positive	Training and skills development		Definite	Local	Short	Low
Positive	Additional capacity (rates & taxes) to local government to provide infrastructure and services to the community		High	Local & Regional	Short	Low
Negative	Negative impacts on the Batlharo (social, cultural, health, etc.)	Production Mine Closure	Low	Local & Regional	Medium	Low
Negative	Loss of employment	Mine Closure	Definite	Local & Regional	Medium	Low
Negative	Social impacts on employees and their families		High	Local & Regional	Medium	Low
Negative	Batlharo dependency on mining		High	Local & Regional	Medium	High

*Hydrology Study to be consulted in this regard.

2.2.2 Potential cumulative impacts

The study area is located in the relatively untransformed Northern Cape Province of South Africa. On a regional scale, the Kathu Bushveld is listed as Least Threatened and 98.8% remains untransformed. That being said, significant developments have been proposed for the Northern Cape in general as well as the region in which the study area is located. Proposed developments include Photovoltaic Plants (solar energy), transmission power lines and mining developments. It is important that the cumulative impacts of these developments are taken into consideration on a regional level.

On a local scale/ individual assessment levels, the development of these mines and solar power plants do not contribute significantly to habitat loss and fragmentation, however their cumulative impact on a regional scale in terms of habitat loss and fragmentation could be significant. It should also be noted that habitat loss is not only associated with the loss of vegetation but that certain animals, are shy of people and will move away or will become prosecuted due to an increase in human density.

The following potential cumulative impacts were identified:

- Regional biodiversity (negative)
- Regional noise levels (negative)
- Regional air quality levels (negative)
- Regional visual impact (negative)
- Regional socio-economic impacts (positive)

In this regard, Sebilo undertakes to work with other mining operations in the area to reduce cumulative impacts through sound monitoring programmes and compliance with environmental management plans.

2.2.3 Potential impact on heritage resources

The project area is considered to be of relatively low cultural heritage sensitivity, as it readily adapts to new developments and has already been impacted on by historical mining activities.

Should any artefact of cultural interest or building older than 60 years be discovered during mining, the relevant authorities will be notified and the area will be demarcated for further studies, according to the requirements of Section 3(2) of the National Heritage Resources Act.

The location of the family farm graves, situated off the project area to the north of the farm homestead currently used by UMK as offices, will be confirmed prior to the commencement of the construction phase of the project and the area will be clearly demarcated. Sebilo will, in consultation with the landowner, keep mining activities >1km from the graves to minimise impacts.

2.2.4 Potential impacts on communities, individuals or land use

The potential impacts on communities, individuals or competing land uses are discussed in detail in the Socio-economic Impact Assessment presented in Section 2.2.1.9 above. The impacts can be summarised as follows:

- Stakeholers who are most likely to be influenced by the proposed Perth Mine are the landowner, the surrounding communities in the immediate vicinity of the proposed mining area and indirectly those community members in the outlying areas further away.

- The proposed Perth Mine may have mainly positive and some negative socio-economic inpacts on the local and sending communities. These impacts may however be minimal, considering the broader impact of managanese mining in the region. The proposed mine could however contribute positively to the economy and social stability of the area through job creation, support to local suppliers, creation of secondary industries, support of local Municipalities and funding of community projects and social services.
- Sebilo intends to employ approximately 130 people on a permanent basis, as far as practically possible from the Joe Morolong and Ga-Segonyana areas. This is expected to generate a collective income of around R10 million per year. This could have a knock-on effect on suppliers of goods and services in the area.
- During the operational phase of mining, Sebilo intends to implement three LED projects, including renovation of the Manyiding School, livestock farming and the provision of sanitation in the Joe Morolong area.
- In addition to the above, the Social and Labour Plan makes provision for Human Resource Development, which could see an increase in literacy as well as a skilled labour force.
- The Batlharo Ba Ga Botlhware Community will directly benefit from the proposed mining project, as this Tribal Authority has a 5% shareholding in the Perth Project. Dividends from the mining operations will be utilised for the upliftment of the community through the development of social infrastructure like building and renovation of schools, child-care facilities, entrepreneurial development and capacity building for the Tribal Authority.
- The specific negative socio-economic impacts that the proposed Perth Mine may contribute to, include the possible influx of migrants in search of jobs, the possible growth of informal settlements, the possible increase in HIV/AIDS, the possible increase in mining-related illness and pressure on infrastructure like water, electricity and roads.
- It is anticipated that farming activities on the farm Perth could be impacted due to reduced grazing and agricultural land. The current and proposed future mining activities will disturbed grazing over and area of approximately 80 ha. According to the carrying capacity specialist study, approximately 15ha should be provided for one head of cattle, if overgrazing of the land is to be avoided. Based on this assessment, the landowner will be loosing grazing land for around 7 animals.
- The landowner and tenant indicated that they are planning to grow lusern within the proposed project area and to irrigate the lusern with water from the pit. Available information suggests that the water in the pit will be unsuitable for irrigation, but loss of income from this possible irrigation project would be incurred over an area of approximately 30 ha.
- Borehole water, that provides drinking water to cattle, could be negatively affected during mine dewatering. This will result in a loss of agricultural activities in the vicinity of the project.
- Subsistence farmers in the surrounding communities are of the opinion that mining activities pollute water streams, depriving them of essential resources for livestock and human consumption.
- Blasting at the opencast operations and general mining activities could generate dust, which may impact negatively on grazing quality and quantity. Blasting is also known to create distress in animals and may impact on breeding processes of cattle.
- Other concerns raised by the landowner include theft, increased traffic, the quality of roads, oil spills and garbage.
- Consultation with the Traditional Authority and the Municipality identified the following impacts on traditional communities:
  - Most mines bring in own workers from outside the local areas;
  - Locals are overlooked for employment opportunities due to lack of necessary skills and expertise;

- Areas like Kathu have reached their capacity and potential for growth which means migrants could flock to areas like Ga-Segonyane and Joe Morolong. Increase in population in areas like the Batlharo could result in a demand for housing and the mushrooming of informal settlements
- Most migrants are skilled and professionals creating a class structure resulting in resentment and tensions with the locals;
- Schools and child-care facilities are already full in the Batlharo area;
- Increase in child-trafficking in the informal settlements;
- Dilution and marginalisation of local languages and cultural practises;
- Men leave women and children with very little remittance back home;
- Teenagers vulnerable to moral degradation (sugar daddy syndrome);
- Increase in teenage pregnancies and related diseases like HIV/AIDS and STDs;
- Increase in unemployment rate as not all job-seekers are successful and some decide to stay in the area;
- Increase in drinking and substance abuse;
- Infiltration of Somali and Pakistani traders' threatening xenophobia attacks;
- Increased traffic volumes (busses ferrying employees and transporting commodities;
- Increase in road accidents related to trucks (that transport manganese); and
- Pot-holes created by these trucks.

- Upon mine closure, the social impacts on employee households and communities are usually severe and leave people impoverished. Mine closure is often traumatic for both mine workers and their dependents and can cause severe psychological impacts on those affected. This is often associated with an escalation in crime rates and above, alcoholism and other substance abuse.
- The Batlharo communities will earn dividends annually, but once the mining operations cease, the income will end. The worst-case scenario is that the Traditional Authority may have become dependent on mining and that the impact will be disastrous for the community. For this reason, a 10-year development plan will be developed for the Batlharo to assist in the sustainable development of the rural communities. It must be noted that the issue of dependency have not been raised during consultations with the Traditional Authority nor the municipality.

2.2.5 Consultation with the landowner and IAP

Sebilo confirms that the potential list of impacts have been compiled with the participation of the landowner and IAP, as detailed in Section 7 below. The impacts were discussed with IAP during the Open Day held on 21 April 2012 as well as during one-on-one discussions with the landowner held on 17 May 2012. The results of these discussions, as well as issues and comments raised by IAP during the public comment period on the EMP, will be compiled into the final public consultation report, which will be submitted to the DMR for comment by the end of June 2012.

2.2.6 Specialist reports

The independent specialist reports used to compile the relevant sections of the EMP are appended as follows:

Appendix 1	Soil Specialist Report (Rehab Green, 2012)
Appendix 2	Carry Capacity Specialist Study (Umfaan, 2012)
Appendix 3	Ecological Assessment (EkoInfo, 2012)

Appendix 4	Surface Water Specialist Study (Epoch, 2012)
Appendix 5	Groundwater Specialist Study (Future Flow, 2012)
Appendix 6	Noise Specialist Study (dBAcoustics, 2012)
Appendix 7	Blasting Specialist Impact Assessment Study (CVB Cunningham, 2012)
Appendix 8	Air Quality Specialist Study (SSI, 2012)
Appendix 9	Visual Impact Assessment (EnviroCam, 2012)
Appendix 10	Socio-Economic Specialist Study (MWA, 2012)

3 SIGNIFICANCE OF IMPACTS AND MITIGATION MEASURES

This summary of the assessment of the significance of the potential impacts and the proposed mitigation measures to minimise adverse impacts, is undertaken in terms of Regulation 52 (2) (c) of the MPRDA.

3.1 Assessment of the significance of the potential impacts

The significance of the potential impacts identified, are presented in Table 54. The Impact Assessment Methodology used in the significance rating is presented in Appendix 12.

In terms of Section 39(3)(b)(i) of the MPRDA as well as Regulation 52(2)(c) and 52(2)(g) (Impact Assessment Methodology Appendix 12).

Table 54 Overall Categorisation and Significance Rating of Mining Impacts

Activity of concern and mining phase	Impact on the environment	Consequence			Likelihood		OS	Cross reference to source	Cross reference to EMP
		Nat/Int/Sev	Spat	Dur	Prob	Freq			
Soil Disturbance Construction, Operational & Closure	Soil will be disturbed in the mining area during stripping. Compaction may occur due to heavy machinery used. Pollution may occur due to spills.	5	1	3	4	5 (Cum)	High negative	Section 2.2.1.1	Table 55.6 Table 67
		3	1	1	2	2 (Cum)	With mitigation: Low negative		
Landuse & capability Construction, Operational & Closure	Land use inside the demarcated area will be lost or affected for the duration of the mining operations.	5	1	3	4	5	High negative	Section 2.2.1.1	Table 55.6 Table 67
		3	1	1	2	2	With mitigation: Low negative		
Biodiversity Construction, Operational & Closure	Red data species may be found on site (Secretary Bird and Kori Bustard) and protected trees. These will be disturbed/removed during mining.	5	2	3	3	5 (Cum)	High negative	Section 2.2.1.2	Table 55.2 Table 67
		3	1	2	2	5 (Cum)	With mitigation: Low negative		
Surface water Construction, Operational & Closure	Impact of pit dewatering and discharge of water to catchment. Mining in the Witleegte riparian zone will negatively affect the stream	5	2	3	3	5 (Sea)	High negative	Section 2.2.1.2	Table 55.1 Table 55.4
		3	2	3	2	2 (Sea)	With mitigation: Medium negative		
Groundwater Construction, Operational & Closure	Impact of pit dewatering on private borehole use. Long-term impact on groundwater quality and possibility of decant from the pit	5	2	3	3	5 (Sea)	High negative	Section 2.2.1.4	Table 55.1 Table 55.5
		3	2	3	2	2 (Sea)	With mitigation: Medium negative		
Noise Construction and Operational	Noise from vehicles and drilling programmes may also cause disturbance.	3	2	3	3	5 (Sea)	Medium negative	Section 2.2.1.8	Table 55.7
		3	2	2	2	2 (Sea)	With mitigation: Low negative		
Air Quality Construction and Operational	Fugitive dust from earth works during construction, traffic on gravel roads,	3	2	3	3	4 (Sea)	Medium negative	Section 2.2.1.9	Table 55.7
		3	1	2	2	2 (Sea)	With mitigation: Low negative		
Blasting Operational	Impact of air blast and ground vibrations on animals and human structures could result in significantly negative impacts	3	3	3	4	4	High negative	Section 2.2.1.6	Section 2.2.1.6
		1	1	2	2	1	With mitigation: Low negative		
Socio-economics Construction and Operational	The project can benefit local communities and businesses through job creation and generation of income.	3	1	2	1	2	Low positive	Section 2.2.19.7	Table 55.10
		5	3	3	4	5	With mitigation: High positive		
Socio-economics Construction and Operational	The project will have a negative impact on local communities, who may become dependent on financial support from the mine	5	2	3	3	4	High negative	Section 2.2.19.7	Table 55.10
		3	2	2	2	2	With mitigation: low negative		