Site specific surface water quantity

No drainage channels occur within the mining area and there is no dendritic system which could be disturbed. The mining area covers the Eenzaamheid Pan located along the ancient paleo channels in an area loosely named the Kalahari. This drainage system is represented by a series of well defined Pans located along the palaeo-drainage system. Eenzaamheid Pan, located in a vast plane with little topographic relief is one of a series of deflation pans located along the paleo-drainage system. It appears as if the paleo-drainage system in which these pans occur is divided by dune formation along the channel. These ancient paleo channels actively flowed in pre-Pliocene times (2 – 12 million years ago) and is known to have joined the Orange River. Surface water only accumulate in the pan after exceptional good rains and normally drains to the lower lying area of the Pan where surface water is more common. It is important to note that inward draining into the centre of the mining area is taking place and given the variability of desert rainfall, the calculation of the mean annual runoff (MAR) would be of no use. The MAR is in any event very low given the low rainfall less than 200 mm per year occurring mainly in the summer months, high evaporation rates, and shallow grade of the slope toward the pan and the permeability of the soils

Site specific surface water quality and water use

The surface water quality (when available) is too saline for potable use or animal consumption. Potable water is obtained from the Kalahari West Rural water supply scheme a pipeline of the local authority running from the Orange River at Upington and supplying potable water to the rural region (refer to Figure 8 above).

Wetlands

No natural wetlands exist in the area except for the Salt Pan and only about 25% are going to be disturbed by mining activities or is already disturbed. Although termed wetland the salt pan is devoid of any wetland vegetation or other wetland features and can rather be termed waste land.

2.11 Groundwater

Depth to water table

Along the river the water table is as shallow as 2 meters but it becomes deeper further away from the river. Within the pan the water table is very shallow especially in the wet season. A pump test was done as part of the geological study on groundwater. The water level measured at 'rest' at the start of the test was 7.87 m, which was drawn down to 8.33m and 8.85 respectively at the end of the 24 hour test. The ground water level of borehole 1 recovered 30 minutes after the halting of the test while borehole 2 recovered by 60%.

Quality of groundwater and use

The composition of groundwater is influenced by the rate of flow through the Dwyka, which in this flat area, are relatively slow. According to Hugo (1974) the composition of brine in the area is close enough to seawater to suggest a marine origin for the salt, derived from the Dwyka beds. The water analysis shows results of NaCl in the excess of 95 % and according to analysis by DWAF, the groundwater is unsuitable for human and animal consumption and no boreholes or springs are present within this drainage system.

Ground water as process water

Salt mining only involve the pumping of brine from boreholes for the production of salt by means of solar evaporation. A top-up of 16-24 m^3 water is obtained from 2 boreholes on the mining area. Although groundwater is use it cannot be seen as process water.

The taking and storing of water is covered by a General Authorisation in terms of section 39 of the National Water Act, 1998 (Act No. 36 of 1998). According to the authorisation no "groundwater taking zones" are excluded for "small industrial users". This mining activity classifies as a "small industrial users" as it qualify as a work creating enterprise that do not use more than twenty cubic metres per day. Prospecting, mining and quarrying are also a category identified in the Standard Industrial Classification of All Economic Activities (5th edition), published by the Central Statistics Service, 1993, as amended and supplemented as a small industry.

The general authorisation states that a person who lawfully has access to land on which the use of water takes place, may on that property or land take groundwater if the taking or storing of water :

(a) does not impact on a water resource or any other person's water use, property or land;

(b) is not excessive in relation to the capacity of the water resource and the needs of other users; and

(c) is not detrimental to the health and safety of the public in the vicinity of the activity.

The registration of the water use is also not necessary as the general authorisation states that a person who uses water in terms of this authorisation must submit to the responsible authority a registration form or any other further information requested in writing by the responsible authority for the registration of the water use before commencement of-

(a) taking more than 50 cubic metres from surface water or 10 cubic metres from groundwater on any given day; or

(b) a combined storage of more than 10 000 cubic metres of water per property.

The applicant will however in accordance with the general authorisation adhere to Record-keeping and disclosure of information.

The authorisation states that the water user must ensure the establishment of monitoring programmes to measure the quantity of water taken and/or stored, as follows-

(a) the quantity of groundwater or surface water abstracted must be metered or gauged and the total recorded as at the last day of each month;

(b) the quantity of water stored must be recorded as at the last day of each month.

The water use was however registered and the following Registration Certificate was issued for the taking of water from a water resource in terms of Section 21(a) of the National Water Act, 1998 (Act No. 36 of 1998):

Reg. No. 25022047 effective from 1998/06/01 for 10 800 m^3 per year (refer para. 10.3).

2.12 Air Quality

The air background quality in the Kalahari is very good due to low industrial activity and very low population density. The main impact of the mine on air quality is intermittent dust generated from vehicles on gravel/dust roads. As the mine is in excess of 70 km from the nearest external human habitation there is no dust impact on people outside of the mine employment that are equipped with protective clothing and industrial air masks/filters to minimize the effect of the dust.

Given the surrounding extent of semi-desert, dust generation is high under windy conditions (dust storm); however under normal conditions no extreme dust conditions are noted on site. The mineral processing operation is also wet operations that will also reduce natural dust generation.

2.13 Noise

There is no background noise level due to the remote rural situation of the mine. Existing noise in the area comes from vehicles using the R360 main road that straddles the mining area. On the mine noise is generated by trucks and machinery and at present such noise levels are low (observed estimate at ±55dBA). Due to the distance of the mine from human habitation the noise only has an effect on mine personnel who are equipped with protective clothing.

2.14 Sites of archaeological and cultural interest

The proposed salt mining at this pan is not expected to have a significant negative impact on the archaeological resources of the region. In the event that sites or features (eg high density of artefacts, a burial, or ostrich eggshell cache) are found during construction or mining, an archaeologist should be alerted immediately in order to assess the find and make recommendations for mitigation, if necessary. A report on a Phase 1 Archaeological Assessment of proposed salt works areas on the Eenzaamheid Pan, north of Upington, Northern Cape by David Morris is attached as part of the supporting documentation (Para 10.4).
No other heritage resources such as built structures over 60 years old, sites of cultural significance associated with oral histories, burial grounds and graves of victims of conflict, and cultural landscapes or viewscapes are present on the mining area.

2.15 Sensitive Landscapes

Given the extent of the current disturbance, this site's landscape is not considered sensitive provided that future rehabilitation will be conducted to at least the level prescribed, bearing in mind that salt mining is very different from other mining operations in that no rock is broken and no mining waste is generated. Therefore the impact on the topography is insignificant and no waste dumps are created above surface. However, given that vehicle tracks in the surrounding undisturbed pan floor remain as visual impacts for many years vehicular movement outside of the mining area shall be restricted.

2.16 Visual aspects

The mining operation is not visible from the R360 main road or any other main road. Due to the specific nature of the mining operation the visual impact is deemed to be insignificant.

2.17 Regional Social structure

Demography

The population in the Khara Hais Municipality is mainly distributed in and around Upington, including Paballelo and Louisvaleweg (refer to Table 5 below).

Table 5: Population structure of Khara Hais Municipality

Age Group	African Black		Coloured		Indian/Asian		White		% of Population (75 671)	TOTAL
	Male	Female	Male	Female	Male	Female	Male	Female		
0-4	749	729	2 884	2 907	3	4	300	290	10.39 %	7 866
5-9	752	781	3 028	2 959	3	4	362	358	10.90 %	8 247
10-14	713	724	2 847	2 810	3	3	461	489	10.64 %	8 050
15-19	786	730	2 779	2 787	4	0	589	592	10.92 %	8 267
20-24	754	663	2 147	2 214	0	0	317	355	8.52 %	6 450
25-29	772	613	1 887	2 016	0	0	407	377	8.02 %	6 072
30-34	759	606	1 797	1 843	7	4	436	422	7.89 %	5 974
35-39	578	495	1 568	1 853	9	4	399	453	7.08 %	5 359
40-44	456	452	1 372	1 515	3	5	342	437	6.06 %	4 582
45-49	285	309	1 027	1 282	3	4	375	353	4.81 %	3 638
50-54	200	229	814	1 061	0	0	295	289	3.82 %	2 888
55-59	163	199	584	776	0	0	246	289	2.98 %	2 256
60-64	157	187	494	678	0	0	228	262	2.65 %	2 006
65-69	151	131	369	532	0	0	164	206	2.05 %	1 553
70-79	156	114	358	503	0	0	200	371	2.25 %	1 702
80+	72	51	131	257	0	0	75	175	1.01 %	761
TOTAL	**7 503**	**7 013**	**24 086**	**26 093**	**35**	**28**	**5 195**	**5 718**	**100%**	**75 671**

(Source: SA Census, 2005)

The estimated population of Khara Hais Municipality is 75 671 people with the major ethnic group being the coloured population, representing 66% of the entire population (refer to Table 5 above). The sex structure is almost equal with 51.3% (38 852) of the total population being female. The male population constitutes the remaining 48.7% (36 819).

Over the past 10 years the Northern Cape and Khara Hais Municipality had a fairly slow population growth rate. In fact, the Northern Cape Province was the only province where the population decreased between 1996 and 2001. Based upon an expected population growth rate of 2 % the Municipality calculated that the population of Khara Hais would increase during the period from 2002 to 2012 from 72 476 (Demographic and Socio-Economic Survey estimate) to 88 348. It is estimated that the population will increase to 107 696 from 2012 to 2022.

A third of the population in Khara Hais is under the age of 15 years (32%) (refer to Table 5 above). This holds particular implications for future development planning as this section of the population will become economically active within the next 5 to 10 years. A consistent economic growth rate and the creation of sufficient job opportunities is therefore of the utmost importance.

A small percentage of the population are older than 65 years of age (5%), but this amount will increase to approximately 11 % over the next few years. Most members of this group of people are no longer economically active and are generally not in favour of development although their presence creates the impression of growth and prosperity.

Social Infrastructure

Housing

The 2003 Demographic and Socio-Economic Survey sets the number of households on 14 607 (2 994 less than 2001 Census). Of these households approximately 79% (11 530) live in formal dwellings (brick houses), whilst 21% (3 024) live in informal or traditional dwellings. Although there is a discrepancy in the amount of households between the Census Data and the Demographic and Socio-Economic Survey the percentages of households living in formal and informal dwellings are more or less similar (refer to Table 6 below).

Table 6: Standard of Housing

TYPE	NUMBER
On-farm	788
Flats	247
Town house complexes	105
Informal	3 821
Formal	10 114
TOTAL	15 075

At the mining site the workers are living in formal households that are obtained from the farm and maintained by the mine.

Service standards: Sewage Removal

In 2001 approximately 4 000 households in //Khara Hais did not have access to water borne sanitation. This figure represents 22.54% of the total number of households in the Municipality. According the SA Census 2005 statistics, approximately 77.4% of households have flush toilets and about 7% of households have no sanitation facilities (refer to Table 7 below).

Table 7: Standard of Sewage Removal

	SEWAGE REMOVAL Sanitation availability per Household					
	Flush	Pit Latrine	Bucket Latrine	None	Chemical	Total Household
TOTAL	13 634	1 381	1 170	1 239	177	17 601
%	77.46%	7.85%	6.65%	7.04%	1.0%	100%

(Source: SA Census, 2005)

At the mining site the workers do not have access to flush latrines and standard personal amenities that will be rectified.

Service standards: Water Reticulation

According to the Census data, almost 80% of households have access to running water either by means of water points situated on their erven (39.14%) or from taps within their dwelling (38.63). Approximately 87% of households rely on a regional or local water scheme as their source of potable water with the remaining households relying on boreholes, natural springs, dams, rivers and water vendors for their supply of water (refer to Table 8 below).

Table 8: Standard of Water Reticulation

	WATER RETICULARION Number of Households with Access to Running Water					
	No Access to Piped Water	Water Dwelling (tap)	On Site/Yard (tap)	Public tap <200m	Public tap >200m	TOTAL
TOTAL	372	6 798	6 889	1 551	1 989	17 599
%	2.11	38.63	39.14	8.81	11.30	100%

(Source: SA Census, 2005)

At the mine potable water is carted in from the Kalahari West Rural water supply scheme (refer to Figure 7 above).

Service standards: Power Supply

In 2001 approximately 76% of households' dwellings were provided with electricity, while some 24% of households still had not have access to electricity and have to rely on candles or paraffin for lighting purposes (refer to Table 9 below).

Table 9: Provision of Electricity

	ELECTRICITY Availability of Electricity for Lighting, Cooking and Heating					
	LIGHTING		COOKING		HEATING	
Energy Source	Households	%	Households	%	Households	%
Electricity	13 318	75.67	11 643	66.15	11 508	65.38
Gas	68	0.39	1 361	7.73	366	2.08
Paraffin	942	5.35	2 507	14.24	1 244	7.07
Candles	3 205	18.21	/	/	/	/
Wood	/	/	1 962	11.15	3 877	22.03
Coal	/	/	26	0.15	28	0.15
Animal dung	/	/	38	0.22	38	0.21
Solar	30	0.17	34	0.19	8	0.04
Other	36	0.20	29	0.16	553	3.14
TOTAL	17 599	100%	17 600	100%	17 602	100%

(Source: Census, 2001)

Personnel at the mine have no access to electricity and have to rely on candles, gas or paraffin for lighting and cooking purposes. It is only the electric water pumps that make use of diesel generators for power supply.

Service standards: Health Services

Health services in Khara Hais are provided by National Government, the Northern Cape Provincial Government, Siyanda District Municipality, Khara Hais Local Municipality and the private sector. The Siyanda District Municipality identified illiteracy and poverty as the key factors affecting the standard of health of the community. Malnutrition, especially amongst children, are prevalent and, according to the District Municipality, it is a result of lack of income to buy adequate and nutritious food and parents, specifically mothers, being illiterate and not understanding the value and importance of ensuring that children eat healthily.

The Khara Hais Municipality has identified a number of health challenges in their 2007 IDP, namely:

a) Shortage of qualified staff personnel.
b) Increase in HIV/AIDS and TB.
c) Increase in Fetal Alcohol Syndrome.
d) Teenage pregnancy.
e) Lack of safety of mobile clinics.
f) Upgrading of mobile clinic vehicles.

Detailed information regarding the standard of health services in the Northern Cape Province, and Khara Hais in particular, are however lacking, especially regarding the prevalence of HIV/Aids infections and the impact of HIV, AIDS and TB on health care resources and ultimately the economy of the province.

According to the Department the province has now progressed from an early HIV epidemic into one of which the full impact of morbidity is beginning to be felt and that at the same time, the health system is becoming massively overburdened. The Department foresee that the burden of HIV/AIDS will increase substantially over the next few years as more of the population becomes symptomatic requiring numerous hospital admissions and primary health care consultation. Although the Siyanda District has the second lowest prevalence rate of HIV in the Northern Cape at 12.64%, it is important to note that this rate is increasing every year (Department of Health Vision 2014 – 10 Year Strategy, 2006).

With regard to the mining operation all of the above issues is addressed in the mine's social and labour plan.

Service standards: Safety and Security

The Khara Hais IDP (2004) describes Upington as a relatively safe area. The safety and crime challenges include vandalism, family violence, smuggling of illegal substances and alcohol and drug related violence. An information crime sheet for Upington Police Station for April to September 2001 to 2007 summarises the crime rate as follows (refer to Table 10 below). The table indicates that serious crime such as murder and attempted murder has decreased since 2001, although the rape statistics stay constant. Prevalent crimes in the Upington area include 'assault with the intent to inflict grievous bodily harm', 'burglary at business and residential premises', 'theft out of or from motor vehicles', and 'shoplifting.

Table 10: Crime statistics for Upington (2001 to 2007)

	Apr - Sep 2001	Apr - Sep 2002	Apr - Sep 2003	Apr - Sep 2004	Apr - Sep 2005	Apr - Sep 2006	Apr - Sep 2007
Murder	21	28	5	6	9	9	4
Attempted murder	68	84	20	18	15	18	15
Rape	30	47	15	23	21	27	26
Indecent assault	6	13	5	11	11	6	9
Assault with the intent to inflict grievous bodily harm	653	707	295	316	299	247	246
Common assault	149	243	112	105	100	82	78
Common robbery	151	181	64	69	51	42	43
Robbery with aggravating circumstances	42	7	17	17	15	12	11
Carjacking (subcategory of aggravated robbery)	-	4	16	16	15	11	11
Robbery at residential premises (subcategory of aggravated robbery)	0	1	1	1	0	0	0
Truck hijacking (subcategory of aggravated robbery)	0	0	0	0	0	0	0
Robbery at business premises (subcategory of aggravated robbery)	-	2	0	0	0	1	0
Robbery at cash in transit (subcategory of aggravated robbery)	-	0	0	0	0	0	0
Bank robbery (subcategory of aggravated robbery)	0	0	0	0	0	1	2
Arson	0	0	0	0	0	0	0
Malicious damage to property	10	12	4	4	4	8	4
Burglary at residential premises	194	198	75	104	81	90	98
Burglary at business premises	238	289	126	165	153	222	124
Theft of motor vehicle and motorcycle	120	102	65	86	82	98	101
Theft out of or from motor vehicle	13	29	16	9	15	8	12
Stock-theft	214	261	197	118	118	142	88
Illegal possession of firearms and ammunition	91	86	65	44	38	37	55
Drug-related crime	6	8	2	6	6	0	8
Driving under the influence of alcohol or drugs	181	67	72	66	32	21	38
All theft not mentioned elsewhere	80	63	24	87	37	50	115
Commercial crime	916	649	497	469	287	291	315
Shoplifting	66	60	49	70	35	23	32
Carjacking	269	224	222	295	217	254	240
Robbery with aggravating circumstances	7	13	7	13	7	8	9
Kidnapping	0	2	1	3	0	0	0
Abduction	1	2	0	1	0	2	0
Neglect and ill-treatment of children	3	0	6	2	0	1	2
Public violence	1	3	0	0	0	0	0
Crimen injuria	28	48	46	41	32	26	25

(Source: SAPS, 2007)

At the mining area the safety and crime challenges include family violence and alcohol and drug related violence. Safety and Security services on the mining area are supplied by the Upington Police with the assistance of the mine manager due to the remote locality of the settlement.

Service standards: Sports and Recreation

Access to sport, recreation and cultural facilities, e.g. museums and theatres are important aspects of the workers well-being. No facilities are available at the mine but workers commute every weekend to Upington the centre of the sport and recreation activities of the region. The following recreational facilities exist in Upington and surrounds:

a) Formal Sports Fields

Public open areas and vacant lots are also used as sports fields, especially for soccer. These occur in most neighbourhoods, rural settlements and private areas. Most of the schools have their own sports facilities for the use of their learners. Formal sports amenities and the associated sports opportunities include:

- Bellvue swimming pool (swimming).
- Danie Kuys sports ground (rugby, soccer and athletics).
- Island sports grounds (rugby, netball, tennis and bowls).
- Kalksloot (soccer and netball).
- Oranje sports complex (rugby, soccer, netball, tennis, jukskei and gymnasium).
- Paballelo sports grounds (soccer, athletics, netball, and basketball).
- Paballelo swimming pool (swimming).
- Raaswater sports grounds (soccer).
- SC Kearns (rugby, soccer, and netball).
- Town swimming pool (swimming and aerobic exercises).
- Unievelde (rugby, soccer, tennis, netball, hockey, cricket, golf and pistol shooting).
- Upington Golf course (golf and squash).

b) Parks

The following parks have playground equipment for recreational purposes for children:

Disa Park.	Hospital Park.
Kalksloot.	Kameeldoring Park.
Koen Park.	Lambrechtsdrift.
Leerkrans.	Louisvale Road.
Louisvale Town.	Morning Glory.
Paballelo.	Progress.
Rosedale.	Sentrum Park.

c) Community facilities

In the Kalahari Shopping Centre there are four film theatres with a capacity of 600 seats. A number of community halls occur throughout the Municipality, namely:

J Shimane Hall.
Kalksloot Community Hall.
Karos Community Hall.
Lambrechtsdrift Community Hall.
Louisvale Road Community Hall.
New Community Hall.
Progress Civic Hall.
Raaswater Community Hall.
Rosedale Community Hall.

2.18 Regional Economic structure

Socio-Economic Status

The Northern Cape has the third highest Human Development Index (HDI) compared to South Africa's other provinces. The HDI provides an alternative method to measure the relative socio-economic development of an area and is seen as a measure of people's ability to live a long and healthy live, to communicate, to participate in the community and have sufficient means to be able to afford a decent living.

It is imperative that the illiteracy and functional level of communities be addressed. Functional illiteracy is indicative of an inability to understand abstract information and usually occurs when a person has completed less than seven years of formal education and at least passed grade seven. According to Table 11 below, 16% of the population of the Municipality is functionally illiterate while 7% are completely illiterate. This is directly connected to low income levels and will push the HDI further down if this is not attended to. A total of 19.31% of the population has some secondary education, while only 11.65% have completed Grade 12.

Provision is made as part of the company's social and labour plan to address these issues.

Table 11: Literacy and Education Levels

	LITERACY LEVELS	
	TOTAL	%
% Totally Illiterate	5 285	6.96%
% Functional Illiterate	12 059	15.91%
Some secondary	14 613	19.31%
Complete Grade 12	8 821	11.65%
Higher Education	2 467	3.26%

(Source: Census, 2005)

The Labour Market constitutes 63% of the total population of Khara Hais (47 843). Only 24% of the Labour Market is employed, with the unemployment rate at 13%. The not economically active people constitute 26% of the Labour Market. The unemployment rate of 13% could therefore be somewhat misleading due to the fact that people not seeking work, which can be classified as unemployed people, are not included.

Table 12: Employment Status.

	EMPLOYMENT STATUS		
	Employed	Unemployed	Not Economically Active
Total Individuals	18 231	9 877	19 735
% of Total Population (75 671)	24.09%	13.05%	26.08%

(Source: Census, 2005)

Of the employed labour force almost 19% earn less than R400 per month, whilst 55% earn between R401 and R1600 per month. Some 74% of the employed labour force thus

earns less than R1600 per month and therefore live in poverty. It is important to note that the employed labour force constitutes only 24% of the total population, which implies that 76% of the people living in Khara Hais Municipality are dependent on the income of the employed labour force. The dependency ratio of that sector of the population that live in poverty (i.e. earn less than R1600) is roughly 1:4, with a maximum of R400 per person available per month.

Table 13: Monthley Income Level

	INDIVIDUAL MONTHLY INCOME									
	No Income	R1 - R400	R401 - R800	R801 - R1600	R1601 - R3200	R3201 - R6400	R6401 - R12800	R12801 - R25600	R25601 - R51200	R51201 or More
TOTAL	373	3021	3451	3564	3516	2660	1172	299	107	68
%	2.04	16.57	18.93	19.55	19.29	14.59	6.43	1.64	0.59	0.37

Primary economic activities

According to the 2001 Census data the Tertiary Sector provides more than 50% of the job opportunities in Khara Hais. The Community, Social and Personal Services employs most people in the Municipality (i.e. 23%) followed closely by the Wholesale and Retail Trade sector, which employs 18% of the employed people.

Table 14: Employment per Economic Sector.

INDUSTRY	NUMBER OF EMPLOYEES	% OF TOTAL EMPLOYEES
PRIMARY SECTOR		
Agriculture & Hunting	2484	13.62
Mining & Quarrying	55	0.30
SECONDARY SECTOR		
Manufacturing	1273	7.00
Electricity, Gas & Water Supply	126	0.70
Construction	911	5.00
TERTIARY SECTOR		
Wholesale & Retail Trade	3394	18.61
Transport, Storage & Communication	888	4.78
Financial Intermediation, Insurance, Real Estate & Business Service	1466	8.04
Community, Social & Personal Services	4195	23.00
MISCELLANEOUS		
Private Households	1937	10.62
Other & Not Adequately Defined	3	0.02
Undetermined	1501	8.23

(Source: Census 2005)

Key aspects of the primary economic sectors are summarised below.

Agriculture

According to the Northern Cape Provincial Growth and Development Strategy (NCPGDS,2004-2014) agriculture is one of the mainstays of the Northern Cape provincial economy contributing 7.3% to the GGP in 2002.

The fertile land located along the Gariep River supports the production of some of the country's finest quality agricultural products. The province is a major exporter of table grapes produced along the Gariep River and is renowned for high-quality meat. The Northern Cape is also well known for the production of wool, mohair and karakul pelts as well as dates, citrus products, wine and raisins. Some of the Kalahari farms are popular for game farming, agri-tourism and hunting.

The economy of Upington relies heavily on agriculture, tourism and the services industry and many large South African companies dealing with wine, table grapes, dried fruit and livestock farming have their head offices in the town.

Mining

Upington is well-known for the variety of semi-precious stones that occur in abundance at no great depth. These include beryl, amethyst, agate, tourmaline, jasper, aquamarine and tiger eye. The area is also known for its high quality salt produced at numerous salt pans.

Small deposits of various minerals occur in the area, including zinc, copper, calcite, lead, barites, fluorspar, tungsten and amethyst. However, due to the reported small quantities these minerals are not exploited on a significant scale (Siyanda EMF 2007).

Transport

a) Public Transport

There is no local bus service available in Upington, but Intercape and SA Roadlink provide a national transport service. Most communities are therefore dependent upon taxis. Two taxi associations exist, namely the Siyanda Local and Long Distance Taxi Association, and Gordonia Goodhope Local and Long Distance Taxi Association.

b) Airport Services

With the fall of the Portuguese regime in Angola, South African Airways (SAA) lost its landing rights in Luanda. As a result, the runway of Upington Airport was constructed to accommodate a Boeing 747 with a full load of passengers, cargo and fuel – allowing planes to take off for Europe without having to stop along the way. Upington was chosen because of its height above sea level (844 m), position and available land. The airport's 4900m-long runway, the longest in Africa, was built in a record seven month period in 1975. From August 1976 to December 1996, SAA used Upington as a refuelling station for two weekly scheduled Boeing 747 flights to London and Zurich. The runway is long enough to land a space shuttle. About 78 tons of cargo a week is flown from Upington during the busiest months of November, December and January.

Cars, fish and courier parcels head for Cape Town, Kimberley and Johannesburg, as well as England, Germany and Spain. Mining equipment leaves Upington for other African countries. Approximately one million tons of grapes are flown from Upington every year and live sheep and goats pass through the airport on their way to Saudi Arabia (Siyanda EMF, 2007). There are daily inland flights from Upington to Kimberley, Johannesburg and Cape Town.

ACSA has identified Upington as an alternative or supplement for Oliver Tambo Airport for cargo traffic. The benefits for cargo airlines and importers and exporters would be greater when using Upington Airport, as there is less congestion and quicker airport turnaround times, shorter-to-market timeframes which would enhance product freshness by one day, and improved supply-chain performance. It is also envisaged that, once a regular service by a reputable airline is established, many new projects will start up and many existing commodities will grow in volume. In particular, meat exports from will increase substantially, with Namibia possibly also making use of this port (Davenport, 2006).

ACSA has initiated a project for the establishment of an aircraft maintenance and storage service. As part of this service aircraft can be parked in circumstances similar to those in dry Middle Eastern countries and the Arizona desert. Such aircraft will be maintained for future use or stripped for the recycling of spare parts.

c) Railway Services

Upington is the location of rail connections to Karasburg in Namibia and Keimoes and Kakamas due west of Upington. There is also a connection to De Aar in the south which, in turn, links to railways to Johannesburg, Kimberley and Cape Town.

Within Upington there is approximately 12 km of internal side-lines connecting local industries to the national rail system. Presently the rail system is mainly used for the transport of goods, although there is a private train that provides a passenger service on a weekly basis between Upington and various centres in Namibia (Khara Hais IDP, 2005).

Manufacturing

The manufacturing sector employs approximately 7% of the total workforce. Although there are a large variety of industries, there is a shortage of manufacturing industries and consideration should be given to incentives to encourage the establishment of such activities (Khara Hais IDP, 2004).

The manufacturing sector is dominated by the food and beverage industry in Upington. Most manufacturing that takes place involves value-addition to the agricultural raw material output of the Northern Cape or the fabrication of intermediate products used in those industries. There is significant scope for growth in certain economic sub-sectors, particularly, if conditions conducive to increased investment in manufacturing can be created through institutional support and reform.

Energy Production

Upington is regarded as one of the most ideal places on the planet for the utilisation of solar power to generate electricity (Bohlweki Environmental, 2006). Due to the fact that Upington offers one of the world's best solar resources the first major social energy initiative on the African continent will be constructed by ESKOM in the //Khara Hais Municipality. ESKOM estimated that by constructing a Concentrated Solar Power (CSP) plant in the area South Africa could produce the lowest-cost solar electricity in the world to date. A 100 MW CSP plant is to be built in order to supplement the ever increasing electricity demand in South Africa by delivering electricity to the national transmission network.

Tourism

Tourism has been identified as one of sectors by the Municipality that needs to be developed. Upington is regarded as inter alia the 'oasis of the Kalahari' and the 'gateway to the Green Kalahari' (defined as a fertile place that offers travellers protection, a restful

and pleasant stopping place; a place to stock up on essentials, such as fuel and food stuffs).

Tourism is potentially one of the most important economic sectors in the Northern Cape, and in Khara Hais. Tourism is globally recognised as a primary creator of employment. As such, the development of the industry in Khara Hais will significantly enhance local economic development.

a) Eco-Destinations

Khara Hais is located in the Green Kalahari Region in which there are two important conservation areas, namely Kgalagadi Transfrontier Park and the Augrabies Falls National Park. A small local authority game reserve, namely Spitskop, is located 13 km north of Upington.

b) Public Resorts

A major tourist destination in Upington is Die Eiland Holiday Resort. The aim of this Municipal resort is to provide holiday accommodation and recreational opportunities to tourists and citizens of Khara Hais.

A primary shortcoming is inadequate access to the Gariep River for tourists. Angling and other river-related recreational activities are popular with the inhabitants and represent a significant potential tourist attraction and resource. Furthermore, the maintenance of the integrity of the river and its riparian zone is hampered by the lack of a zoning plan and recreational land use guidelines.

c) General Amenities and Opportunities

A broad spectrum of tourist amenities and opportunities occur, namely:

Agri-tourism opportunities providing insight into vineyard farming, processing of agricultural products, wine-making, etc.

Conferencing.

Culture tourism presented in Paballelo.

Holiday accommodation in the form of approximately 50 registered guest houses, bed-and-breakfast facilities and over-night facilities, and two hotels.

River-based eco-opportunities such as 'Sakkie-se-Arkie'.

Various lodges outside of Upington, including Gariep Lodge, Uizip Resort and Kalahari Lodge.

The testing of motor vehicles in the area holds huge benefits for the tourism sector. Major car manufacturers bring their cars and commercial vehicles to Upington for testing in the extreme climatic conditions. There are very few places in the world where such conditions occur and where accessibility is ensured by long distances of good quality tarred roads and the airport facilities. A further important attribute in this regard is the availability of support facilities in the form of service centres and qualified mechanics.

d) Festivals

Khara Hais has a variety of industries and activities and this has given rise to a number of festivals, including the following:

Kalahari Kuierfees is held every year in the first week of September. This popular festival is held over four days and attracts more than 35 000 visitors. Die Eiland Resort is the main venue and attractions include firework shows, artistic and drama shows, theatre productions, sport activities, food and wine stalls, etc.

Upington Landbou Skou (i.e. Northern Cape Expo) is an annual event held in the first week of May. It includes well-known South African artists, variety of music, hundreds of

stalls, food, sport activities such as a half-marathon, cycling, badminton, etc.
Orange River Young Wine Show which is held in September primarily to showcase the different wines of the area.

Service Sector

The services sector includes all activities that relate to professional, government and financial services and collectively accounts for 31% of the total employment in the area. Upington is the regional service centre and hub for government-related services, banks, shopping malls, schools, higher order educational and health facilities.

2.19 Interested and Affected Parties

Only the different regulating authorities and landowner was identified as affected parties. Consultation in terms of the Minerals and Petroleum Resources Development Act 28, 2002 with the regulating authorities is the responsibility of DME while all interested parties was invited to submit any written comments with regard to this amendment to the approved EMPR by means of an advertisement in the local newspaper. The newspaper clipping is attached as part of the supporting documentation together with concerns received if any (Para 10.5).

3. PART 3 - MOTIVATION FOR THE PROPOSED PROJECT:

3.1 Introduction

The economic, social and environmental advantages of mining this site are that:

- Environmentally, the further mining of an existing site limits environmental impacts. The proposed mining can be programmed to further reduce existing residual environmental impacts.
- Economically and socially, the provision of employment, creation of spending power with the associated multiplier effect {virtually exponential in an area of such poverty and high levels of dependency) are huge benefits to this economically depressed region.
- The proposed project is also in keeping with the principles of optimization of resources as required by the MPRDA, and the government's GEAR programme

3.2 Benefits of the Project

The sale of the salt on the local and international market will provide for foreign exchange earnings

The estimate of the labour force at full production is approximately 15 employees so there is a positive impact on unemployment although very small. In determining the impact of the multiplier effect it must be remembered that the processing industry will result in the multiplier effect having an exponential impact on the local population. Increased spending power (and saving in some instances) will result in higher investment potential in the area.

3.3 Consideration of project alternatives

Note that all project alternatives were assessed against a background of reduction or elimination of any potential environmental impacts and secondly, cost to the company.

Salt mining is very different from other mining operations in that no rock is broken and no mining waste is generated. Therefore the impact on the topography is insignificant and no waste dumps are created above surface. The proposed mining of the remaining reserves is in accordance with the principle of optimization of mineral resources as stipulated in the MPRDA. Ubiquitous salt reserves in the country, as well as growing demand, consistent with unprecedented levels of economic growth, create further opportunities for increased supply needs for salt particularly as South Africa imports more than 50 percent of salt to meet its demand levels.

4. PART 4 - DETAILED DESCRIPTION OF THE PROJECT:

4.1 Construction phase

Eenzaamheid was an established salt mine at the beginning of operations and most of the surface infrastructure was already in place and only needed upgrading.
The mine operation straddles the R360 main road and no further access roads need to be constructed. The nearest rail station is at Upington, 113 km away via the R360 (refer to Figure 2).
The following activities will take place in the construction phase of the operation:
Maintenance of:

- Services
  - Potable water will obtained from the pipeline of the local authority and carted to the site
  - powerlines - electrical supply will be by generators
  - access road

Construction, development or upgrading of:

- Workshops and other buildings
  - Personnel amenities will where necessary be upgraded and recommissioned

The following facilities will be developed or upgraded in accordance with the construction principles as discussed in the Environmental Management Program Part 6.

  - Workshop and parking garages
  - Bunded storage area for mobile fuel tanker
  - Temporary storage area for domestic and industrial waste
  - Generator bay - with diesel spill floor

- Solid waste management systems
  - temporary-waste storage area including facilities for oil and fuel waste handling
  - scrap yard for temporary storage of scrap steel and equipment prior to sale

- Mine residue disposal sites

Salt mining is characteristically conducted in an unconventional manner in that no rock is broken in the process and the fact that the impact on the environment and hence rehabilitation is less than any other mining project, with minimal environmental impact and no mine residue.

- Water pollution management facilities
  - Sewage plant - personnel amenities waste will be fed into a system of French drains that exist at present but will require upgrading
  - Pollution control dams and evaporation dams – due to the extremely low rainfall, high evaporation rate, permeability of the soils, the use of French drains and the lack of pollutants used in the mining process, no storm water management system nor pollution control/evaporation dams will be required.
  - Polluted water treatment facilities - there are no pollutants other than oil and diesel used in the mining operation. As such no polluted water treatment facility is provided.

- Oil/grease/diesel management system
  - Oil and Grease
    - Oil (new and used) and grease must be stored in areas provided with concreted floors and bund walls.
    - All workshops and workshop apron areas for servicing large equipment must be provided with oil traps from which oil can be bailed out.
    - The diesel generator room must be provided with bund walls and an oil trap to stop all oily run-offs from the concrete floor.
  - Diesel
    - The parking area for the mobile diesel tanker must be bunded and provided with a concrete apron.
- Process water supply system: design, capacity and process

Salt mining only involve the pumping of brine from boreholes for the production of salt by means of solar evaporation. A top-up of 16 m^3 water is obtained from 2 boreholes on the mining area. Although groundwater is use it cannot be seen as process water.

- Mineral processing plant

At this stage, Eenzaamheid does not directly beneficiate its own production further than the sorting, valuation and sales preparation. This means that the salt produced at Eenzaamheid is sold as FoT product to a salt refinery in Upington where the various types of salt have unique production, processing and packaging factors that determine their selling price.

4.2 Operational Phase

(Also refer to Figure 9 to 10 for layout of mine workings)

- Soil Utilisation Guide

The deflated surface of the pan is covered in a thin layer of tillite scree that cannot be regarded as topsoil. This layer is removed from the areas where the crystallisation pans are developed and used to form a bund wall around the pans to control storm water. Fresh water will dissolve any salt crystals formed and thereby destroy the production. The second soil horisont is a clay layer that will be levelled to form the floor of the crystallisation pans. Topsoil management is therefore not applicable to the mining of salt.

- Proposed Mine Surface Layout
  - Access to the workings - access to the site is via a short access road that lead from the R360 main road
  - Structures that may be, affected by blasting – no blasting takes place in the mining process
  - Location & extent of subsidence - not applicable given that only surface mining will take place.
  - Structures and drainage affected by surface subsidence - not applicable given that only surface mining will take place.

- Mine Plan

In the case of inland pans, salt production starts with the drilling of bore holes for the pumping of brine. The average depth of boreholes is 60 meters but brine is pumped at a depth of 30 meters.

The second step would be to plan the concentration ponds and/or crystallisation pans. The crystallisation pans are on average 1.6 Ha in size. The loose scree material on the pan floor is removed to form a bund wall to prevent storm water from flooding the pans as freshwater can ruin the production.

Brine is then pumped into these pans over a period of one year to form a level hardened floor on which salt can crystallize. The first salt to be processed is used to build platforms. When the pans are in full production these platforms are used for stockpiling the salt until it is dry.

Eenzaamheid started off with 6 historic crystallisation pans that only needed maintenance. The total footprint of these pans is about 10.5 Ha.

At Eenzaamheid no concentration ponds are use and brine is pumped directly into a series of shallow average 80cm deep crystallisation pans where solar evaporation takes place, resulting in the deposition of salt. Salt is harvested when crystals are about 50 mm thick producing about 350 tons per month on a 1 Ha crystallisation pan.

In the summer (September to April) months production rates are at the optimum level and during the winter (May to August) the salt pans go into a resting period where no salt is being produced. Maintenance to the "dam" floors is being done during these resting periods. Due to this rest period and the productive yield of the bore holes the life of the mine is indefinite and can only be influenced by climate change.

- Mineral Processing

At this stage, Eenzaamheid does not directly beneficiate its own production further than the sorting, valuation and sales preparation. This means that the salt produced at Eenzaamheid is sold as FoT product to a salt refinery in Upington where the various types of salt have unique production, processing and packaging factors that determine their selling price.

- Product Transport

Salt produced at Eenzaamheid is sold as FoT product to be transported in bulk with $20m^3$ to the salt refinery in Upington.

Figure 9: Mine Layout

Boundary Co-Ordinares

A S27.66254° E20.83009°
B S27.66163° E20.83190°
C S27.65662° E20.84435°
D S27.67071° E20.85090°
E S27.67414° E20.84253°
F S27.67087° E20.83860°
G S27.67125° E20.83811°
H S27.66750° E20.83460°
I S27.66451° E20.83217°

Key

CP Crystallisation Pans

No.	Area	Centre position
CP1	1.6 Ha	S27.66579° E20.83866°
CP2	1.6 Ha	S27.66606° E20.84041°
CP3	1.8 Ha	S27.66657° E20.83848°
CP4	1.6 Ha	S27.66694° E20.84024°
CP5	1.6 Ha	S27.66733° E20.83833°
CP6	1.6 Ha	S27.66772° E20.84005°

ED Evaporation Dam

1.0 Ha S27.66856° E20.83810°

BH Boreholes

No.	Yield	Depth	Position
BH1	8m³/h	30m	S27.66861° E20.84128°
BH2	8m³/h	30m	S27.66938° E20.84076°
BH3	8m³/h	30m	S27.66886° E20.83760°

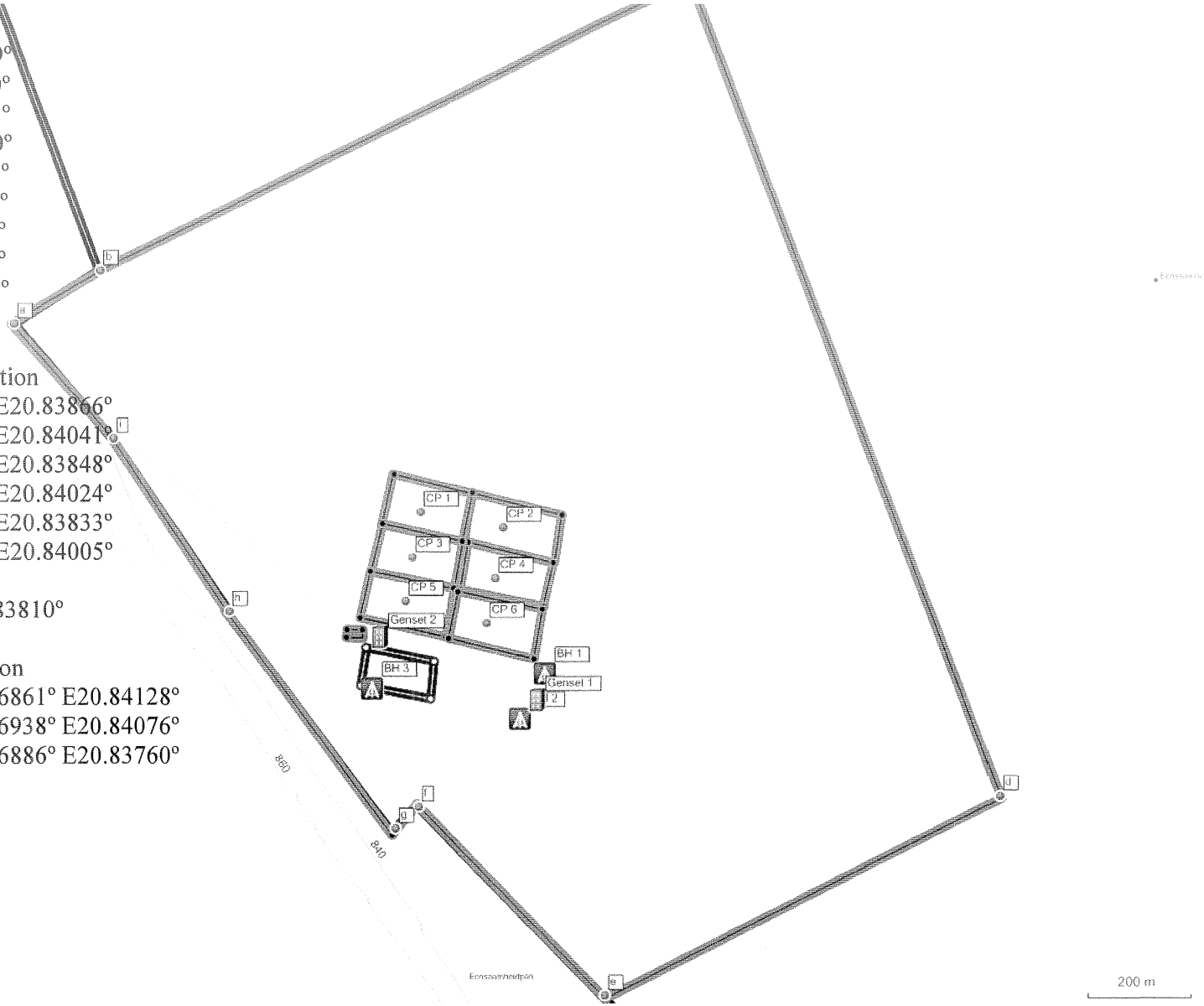
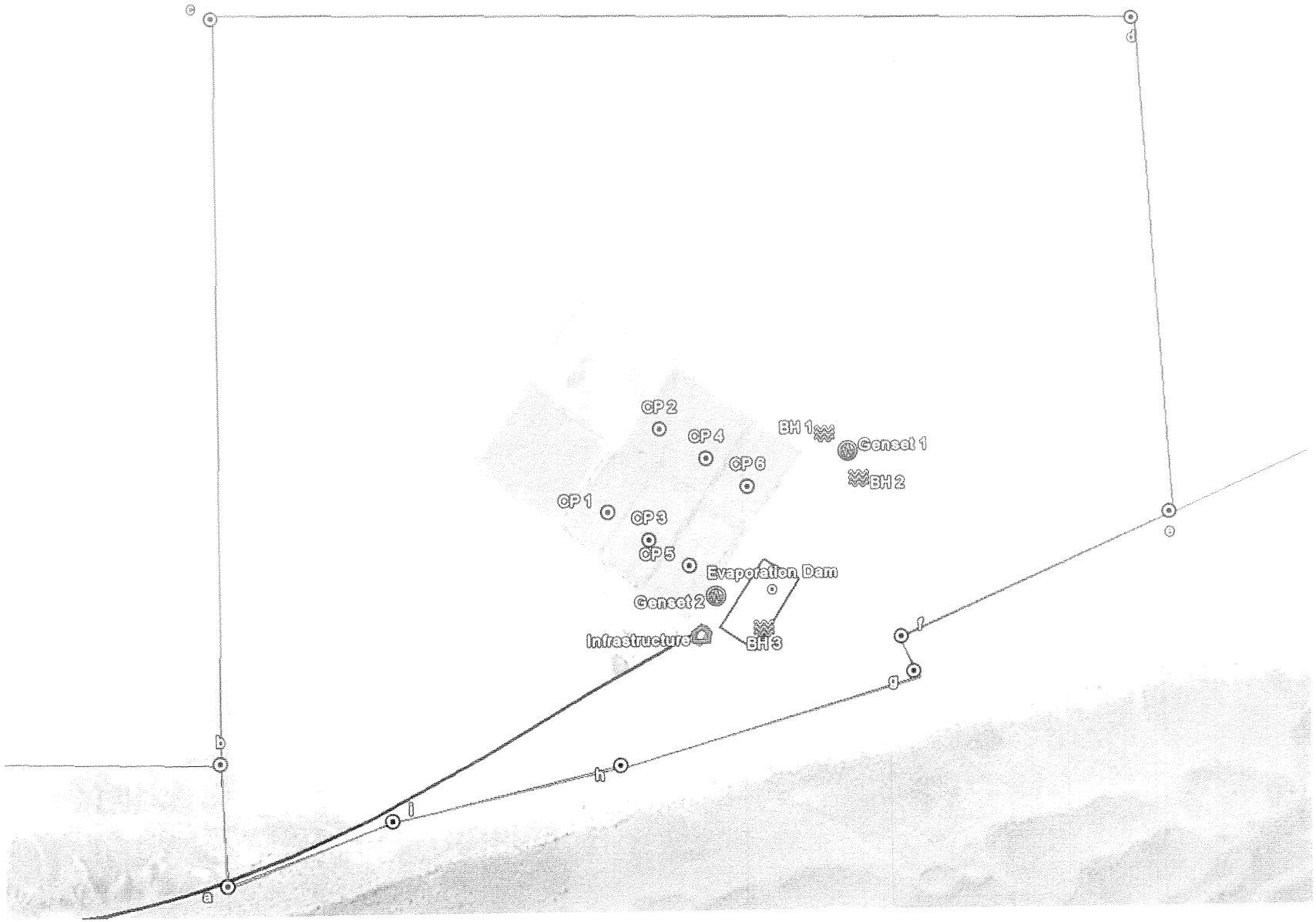


Figure 10: Mine Plan



4.3 Mine Decommissioning and Closure

Regulations 56 to 62 outline the entire process of mine closure, both as a guide to the process to be followed for mine closure, and also to address the legal responsibility with regard to the proper closure of operations. In terms of Section 37 of the Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002), the holder of a right is liable for any and all environmental damage or degradation emanating from his operation, until a closure certificate is issued in terms of Section 43 of the MPRDA, 2002.

An application for a closure certificate must be accompanied by an environmental risk report which must include-

(a) the undertaking of a screening level environmental risk assessment where-

(b) the undertaking of a second level risk assessment on issues classified as potential significant risks where-

(c) assessing whether issues classified as posing potential significant risks are acceptable without further mitigation;

(d) issues classified as uncertain risks be re-evaluated and re-classified as either posing potential significant risks or insignificant risks;

(e) documenting the status of insignificant risks and agree with interested and affected parties;

(f) identifying alternative risk prevention or management strategies for potential significant risks which have been identified, quantified and qualified in the second level risk assessment;

(g) agreeing on management measures to be implemented for the significant risks

- Closure Objectives

Closure objectives are discussed in more detail in the rehabilitation plan that also provide for the proposed closure cost. The environment affected by the mining operation shall be rehabilitated, as far as is practicable, to its natural state. The broad future land use objective(s) for the site will be the same as before mining with the same production with regard to small stock farming.

The key objectives for mine closure is to leave the site in as safe and self-sustaining a condition as possible and in a situation where no post-closure intervention is required to ensure that the rehabilitation measures prove successful. The aim is to ensure a stable environment and to allow pan processes and water regimes to continue naturally. The aesthetic value of the area also needs to be reinstated. The rehabilitation of the inherited liabilities will be addressed together with production. At final closure the following actions are required to finalise decommissioning and rehabilitation of the site.

- All scrap and other foreign materials will be removed from the area and disposed of as in the case of other refuse, whether these accrue directly from the mining operation or are brought on to the site. Unwanted steel and sheet metal will be sold or disposed of as scrap metal.
- The temporary stockpiles must be removed or used to backfill the concentration ponds and/or other excavations.
- The pan floor and stockpile platforms then need to be ripped and levelled including the collecting sump. Scarifying of all compacted areas needs to be done.
- All internal roads need to be ripped except for the ones still needed by the landowner. This also includes repairs to all fences and gates.

- Provision of efficient storm water control to prevent erosion of steep slopes and roadways and elsewhere are required
- Where the surface rights owner formally requests that certain buildings and roads be left for his use this will be done with the Department of Mineral Recourses approval. The proposed end-state of the area will be consulted with interested and affected parties in terms of Regulation 52(2) (g).

- Infrastructure areas

The living quarters and other infrastructure are leased from the landowner and cannot be demolished at final closure. The remaining plant, buildings, foundations, footings and services such as electricity and water supply is subject to Section 40 of the MPRDA. All disturbed areas needs to be rehabilitated according to the management and mitigating measures described in the Environmental Management Program (EMP) Part 6.

- Mine Residue Deposits and dangerous excavations

Successful implementation of the EMPR (part 6) during the life of the mine will cover all the significant aspects affecting the environment. Those aspects that will require some attention during the decommissioning phase are detailed below:

- shape the pre-existing crystallisation pans (if not completed in operational phase)
- rip-up harden pan floors and stock pile areas
- shape the new crystallisation pans and stock pile areas
- rip-up dust roads where necessary or in consultation with land owner
- remove all power supply installations
- remove all pumps and water installations except for potable water
- all other structures constructed as part of the mining operation will be subject to the requirements of Section 40 of the MPRDA

It is envisaged that at the time of mine closure the total area will be flat so long term stability is not an issue. All dumps will be backfilled and the area profiled.

- Monitoring & Aftercare

Regular monitoring of the effectiveness of environmental management and mitigating measures implemented during the post mining decommissioning phase. Monitoring must continue until a closure certificate is awarded.

4.4 Legal provisions

Mine management must also take cognisance of the provisions of other legislation dealing with matters relating to conservation, and which include, inter alia, the following:

- National Monuments Act, 1969 (Act 28 of 1969).
- National Parks Act, 1976 (Act 57 of 1976)
- Environmental Conservation Act, 1989 (Act 73 of 1989)
- National Environmental Management Act, 1998 (Act No. 107 of 1998)
- Atmospheric Pollution Prevention Act, 1965 (Act 45 of 1965)
- The National Water Act, 1998 (Act 36 of 1998)
- Mine Safety and Health Act, 1996 (Act 29 of 1996)
- The Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983).

4.5 Additional requirements set for the operation by the Regional Manager.

The conditions set for the approved EMPR as per the approval letter dated 04 April 2006 form part of the Environmental Management Plan and all elements and instructions must be complied with by mine management. This specific legislation includes the following:

a) National Water Act, 1998 (Act No. 36 of 1998) (Section 19 and 20)

Prevention and remedying effects of pollution

19. (1) An owner of land, a person in control of land or a person who occupies or uses the land on which -

(a) any activity or process is or was performed or undertaken; or

(b) any other situation exists, which causes, has caused or is likely to cause pollution of a water resource, must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring.

(2) The measures referred to in subsection (1) may include measures to -

(a) cease, modify or control any act or process causing the pollution;

(b) comply with any prescribed waste standard or management practice;

(c) contain or prevent the movement of pollutants;

(d) eliminate any source of the pollution;

(e) remedy the effects of the pollution; and

(f) remedy the effects of any disturbance to the bed and banks of a watercourse.

(3) A catchment management agency may direct any person who fails to take the measures required under subsection (1) to -

(a) commence taking specific measures before a given date;

(b) diligently continue with those measures; and

(c) complete them before a given date.

(4) Should a person fail to comply, or comply inadequately with a directive given under subsection (3), the catchment management agency may take the measures it considers necessary to remedy the situation.

(5) Subject to subsection (6), a catchment management agency may recover all costs incurred as a result of it acting under subsection (4) jointly and severally from the following persons:

(a) Any person who is or was responsible for, or who directly or indirectly contributed to, the pollution or the potential pollution;

(b) the owner of the land at the time when the pollution or the potential for pollution occurred, or that owner's successor-in-title;

(c) the person in control of the land or any person who has a right to use the land at the time when -

(i) the activity or the process is or was performed or undertaken; or

(ii) the situation came about; or

(d) any person who negligently failed to prevent -

(i) the activity or the process being performed or undertaken; or

(ii) the situation from coming about.

(6) The catchment management agency may in respect of the recovery of costs under subsection (5), claim from any other person who, in the opinion of the catchment management agency, benefitted from the measures undertaken under subsection (4), to the extent of such benefit.

(7) The costs claimed under subsection (5) must be reasonable and may include, without being limited to, labour, administrative and overhead costs.

(8) If more than one person is liable in terms of subsection (5), the catchment management agency must, at the request of any of those persons, and after giving the others an opportunity to be heard, apportion the liability, but such apportionment does not relieve any of them of their joint and several liability for the full amount of the costs.

Control of emergency incidents

20. (1) In this section ``incident'' includes any incident or accident in which a substance -

(a) pollutes or has the potential to pollute a water resource; or

(b) has, or is likely to have, a detrimental effect on a water resource.

(2) In this section, ``responsible person'' includes any person who -

(a) is responsible for the incident;
(b) owns the substance involved in the incident; or
(c) was in control of the substance involved in the incident at the time of the incident.
(3) The responsible person, any other person involved in the incident or any other person with knowledge of the incident must, as soon as reasonably practicable after obtaining knowledge of the incident, report to -
(a) the Department;
(b) the South African Police Service or the relevant fire department; or
(c) the relevant catchment management agency.
(4) A responsible person must -
(a) take all reasonable measures to contain and minimise the effects of the incident;
(b) undertake clean-up procedures;
(c) remedy the effects of the incident; and
(d) take such measures as the catchment management agency may either verbally or in writing direct within the time specified by such institution.
(5) A verbal directive must be confirmed in writing within 14 days, failing which it will be deemed to have been withdrawn.
(6) Should -
(a) the responsible person fail to comply, or inadequately comply with a directive; or
(b) it not be possible to give the directive to the responsible person timeously, the catchment management agency may take the measures it considers necessary to -
(i) contain and minimise the effects of the incident;
(ii) undertake clean-up procedures; and
(iii) remedy the effects of the incident.
(7) The catchment management agency may recover all reasonable costs incurred by it from every responsible person jointly and severally.
(8) The costs claimed under subsection (7) may include, without being limited to, labour, administration and overhead costs.
(9) If more than one person is liable in terms of subsection (7), the catchment management agency must, at the request of any of those persons, and after giving the others an opportunity to be heard, apportion the liability, but such apportionment does not relieve any of them of their joint and several liability for the full amount of the costs.

b) Environmental Conservation Act No. 73 OF 1989 (Section 20)

20. **Waste management**

(1) No person shall establish, provide or operate any disposal site without a permit issued by the Minister of Water Affairs and that Minister may-
(a) issue a permit subject to such conditions as he may deem fit;
(b) alter or cancel any permit or condition in a permit;
(c) refuse to issue a permit:
Provided that such Minister may exempt any person or category of persons from obtaining a permit, subject to such conditions as he may deem fit.
[Sub-s. (1) substituted by s. 9 of Act No. 79 of 1992.]

(2) Any application for a permit referred to in subsection (1) shall be in the form and be accompanied by such information as the Minister may prescribe.

(3) If the Minister of Water Affairs should require any further information to enable him to make a decision on an application for a permit referred to in subsection (1), he may demand such information from the applicant.

(4) The Minister of Water Affairs shall maintain a register in which details of every disposal site for which a permit has been issued shall be recorded.

(5) The Minister of Water Affairs may from time to time by notice in the *Gazette* issue directions with regard to-
(a) the control and management of disposal sites in general;
(b) the control and management of certain disposal sites or disposal sites handling particular types of waste; and
(c) the procedure to be followed before any disposal site may be withdrawn from use or utilised for another purpose.

(6) Subject to the provisions of any other law no person shall discard waste or dispose of it in any other manner, except-
(a) at a disposal site for which a permit has been issued in terms of subsection (1); or
(b) in a manner or by means of a facility or method and subject to such conditions as the Minister may prescribe.

c) National Water Act, 1998 (Act No. 36 of 1998) Regulations on use of water for mining and related activities aimed at the protection of water recources (Regulation 4, 6 and 7)

4. Restrictions on locality

No person in control of a mine or activity may-
(a) locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year flood-line or within a horizontal distance of 100 metres from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on water-logged ground, or on ground likely to become waterlogged, undermined, unstable or cracked;
(b) except in relation to a matter contemplated in regulation 10, carry on any underground or opencast mining, prospecting or any other operation or activity under or within the 1:50 year flood-line or within a horizontal distance of 100 metres from any watercourse or estuary, whichever is the greatest;
(c) place or dispose of any residue or substance which causes or is likely to cause pollution of a water resource, in the workings of any underground or opencast mine excavation, prospecting diggings, pit or any other excavation; or
(d) use any area or locate any sanitary convenience, fuel depots, reservoir or depots for any substance which causes or is likely to cause pollution of a water resource within the 1:50 year flood-line of any watercourse or estuary.

6. Capacity requirements of clean and dirty water systems

Every person in control of a mine or activity must-
(a) confine any unpolluted water to a clean water system, away from any dirty area;
(b) design, construct, maintain and operate any clean water system at the mine or activity so that it is not likely to spill into any dirty water system more than once in 50 years;
(c) collect the water arising within any dirty area, including water seeping from mining operations, outcrops or any other activity, into a dirty water system;
(d) design, construct, maintain and operate any dirty water system at the mine or activity so that it is not likely to spill into any clean water system more than once in 50 years; and
(e) design, construct, maintain and operate any dam or tailings dam that forms part of a dirty water system to have a minimum freeboard of 0.8 metres above full supply level, unless otherwise specified in terms of Chapter 12 of the Act.
(f) design, construct and maintain all water systems in such a manner as to guarantee the serviceability of such conveyances for flows up to and including those arising as a result of the maximum flood with an average period of recurrence of once in 50 years.

7. Protection of water resources

Every person in control of a mine or activity must take reasonable measures to-

(a) prevent water containing waste or any substance which causes or is likely to cause pollution of a water resource from entering any water resource, either by natural flow or by seepage, and must retain or collect such substance or water containing waste for use, re-use, evaporation or for purification and disposal in terms of the Act;

(b) design, modify, locate, construct and maintain all water systems, including residue deposits, in any area so as to prevent the pollution of any water resource through the operation or use thereof and to restrict the possibility of damage to the riparian or in-stream habitat through erosion or sedimentation, or the disturbance of vegetation, or the alteration of flow characteristics;

(c) cause effective measures to be taken to minimise the flow of any surface water or floodwater into mine workings, opencast workings, other workings or subterranean caverns, through cracked or fissured formations, subsided ground, sinkholes, outcrop excavations, adits, entrances or any other openings;

(d) design, modify, construct, maintain and use any dam or any residue deposit or stockpile used for the disposal or storage of mineral tailings, slimes, ash or other hydraulic transported substances, so that the water or waste therein, or falling therein, will not result in the failure thereof or impair the stability thereof;

(e) prevent the erosion or leaching of materials from any residue deposit or stockpile from any area and contain material or substances so eroded or leached in such area by providing suitable barrier dams, evaporation dams or any other effective measures to prevent this material or substance from entering and polluting any water resources;

(f) ensure that water used in any process at a mine or activity is recycled as far as practicable, and any facility, sump, pumping installation, catchment dam or other impoundment used for recycling water, is of adequate design and capacity to prevent the spillage, seepage or release of water containing waste at any time;

(g) at all times keep any water system free from any matter or obstruction which may affect the efficiency thereof; and

(h) cause all domestic waste, including wash-water, which cannot be disposed of in a municipal sewage system, to be disposed of in terms of an authorisation under the Act.

4.6 Estimated cost for further requirements to fully decommission the site

Financial provision was provided in the form of a bank guarantee from ABSA Bank to the amount of R82 700.00. A complete rehabilitation plan with cost estimate is attached as appendix 4. The rehabilitation of the inherited liabilities will be addressed together with production that will reduce the amount needed for final closure even further.

5. PART 5 - ENVIRONMENTAL IMPACT ASSESSMENT:

The following is a description of the expected impact of the project on the environment with an indication whether the impact can be regarded as significant or insignificant. If the impact is regarded as significant, an estimate of the magnitude is also given, e.g. temporary, short term, long terms, etc. If the impact is felt to be insignificant, the reason for this is given.

5.1 Construction phase

Eenzaamheid was an established salt mine at the beginning of operations and most of the surface infrastructure was already in place and only needed upgrading. This phase will include the upgrading and/or construction of:

- Offices in the form of mobile containers.
- Workshop fitted with sloping concreted apron at the entrance. This apron must direct water into a shallow drain at the base of the apron which will feed water into an oil trap.
- Temporary storage area for domestic and industrial waste including facilities for oil and fuel waste handling.
- Accommodation, personnel amenities will where necessary be upgraded.
- Bunded parking area for mobile fuel tanker fitted with concrete apron and dry powder fire extinguishers
- Scrap yard for temporary storage of scrap steel and equipment prior to sale.
- Equipment wash bay.
- Generator bay - with diesel spill floor or steel tray

The impact of the above activities on the different environmental aspects is assessed below:

Geology

Significance/Magnitude	**Duration**	**Probability**	**Timing**
Zero impact	Zero impact	Unlikely	Zero impact

The entire infrastructure mentioned will be above ground level and therefore will have no impact on the geology.

Topography

Significance/Magnitude	**Duration**	**Probability**	**Timing**
Zero impact	Zero impact	Unlikely	Zero impact

Most of the infrastructure did exist as farm infrastructure that was upgraded for use by the mining operation therefore no new infrastructure area will be developed.

Soils

Significance/Magnitude	**Duration**	**Probability**	**Timing**
Low	Permanent	Certain	From establishment

Most of the infrastructure did exist as farm infrastructure that was upgraded for use by the mining operation therefore no new infrastructure area will be developed. Given that the attenuation measures proposed for erosion control, oil contamination and refuse removal described in part 6 will be adhered to, the effect on soil will be negligible.

Land Capability

Significance/Magnitude	Duration	Probability	Timing
Low	Permanent	Certain	From establishment

The development area for infrastructure did exist as part of agricultural operations. This area is very small less than 2 Ha and the effect on land capability with regard to production of live stock will be negligible. The area will still be needed by the landowner post closure therefore no specific attenuation measures required.

Land Use

Significance/Magnitude	Duration	Probability	Timing
Low	Permanent	Certain	From establishment

The development area for infrastructure did exist as part of agricultural operations. This area is very small less than 2 Ha and the effect of the change in land use from grazing to development zone will be negligible. The area will not revert back to its former land use grazing as the infrastructure will still be needed by the landowner post closure and therefore no specific attenuation measures required

Natural Vegetation / Plant Life

Significance/Magnitude	Duration	Probability	Timing
Low	Permanent	Certain	From establishment

In general all salt pans are devoid of vegetation due to the high salinity. The vegetation only occurs in some instances on the marginal zone of the pan.

Animal Life

Significance/Magnitude	Duration	Probability	Timing
Low	Life of mine	Certain	From establishment

The new areas to be disturbed for development of infrastructure is small and vast tracts of similar land types are available for any animals which maybe scared off the site by heavy vehicle movement and human activity

Surface water

Significance/Magnitude	Duration	Probability	Timing
Low	Transient	Unlikely	Life of mine

The construction phase allows for the following infrastructure with associated activities that can have an impact on surface water through contamination due to oil and fuel spills:

- Workshops and equipment wash bay
- Temporary storage area for domestic and industrial waste including facilities for oil and fuel waste handling.
- Fuel tankers

Development is located on the marginal zone of the pan, and no streams run through the site. The salt pan also lies in the centre of the mining area therefore any run-off would-enter the pan and not any other drainage area. Given that the measures described in part 6 will be adhered to, there should be negligible impact on surface water.

Groundwater

Significance/Magnitude	Duration	Probability	Timing
Negligible	Point	Unlikely	From establishment

No effect on groundwater from the infrastructure area is expected. Spillage of oil and other lubricants are a possibility as is the case with surface water.

Air Quality

Significance/Magnitude	Duration	Probability	Timing
Low	Transient	Certain	From establishment

Dust generation by vehicles and construction will occur, but given the isolation of the site and low levels of dust generation, no mitigation procedures will be necessary except from an employee health point of view (legislated in terms of the Occupational Health and Safety Act).

Noise

Significance/Magnitude	Duration	Probability	Timing
Low	Transient	Certain	From establishment

Noise generated by earth moving equipment and other construction vehicles will be inevitable. It would however be short-term, and have no lasting effect. The noise will not affect other land users / public given the isolation of the site. The only concern is from an employee health point of view (legislated in terms of the OHS Act).

Sites of Archaeological and Cultural interest

Significance/Magnitude	Duration	Probability	Timing
Zero impact	Zero impact	Zero impact	Zero impact

The construction will take place on previous disturbed areas and most of the structures already exists and only needs upgrading. The proposed salt mining at this pan is not expected to have a significant negative impact on the archaeological resources of the region. In the event that sites or features (e.g. high density of artefacts, a burial, or ostrich eggshell cache) are found during construction or mining, an archaeologist should be alerted immediately in order to assess the find and make recommendations for mitigation, if necessary (refer Para 10.4).

Sensitive landscapes

Significance/Magnitude	Duration	Probability	Timing
Zero impact	Zero impact	Zero impact	Zero impact

The construction will take place on previous disturbed areas and most of the structures already exists and only needs upgrading.

Visual

Significance/Magnitude	Duration	Probability	Timing
Zero impact	Zero impact	Zero impact	Zero impact

The development area is not readily visible from the R360 main road and do not differ from numerous similar farmsteads along the main road.

Regional and Socio-economic structure

Significance/Magnitude	Duration	Probability	Timing
Highly Beneficial	Life of mine	Certain	From establishment

Employment will be created during the construction phase for contractors and their supporting industries (suppliers). At their discretion the building contractors may choose to use local labour.

5.2 Operational phase

Eenzaamheid was an established salt mine at the beginning of operations and most of the operations were already in place and only needed upgrading. This phase will include the upgrading and maintenance of:

- Bore holes for the pumping of brine.
- Pumps and pipelines for extraction of brine.
- Crystallisation pans for production of salt with bund wall to prevent storm water.
- Stockpiling platforms for the salt to dry.
- Loading and transport of salt as FoT product

The impact of the above activities on the different environmental aspects is assessed below:

Geology

Significance/Magnitude	**Duration**	**Probability**	**Timing**
Zero impact	Zero impact	Zero impact	Zero impact

Salt mining is very different from other mining operations in that no rock is broken and no mining waste is generated. Therefore there is no impact on the geology. Production essentially entails the pumping of brine onto hardened surfaces where crystal growth occurs by solar evaporation. The geological sequence of the sediments will therefore not be disturbed.

Topography

Significance/Magnitude	**Duration**	**Probability**	**Timing**
Medium and beneficial	Life of mine	Certain	Activity

Salt mining is very different from other mining operations in that no rock is broken and no mining waste is generated. Therefore the impact on the topography is insignificant and no waste dumps are created above surface. The crystallisation pans and stockpile platforms are however raised 300 mm above the pan floor.

The main elements impacting on topography that require environmental management measures to reduce their impact are as follows:

- Bund wall around historic crystallisation pans
- Bund wall around new crystallisation pans
- Stockpiling platforms

One of the conditions of mining is rehabilitation of the old, un-rehabilitated areas. The rehabilitation and levelling of disturbed areas will have a beneficial, long term impact on the topography.

Soils

Significance/Magnitude	Duration	Probability	Timing
Low	Life of mine	Certain	Activity

The deflated surface of the pan is covered in a thin layer of tillite scree that cannot be regarded as topsoil. The loose scree material on the pan floor is removed to form a bund wall around the crystallisation pans to prevent storm water from flooding the pans as freshwater can ruin the production. Given that the attenuation measures proposed for erosion control, oil contamination and refuse removal described in part 6 will be adhered to, the effect on soil will be negligible.

Land capability

Significance/Magnitude	Duration	Probability	Timing
Low	Life of Mine	Certain	Activity

The production rate with regard to grazing within the pan floor is zero as the area is devoid of vegetation due to salinity. Salt production will therefore have no impact on land capability. Post mining the production rate will be the same as pre-mining and no specific attenuation measures is required.

Land use

Significance/Magnitude	Duration	Probability	Timing
Low	Life of Mine	Certain	Activity

Less than 25% of the pan will be disturbed by mining. The only economic land use for the pan floor except for its scenic value is salt mining. After mitigating the impact on the topography the scenic value will be restored and mining will have no long term impact on land use.

Natural vegetation / Plant life

Significance/Magnitude	Duration	Probability	Timing
Zero impact	Zero impact	Unlikely	Zero impact

In general all salt pans are devoid of vegetation due to the high salinity. No growth medium is present on the pan floor and therefore the area is devoid of any vegetation.

Animal Life

Significance/Magnitude	Duration	Probability	Timing
Low to medium	Life of Mine	Certain	Activity

Given the vast expanses of similar habitat and the small scale of the operation, the effect on animal life will be minor.

Surface water

Significance/Magnitude	Duration	Probability	Timing
Low	Transient	Unlikely	Life of mine

The operational phase allows for the following infrastructure with associated activities that can have an impact on surface water through contamination due to oil and fuel spills:

- Generator bays - with diesel spill floor or steel tray
- Tractors and vehicles used in the mining process

No drainage channels occur within the mining area and there is no dendritic system which could be disturbed. The MAR is in any event very low given the low rainfall, high evaporation rates, and shallow grade of the slope toward the pan and the permeability of the soils. Given that the measures described in part 6 will be adhered to, there should be a negligible impact on surface water. No surface water will be withdrawn for mining.

Ground water

Significance/Magnitude	**Duration**	**Probability**	**Timing**
Negligible	Point	Unlikely	Activity

Any associated impacts would be point impacts related to oil and fuel spills. These impacts would be minimised if the correct attenuation measures were implemented as described in part 6.1. The impact from taking of groundwater will also be negligible due to the quality of the water and the small quantity taken. DWAF classify the water as unfit for human or animal consumption and the water use was also registered with Water Affairs for the taking of water from a water resource in terms of Section 21(a) of the National Water Act, 1998 (Act No. 36 of 1998). Given that the attenuation measures proposed for oil contamination and refuse removal will be adhered to, the effect on groundwater will be negligible.

Air Quality

Significance/Magnitude	**Duration**	**Probability**	**Timing**
Low	Transient	Certain	Activity

The mining of salt is a wet process with no dust and existing dust generation from vehicular traffic on un-surfaced roads has no noteworthy environmental impact on surrounding areas.

Noise

Significance/Magnitude	**Duration**	**Probability**	**Timing**
Low	Transient	Certain	Activity

Noise generated by earth moving equipment and other construction vehicles will be inevitable. The noise will not affect other land users / public given the isolation of the site. The only concern is from an employee health point of view (legislated in terms of the Occupational Health and Safety Act).

Sites of Archaeological and Cultural interest

Significance/Magnitude	**Duration**	**Probability**	**Timing**
Zero impact	Zero impact	Zero impact	Zero impact

The construction will take place on previous disturbed areas and most of the structures already exists and only needs upgrading. The proposed salt mining at this pan is not expected to have a significant negative impact on the archaeological resources of the region. In the event that sites or features (eg high density of artefacts, a burial, or ostrich eggshell cache) are found during construction or mining, an archaeologist should be alerted immediately in order to assess the find and make recommendations for mitigation, if necessary (refer Para 10.4).

Sensitive landscapes

Significance/Magnitude	Duration	Probability	Timing
Zero impact	Zero impact	Zero impact	Zero impact

Mining takes place as an extension of the previously developed area which was never rehabilitated.

Visual aspects

Significance/Magnitude	Duration	Probability	Timing
Low	Life of mine	Certain	Activity

The site is not visible from the R360 main road. At final closure all equipment will be removed and after implementation of the mitigating measures described under the heading topography the visual impact of the mining operation will be minimal.

Regional socio-economic structure

Significance/Magnitude	Duration	Probability	Timing
Highly Beneficial	Life of mine	Certain	Activity

Employment would be created by the mining operation. As described previously the majority of the labour force will come from the surrounding communities. Job creation means increased spending power, which uplifts the entire community via the associated multiplier effect. The company also have a social and labour plan in place that addresses their contribution to local economic development in addition to the positive impact of job creation.

6. PART 6 — ENVIRONMENTAL MANAGEMENT PROGRAMME

6.1 General requirements

Mapping and setting out

A copy of the layout plan as provided for in Regulation 2.2 must be available at the mining site for scrutiny when required.

The plan must be updated on a regular basis with regard to the actual progress of the establishment of surface infrastructure, mining operations and rehabilitation (a copy of the updated plan shall be forwarded to the Regional Manager on a regular basis).

A final layout plan must be submitted at closure of the mine or when operations have ceased.

Demarcating of mining area

The mining area must be clearly demarcated by means of beacons at its corners, and along its boundaries if there is no visibility between the corner beacons.

The mining area must be fenced off and fences must be maintained in a good order.

Restrictions on mining

No owner or manager shall carry on any mining operations under or within a horizontal distance of a 100 meters from buildings, roads, or any structure whatever, or under or within a horizontal distance of 100 meters from any surface which it may be necessary to protect, without first having given notice in writing to the Principle Inspector of Mines of his intention to do so and obtain his permission therefore.

No mine waste will be allowed to be deposited in natural drainage lines or erosion gullies without the necessary authorization from DWAF and a written permission from the DMD. Mining must be conducted in such a manner as to ensure that natural drainage lines are not destabilized and that surface and ground water quality is not impaired.

Responsibility

The environment affected by the mining operations shall be rehabilitated by the holder, as far as is practicable, to its natural state or to a predetermined and agreed to standard or land use which conforms with the concept of sustainable development. The affected environment shall be maintained in a stable condition that will not be detrimental to the safety and health of humans and animals and that will not pollute the environment or lead to the degradation thereof. It is the responsibility of the holder of the mining right to ensure that the manager on the site and the employees are capable of complying with all the statutory requirements which must be met in order to mine, which includes the implementation of this EMP and the environmental awareness plan.

The holder of the mining right will be responsible for all historic disturbances caused by mining on the site pertaining to the rehabilitation of the area and the pollution control measures to be implemented.

Pollution Prevention Measures

- Domestic Waste Management Programmes

The owner will instruct the employees in the need for procedure/tasks as well as the actual handling of domestic waste, relating to domestic waste management.

Domestic waste (lunch wrappers, containers, food tins, bottles) of daily workers as well as the domestic waste from the mining logistics will be provided for and handled as follows:

- Provide waste collection drums at strategic points (workshops/personnel amenity area, residential and recreational facilities).
- Demarcate an area for and constructed as "temporary waste storage area" for temporary collection and storage of the drums, prior to delivery to municipal disposal site for disposal. (On-site dumping/burial is not allowed without registration/licensing of such a site with the Department of Water Affairs and Forestry in terms of the Environment Conservation Act).
- Instruct staff on the distinction between domestic refuse and industrial waste.

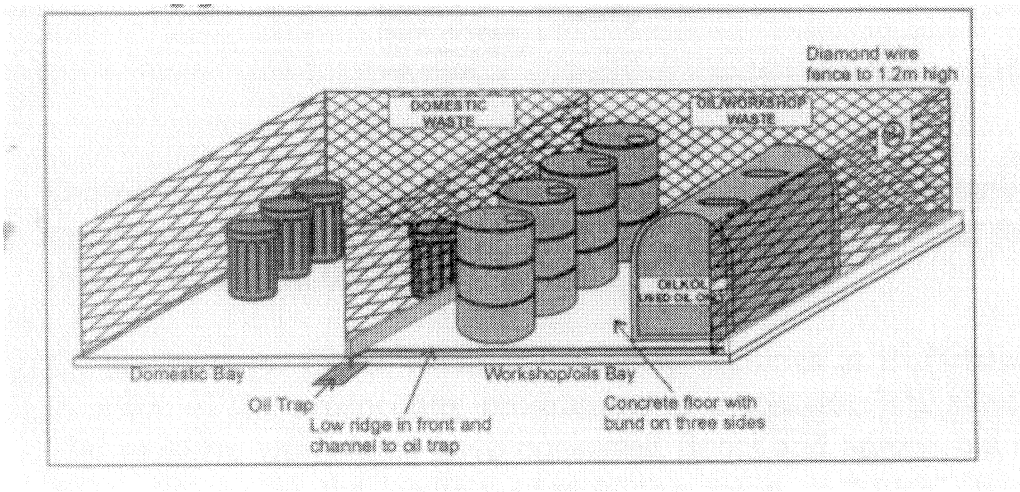
- Industrial Waste Management

Identify and demarcate (by fences) the following sites:

- A salvage yard for temporary storage of scrap steel and equipment prior to sale or removal as scrap. Arrange regular sale and collection of scrap from the site.
- A used oil collection and temporary storage area
- Temporary storage area for all used lubrication products and other hazardous chemicals (also refer Figure 11 below)

No engines or other equipment parts are to be stored in the scrap yard without either having had the oil drained or suitable measures have been taken to prevent leaking of oil.

Figure 11: Proposed layout of temporary waste storage area



- Diesel and Lubricant Handling Programme:

Refuelling:

Refuelling of equipment will be done from a mobile trailer bowser. The concreted apron upon which the vehicles will be parked must be equipped with a drain along its extremities to collect any oil contaminated run-off and channel it to the oil trap where separated oil will be collected and disposed of in the oil recycling container.

Generator bays need to be fitted with a cement floor or steel tray equipped with a drain along its extremities to collect any oil and diesel contaminated run-off and channel it to the oil trap where separated oil will be collected and disposed of in the oil recycling container. Any oil spills on the concreted aprons or floors is to be treated with Spillsorb or equivalent as per the product instructions.
Staff will require instruction in the identification of oil and diesel leaks, the operation of the oil trap (including the disposal of trapped oil) and use of Spillsorb (or equivalent) products. An Environmental awareness plan in terms of Sect 39 (3) (c) is attached and training of employees needs to take place as part of the core work skills plan.

On-site repairs:
Only minor repairs will be done on site. A drip tray or PVC facility needs to be used when servicing equipment on site to prevent any oil spills. Al moving equipment needs to be equipped with permanent drip trays to prevent oil spills. All major repairs will take place at a workshop either on site or in Upington. The workshop on site needs to be upgraded with a concrete floor and apron sloped from the entrance to the workshop. The apron will be constructed with a drain along its extremities to collect any oil contaminated run-off and channel it to the oil trap where separated oil will be collected and disposed of in the oil recycling container. Waste oils from servicing of vehicles will be disposed of in the waste oil collection facility.
Contaminated spares, oil filters, gaskets, etc. will be collected in a separate drum at the designated storage facility for disposal at a suitable site off-site. Staff will require instruction in the:

- deleterious effects of oil /fuel on the environment
- identification and reporting of oil leaks
- the operation of the oil trap (including the disposal of trapped oil)
- location and method of the storage of contaminated spares and oil
- use of Spillsorb (or equivalent) products

Collection of contaminated spares and waste oils:
Contaminated spares, oil filters, gaskets, etc. will be collected in a separate drum at the designated storage facility for disposal at a suitable site off-site. Waste oils from servicing of vehicles will be disposed of in the waste oil collection facility.
Staff will require instruction in:

- deleterious effects of oil / fuel on the environment
- location and method of the storage of contaminated spares

Temporary storage:
Used oils will be stored in drums provided by the oil recycling companies such as Oilkol. A concrete platform and fence with signposts is to be constructed to store used oil and drums containing used spares, cloths, etc. which are oil contaminated and must be temporarily stored for collection/dispatch to suitable regional disposal site. Staff will require instruction in:

- deleterious effects of oil / fuel on the environment
- location and method of the storage of contaminated spares and used oil

Off-site disposal by a recycling company:
All waste oils must be collected in the facility for collection by a waste oil recycling company. Instruct the staff in the reasons for good fuel management and the alternative consequences. Identify area for siting of diesel bulk tank to remove fuel from delivery tanker truck - provide tank with bund wall and apron and construct used oil/lubricant collect/temporary storage point. Instruct staff in use of oil decontaminant procedure including:

- removal of contaminated soil in drums/bags to suitably licensed disposal dump,
- treatment of any residual contamination in situ with Spillsorb or similar decontaminant

- Occupational Health Awareness Programme:

Noise:
All employees must be supplied with HPD's and must wear these whenever exposed to noise levels greater than 85dB (in terms of the Mine Health and Safety Act).

Dust:
All employees must be supplied with masks to prevent inhalation of dust, when working under dusty conditions for e.g. topsoil removal, etc.

Hardhats:
All employees must be supplied with hard hats.

6.2 Construction phase

As described in paragraph 5.1, the construction phase relates to the upgrading and/or construction of:

- Offices in the form of mobile containers.
- Workshop fitted with sloping concreted apron at the entrance. This apron must direct water into a shallow drain at the base of the apron which will feed water into an oil trap.
- Temporary storage area for domestic and industrial waste including facilities for oil and fuel waste handling.
- Accommodation, personnel amenities will where necessary be upgraded.
- Bunded parking platform for mobile fuel tanker fitted with concrete apron and dry powder fire extinguishers
- Scrap yard for temporary storage of scrap steel and equipment prior to sale.
- Equipment wash bay.
- Generator bay - with diesel spill floor or steel tray

The following is the mitigating and/or management measures for all the significant impact identified in Part 5 with regard to the different environmental aspects

Geology
No impact, therefore no mitigation required.

Topography
No impact, therefore no mitigation required. The mine is responsible for the maintenance and upgrading of all services but it will still be needed by the landowner at final closure.

On completion of mining operations, the vehicle maintenance yard and secured storage's areas shall be cleared of any contaminated soil. The surface shall then be ripped or ploughed to a depth of at least 300 mm.
Progressive maintenance and upgrading of all services will take place and in the case of temporary closure, sudden closure during the normal operation of the project or at final planned closure there must be no outstanding rehabilitation.

Soils
The impact is low and localized. No specific mitigation measures is required as the mitigating and management measures described in paragraph 6.1 will be sufficient. The access road to the accommodation is a duel use road and the mine is only responsible for the maintenance of the road.
Provision must be made for efficient storm water control to prevent erosion of steep slopes and roadways. Any access road or portions thereof, constructed by the holder and which will no longer be required by the landowner, shall be removed and rehabilitated. Any gate or fence erected by the holder which is not required by the landowner, shall be removed and the situation restored to the pre mining situation.

Land capability
No specific attenuation measures required.

Land use
No specific attenuation measures required.

Natural vegetation /Plant life
The following general aspects must be implemented to reduce any potential impact:

- Movement areas must be clearly demarcated and any movement outside of these areas must not be allowed
- No ad hoc roads, dumping or topsoil borrowing
- Topsoil if directly re-used has immediate re-vegetation results given the seed bank present in the topsoil.

As such, topsoil management and re-vegetation programmes rely on:

- Minimum disturbance
- Re-top soiling with red soil
- Direct re-use of removed topsoil on a strip mining basis
- Top soiling to min of 10 cm to promote basic growth

Note that in respect of topsoil (upper 100 mm horizon) offers the advantage of bearing the seed bank and the broken organic material (after dozing), which will re-root. The lower topsoil horizon (100 mm to up to 400 mm in depth) still achieves the desired results in the re-vegetation programme. It merely takes a while longer i.e. no significant growth in the first year. No wood collected in the surrounding area will be allowed and cooking equipment, gas and paraffin must be supplied to the workers staying on the site. Invader species will be handled in terms of CARA and NEMBA as part of the land owners alien invasive control program.

Animal life
No specific attenuation measures are required. During all activities all staff must be educated about the role of wildlife in ecology and the tourism industry and warned against poaching. Management should conduct field inspections of the surrounding area of the mine for snares.

Surface water
No river diversions will take place. Should the attenuation measures described in paragraph 6.1 be implemented, the effect on surface water will be minimal. The most important of these is that any oil or fuel leaks caused during establishment must be removed immediately with the saturated soil and placed in bags or drums for disposal at a suitable site.

Ground water
All attenuation measures for surface water will also apply to groundwater.
A standard French drain system is in use for sewage and grey water disposal. Domestic waste must be sorted and all biodegradable waste stored in separate drums provided for. This waste will be dumped in a landfill provided for. The topsoil and overburden removed from the landfill excavation must be stored separately in a bund wall around the excavation to prevent storm water surface runoff from entering the landfill. The landfill must be demarcated with a fence to prevent windblown dispersal of waste. Waste in the landfill must be covered with a thin layer of overburden every week until surface level is reached. The landfill must then be covered with the topsoil to 300 mm above ground level to make provision for settling and prevent the forming of a depression.

Air quality
No attenuation measures required given the isolation of the site.

Noise
Despite noise having no impact on other uses / public given the isolation of the site, continue to pursue methods of mining which reduce noise in the interest of worker health and safety. All vehicles must be equipped with approved silencers. All employees must be supplied with HPD's and must wear these whenever exposed to noise levels greater than 85dB (in terms of the Mine Health and Safety Act).

Sensitive landscapes
No attenuation measures required.

Visual aspects
Progressive maintenance and upgrading of all infrastructures will take place and in the case of temporary closure, sudden closure during the normal operation of the project or at final planned closure there must be no outstanding rehabilitation.
At final closure all equipment will be removed and after implementation of the mitigating measures described under the heading topography the visual impact of the mining operation will be minimal.

Regional socio-economic structure

As far as possible, local labour must be used by the applicants. Contractors used during the construction phase will be responsible for their own personnel. Stimulation of the supporting industries must occur and supplies must be obtained from the surrounding towns.

6.3 Operational phase

Geology

No attenuation measures proposed. The only activity that can be regarded as underground workings is the drilling of boreholes for the pumping of brine. These boreholes will still be needed by the landowner at final closure. Progressive maintenance and upgrading of the boreholes will take place and in the case of temporary closure, sudden closure during the normal operation of the project or at final planned closure there must be no outstanding rehabilitation.

Topography

Salt mining is very different from other mining operations in that no rock is broken and no mining waste are generate. Therefore the impact on the topography is insignificant and no waste dumps are created above surface. Production essentially entails the pumping of brine onto hardened surfaces where crystal growth occurs by solar evaporation. Only the bund wall around the crystallisation pans and stockpile platforms are raised above ground level to prevent storm water from making contact with the salt crystals as it will dissolve the crystals and ruin the production.

The main elements impacting on topography that require environmental management measures to reduce their impact are as follows:

- Bund wall around historic crystallisation pans
- Bund wall around new crystallisation pans
- Stockpiling platforms

The total mining area consists of a 215 Ha portion of the Remainder of the Farm Eenzaamheid No. 626. Active mining however only takes place on 25% of the total area. Some inherited surface disturbance does occur that will be rehabilitated together with production. After rehabilitation of the inherited disturbances more than 80% of the area can be regarded as undisturbed virgin area. This is more than the biodiversity target of 30% for this specific habitat not to be transformed. Although only a small percentage of the land will be transformed by mining it does not mean that it is the intension to sterilise the area as the total area is needed for the protection of the ground water resource and ensure a sustainable yield over a 30 year period that is planned for the life of the mine.

In the mining area the remains of historic crystallisation pans is present. No concentration ponds are use and brine is pumped directly into a series of shallow average 80 cm deep crystallisation pans where solar evaporation takes place. In the summer (September to April) months production rates are at the optimum level and during the winter (May to August) the salt pans go into a resting period where no salt is being produced. Maintenance to the "pan" floors is being done during these resting periods.

The creation of overburden dumps on natural ground level will not take place. All material removed while cleaning the crystallisation pans will be used as backfill into existing excavations.

Soils

The deflated surface of the pan is covered in a thin layer of tillite scree that cannot be regarded as topsoil. No growth medium is present on the pan floor and therefore the area is devoid of any vegetation. The loose scree material on the pan floor will be removed to form a bund wall around the crystallisation pans to prevent storm water from flooding the ponds as freshwater can ruin the production. The second soil horisont is a clay layer that will be levelled to form the floor of the crystallisation pans. Due to the specific type of mining a soil utilisation guide is not needed and topsoil management is not applicable. This bund wall about 300 mm high will be spread over the crystallisation pans at final closure and levelled to blend in with the natural topography.

Land capability

The production rate of the salt pan with regard to agriculture will stay the same and mining will have no impact on land capability

Land use

The only economic land use except for the scenic value is salt mining. After mitigating the impact on the topography the scenic value will be restored and mining will have no other impact on land use.

Natural vegetation /Plant life

The pan floor is devoid of any vegetation and there will be no impact on the surrounding vegetation due to salt mining practices. All management roads will be constructed on the pan floor with no impact on natural vegetation. Management roads needs to be ripped at final closure and levelled to promote the aesthetic value of the area and re-vegetation is not an option.

Animal life

Historical disturbance will form part of the on-going rehabilitation process thereby restoring animal habitats temporarily lost. The presence and activity of the earth moving equipment will "chase" the animals to the vast expanse of similar habitat surrounding the affected area.

Surface water

Storm water collect on the deflated surface of the pan after above normal rain events. Salt production is affected by storm water and therefore bund walls were constructed to prevent storm water and surface water from entering the production areas. As part of prevention of contamination of storm water the following will be adhere to:

- Unwanted steel, sheet metal and equipment in the salvage yard will be sold or disposed of as scrap metal. This will be done at least every three months so that in the case of temporary closure, sudden closure during the normal operation of the project or at final planned closure there will only be three month worth of scrap present to be dealt with.
- All waste in the temporary storage area for used lubrication products and other hazardous chemicals will be disposed of at a collection point in Upington from where it will be collected by a waste recycling company. This will be done at least

every three months so that in the case of temporary closure, sudden closure during the normal operation of the project or at final planned closure there will only be three month worth of waste products to be dealt with.

Ground water

Salt mining involve the pumping of brine from boreholes for the production of salt by means of solar evaporation. A top-up of 16-24 m^3 water is obtained from 2 boreholes on the mining area. Although groundwater is use it cannot be seen as process water.

The water was tested and the analysis shows results of NaCl in the excess of 95 %. According to analysis by Department Water Affairs and Forestry, the groundwater is unsuitable for human and animal consumption. The water use was also registered with Water Affairs for the taking of water from a water resource in terms of Section 21(a) of the National Water Act, 1998 (Act No. 36 of 1998):

The prevention of contamination of water resources is however of the outmost importance not only to the environment but also to the purity of salt.

Two of the main issues that need to be address are the generator bays for the pumps that need to be equipped with the necessary pollution control measures and maintenance of vehicles used in the production process. The maintenance of vehicles and equipment used for any purpose during the mining operation will take place only in the maintenance yard area. Equipment used in the mining process must be adequately maintained so that during operations it does not spill oil, diesel, fuel, or hydraulic fluid. All vehicles will be equipped with permanent drip trays.

Air quality

The mining of salt is a wet process and existing dust generation has no noteworthy environmental impact on surround areas. Excessive dust should be controlled in the interest of improved worker health and safety. In this instance periodic wetting of the manoeuvring areas or even an annual application of a dust palliative can be considered. (No used oil or diesel is to be sprayed on the roadway for dust suppression).

Noise

Despite noise having no impact on other uses / public given the isolation of the site, continue to pursue methods of mining which reduce noise in the interest of worker health and safety.

Sites of Archaeological and Cultural interest

No attenuation measures necessary.

Sensitive landscapes

No attenuation measures necessary.

Visual aspects

At final closure all equipment will be removed and after implementation of the mitigating measures described under the heading topography the visual impact of the mining operation will be minimal.

Regional socio-economic structure

The majority of the labour force will be drawn from the local communities. This will increase the skills base in the vicinity, increase spending power and stimulate supporting industries.

6.4 Decommissioning phase

Closure objectives

Internationally, there seem to be three schools of thought:

- "What the affected community wants, the affected community gets" – that is, the key focus is on providing the end product requested by the affected communities, rather than focusing on the previous status quo of the receiving environment
- "Restoration of previous land use capability" – the original thought process in the South African context, because mining often occurs on land with high agricultural potential
- "No net loss of biodiversity" – the focal point in the ICMM/IUCN dialogue sponsored guidelines for mining and biodiversity, and of many mining corporate policies.

The thought process for the closure of the Eenzaamheid Mine is based on the last two. The main closure objective therefore is to leave the site in as safe and self-sustaining a condition as possible and in a situation where no post-closure intervention is required.

The aim is to ensure that the affected environment is maintained in a stable condition that will not be detrimental to the safety and health of humans and animals and that will not pollute the environment or lead to the degradation thereof. The aesthetic value of the area will also be reinstated.

Successful implementation of the Environmental Management Program during the life of the mine will cover most of the significant aspects affecting the environment. The production area itself will be the only outstanding rehabilitated at final closure

Those aspects that will require some attention during the final decommissioning phase are listed below:

- Any stockpiles left must be removed or used to backfill the concentration ponds and/or other excavations
- Scarifying of all compacted areas including the harden pan floors and stock pile platforms.
- Shape the bund walls of the crystallisation pans and stock pile platforms.
- Remove all power supply installations including generators and demolish generator bays and footings.
- Remove all water installations including pumps and pipelines except for potable water
- All internal roads need to be ripped except for the ones still needed by the landowner; this also includes repairs to all fences and gates.
- Provision of efficient storm water control to prevent erosion of steep slopes and roadways and elsewhere are required
- All equipment and other items used during the mining operation needs to be removed from the site.

- Waste material of any description, including receptacles, scrap, rubble and tyres, will be removed entirely from the mining area and disposed of at a recognised landfill facility. It will not be buried or burned on the site.

The living quarters and other infrastructure are leased from the landowner. The mine is responsible for the maintenance and upgrading of this infrastructure but will still be needed by the landowner at final closure. Unwanted ruins, buildings, foundations, footings will be demolished and the rubble removed to Upington due to the absence of excavations in the mining process. Decommissioning is however subject to Section 40 of the MPRDA.

Residual Impacts after Closure

The mining of salt does not involve the breaking of rock and no waste dumps are created so there is no possibility for acid mine drainage or poor quality leaching emanating from the mine or residue deposits. It is envisaged that at the time of mine closure the total area will be flat so long term stability is not an issue.

Aftercare

As the final phase in the project cycle, decommissioning may present positive environmental opportunities associated with the return of the land for alternative use and the cessation of impacts associated with operational activities. However, depending on the nature of the operational activity, the need to manage risks and potential residual impacts may remain well after operations have ceased. Examples of potential residual impacts and risks include contamination of soil and groundwater, stock that has been abandoned (e.g. oil drums, scrap equipment, old chemicals) and old (unserviceable) structures. The closure plan to be submitted at final closure will provide specific guidance with respect to the management of the environmental risks associated with the decommissioning stage of a project. Unauthorized entry will be taken very seriously during final closure and traffic onto the property will be kept to a minimum. Regular monitoring of the effectiveness of environmental management and mitigating measures implemented during the post mining decommissioning phase will continue until a closure certificate is awarded.

6.5 Inspections and monitoring

A second closure objective is to ensure that the rehabilitation and mitigating measures applied during operation prove successful. The only way to accomplish this is by regular monitoring. Regular monitoring of all the environmental management measures and components shall be carried out by the holder of the mining right in order to ensure that the provisions of this program are adhered to. Various points of compliance will be identified with regard to the various impacts that the operations will have on the environment. Inspections and monitoring shall be carried out on both the implementation of the program and the impact on plant and animal life. Visual inspections on erosion and physical pollution shall be carried out on a regular basis.

If find that certain aspects are not addressed or impacts on the environment are not mitigated properly, it must be rectify immediately.

Regulation 55 of the Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002) clearly describes the process and procedure as well as requirements for monitoring and auditing of the performance of this plan to adequately address environmental impacts from the operation.

Regulation 55 promulgated in terms of the MPRDA requires the following:

(1) As part of the general terms and conditions for a prospecting right, mining right or mining permit and in order to ensure compliance with the approved environmental management program or plan and to assess the continued appropriateness and adequacy of the environmental management program or plan, the holder of such right must-

(a) conduct monitoring on a continuous basis;

(b) conduct performance assessments of the environmental management program or plan as required; and

(c) compile and submit a performance assessment report to the Minister to demonstrate adherence to sub-regulation (b).

(2) The frequency of performance assessment reporting shall be-

(a) in accordance with the period specified in the approved environmental management program or plan , or, if not so specified;

(b) as agreed to in writing by the Minister; or

(c) biennially (every two years).

(3) The performance assessment report, shall be in the format provided in guidelines that will from time to time be published by the Dep. and shall as a minimum contain-

(a) information regarding the period that applies to the performance assessment;

(b) the scope of the assessment;

(c) the procedure used for the assessment;

(d) the interpreted information gained from monitoring the approved environmental management program or plan;

(e) the evaluation criteria used during the assessment;

(f) the results of the assessment; and

(g) recommendations on how and when deficiencies that are identified and/or aspects of non-compliance will be rectified

(4) The holder of a prospecting right, mining right or mining permit may appoint an independent qualified person(s) to conduct the performance assessment and compile the performance assessment report provided that no such appointment shall relieve the holder of the responsibilities in terms of these regulations.

(5) Subject to section 30(2) of the Act, the performance assessment report submitted by the holder shall be made available by the Minister to any person on request.

(6) If upon consideration by the Minister, the performance assessment executed by the holder is not satisfactory or the report submitted by the holder is found to be unacceptable, the holder must-

(a) repeat the whole or relevant parts of the performance assessment and revise and resubmit the report; and/or

(b) submit relevant supporting information; and/or

(c) appoint an independent competent person(s) to conduct the whole or part of the performance assessment and to compile the report.

(7) If a reasonable assessment indicates that the performance assessment cannot be executed satisfactorily by the holder or a competent person(s) appointed by the holder, the Minister may appoint an independent performance assessment person(s) to conduct such performance assessment. Such appointment and execution shall be for the cost of the holder.

(8) When the holder of a prospecting right, mining right or mining permit intends closing such operation, a final performance assessment shall be conducted and a report submitted to the Minister to ensure that -

(a) the requirements of the relevant legislation have been complied with;

(b) the closure objectives as described in the environmental management program or plan have been met; and

(c) all residual environmental impacts resulting from the holder's operations have been identified and the risks of latent impacts which may occur have been identified, quantified and arrangements for the management thereof have been assessed.

(9) The final performance assessment report shall either precede or accompany the application for a closure certificate in terms of the Act.

7. PART 7 — CONCLUSION

Salt mining is characteristically conducted in an unconventional manner in that no rock is broken in the process and the fact that the impact on the environment and hence rehabilitation is less than any other mining project, with minimal environmental impact. Salt mining as conducted on the Eenzaamheid property will have a very low environmental impact on the surrounding region, but benefits the socioeconomic state of the region during operation by providing job opportunities and skill development to residents in the region.

8. PART 8 — STATUTORY REQUIREMENTS AND SUPPORTING DOCUMENTATION

Not at this time.

9. PART 9 — AMENDMENTS TO EMPR

This is the first amendment to the approved EMPR.

10. PART 10 — SUPPORTING DOCUMENTATION

10.1 The geology of the Eenzaamheidpan, Council for Geoscience

10.2 Botanical assessment of Eenzaamheid Pan portion 9/10 & Kalahari Wes 251, portion 148 (Vrysoutpan), A. van Heerden & T.A. Anderson, McGregor Museum

10.3 Registration certificate issued in terms of the National Water Act, 1998

10.4 Report on a Phase 1 Archaeological Assessment of proposed salt works areas on the Eenzaamheid Pan, north of Upington, Northern Cape

10.5 Comments with regard to the Amended EMPR received from interested and affected parties.

11. PART 11 — CONFIDENTIAL

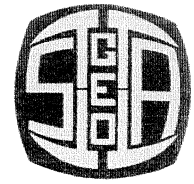
Not at this time.

12. PART 12 —UNDERTAKING

I, Elizabeth G. (Elda) du Toit as representative duly authorized thereto by Saamwerk Soutwerke BK , have studied and understand the contents of this document in its entirety and hereby duly undertake to adhere to the conditions as set out therein including the amendment(s) agreed to by the Regional Manager and approved on .....

Signed on this 02nd day of September 2010 at Upington

EdeToit
.....
E. du Toit
Saamwerk Soutwerke BK



Council for Geoscience

THE GEOLOGY OF EENSAAMHEIDPAN, NORTHERN CAPE PROVINCE.

1. INTRODUCTION

A study of the geology and geo-hydrology of the area in and around Eensaamheidpan was undertaken. The feasibility and mining potential of the salt mining operation on this 'salt' pan was also investigated. The area is situated towards the north of Upington on the farm Eenzaamheid 324 **(Figure 1, Locality map)**.

Salt mines in the area are located in similar pans which are found along old drainage channels or paleo-rivers. This area forms part of the Kalahari Desert and can be described as a harsh semi desert area, with extreme seasonal fluctuations in temperature, erratic rainfall and no perennial rivers.

Na-rich water (brine) is pumped unto the hardened surfaces on these pans and crystal growth ensues **(Figure 2)** with the help of solar evaporation. The course salt crystals are then harvested **(Figure 3)** and moved to the plant in Upington from were the refining, packaging and distribution are done.

Salt has a geochemical composition of sodium chloride, a vitreous lustre, is transparent to translucent, brittle and exhibits conchoidal fracture. It crystallises in cube and has a perfect cleavage parallel to the cube faces. The relative density of salt varies from 2.12 to 2.204 and has a hardness of 2.5 on Mohs scale.

2. METHODOLOGY

The investigation was done first as a desk study to determine the general geological setting of the pan and various bore holes situated in this area of operation. A field visit was undertaken to the salt pan to look at the local geology and boreholes. The positions of these holes were established and certain boreholes identified for testing **(Appendix A)**. These holes then underwent 24 hour pump tests to establish the various yields.

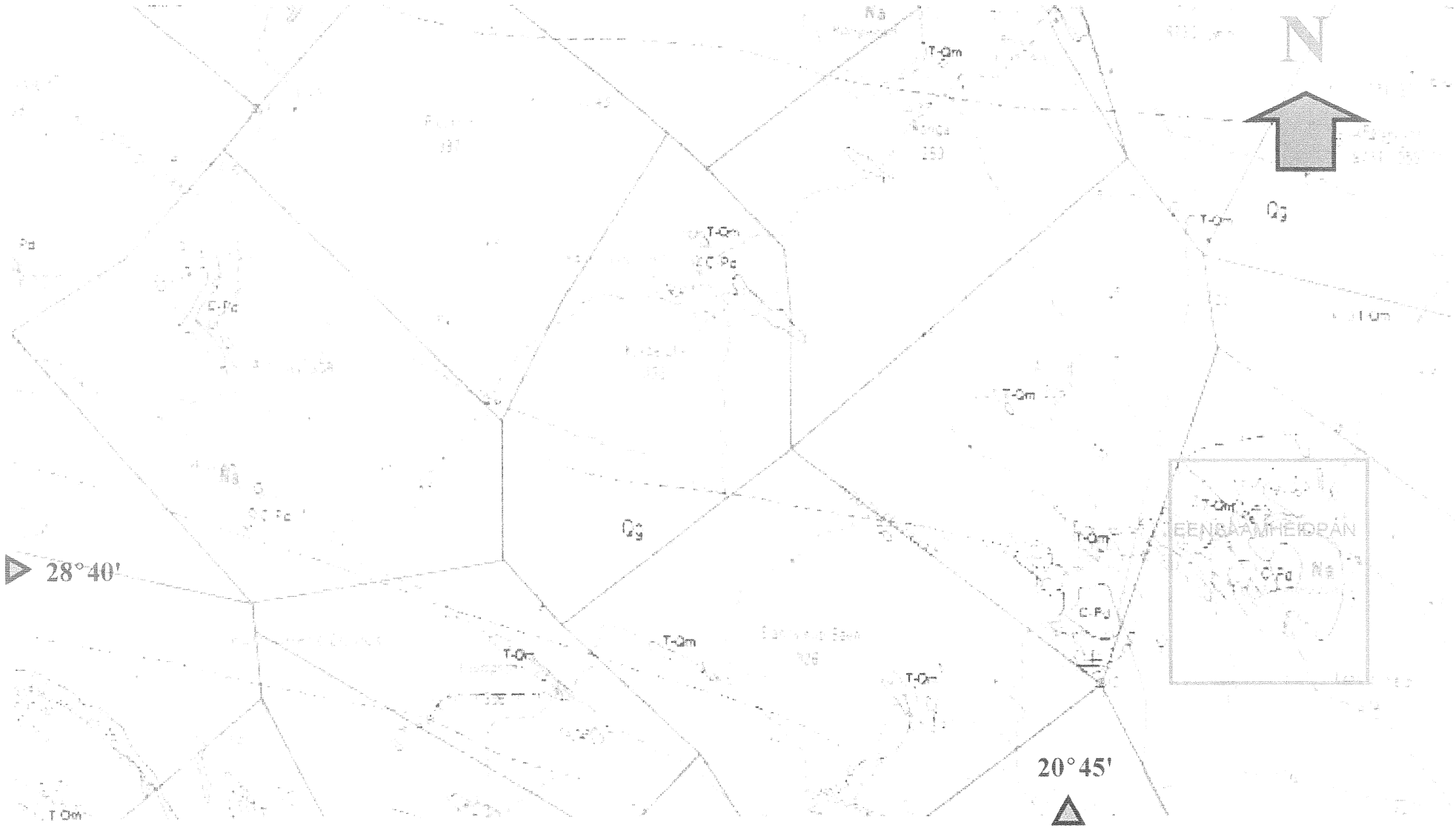


FIGURE 1. GEOLOGICAL AND LOCALITY MAP OF EENSAAMHEIDPAN.

SCALE 1:250 000

LEGEND

SEE TEXT

Figure 2. **Brine on the surface with resulting salt crystal growth on Eensaamheidpan.**

Figure 3. **Harvesting of salt at Eensaamheidpan.**

3. GENERAL GEOLOGY

The geology surrounding the salt pan is not complex, and comprises essentially the rocks from the Dwyka- and Kalahari Groups. Some tillite float was encountered on the deflation surface of the pans.

Red-coloured sand dunes of the Gordonia Formation of the Kalahari group are found along the edges of these pans **(Figure 4)**. It appears as if the paleo-drainage system in which these pans occur is divided by dune formation along the channel.

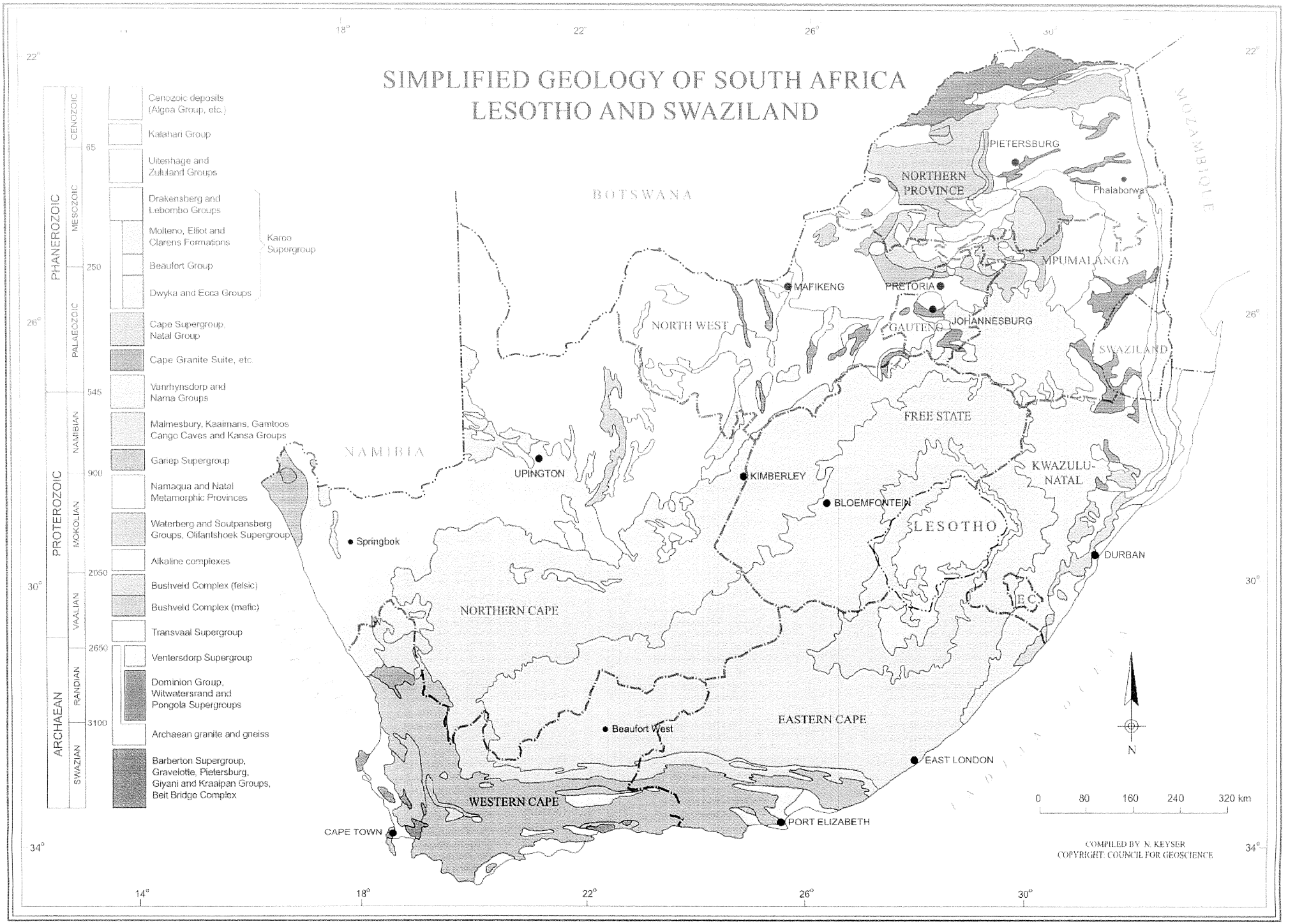
For the scope of this study the 'younger' lithologies of the Karoo Supergroup and Kalahari Group are investigated **(See Figure: 'Simplified Geology of South Africa, Lesotho and Swaziland')**.

The sedimentation of the Karoo Supergroup was initiated by the Permo-Carboniferous[1] glaciation known as the Dwyka Formation. The composition of much of the sediments show that most of the material was deposited from melt-water streams issuing from the fronts of glaciers, and pebble drop mudstone indicates that the shore of the Dwyka Sea was located nearby. The movement of the Dwyka ice sheets has been interpreted as representing a series of lobes moving broadly southwards. The Karoo episode closes in the Jurassic with the Drakensberg volcanic event of which only the hypabyssal event i.e. the intrusion of dolerite dykes are present in the study area. This volcanic event is related directly to the break-up of Gondwanaland and the separation of Africa from the southern continents.

The formation of the escarpment and interior basin was a direct result of the rifting which accompanied the break-up of Gondwanaland as a consequence of sea-floor spreading and plate tectonics. By Early Cretaceous, Africa emerged as a separate plate and the Kalahari Basin, of which we see the southern fringe, was created as a shallow depository. By this time the Southern African landmass was one of erosion related to new base levels. .

The Kalahari Basin has been in existence for the whole Cenozoic with rivers draining into this region, dumping gravel, clay and calcareous sand. Initially the climate was wet and large valleys were cut into the African Surface. This fairly wet cycle was followed by a generally dry cycle which gave rise to the Gordonia Formation.

[1] See Appendix D for geological time scale


SIMPLIFIED GEOLOGY OF SOUTH AFRICA
LESOTHO AND SWAZILAND
PHANEROZOIC
PROTEROZOIC
ARCHAEAN
CENOZOIC
MESOZOIC
PALAEOZOIC
NAMIBIAN
MOKOLIAN
VAALIAN
RANDIAN
SWAZIAN
65
250
545
900
2050
2650
3100
Cenozoic deposits (Algoa Group, etc.)
Kalahari Group
Uitenhage and Zululand Groups
Drakensberg and Lebombo Groups
Molteno, Elliot and Clarens Formations
Beaufort Group
Dwyka and Ecca Groups
Karoo Supergroup
Cape Supergroup, Natal Group
Cape Granite Suite, etc.
Vanrhynsdorp and Nama Groups
Malmesbury, Kaaimans, Gamtoos Cango Caves and Kansa Groups
Ganep Supergroup
Namaqua and Natal Metamorphic Provinces
Waterberg and Soutpansberg Groups, Olifantshoek Supergroup
Alkaline complexes
Bushveld Complex (felsic)
Bushveld Complex (mafic)
Transvaal Supergroup
Ventersdorp Supergroup
Dominion Group, Witwatersrand and Pongola Supergroups
Archaean granite and gneiss
Barberton Supergroup, Gravelotte, Pietersburg, Giyani and Kraalpan Groups, Beit Bridge Complex
BOTSWANA
NAMIBIA
MOZAMBIQUE
NORTHERN PROVINCE
PIETERSBURG
Phalaborwa
MPUMALANGA
NORTH WEST
MAFIKENG
PRETORIA
JOHANNESBURG
GAUTENG
SWAZILAND
FREE STATE
KWAZULU-NATAL
UPINGTON
KIMBERLEY
BLOEMFONTEIN
LESOTHO
DURBAN
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A SUMMARY OF ECONOMIC GEOLOGY OF SOUTH AFRICA

M.G.C. Wilson

The geological history of South Africa is a long and complex one which dates back some 3.7 billion years. The keystone on and around which the rest of the geological formations of South Africa have developed is the **Kaapvaal Craton**, which underlies the northeastern part of the country. It is made up largely of **Archaean gneisses and granitoids**, along with lesser volumes of metamorphosed, volcanosedimentary rocks (greenstone belts).

The greenstones are economically important, hosting many gold, antimony, copper-zinc, iron, asbestos, talc, mercury, magnesite and gemstone deposits. The gneisses and granitoids are only weakly mineralised but do host pegmatite minerals (including feldspar, mica and silica), corundum, graphite, and epigenetic copper and gold in places.

The **Barberton Mountain Land** is the most significant gold-producing greenstone belt in South Africa, whilst the **Murchison Belt** continues to be an important source of antimony.

Large sedimentary basins of the **Kaapvaal Craton** hold some of South Africa's richest mineral resources. The sedimentary strata of the **Witwatersrand Supergroup** are confined to a basin, south of Johannesburg, measuring some 320 km by 160 km, and constitute the world's largest repository of gold. They were deposited between 3 074 and 2 714 million years ago. Similar strata of the **Pongola Supergroup** and upper **Pietersburg Group** were deposited during the same time period and are also known to host gold, though at lower concentrations. Volcanic and sedimentary rocks of the **Ventersdorp Supergroup**, which overlie the Witwatersrand Supergroup, host gold once[illegible] ns a[illegible] arts [illegible] r basi[illegible] contact with the Witwatersrand strata.

Between 2 500 and 2 100 million years ago, infilling of the **Transvaal and Griqualand West basins** took place. The largely clastic Wolkberg **Group** and overlying **Black Reef Formation** at the base of the **Transvaal Supergroup** both host small gold deposits. Vast thicknesses of carbonate sediments are exploited in several places for limestone and dolomite.

Zinc and lead mineralisation is hosted near the base of the carbonate-dominated sequence and is mined at Reivilo, southwest of Vryburg in the North West Province. In the Pilgrim's Rest area of the Mpumalanga Province, flat-bedded epigenetic gold reefs are hosted within, and close to, the upper contact of the Malmani Subgroup dolomites. Extensive karsting of the dolomites in the Griqualand West area of the Northern Cape Province, near Kuruman, resulted in the formation and accumulation of substantial manganese deposits which, along with the vast deposits in the Kalahari Manganese Field to the north around Hotazel, constitute the largest land-based repository of manganese on earth.

Fluorspar also occurs in the dolomite formations of the Transvaal Supergroup, in the north of the country. Overlying these are substantial deposits of banded iron formation, which are exploited for iron ore in several localities, the most important being Sishen (near Kuruman). The iron formation also hosts amphibole asbestos, which was extensively mined in the past. A silicified form of the asbestos, known as tiger's eye, is prized as a gemstone and is unique to South Africa. Almost 40% of the world's known andalusite mineralisation occurs in the pelitic strata of the Transvaal basin where these fall within the metamorphic aureole of the Bushveld Complex that intruded the Transvaal Supergroup sediments about 2 050 million years ago.

The [illegible] eld [illegible] lex i[illegible] worl[illegible] largest known layered intrusion and has an estimated areal extent of 66 000 km^2. It contains an ultrabasic to basic unit, up to 9 km thick, which outcrops as eastern, western and northern lobes surrounding an acid core of largely granitic rocks. The economically viable chromite reserves of the Bushveld Complex are estimated at almost 70% of the world's total. The **Merensky Reef,** which is the best known and most commonly exploited platiniferous horizon in the Complex, can be traced for at least 240 km along strike and is estimated to contain 60 000 t of platinum group metals, in its upper 1 200 m, as well as significant resources of cobalt, copper and nickel. The pyroxenitic Platreef horizon, north of Potgietersrus, is a wide zone containing platinum-group mineralisation, along with nickel and copper.

Vanadium-bearing minerals occur in concentrations of between 0,3 and 2% in up to 21 layers of titaniferous magnetite in the upper zone of the Complex. This represents the world's largest source of vanadium.

Significant tin, fluorite and copper mineralisation is hosted within the acid phase of the Bushveld Complex. A substantial amount of black norite and red syenite of the Bushveld Complex is quarried as dimension stone.

Another economically important intrusive of similar age to the Bushveld Complex is the alkaline (carbonatite) **Phalaborwa Complex**, in the east of the Northern Province. It is unique in that it is the only carbonatite in the world currently being mined for its copper content. By the time open-pit copper mining ceases in 2002, an estimated 3.4 Mt of copper metal will have been extracted along with millions of tons of titaniferous magnetite and significant amounts of nickel, uranium, baddeleyite, gold, silver, rare-earth elements and platinum-group metals. It is estimated that the complex contains 298 Mt of merchant- grade phosphate (in the form[illegible] atite[illegible] p[illegible] 00 [illegible] epth); addition, it is the world's largest resource of high grade vermiculite.

The **Pilansberg Alkaline Complex**, **Vergenoeg breccia pipe** and the **Premier diamond pipe**, near Pretoria, were emplaced into the Kaapvaal Craton 1 300 million years ago. Vergenoeg, some 110 km north of Pretoria, is an important source of fluorspar, whilst the Premier pipe has yielded the world's largest gem diamond and continues to yield large gems.

The **Namaqua-Natal Metamorphic Province** forms an arcuate belt, up to 400km wide, which is draped onto and around the western and southern margins of the Kaapvaal Craton. It hosts several copper, zinc-copper and zinc-lead-copper-silver deposits, some of which are associated with barite. Several of these deposits are being, or have been, mined at Springbok, Pofadder and Prieska in the Northern Cape Province.

The **Karoo Supergroup** fills the vast Karoo basin, which covers about two-thirds of South Africa and hosts the fluvio-deltaic sediments and coal deposits of the extensive **Ecca Group**. These are economically exploited mainly in the northern and eastern parts of the basin. The coalfields measure some 700 km by 500 km in extent. They provide the main source of energy for South Africa and support a massive export industry of mainly bituminous, thermal- grade coal with a relatively low sulphur content. Extensive basic and acid lavas cap the Karoo Supergroup. Their extrusion preceded the fragmentation of Gondwanaland which began in the north-east, some 200 million years ago, and spread southward and westward until the proto-Atlantic was formed about 120 million years ago. This break-up was accompanied and followed by widespread anorogenic alkaline magmatism which, *inter alia*, gave rise to the intrusion of economically significant kimberlites, especially in the Kimberley area.

Since [illegible] brea[illegible] of G[illegible] mala[illegible] **Cretaceous** and **Cenozoic** basins and structural traps have developed around the coast. Deposits of oil and natural gas have accumulated in some of these, significantly those near Mossel Bay. A thick blanket of terrestrial and fresh-water sediments of Cenozoic age, which are loosely known as the **Kalahari Group**, were deposited in parts of the Northern Cape and North West Provinces.

Vast quantities of minerals and metals occur in coastal dune sands, though their concentrations are only economically viable in a few places. Major mining operations at Richards Bay, on the Kwazulu-Natal coast, and at the Namakwa Sands project on the Cape west coast, near Vredendal, extract large tonnages of titanium minerals, zircon and monazite. Diamonds have also been concentrated in alluvial and marine deposits on the west coast of the Northern and Western Cape Provinces, and have been exploited for over a century.

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SOUTH AFRICA

Web page: http://www.geoscience.org.za

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Following is a short description of the lithologies found on the geological map **(Figure 1):**

3.1 Qg - Gordonia Formation

The Gordonia Formation is represented by a vast accumulation of unconsolidated, red aeolian sand. These aeolian sands are made up of highly rounded quartz grains and commonly form longitudinal dunes **(Figure 4)**. These dunes are separated by 'straats', often exposing the calcrete of the Mokalanen Formation. The Gordonia Formation overlies a fairly even surface of the Mokalanen Formation.

The red colouration is caused by a thin coat of iron-oxide on the grains. The possible source of the iron is accessory- and clay minerals in the sand. In pans and certain river beds the red sands were leached to produce a white-coloured sand. Although the sand is unconsolidated, the dunes have been, for most part, fixed by vegetation.

3.2 T-Qm - Mokalanen Formation[2]

The Mokalanen Formation comprises essentially calcrete, diatomaceous in places and diatomaceous limestone. This unit has a wide distribution and forms the boundary between the Tertiary and Quaternary rocks (Thomas, et al. 1989). The calcareous rocks can be subdivided into a sandy limestone and a hardpan calcrete. This hard calcrete is a calc-conglomerate with angular calcareous clasts, cemented by a calcareous matrix containing rounded quartz grains. The limestone is silicified in some areas and gives rise to small lenses and discontinuous layers of grey silicate.

The diatomaceous limestone is a white coloured, loosely consolidated limestone with low density. It contains hollow tubes of recent origin and minor rounded quartz grains are included. The limestone is fossilifereous and various types of fauna were identified. The paleo-environment suggested is that of sluggish flowing rivers or still, freshwater lakes.

[2] Name not yet approved by SACS

Figure 4. **Red dunes of the Gordonia Formation surrounding Eensaamheidpan.**

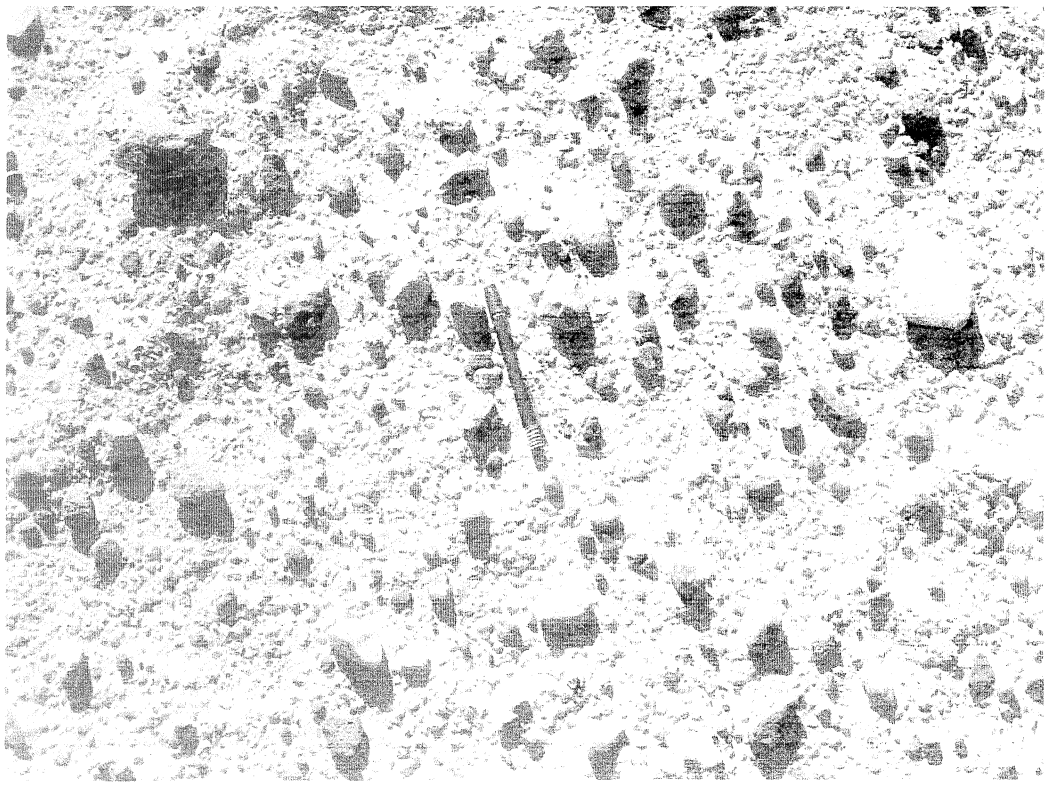

Figure 5. **Variety of pebbles on the deflation surface at Eensaamheidpan.**

3.3 C-Pd - Dwyka Formation

Large areas on the map are underlain by sedimentary rocks of the Dwyka Formation. The exposed rocks in the area comprise essentially tillite, blue-green shales and mudstone.

The tillite contains pebble-sized, sub-angular clasts with surface glacial striations and chatter marks. There is a wide variety of rock types found on the deflation surfaces of the pans and some of these pebbles show a provenance from the east and north-east. The clasts include lava, dolomite, banded ironstone, jasper, quartzite, granite and gneiss. The tillite becomes sandy towards the top of the succession and is associated with lenses and pockets of immature conglomerate, ferruginous sandstone and impure limestone and calcarenite. These clastic beds are laterally discontinuous.

3.4 Pan sediments

In the most pans the sediments are generally off-white to buff coloured and finer grained than that of the Gordonia Formation.

The sediments are derived from dune sand, with the white colour removed by leaching by ground water. Both the pans at Norokei and Groot Witpan are covered in pebbles derived from the eroded Dwyka tillite **(Figure 5)**.

These pebbles represent a wide variety of lithologies as described under the previous heading. Small inner dunes can be seen in some areas. These inner dunes are of the same composition of sandy-clay sediments found in the pans. The larger outer dunes have the same composition as the surrounding sand which leads to the conclusion that they formed as the sand was initially blown away from the depression.

4. PAN FORMATION

In the forming of the pans **(Figure 6)** in the study area, the main factors are disruption of the drainage patterns, structural influences and salinity. All three these factors have a certain part to play in the forming of these features and will be looked at under the main headings:

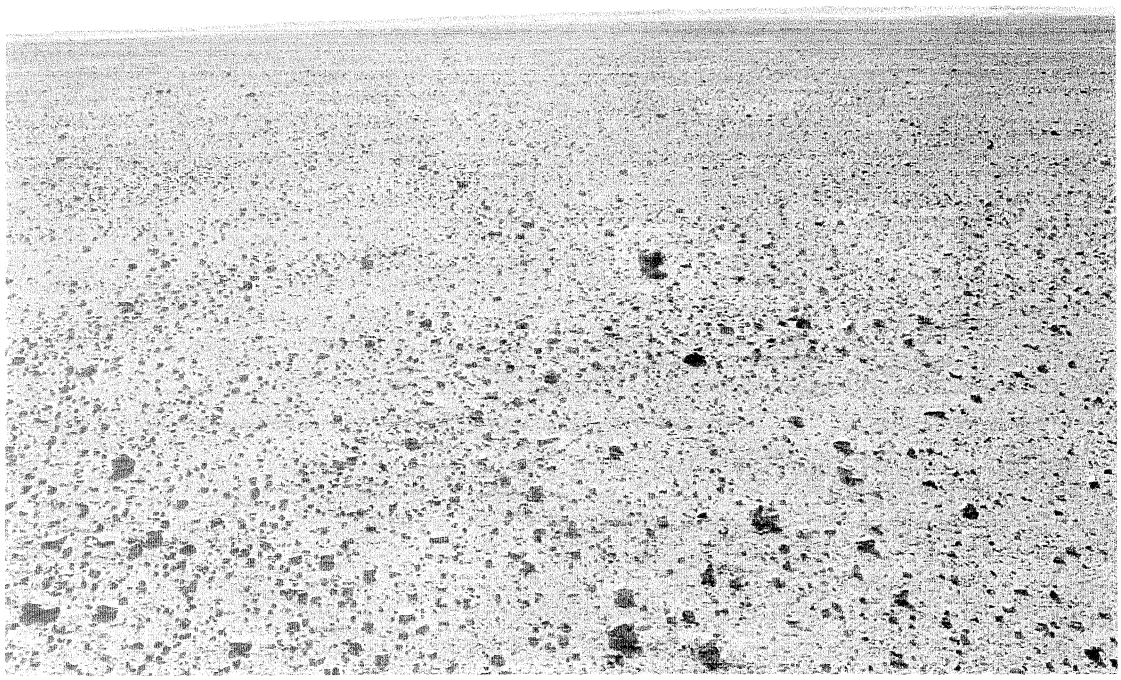

Figure 6. **Picture taken on Eensaamheidpan looking towards the north.**

4.1 Disruption of drainage patterns

The disruption of drainage courses by uplift or river capture can cause old channels to become blocked by sediment, or dunes may move across them. You then may get water accumulation in hollows on the old stream bed, which become more saline with evaporation. The pans then develop in these saline hollows (see 4.3 below) (Levin, 1980; (Malherbe et al., 1986)

4.2 Structural relationships

Pans may overlie dykes or faults - this is possibly related to weathering caused by preferential movement of groundwater along these features (Mallick et al, 1981). They may also form by solution cavities in calcretes with erosion by wind increasing their size (Goudie and Thomas, 1985).

4.3 Salinity

Salt increases mechanical weathering, attracts animals and most importantly keeps vegetation growth down which exposes the pan to wind erosion. Salinity may be related to bedrock (Goudie and Thomas, 1985) with weathering of Dwyka releasing salt and/or chloride (which is the case in this instance). This is then transported by groundwater to the surface. Even where sub-surface water is relatively fresh, evaporation over time increases the salinity at the surface (Bruno, 1985). Pans are usually surrounded by lunette dunes which consist of a high percentage of clay particles from the pan floor as well as more sandy material blown or washed into the pan from surrounding areas.

5. RESULTS

The salt resources are confined to the underground brines which are of secondary origin, having leached from salt-bearing sediments i.e. Dwyka Formation sediments. These particular sediments are mainly the shales and tillites of the Dwyka. This potential source of salt is unlimited, and the leaching of these will continue as long as water move through the sediments. The composition of groundwater is influenced by the rate of flow through the Dwyka, which in this flat area, are relatively slow. According to Hugo (1974) the composition of brine in the area is close enough to seawater to suggest a marine origin for the salt, derived from the Dwyka beds.

For the production of salt by means of solar evaporation, the annual evaporation must exceed the rainfall for effective salt production. These criteria are easily met as a result of high temperatures

and long hours of sunlight.

According to previous investigations done by Thomas et al. (1989) and Hugo (1974), salt production has been going on for years in the surrounding area, and on Eensaamheidpan in particular. Looking at the geochemical results at present, the quality of salt is exceptional and the mining potential is extensive. The salt analysis **(Apendix C)** show results of NaCl in the excess of 95%.

According to Lourens (1992) the salt grades for South Africa are:

Grade I: Coarse or milled; 95% NaCl and a maximum of 1,5% SO_4.

Grade II: Coarse or milled; 85 - 95% NACl

Grade III: Coarse: 75 - 85% NaCl

Grade IV: Coarse; < 75% NaCl or contaminated grades I, II and III.

According to Oosterhuis (1998) the demand for salt will increase from 858 kt in 1992 to 1130 kt by the year 2000.

See Appendix D for results of borehole testing.

6. REFERENCES

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APPENDIX A

B1	S 27° 40' 08.7 ''	E 20°50'28.2''	Eensaamheidpan
B2	S 27°40'07.0''	E 20°50'28.6''	

CENTRAL ANALYTICAL LABORATORIES (PTY) LTD LABS SENTRALE ANALITIESE LABORATORIUMS (EDMS) BPK

ONTLEDINGSVERSLAG

MAATSKAPPY :KALKPOORT SOUTWERKE
ADRES :POSBUS 1228
ADRES :UPINGTON
POSKODE :8800

NAAM :E DU TOIT
DATUM ONTVANG :26/05/2003
MAAL :3
FAX :TEL: (054) 331-1408/n

Lab No	PRODUK	PROT	P	Ca	Na	Cl
		%	%	%	%	%
25685	SOUT 2	0.07	0.04	0.13	37.90	* 62.00

*Die Cl is in duplikaat op verskillende dae
bepaal. Daar is nie duidelikheid oor hoe
hoë Cl wat die waarde sou beïnvloed nie.
Skaakel gerus as daar enige navrae is.

Gesertifiseer Direkteur Operasioneel / Certified Director Operations

APPENDIX C

Eon/Eonothem		Era/Erathem	Sub-era	Period/System	Epoch/Series	Starting Ma
PHANEROZOIC		Cenozoic	Quaternary	Pleistogene	Holocene	0.01
					Pleistocene	2.0
			Tertiary	Neogene	Pliocene	5.1
					Miocene	24.6
				Palaeogene	Oligocene	38
					Eocene	55
					Palaeocene	65
		Mesozoic		Cretaceous		144
				Jurassic		213
				Triassic		248
		Palaeozoic	Upper Palaeozoic	Permian		286
				Carboniferous		360
				Devonian		408
			Lower Palaeozoic	Silurian		438
				Ordovician		505
				Cambrian		590
PROTEROZOIC	PRECAMBRIAN					2500
ARCHAEAN						4000
PRISCOAN						4600

APPENDIX D

The "FC-method"

The "Flow Characteristic" – is used to determine the sustainable yield of a borehole. This method was developed by the Free State University Institute for Groundwater Studies.

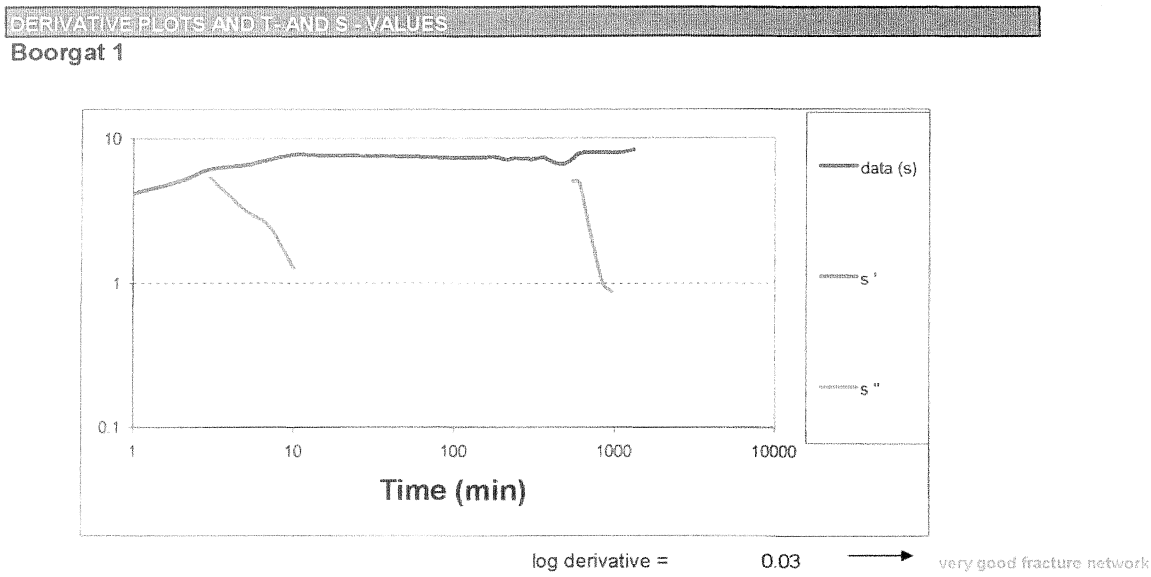
Constant Yield test of B1, Eensaamheidpan

Borehole B1 was pumped for 1440min (24h) with a yield of 3.1 liter per second. The volume of 267m^3 was removed during the test period. The water level measured at 'rest' at the start of the test was 7.87m, which was drawn down to 8.33m at the end of the 24 hour test. After 7 minutes, the water level reached a depth of 7.3m to 8.3m which was constant for the duration of the test period. The ground water level of the borehole recovered in 30 minutes after the end of testing.

Recommendation and Discussion

The graphic (Graphic 1) of the derivate shows a good joint system supplying water to the borehole. The fist derivate (green line) shows a lateral flow to the hole.

Graphic 1: Derivate plots



The sustainable yield determinations **(Table 1)** show the following:

- A value of no replenishing for 2 years was taken.
- Radius of the subtraction cone is 20m
- The ground water level can be subtracted down to a maximum of 30 m.
- The risk subtraction of 1.24m means that a safety risk factor of 95% is used. There can thus be said with 95% certainty that the borehole, with a certain yield, will not dry up.

Table 1: Determination of sustainable yields.

FC-METHOD: Estimation of the sustainable yield of a borehole

Boorgat 2

Extrapolation time in years = (enter)	2	1051200	Extrapol.time in minutes	
Effective borehole radius (r_e) = (enter)	47.83	47.83	Est. r_e	From r(e) sheet
Q (l/s) from pumping test =	3.1	7.04E-04	S-late	Change r_e
s_a (available drawdown), sigma_s = (enter)	20	0.8	Sigma_s from risk	
Annual effective recharge (mm) =	0	19.20	s_available working drawdown(m)	
t(end) and s(end) of pumping test =	1440	1.06	End time and drawdown of test	
Average maximum derivative = (enter)	0.8	0.8	Estimate of average of max deriv	
Average second derivative = (enter)	-0.1	-0.1	Estimate of average second deriv	
Derivative at radial flow period = (enter)	0.3	0.26	Read from derivative graph	
	T-early[m^2/d] =	189.18	Aqui. thick (m)	20
T and S estimates from derivatives	T-late [m^2/d] =	64.08	Est. S-late =	1.10E-03
To obtain correct S-value, use program RPTSOLV!	S-late =	1.10E-03	S-estimate could be wrong	

BASIC SOLUTION

(Using derivatives + subjective information about boundaries)

(No values of T and S are necessary)

	No boundaries	Maximum influence of boundaries at long time: 1 no-flow	2 no-flow	Closed no-flow
sWell (Extrapol.time) =	5.28	7.47	9.66	16.23
Q_sust (l/s) =	11.27	7.97	6.16	3.67
	Best case →			Worst case
Average Q_sust (l/s) =	6.71	WARNING!! Est. Q_sust > Q during pumping test		
with standard deviation=	3.20	Suggestion: check available drawdown and rech		

(If no information exists about boundaries skip advanced solution and go to final recommendation)

ADVANCED SOLUTION

(Using derivatives+ knowledge on boundaries and other boreholes)

(Late T-and S-values a priori + distance to boundary)

T-late [m^2/d] = (enter) →	64.08			
S-late = (enter) →	1.40E-03			
1. BOUNDARY INFORMATION (choose a or b)	(Code =9999 = dummy value if not applicable)			
(a) Barrier (no-flow) boundaries →	Closed Square	Single Barrier	Intersect. 90°	2 Parallel Barriers
Bound. distance a[meter] : (enter)	9999	9999	9999	9999
Bound. distance b[meter] : (enter)			9999	9999
s_Bound(t = Extrapol.time) [m] =	0.01	0.00	0.01	0.01
(b) Fix head boundary + no-flow →	Closed Fix	Single Fix	90°Fix+no-flow	// Fix+no-flow
Bound. distance to fix head a[meter] : (enter)	9999	9999	9999	9999
Bound. distance to no-flow b[meter] : (enter)			9999	9999
s_Bound(t = Extrapol.time) [m] =	-0.02	0.00	0.00	0.00
2. INFLUENCE OF OTHER BOREHOLES →	Q (l/s)	r (m)	u_r	W(u,r)
BH1	3.1	200	2.99E-04	7.54
BH2			0.00E+00	#NUM!
s_(influence of BH1,BH2) =	2.51	0.00	1.71E-05	10.40
SOLUTION INCLUDING BOUNDS AND BH's				
Fix head + No-flow : Q_sust (l/s) =	9999.00	9999.00	9999.00	9999.00
No-flow : Q_sust (l/s) =	9999.00	9999.00	9999.00	9999.00
Enter selected Q for risk analysis = (enter) →	6.00	Sigma_s =	0.000	

(Go to Risk sheet and perform risk analysis from which sigma_s will be estimated : only for barrier boundaries)

FINAL RECOMMENDED ABSTRACTION RATE

Abstraction rate (l/s) for 24 hr/d = (enter)	2.46
Total amount of water allowed to be abstracted per month (m^3) =	6376

COMMENTS

Q_sust with 68% safety =	6.99
Q_sust with 95% safety =	6.71

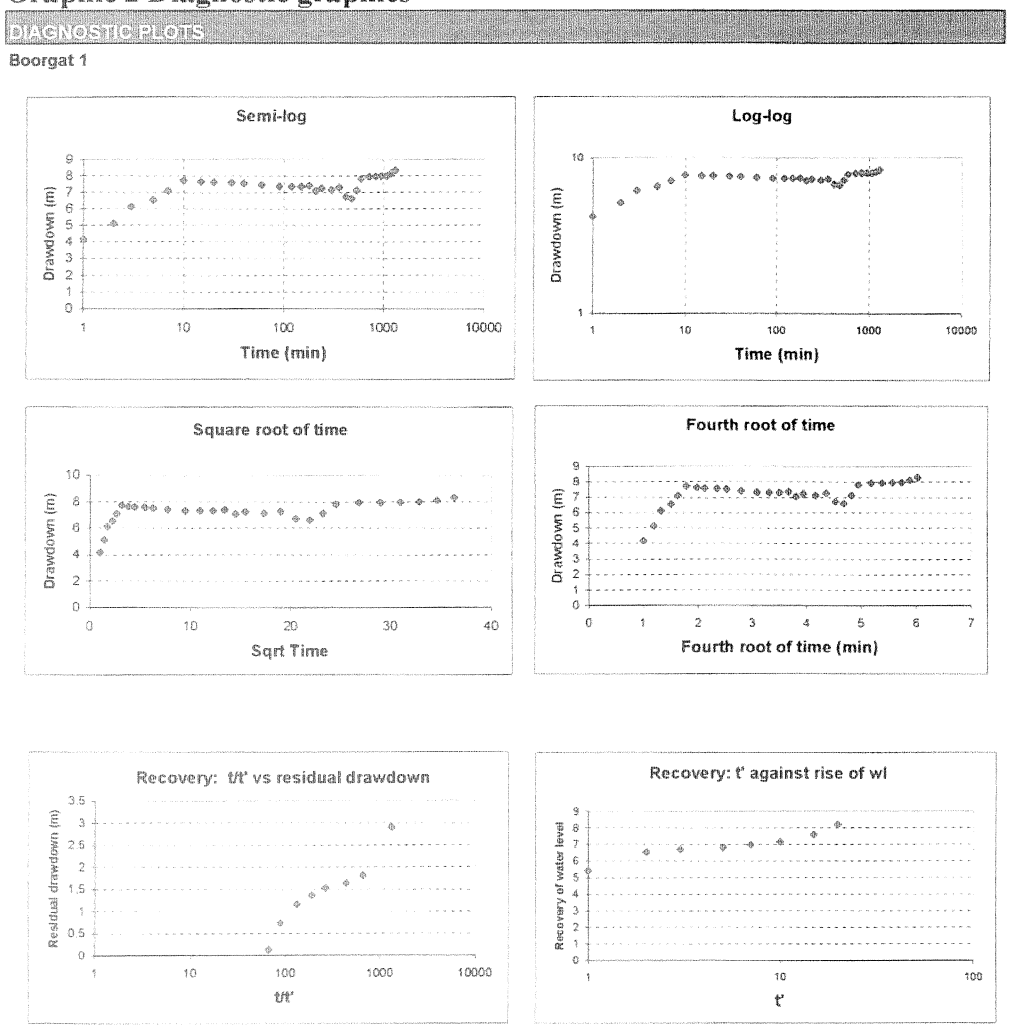
Table 2 gives an explanation of test times for the borehole.

Table 2

Recommended abstraction rate (L/s)	2.12	for 24 hours per day						
Pump setting for pumping	12	2.99	L/s	or	10777	l/h	for	12 hours per da
Amount of water allowed to be abstracted per day	182.9	m^3						
Amount of water allowed to be abstracted per month	5486	m^3						
Borehole could satisfy the large animal need of 50	3657	large animals						
Borehole could satisfy the person human need of 25	7314	persons						
Borehole could satisfy the basic human need at 20 l	1524	persons						

The diagnostic graphics (Graphic 2) give a more detailed explanation of the different representation of the pump test data.

Graphic 2 Diagnostic graphics



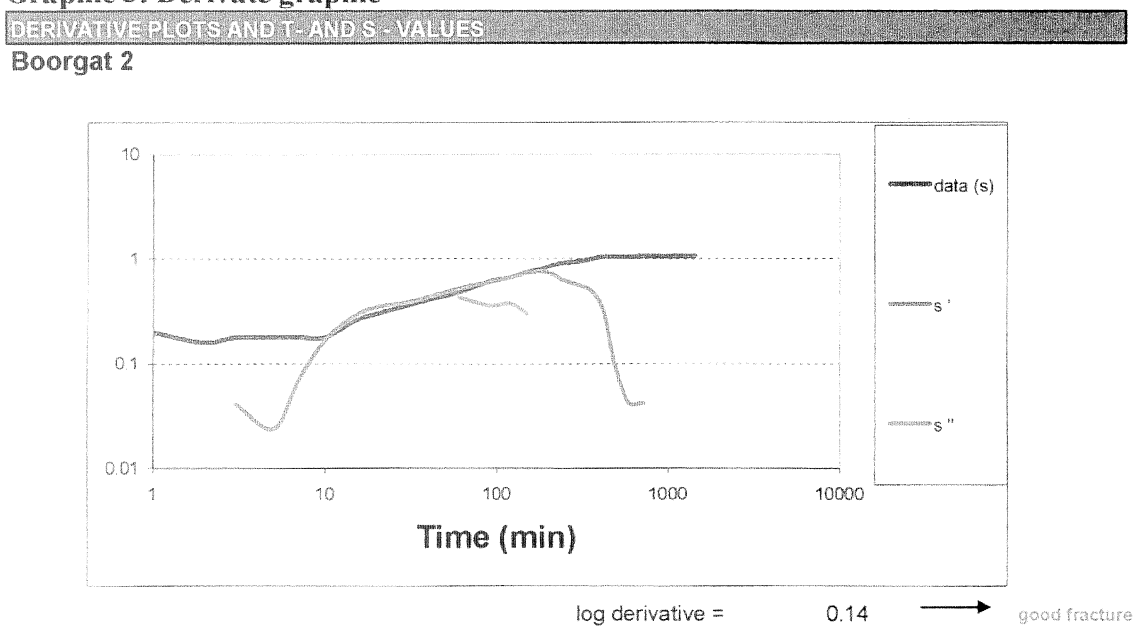
Constant Yield test of B2, Eensaamheidpan

Borehole B2 was pumped for 1440min (24h) with a yield of 3.1 liter per second. A total volume of 267m^3 was removed during this time. The ground water level (at rest for 18 hours) at the start of the test was at 7.80m. This level was drawn down with 1.06m to 8.86 at the end of the test (24h). The groundwater level was drawn down to 8.85m after 360 minutes, at which it stayed until the end of the test period. The water level recovered 59% or 0.56m after 20 minutes from the end of testing.

Recommendation and Discussion

The graphic (Graphic 1) of the derivate se show a good joint system supplying water to the borehole. The fist derivate (green line) shows a lateral flow to the hole

Graphic 3: Derivate graphic



The sustainable yield determinations (Table 3) show the following:

- A value of no replenishing for 2 years was taken
- Radius of the subtraction cone is 200m
- The ground water level can be subtracted down to a maximum of 13 m.
- The risk subtraction of 0.8m means that a safety risk factor of 95% is used. There can thus be said with 95% certainty that the borehole, with a certain yield, will not dry up.

Table 3: Determination of Sustainable Yield

FC-METHOD : Estimation of the sustainable yield of a borehole

Boorgat 2

Extrapolation time in years = (enter)	2	1051200	Extrapol.time in minutes	
Effective borehole radius (r_e) = (enter)	47.83	47.83 ← Est. r_e	From r(e) sheet	
Q (l/s) from pumping test =	3.1	7.04E-04 ← S-late	← Change r_e	
s_a (available drawdown), sigma_s = (enter)	20	0.8 ← Sigma_s from risk		
Annual effective recharge (mm) =	0	19.20	s_available working drawdown(m)	
t(end) and s(end) of pumping test =	1440	1.06	End time and drawdown of test	
Average maximum derivative = (enter)	0.8	0.8	Estimate of average of max deriv	
Average second derivative = (enter)	-0.1	-0.1	Estimate of average second deriv	
Derivative at radial flow period = (enter)	0.3	0.26	Read from derivative graph	
T and S estimates from derivatives	T-early[m^2/d] =	189.18	Aqui. thick (m)	20
	T-late [m^2/d] =	64.08	Est. S-late =	1.10E-03
(To obtain correct S-value use program RPTSOLVE)	S-late =	1.10E-03	S-estimate could be wrong	

BASIC SOLUTION

(Using derivatives + subjective information about boundaries)

(No values of T and S are necessary)

	Maximum influence of boundaries at long time			
	No boundaries	1 no-flow	2 no-flow	Closed no-flow
sWell (Extrapol.time) =	5.28	7.47	9.66	16.23
Q_sust (l/s) =	11.27	7.97	6.16	3.67
	Best case →			Worst case
Average Q_sust (l/s) =	6.71	WARNING!! Est. Q_sust > Q during pumping test		
with standard deviation=	3.20	Suggestion check available drawdown and rech		

(If no information exists about boundaries skip advanced solution and go to final recommendation)

ADVANCED SOLUTION

(Using derivatives+ knowledge on boundaries and other boreholes)

(Late T-and S-values a priori + distance to boundary)

T-late [m^2/d] = (enter) →	64.08			
S-late = (enter) →	1.40E-03			
1. BOUNDARY INFORMATION (choose a or b)	(Code =9999 = dummy value if not applicable)			
(a) Barrier (no-flow) boundaries →	Closed Square	Single Barrier	Intersect. 90°	2 Parallel Barriers
Bound. distance a[meter] : (enter)	9999	9999	9999	9999
Bound. distance b[meter] : (enter)			9999	9999
s_Bound(t = Extrapol.time) [m] =	0.01	0.00	0.01	0.01
(b) Fix head boundary + no-flow →	Closed Fix	Single Fix	90°Fix+no-flow	// Fix+no-flow
Bound. distance to fix head a[meter] : (enter)	9999	9999	9999	9999
Bound. distance to no-flow b[meter] : (enter)			9999	9999
s_Bound(t = Extrapol.time) [m] =	-0.02	0.00	0.00	0.00
2. INFLUENCE OF OTHER BOREHOLES →	Q (l/s)	r (m)	u_r	W(u,r)
BH1	3.1	200	2.99E-04	7.54
BH2			0.00E+00	#NUM!
s_(influence of BH1,BH2) =	2.51	0.00	1.71E-05	10.40
SOLUTION INCLUDING BOUNDS AND BH's				
Fix head + No-flow : Q_sust (l/s) =	9999.00	9999.00	9999.00	9999.00
No-flow : Q_sust (l/s) =	9999.00	9999.00	9999.00	9999.00
Enter selected Q for risk analysis = (enter) →	6.00	Sigma_s =	0.000	

(Go to Risk sheet and perform risk analysis from which sigma_s will be estimated : only for barrier boundaries)

FINAL RECOMMENDED ABSTRACTION RATE

Abstraction rate (l/s) for 24 hr/d = (enter)	2.46
Total amount of water allowed to be abstracted per month (m^3) =	6376

COMMENTS

Q_sust with 68% safety =	6.99
Q_sust with 95% safety =	6.71

Table 4 gives an explanation of test times for the borehole.

Tabel 4

Recommended abstraction rate (L/s)	**2.46**	for 24 hours per day						
Hours per day of pumping	12	**3.48**	**L/s**	or	**12527**	**l/h**	for **12**	hours per da
Amount of water allowed to be abstracted per day	212.5	m^3						
Amount of water allowed to be abstracted per month	6376	m^3						
Borehole could satisfy the large animal need of 150 l	4251	large animals						
Borehole could satisfy the basic human need of 25 l	8502	persons						
Borehole could satisfy the basic human need of 120 l	1771	persons						

The diagnostic graphics (Graphic 4) give a more detailed explanation of the different representation of the pump test data.

Graphic 4 Diagnostic graphics