APPENDIX K

Freshwater Specialist Report

WITVLEI BOERDERY TRUST

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Fresh Water Report

Proposed Feldspar Mining Operation on

Portion 5 of Farm Rozynenbosch 104 Kenhardt RD

A requirement in terms of the National Water Act (36 of 1998).

October 2019

EnviroAfrica

WATSAN Africa

Index

Abbreviations

Critical Biodiversity Area	CBA
Department of Environmental Affairs	DEA
Department of Mineral Resources	DMR
Department of Water and Sanitation	DWA
Ecological Importance	EI
Ecological Sensitivity	ES
Ecological Support Area	ESA
Environmental Management Plan	EMP
Environmental Impact Assessment	EIA
Electronic Water Use License Application (on-line)	eWULAA
Government Notice	GN
Metres Above Sea Level	masl
National Environmental Management Act (107 of 1998)	NEMA
National Freshwater Environment Priority Area	NFEPA
National Water Act (36 of 1998)	NWA
Northern Cape Department of Environment and Nature Conservation	DENC
Present Ecological State	PES
S	Section of an Act
South Africa National Biodiversity Institute	SANBI
Water Use License Application	WULA

List of Figures

List of Tables

3 Introduction

Feldspar has been mined in the Kakamas area for many years. According to the land owner of the Farm Rozynenbosch there were 23 mines in 1978. Of these only 2 are left. One of the two is on Portion 5 of Farm Rozynenbosch 104 on the gravel road between Kakamas and Kenhardt. The feldspar is in a ridge or seem, a geological intrusion, that spans in a south westerly direction across the property over a distance of more than 4 km. Only a part of this is of a high enough quality to be mined.

This is an existing open cast mine. The owner of the mine, Mr CA Bruwer, whose family has been on the land for generations, now wishes to operate the mine within the ambit of current legislation. He has appointed Enviro Africa to formally apply for a mining permit with the DMR.

The mining area is within a close distance of drainage lines. These are mostly dry and only have water during and shortly after heavy summer thunder storms. These drainage lines are nevertheless regarded as legitimate water resources in terms of the NWA and the DWS regards them as important ecological features. Therefore, a WULA is required for the mining operation to legitimately continue. Consequently, Mr Bruwer appointed Dr Dirk van Driel of WATSAN Africa to deal with the WULA.

The WULA entails a Fresh Water Report that is to be compiled according to set guidelines. It has to contain a Risk Matrix. This then is the Fresh Water Report and the motivation for the values that has been given in the Risk Matrix.

2 Legal Framework

The proposed development "triggers" sections of the National Water Act. These are the following:

S21 I *Impeding or diverting the flow of a water course*

The proposed pipeline transverses a number of drainage lines. The drainage lines could possibly be altered, should the development go ahead.

S21 (i) *Altering the bed, bank, course of characteristics of a water course.*

The proposed pipeline may alter the characteristics of the drainage lines.

Government Notice 267 of 24 March 2017

Government Notice 1180 of 2002. *Risk Matrix.*

The Risk Matrix as published on the DWS official webpage must be completed and submitted along with the Water Use Licence Application (WULA). The outcome of this risk assessment determines if a letter of consent, a General Authorization or a License is required.

Government Notice 509 of 26 August 2016

An extensive set of regulations that apply to any development in a water course is listed in this government notice in terms of Section 24 of the NWA. No development take place within the 1:100 year-flood line without the consent of the DWS. If the 1:100-year flood line flood line is not known, no development may take place within a 100m from a water course without the consent of the DWS. Likewise, no development may take place within 500m of a wetland without the consent of the DWS.

This report deals with S21 I and I of the NWA.

National Environmental Management Act (107of 1998)

NEMA and regulations promulgated in terms of NEMA determines that no development without the consent and permission of the DEA and its regional agencies, in this case the DENC of the Northern Cape Provincial Government, may take place within 32m of a water course. The mostly dry drainage lines are perceived to be legitimate water courses.

3 Climate

Upington is the closest locality for which climate data is available on line. Normally Upington receives about 94mm of rain per year (Figure 1 mainly during autumn. The chart below (Figure 1, lower left) shows the average rainfall values for Upington per month. It receives the lowest rainfall (0mm) in June and the highest (29mm) in March. The monthly distribution of average daily maximum temperatures (centre chart below) shows that the average monthly temperatures in Upington range from 19.8°C in June to 33°C in January. The region is the coldest during July when the mercury drops to 2.8°C on average during the night.

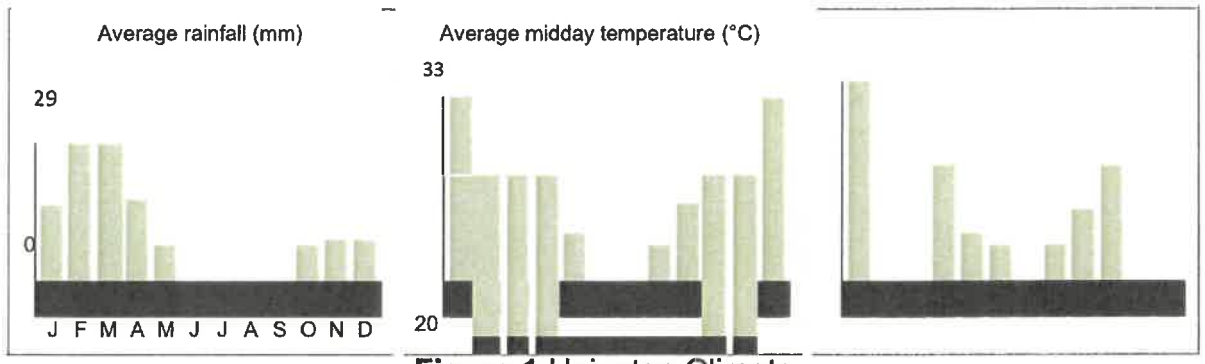

Figure 1 Upington Climate

It is evident from Figure 1 that this is an arid region. The drainage lines exist because of sudden and intense downpours that occur only once in several years. These must have been formed over millennia since historical times. The contribution to the flow in the Orange River is negligible.

4 Quaternary Catchment

Rozynenbosch Farm is located in the D53J quaternary catchment

5 Vegetation

The South African National Biodiversity Institute (SANBI) indicated the vegetation type at the proposed mining area as Bushmanland Arid Grassland. Despite the general lack of water, the Hartbees River next to the site is classified as a National Freshwater Ecosystem Priority Area (NFEPA).

6 Location

Figure 2 Rozynenbosch Location

The feldspar mine on the Farm Rozynenbosch is 43km southwest of Kakamas on the bank of the Hartbees River (Figure 2). The Hartbees River is a mostly dry tributary of the Lower Orange River.

7 The Hartbees River, Sak River and the Pans

The agricultural development is located on the bank of the Hartbees River. The Hartbees River rises as the Sak River on the highlands to the south of Sutherland more than 450km to the south (Figure 3).

The catchment area of this river system is large and covers a sizable chunk of the Bushmanland and the western Karoo.

A series of pans separate the Sak River from the Hartbees River. Verneukpan is perhaps the one that is better known because the historical land speed record was set there. The Hartbees River only flows when these pans overflow. This happened in 1999 and in 2010. It is expected that these overflows will occur less often in future as water abstraction from the Sak River for agriculture increases.

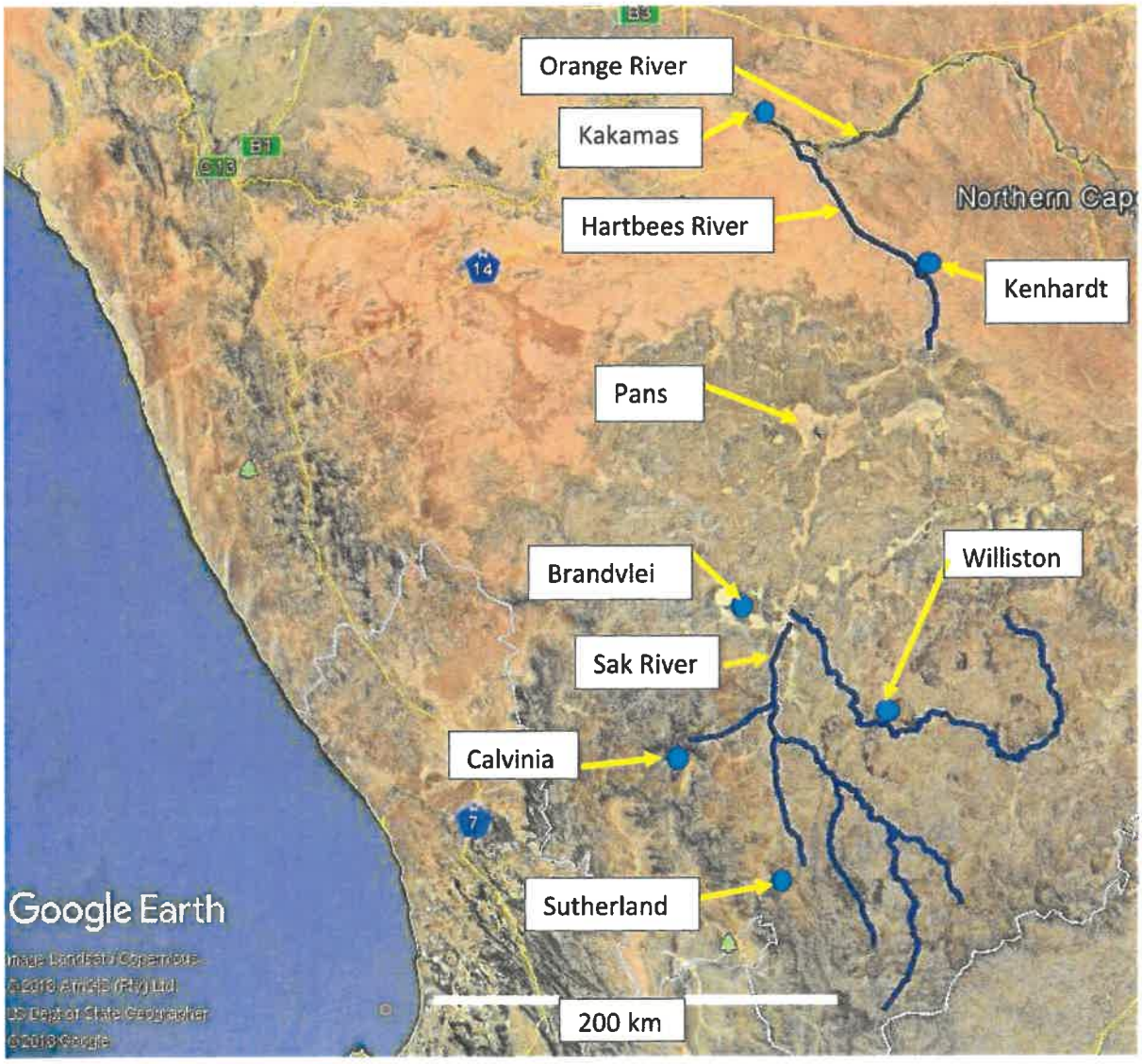

Figure 3 Sak / Hartbees River system

It is however important to note that the Sak River do not contribute towards the Mean Annual Runoff (MAR) of the Orange River (Department of Water and Environmental Affairs, 2006, p8). This is an arid region and its contribution is negligible. The flow of the Orange River is mainly because of the contribution of the Lesotho Highlands.

The banks of the Hartbees River have been impacted since historical times, with agriculture leaving its mark. At this time there are several active agricultural concerns. In addition, there are several sand mines, some in the bed of the river, which are reportedly legally licenced entities.

The possible impact of the Rozynenbosch mining operation on the Hartbees River is discussed in the paragraphs to follow, but it is not expected to be of any significance.

8 Drainage Lines

The landscape around much of the Lower Orange River and the Sak River is dominated by a dense succession of drainage lines. They spread along the river with many smaller tributaries to cover the entire area. The iron oxides in the sands renders a red hue that is visible from space on the Google Earth images. These reds are concentrated in the drainage lines, making them even more visible (Figure 4).

The drainage lines are mostly dry, with water only during rains and perhaps shortly thereafter. During the odd thunder storm, drainage lines can come down in flood. These floods maintain the drainage line's morphological integrity, as sediments are moved and these water ways are scoured out.

Because rainfall events are far apart, the drainage lines must have been form over millennia, even since geological times.

Much of the discussion in this report is about these drainage lines.

Around the Orange River and even the Sak and Hartbees River, large-scale agriculture has changed the drainage lines into drainage channels among the vineyards and orchards. The upper reaches away from the rivers are less impacted, even near-pristine, as intense agriculture is not possible, apart from those areas where water is piped over long distances from the Orange River.

The impact of the mining operation at Rozynenbosch is discussed in the following paragraphs.

9 Mining Locality

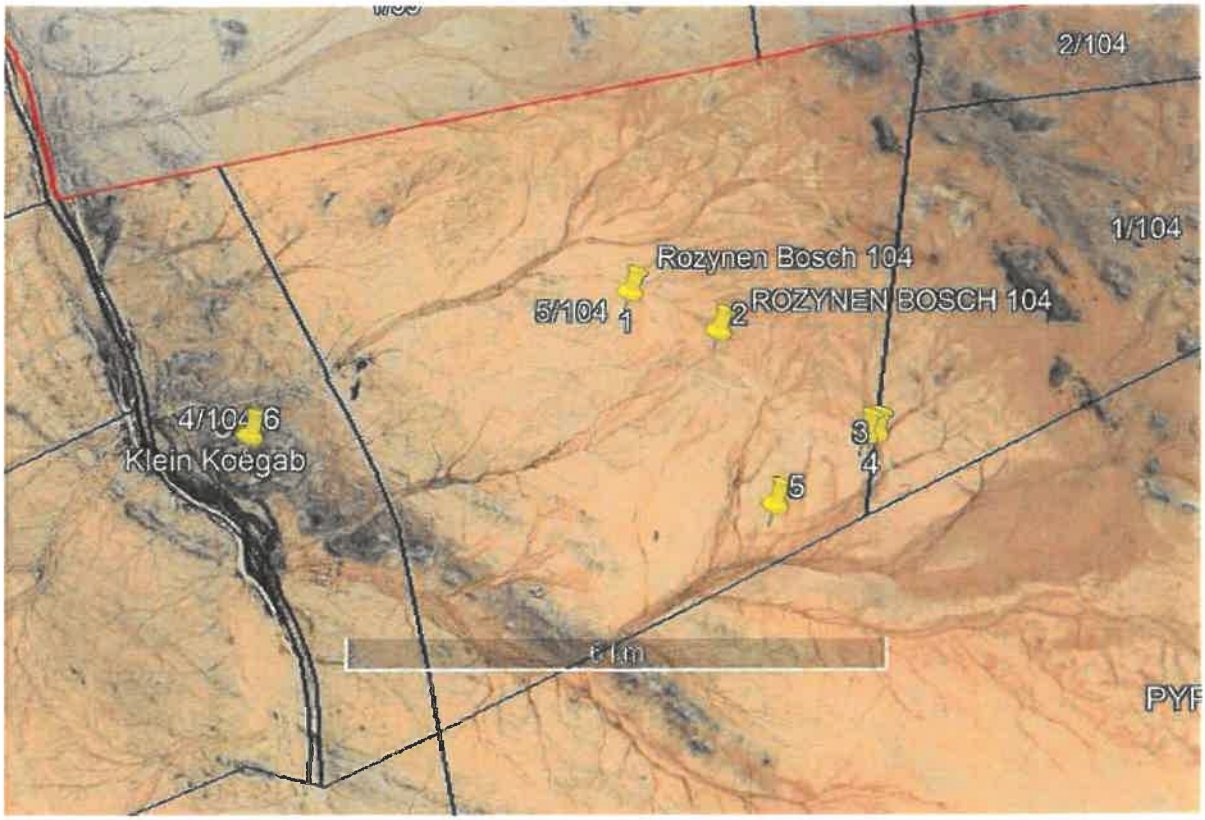

Figure 4 Mining Localities

Table 1 Mining Localities

No.	Coordinates
1	29°03'01.85" S 20°49'55.70E
2	29°03'25.42" S 20°50'31.89E
3	29°04'10.66" S 20°51'39.94E
4	29°03'12.08" S 20°45'36.64E
5	29°03'38.87" S 20°50'57.15E
6	29°04'09.21" S 20°47'10.65E

The mining localities on Farm Rozynen Bosch 5/104 is indicated in Figure 4 and listed in Table 1.

The explicit brief from the land owner is that the mining activities on the Farm Rozynen Bosch 5/104 is be to be addressed in this Fresh Water Report and not on any other properties or parts of properties.

Areas 1 1nd 2 are too be mined. Localities 3,4 and 5 are prospecting areas and will not be mined. Area 6 is a prospecting area as well, will not be mined and is outside of the property that is covered by this report.

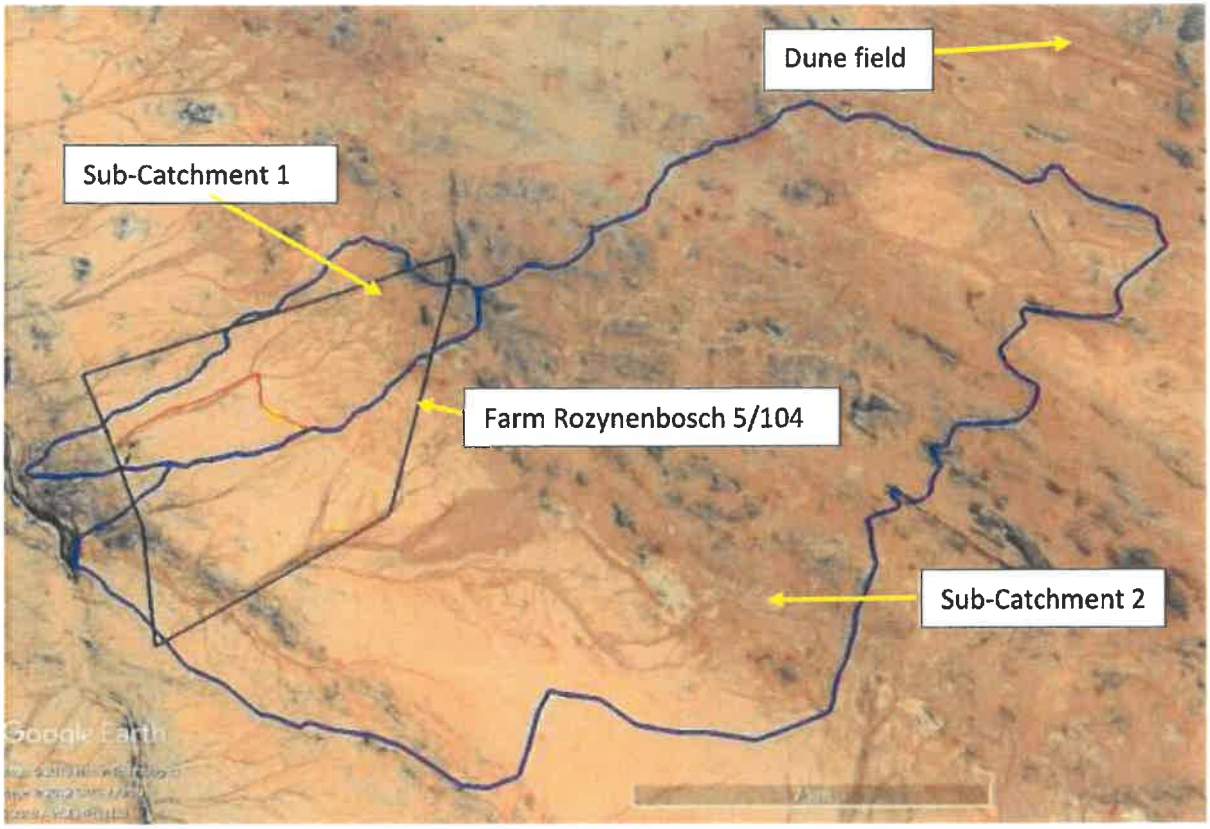

Figure 5 Sub-Catchments

The Farm Rozynenbosch 5/104 is located in two sub-catchments, each with a drainage line, which is clearly visible on Figure 5

The sub-catchments were demarcated with the polygon function of Google Earth. This can be done by connecting the highest points around the drainage lines.

The smaller one of the two (Sub-Catchment 1, Figure 5) is 2750ha, with a circumference of 26.2 km. It is 11 km long. The highest point at the top of the sub-catchment is 855masl and the lowest at the confluence with the Hartbees River is 722masl. The general slope is 0.57m vertical in every 100m vertical metres. This is a gentle slope that is not conducive to a high erosion potential.

The larger one of the two is much bigger, with a surface area of 22 000ha and with a circumference of 73km. There is a rocky ridge at the top end of sub-catchment 1 that

extends over the width of sub-catchment 2. The drainage line of sub-catchment 2 breaks through this rocky ridge to go much further to the north west. A dune field stretched across the landscape (Figure 5). Higher ground to the south of the dune field marks the northern boundary of this sub-catchment.

This highest point is 957masl and the lowest in the Hartbees River is 229masl. This is a drop of 229m over a distance of 26.2km, with a drop of 0.87m vertical over every 100 horizontal metres.

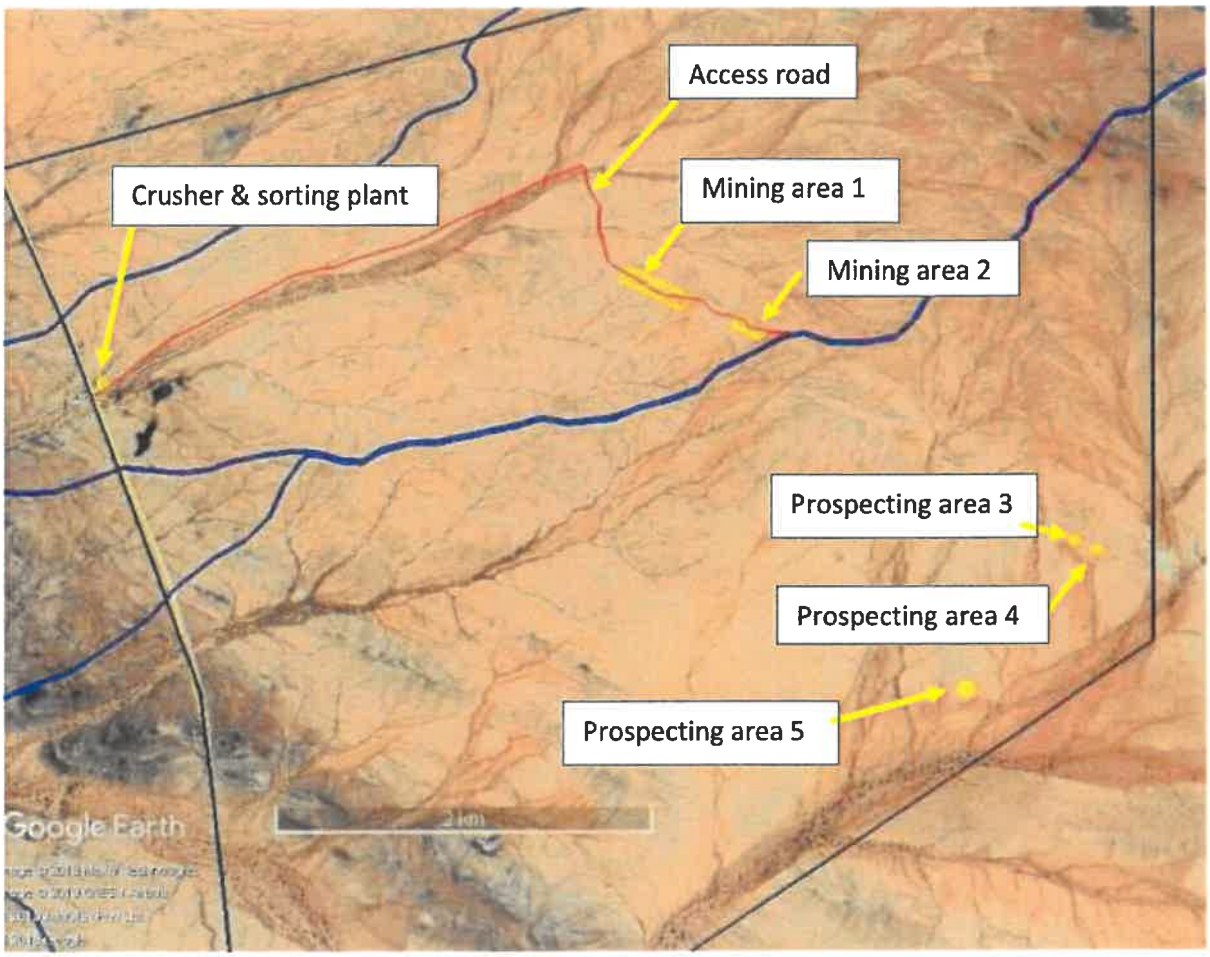

Figure 6 Location of mining areas in sub-catchments

The two mining areas as well as the crusher and sorting plant will be located in Sub-Catchment 1. The prospecting areas are located in Sub-Catchment 2.

The access road to the mining areas is indicated in Figure 6. It is 5.8km long. It stretches across the tributaries of the drainage line, then over the main drainage line and follows the drainage line to the where the crusher and sorting plant will be located, where it connects to the main road from Kakamas to Kenhardt. This main road is a dirt road.

10 The Mining Areas

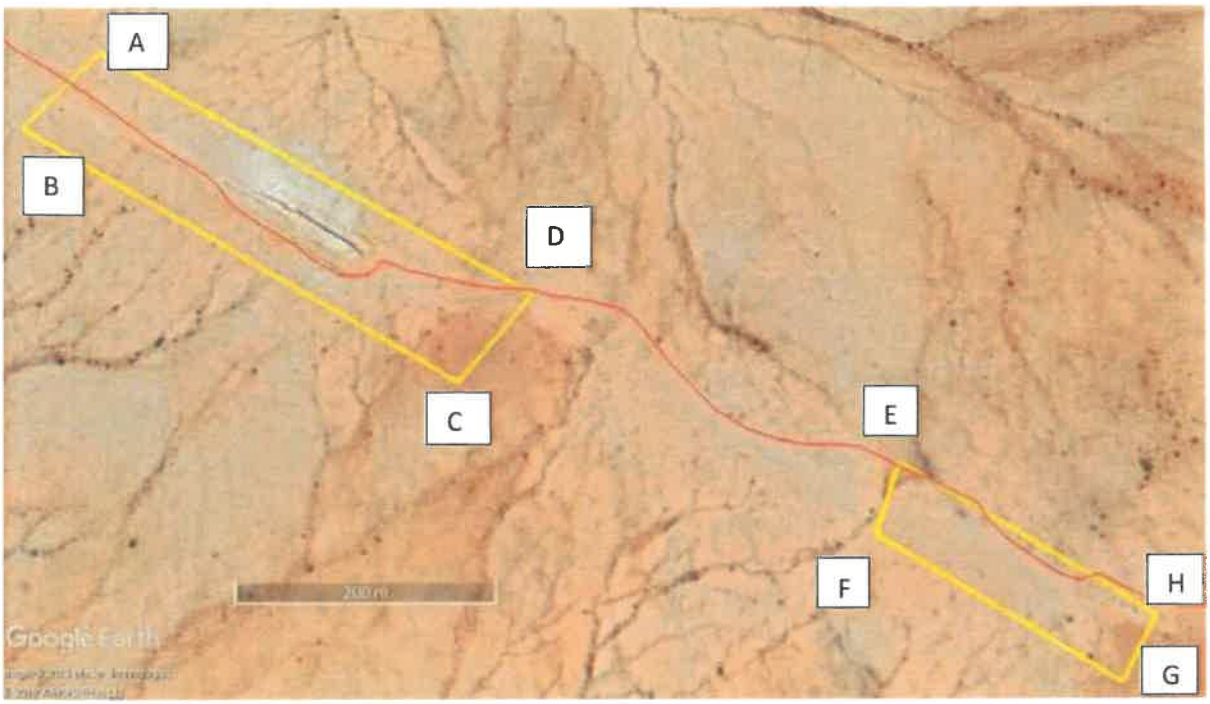

Figure 7 Mining areas

The two mining areas are shown in Figure 7. The areas are within 32 m and 100m of the drainage line's tributaries. This trigger both the requirements set out in GN509 of the NWA and those of the NEMA.

The coordinates of the mining areas are as follows:

Table 1 Mining Areas Coordinates

Mining Area 1	
A B C D	29°03'01.76S 20°49'43.49'E 29°03'04.33S 20°49'41.70'E 29°03'11.82S 20°49'57.28'E 29°03'09.48S 20°49'58.12'E
Mining Area 2	
E F G H	29°03'15.15S 20°50'10.34'E 29°03'17.17S 20°50'09.26'E 29°03'21.54S 20°50'15.59'E 29°03'19.25S 20°50'17.01'E

11 The Mining Operation

Figure 8 Mining Operation

This is essentially an open cast mine. The overburden is taken off with an excavator (Figure 8) and heaped on one side of the trench (Figure 9). Much of what comes out of the trench are rocks and chunks of mainly quartzite with various forms of mineralization. This waste rock is stored on the other side of the trench. The marketable feldspar is simply loaded onto a waiting truck and transported along the access road to the crusher and sorting plant.

Figure 9 Trench

This is hard work for the excavator, as the substrate is hard and not easily broken up.

At the crusher (Figure 10), the ore gets broken up in various grades, to suit the client's specifications. Again, the final product is loaded onto trucks with a front-end loader. The product is taken off-site to wherever it is required.

Figure 10 Crusher

The crusher currently is located on another property and will be moved to its designated locality (Figure 10) within the near future.

The ore is not washed. The entire operation is not using any water.

Only 4 or 5 people are present on site, such as the operators of the heavy earth moving machinery, truck drivers and the mining manager. Drinking water is provided in prepacked containers and for ablutions chemical toilets are on site.

12 Current Impacts

First and foremost, the Fresh Water Report essentially has to focus on possible impacts on the aquatic environment as well as the groundwater. Disturbed soil can possibly be transported along with the storm water into the drainage lines and eventually end up in the Hartbees River. The chances of this happening are remote and the impact would be insignificant, as will be evident from the Risk Matrix. The runoff from Mining Area 1 is in both north west and south east directions. The mining area is only one or two metres above the surrounding landscape, which does not bode

for strong currents and high sediment transport potential. The runoff from Mining Area 2 is in a south easterly direction and again, the slope is even, not leaving much potential for strong current and a huge sediment transport.

The boreholes in the area are 33m deep, with good quality water, according to the land owner. None of the components or substances that are to be used on the mining sites pose any threat to ground water quality. The trench of the current mining operations is bone dry and there is no sign of any ground water of wetness. It is unlikely that the mining activities will have any impact on the ground water.

The most striking impact is the trench from where the ore is mined, along with the heaps of overburden and waste rock beside it (Figure 9).

Holes have been dug for the purpose of prospecting, the position of which is shown in Figure 6.

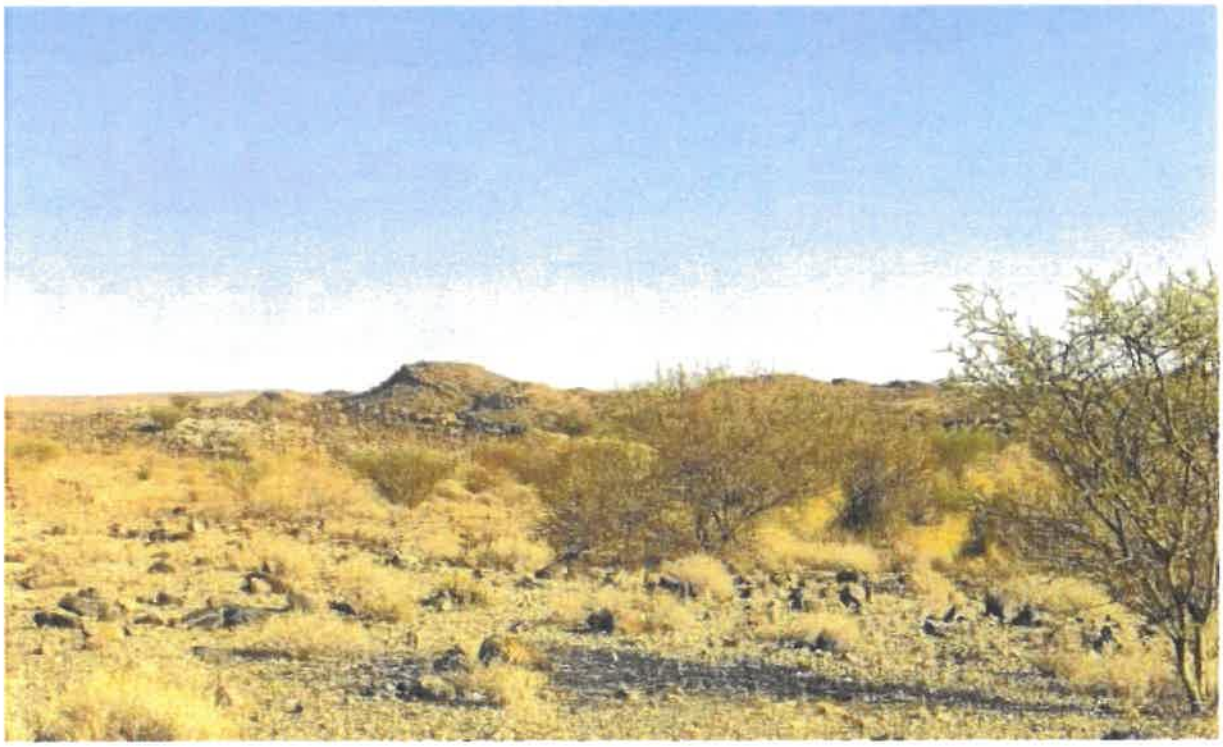

Figure 11 Excavated rock at Prospecting Site 4

Where the access road passes through the drainage line and its tributaries, erosion is visible adjacent and downstream of the road. The land owner curtailed further erosion by the placement of riprap (rocks) in the eroded areas (Figure 12).

Figure 12 Riprap in eroded areas

Figure 13 Small retaining wall

It can be expected that there will be sizable stockpiles of ore and worked material at the site of the crusher and sorting plant. This will make an impression of the otherwise very flat landscape.

Not connected to mining, but nevertheless worth mentioning, farmers in the area have adopted a standing policy of construction dam walls across drainage lines. This is for the purpose of erosion control, as well as for retaining rain water. These small dams are only temporary, as water quickly evaporates in the summer heat. It is hoped that at least some of this surface water sinks into the sandy and rocky soil to replenish ground water.

Figure 13 shows one such a small retaining wall that has been constructed out of the material that came out of the prospecting hole at Prospecting Area 3 (Figure 6). Behind the wall, heaps of excavated material can be seen that came out of this prospecting area.

The dust emanating from the crushing and sorting operation can be a problem, taking the prevailing strong winds into consideration. This aspect is to be addressed in the EMP and does not pose a threat to the aquatic environment.

In any mining operation the possibility of an accidental diesel spill should always be a prominent item for the EMP. Storage tanks should be bunded and an on-site clean-up kit should be ready for use by trained staff.

13 Rehabilitation

For the purpose of the WULA, only the most obvious aspects of the rehabilitation are mentioned. For this mining application to succeed a most elaborate rehabilitation plan is to be drafted.

The trench must be filled in again, when mined out and as the mining proceeds along the seem of feldspar. It should not wait until the mining is done, but should follow the mining face. The waste should be pushed back into the trench, followed by the overburden, to eventually leave a landscaped site behind that is lower than the original one, but that blends in with its surroundings.

Immediately following prospecting, the rocks and other material should be pushed back into the holes. The areas should be levelled and landscaped to blend in with the surroundings. This is particularly applicable to Prospection Areas 3 and 4.

Likewise, the stockpiles at the crusher should be removed completed once the mining operation has ceased.

Erosion control along the access road in the drainage lines, where unsightly, should be covered with soil in order to soften the visual impact. The road should be kept in good order, with repairs done where the heavily laden trucks caused damage.

14 Present Ecological State (PES)

The PES and EIS are protocols that have been produced by Dr Neels Kleynhans (Table 3) in 1999 of the then DWAF to assess river reaches. The scores given are solely that of the practitioner and are based on expert opinion.

Table 3 Habitat Integrity according to Kleynhans, 1999

Category	Description	% of maximum score
A	Unmodified, natural	90 – 100
B	Largely natural with few modifications. A small change in natural habitats and biota, but the ecosystem function is unchanged	80 – 89
C	Moderately modified. A loss and change of the natural habitat and biota, but the ecosystem function is predominantly unchanged	60 – 79
D	Largely modified. A significant loss of natural habitat, biota and ecosystem function.	40 – 59
E	Extensive modified with loss of habitat, biota and ecosystem function	20 – 39
F	Critically modified with almost complete loss of habitat, biota and ecosystem function. In worse cases ecosystem function has been destroyed and changes are irreversible	0 - 19

Both the instream and riparian habitat have been classified as a "B" (Table 4). The farm is grazed by sheep and the roads and small dam walls keep the score from moving up to A. In all other respects the drainage line is near-pristine.

It is not expected that the mining operation would change the PES of the drainage line.

A case could be made out that an assessment of the Hartbees River is not necessary for the WULA, because the mine is too far away from the river. The crusher and sorting plant are closer, but still 2km away. This is too far away to warrant an assessment.

Table 4 Present Ecological State of the Rozynenbosch Drainage Line

Instream	Score	Weight	Product	Maximum score
Water abstraction	23	14	322	350
Flow modification	18	13	234	325
Bed modification	18	13	234	325
Channel modification	20	13	260	325
Water quality	23	14	322	350
Inundation	22	10	220	250
Exotic macrophytes	24	9	216	225
Exotic fauna	24	8	192	200
Solid waste disposal	24	6	144	150
Total		100	2144	2500
% of total			85.8	
Class			B	
Riparian				
Water abstraction	23	13	299	325
Inundation	22	11	242	275
Flow modification	18	12	216	300
Water quality	23	13	299	325
Indigenous vegetation removal	24	13	299	325
Exotic vegetation encroachment	24	12	288	300
Bank erosion	23	14	322	350
Channel modification	22	12	264	300
Total			2229	2500
% of total			89.2	
Class			B	

15 Ecological Importance

The Ecological Importance (EI) is based on the presence of especially fish species that are endangered on a local, regional or national level (Table 5).

There are no fish in the drainage lines, as there is no permanent water. According to this assessment, which is prescribed for WULA's, the drainage line is not important.

No other endangered species, either plant or animal, were detected in or near the drainage line. Camel thorn *Vachellia erioloba* is listed as "least concern" on the SANBI Red List, but is not particular associated with the riparian zone of drainage lines. Neither are there any quiver trees *Aloidendron dichitomum* in the way of the mining operation or the access road.

Table 5 Ecological Importance according to endangered organisms (Kleynhans,1999).

Category	Description
1	One species or taxon are endangered on a local scale
2	More than one species or taxon are rare or endangered on a local scale
3	More than one species or taxon are rare or endangered on a provincial or regional scale
4	One or more species or taxa are rare or endangered on a national scale (Red Data)

16 Ecological Sensitivity

The question arises, according to the ES definition, if the drainage lines would recover to its original ecological state prior to any human impact. If the mine and its associated infrastructure were to be removed, along with the livestock, would the drainage lines recover?

The in-stream habitat, with its sandy bottom, would probably resemble its current characteristics, even though it might have shifted over time across the sandy landscape, as waterways do.

This is an arid region, with vegetation recovery rates very slow, it would take many decades, perhaps a century, for the impacted riparian habitat around the drainage line to recover to its pristine state. From this point of view the drainage lines can be listed as ecologically sensitive.

17 Impact Assessment

Some of the decision-making authorities prescribe an impact assessment according to a premeditated methodology (Table 24.1, Appendix).

The main benefit of this exercise is that it allows for the evaluation of mitigation measures. Later follows the Risk Matrix. This is different from the Impact Assessment as it does not attempt to weigh the success of mitigation measures.

The impact assessment is broken down into its various component in Table 6. It indicates that the mitigation measures are necessary and that they can indeed make a positive difference. The significance of the impacts is generally lowered from "medium" to "low".

Table 6 Impact Assessment

Description of impact Removal of the overburden Stockpiling of the overburden Mining the ore Stockpiling the waste Sediments washing down drainage line during storm events **Mitigation measures** Prevent sediments washing down the drainage line								
Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceability
Without mitigation								
Negative	Regional	Medium	Medium term	Medium	Probable	Certain	Reversible	Replaceable
With mitigation measures								
Negative	Local	Low	Medium term	Low	Unlikely	Sure	Reversible	Replaceable

Description of impact Transport ore to crusher Ore falling of trucks into drainage line **Mitigation measures** Prevent ore from falling of the trucks								
Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceability
Without mitigation								
Direct	Regional	Medium	Medium term	Medium	Probable	Certain	Reversible	Replaceable
With mitigation measures								
Negative	Local	Low	Medium term	Low	Unlikely	Sure	Reversible	Replaceable

Description of impact

Maintenance of access road
Erosion control at crossings in drainage line
Alteration of drainage line

Mitigation measures

Maintain erosion control infrastructure
Tidy up erosion control infrastructure

Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceability
Without mitigation								
Direct	Regional	Medium	Medium term	Medium	Probable	Certain	Reversible	Replaceable
With mitigation measures								
Direct	Local	Low	Medium term	Low	Probable	Sure	Reversible	Replaceable

Description of impact

Operation of crusher
Stockpiling of ore and product at crusher
Sediments washed down drainage line during storm events

Mitigation measures

Prevent sediments leaving the crusher site

Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceability
Without mitigation								
Negative	Regional	Medium	Medium term	Medium	Probable	Certain	Reversible	Replaceable
With mitigation measures								
Negative	Local	Low	Medium term	Low	Unlikely	Sure	Reversible	Replaceable

Description of impact

Rehabilitation of mining site
Filling in of trench
Replacing overburden
Rehabilitation of prospecting sites, filling in of holes, landscaping of the sites
More sediments down drainage line

Mitigation measures

Prevent sediments leaving the mining site

Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceability
Without mitigation								
Negative	Regional	Medium	Short term	Medium	Probable	Certain	Reversible	Replaceable
With mitigation measures								
Negative	Local	Low	Short term	Low	Probable	Sure	Reversible	Replaceable

Description of impact

Rehabilitation of crusher site
Remove all of the stockpiles
More sediments washing down the drainage line

Mitigation measures

Prevent sediments leaving the crusher site

Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceability
Without mitigation								
Negative	Regional	Medium	Short term	Medium	Probable	Certain	Reversible	Replaceable
With mitigation measures								
Negative	Local	Low	Short term	Low	Probable	Sure	Reversible	Replaceable

18 Risk Matrix

The assessment was carried out according to the interactive Excel table that is available on the DWS webpage. Table 7 is a replica of the Excel spreadsheet that has been adapted to fit the format of this report.

The methodology is set out in the Appendix. It has been copied directly out of the DWS webpage.

The purpose of the Risk Matrix is to determine if a General Authorisation of a License is applicable.

Table 7 Risk Matrix

No.	Activity	Aspect	Impact	Significance	Risk Rating
1	Removal of the overburden Stockpiling of the overburden Mining the ore Stockpiling the waste	Mobilisation of sediments	Sediments in drainage line	45	Low
2	Transport ore to crusher	Ore falling of trucks	Ore ending up in drainage line	40	Low
3	Maintenance of access road Erosion control at crossings in drainage line	Alteration of drainage line	Aquatic habitat destruction	45	Low
4	Operation of crusher Stockpiling of ore and product at crusher	Sediments washed down drainage line	Aquatic habitat alteration	49.5	Low
5	Rehabilitation of mining site, prospecting sites Filling in of trench Replacing overburden	More sediments down drainage line	Alteration of aquatic habitat	34	Low
6	Rehabilitation of crusher site Remove all of the stockpiles	More sediments down drainage line	Alteration of aquatic habitat	34	Low

Table 7 Continued Risk Rating

No	Flow	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Conse-quence
1	1	2	1	1	1.25	1	2	4.5
2	1	1	1	1	1	1	2	4
3	2	1	2	1	1.5	1	2	4.5
4	1	1	2	2	1.5	1	2	4.5
5	1	2	1	1	1.25	1	2	4.25
6	1	2	1	1	1.25	1	2	4.25

No	Frequency of activity	Frequency of impact	Legal issues	Detection	Likelihood	Significance	Risk Rating
1	2	1	5	1	10	45	Low
2	2	1	5	1	10	40	Low
3	2	1	5	1	10	45	Low
4	2	3	5	1	11	49.5	Low
5	1	1	5	1	8	34	Low
6	1	1	5	1	8	34	Low

The risks are "Low", after carefully and thoughtfully scoring the various impacts, under the assumption that all mitigation measures are in place.

The Risk Matrix indicate that a General Authorisation should be considered. This can be done, according to departmental policy, by the regional office in Upington. This WULA should not be submitted to the head office in Pretoria for a License.

19 Resource Economics

The goods and services delivered by the environment, in this case the Rozynenbosch drainage lines, is a Resource Economics concept as adapted by Kotze *et al* (2009). The methodology was designed for the assessments of wetlands, but in the case of the drainage line the goods and services delivered are particularly applicable and important, hence it was decided to include it in the report.

The diagram (Figure 14) is an accepted manner to visually illustrate the resource economic footprint of the drainage lines, from the data in Table 8.

Table 8. Goods and Service Rozynenbosch Drainage Lines

Goods & Services	Score
Flood attenuation	4
Stream flow regulation	4
Sediment trapping	3
Phosphate trapping	1
Nitrate removal	1
Toxicant removal	1
Erosion control	3
Carbon storage	2
Biodiversity maintenance	4
Water supply for human use	1
Natural resources	3
Cultivated food	2
Cultural significance	2
Tourism and recreation	1
Education and research	2

0	Low
5	High

The star shape for the Rozynenbosch drainage lines combined are bigger than that of other drainage lines that have been assessed for similar projects in the region. The combined surface area of the Rozynenbosch drainage lines covers many hectares and makes up a significant portion of the lower Hartbees River catchment area. Therefore, the flood attenuation, stream flow regulation and sediment trapping has been assessed a notch higher. Nevertheless, the shallow sandy soil on the rocky substrate is ready erodible and in many instances the drainage lines produce sediments instead of trapping it.

The riparian zone is poorly defined, with some higher vegetation, but it cannot serve as a carbon or nitrogen sink of any significance. Nevertheless, the higher vegetation

provided habitat to a range of organisms, which would have been absent if there were no drainage lines. In this respect drainage lines adds to biodiversity, albeit in a small degree in this arid region.

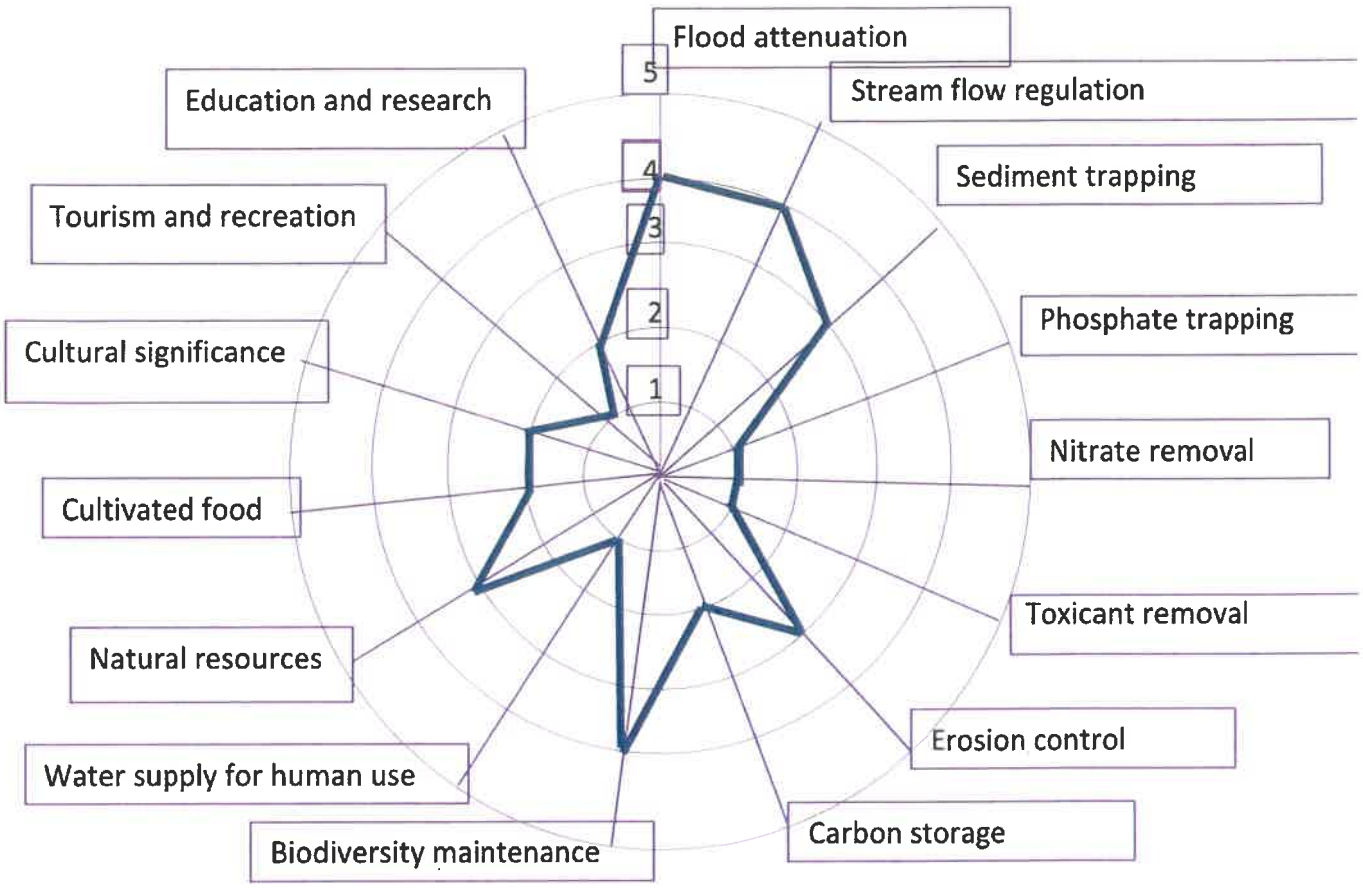

Figure 14. Resource Economics Footprint of the Rozynenbosch Drainage Lines

The drainage lines are dammed with small walls all over the district, with the hope that surface water will percolate down to replenish the aquifers. Hence these drainage lines have at least some value when it comes to the provision of water to livestock.

Sand is mined from many of these drainage lines. So, they add to the score for natural resources.

Late stone age tools are regularly found in and around these drainage lines. Hence it has some archaeological value.

20 Conclusions

Figure 15 has been adapted from one of the most recent DWS policy documents.

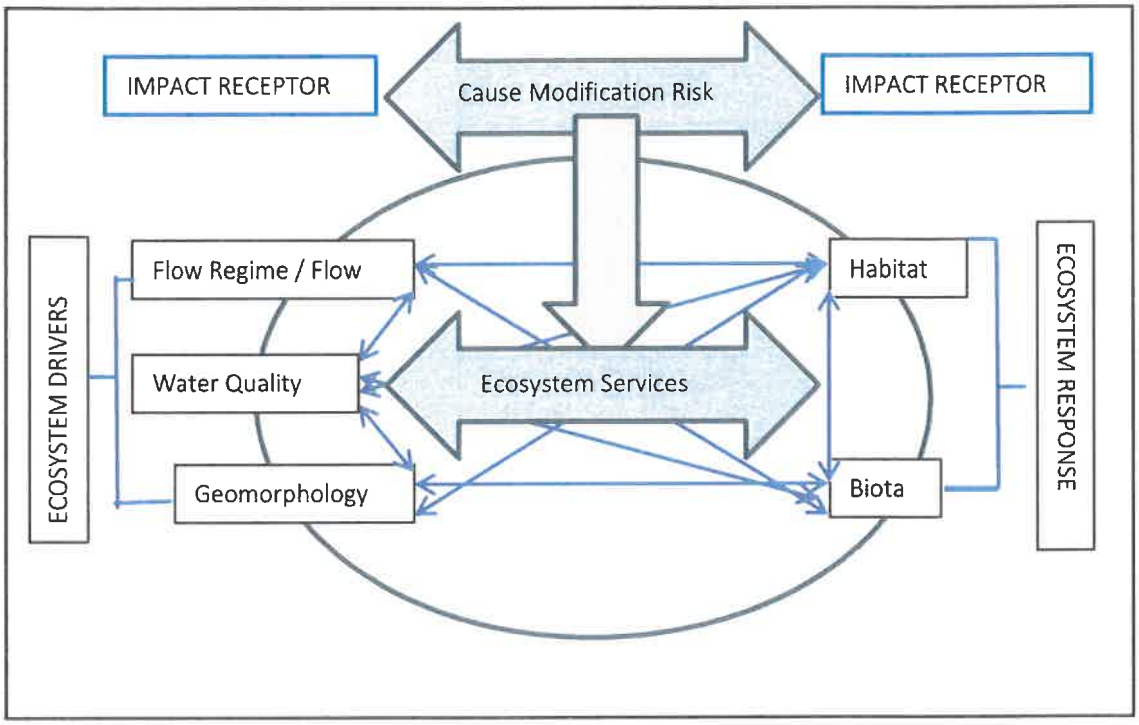

Figure 15 Minimum Requirements for a S21(c) and (i) Application

An anthropogenic activity can impact on any of the ecosystem drivers or responses and this can have a knock-on effect on all of the other drivers and responses. This, in turn, will predictably impact on the ecosystem services (Figure 15). The WULA and the EAI must provide mitigation measured for these impacts.

The driver of the mostly dry drainage lines is the occasional flood that follows sudden and intense rainfall events. This is followed by prolonged droughts and intense summer heat that prevents the development of any viable aquatic habitat. This is apart from shallow ground water that explains the growth of vegetation along the drainage lines that provides habitat in an arid region where habitat and habitat variability is hard to come by.

The conservation of drainage lines along the Lower Orange River deserves and demands attention by decision-making authorities, environmental practitioners, the conservation and farming community alike. As more of these drainage lines are impacted upon, and because impacts are radical by nature, because sections of drainage lines are replaced by vineyards or other forms of agriculture, or transformed

into return flow infrastructure, the necessity for a widely accepted conservation policy becomes urgent as development escalates.

A percentage of still unimpacted drainage lines should be identified, prioritised and set aside for conservation. Only specified practices with no or limited impacts should be allowed in these sub-catchments and their drainage lines.

The potential impact of the proposed expansion of the Rozynenbosch mine and its associated infrastructure is insignificant. The impact on the surrounding landscape is rather striking and would be permanent if not rehabilitated.

The Risk Matrix suggests that a General Authorization is the appropriate level of authorization.

21 References

Department of Water and Environmental Affairs (DWA), 2009. *Development of an Integrated Water Quality Management Strategy for the Upper and Lower Orange Water Management Areas, Desktop Catchment Assessment Study: Lower Orange Water Management Area (WMA 14).* Report No. 2.2 (P RSA D000/00/7909/3). Edition 1. DWA, Pretoria.

Kleynhans, C.J. 1999. *Assessment of Ecological Importance and Sensitivity.* Department of Water Affairs and Forestry. Pretoria.

Kotze, G., G. Marneweck, A. Batchelor, D. Lindley & Nacelle Collins. 2009. *A technique for rapidly assessing ecosystem services supplied by wetlands.* Water Research Commission, Pretoria.

Van Driel D. 2018. *Proposed Sand Mining Operation on Plot 2372 of Alheidt, Kakamas.* WATSAN. Cape Town

22 Declaration of Independence

I, Dirk van Driel, as the appointed independent specialist hereby declare that I:

- Act/ed as the independent specialist in this application
- Regard the information contained in this report as it relates to my specialist input/study to be true and correct and;
- Do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2010 and any specific environmental management act;
- Have and will not have vested interest in the proposed activity;
- Have disclosed to the applicant, EAP and competent authority any material information have or may have to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the environmental Impact Assessment Regulations, 2010 and any specific environmental management act.
- Am fully aware and meet the responsibilities in terms of the NEMA, the Environmental Impacts Assessment Regulations, 2010 (specifically in terms of regulation 17 of GN No. R543) and any specific environmental management act and that failure to comply with these requirements may constitute and result in disqualification;
- Have ensured that information containing all relevant facts on respect of the specialist input / study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties facilitated in such a manner that all interested and affected parties were provided with reasonable opportunity to participate and to provide comments on the specialist input / study;
- Have ensured that all the comments of all the interested and affected parties on the specialist input were considered, recorded and submitted to the competent authority in respect of the application;
- Have ensured that the names of all the interested and affected parties that participated in terms of the specialist input / study were recorded in the register of interested and affected parties who participated in the public participation process;
- Have provided the competent authority with access to all information at my disposal regarding the application, weather such information is favourable or not and;
- Am aware that a false declaration is an offence in terms of regulation 71 of GN No. R543.

Signature of the specialist: 21 October 2019

23 Résumé

Dr Dirk van Driel
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Water Scientist

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Experience

WATSAN Africa, Cape Town. Scientist **2011 - present**

USAID/RTI, ICMA & Chemonics. Iraq & Afghanistan **2007 -2011**
Program manager.

City of Cape Town **1999-2007**
Acting Head: Scientific Services, Manager: Hydrobiology.

Department of Water & Sanitation, South Africa **1989 – 1999**
Senior Scientist

Tshwane University of Technology, Pretoria **1979 – 1998**
Head of Department

University of Western Cape and Stellenbosch University 1994- 1998 part-time

- Lectured post-graduate courses in Water Management and Environmental Management to under-graduate civil engineering students
- Served as external dissertation and thesis examiner

Service Positions

- Project Leader, initiator, member and participator: Water Research Commission (WRC), Pretoria.
- Director: UNESCO West Coast Biosphere, South Africa
- Director (Deputy Chairperson): Grotto Bay Home Owner's Association
- Member Dassen Island Protected Area Association (PAAC)

Membership of Professional Societies

- South African Council for Scientific Professions. Registered Scientist No. 400041/96
- Water Institute of South Africa. Member

Reports

- Process Review Kathu Wastewater Treatment Works
- Effluent Irrigation Report Tydstroom Abattoir Durbanville
- River Rehabilitation Report Slangkop Farm, Yzerfontein
- Fresh Water and Estuary Report Erf 77 Elands Bay
- Ground Water Revision, Moorreesburg Cemetery
- Fresh Water Report Delaire Graff Estate, Stellenbosch
- Fresh Water Report Quantum Foods (Pty) Ltd. Moredou Poultry Farm, Tulbagh
- Fresh Water Report Revision, De Hoop Development, Malmesbury
- Fresh Water Report, Idas Valley Development Erf 10866, Stellenbosch
- Wetland Delineation Idas Valley Development Erf 10866, Stellenbosch
- Fresh Water Report, Idas Valley Development Erf 11330, Stellenbosch
- Fresh Water Report, La Motte Development, Franschhoek
- Ground Water Peer Review, Elandsfontein Exploration & Mining
- Fresh Water Report Woodlands Sand Mine Malmesbury
- Fresh Water Report Brakke Kuyl Sand Mine, Cape Town
- Wetland Delineation, Ingwe Housing Development, Somerset West
- Fresh Water Report, Suurbraak Wastewater Treatment Works, Swellendam
- Wetland Delineation, Zandbergfontein Sand Mine, Robertson
- Storm Water Management Plan, Smalblaar Quarry, Rawsonville
- Storm Water Management Plan, Riverside Quarry
- Water Quality Irrigation Dams Report, Langebaan Country Estate
- Wetland Delineation Farm Eenzaamheid, Langebaan
- Wetland Delineation Erf 599, Betty's Bay
- Technical Report Bloodhound Land Speed Record, Hakskeenpan
- Technical Report Harkerville Sand Mine, Plettenberg Bay
- Technical Report Doring Rivier Sand Mine, Vanrhynsdorp
- Rehabilitation Plan Roodefontein Dam, Plettenberg Bay
- Technical Report Groenvlei Crusher, Worcester
- Technical Report Wiedouw Sand Mine, Vanrhynsdorp
- Technical Report Lair Trust Farm, Augrabies
- Technical Report Schouwtoneel Sand Mine, Vredenburg
- Technical Report Waboomsrivier Weir Wolseley
- Technical Report Doornkraal Sand Mine Malmesbury
- Technical Report Berg-en-Dal Sand Mine Malmesbury
- Wetland Demarcation, Osdrif Farm, Worcester
- Technical Report Driefontein Dam, Farm Agterfontein, Ceres
- Technical Report Oewerzicht Farm Dam, Greyton
- Technical Report Glen Lossie Sand Mine, Malmesbury
- Preliminary Report Stellenbosch Cemeteries
- Technical Report Toeka & Harmony Dams, Houdenbek Farm, Koue Bokkeveld
- Technical Report Kluitjieskraal Sand & Gravel Mine, Swellendam
- Fresh Water Report Urban Development Witteklip Vredenburg
- Fresh Water Report Groblershoop Resort, Northern Cape
- Fresh Water Report CA Bruwer Quarry Kakamas, Northern Cape
- Fresh Water Report, CA Bruwer Sand Mine, Kakamas, Northern Cape
- Fresh Water Report, Triple D Farms, Agri Development, Kakamas
- Fresh Water Report, Keren Energy Photovoltaic Plant Kakamas
- Fresh Water Report, Keren Energy Photovoltaic Plant Hopetown
- Fresh Water Report Hopetown Sewer
- Fresh Water Report Hoogland Farm Agricultural Development, Touws River
- Fresh Water Report Klaarstroom Waste Water Treatment Works

- Fresh Water Report Calvinia Sports Grounds Irrigation
- Fresh Water Report CA Bruwer Agricultural Development Kakamas
- Fresh Water Report Zwartfontein Farm Dam, Hermon
- Statement Delsma Farm Wetland, Hermon
- Fresh Water Report Lemoenshoek Farms Pipelines Bonnyvale
- Fresh Water Report Water Provision Pipeline Brandvlei
- Fresh Water Report Erf 19992 Upington
- Botanical Report Zwartejongensfontein Sand Mine, Stilbaai

24 Appendix

24.1 Methodology used in determining significance of impacts

The methodology to be used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks associated with the alternatives is provided in the following tables:

Table 24.1.1 Nature and type of impact

Nature and type of impact	Description
Positive	An impact that is considered to represent an improvement to the baseline conditions or represents a positive change
Negative	An impact that is considered to represent an adverse change from the baseline or introduces a new negative factor
Direct	Impacts that result from the direct interaction between a planned project activity and the receiving environment / receptors
Indirect	Impacts that result from other activities that could take place as a consequence of the project (e.g. an influx of work seekers)
Cumulative	Impacts that act together with other impacts (including those from concurrent or planned future activities) to affect the same resources and / or receptors as the project

Table 24.1.2 Criteria for the assessment of impacts

Criteria	Rating	Description
Spatial extent of impact	National	Impacts that affect nationally important environmental resources or affect an area that is nationally important or have macro-economic consequences
	Regional	Impacts that affect regionally important environmental resources or are experienced on a regional scale as determined by administrative boundaries or habitat type / ecosystems
	Local	Within 2 km of the site
	Site specific	On site or within 100m of the site boundary
Consequence of impact/ Magnitude/ Severity	High	Natural and / or social functions and / or processes are severely altered
	Medium	Natural and / or social functions and / or processes are notably altered
	Low	Natural and / or social functions and / or processes are slightly altered
	Very Low	Natural and / or social functions and / or processes are negligibly altered
	Zero	Natural and / or social functions and / or processes remain unaltered
Duration of impact	Temporary	Impacts of short duration and /or occasional
	Short term	During the construction period
	Medium term	During part or all of the operational phase
	Long term	Beyond the operational phase, but not permanently
	Permanent	Mitigation will not occur in such a way or in such a time span that the impact can be considered transient (irreversible)

Table 24.1.3 Significance Rating

Significance Rating	Description
High	High consequence with a regional extent and long-term duration High consequence with either a regional extent and medium-term duration or a local extent and long-term duration Medium consequence with a regional extent and a long-term duration
Medium	High with a local extent and medium-term duration High consequence with a regional extent and short-term duration or a site-specific extent and long-term duration High consequence with either local extent and short-term duration or a site-specific extent with a medium-term duration Medium consequence with any combination of extent and duration except site-specific and short-term or regional and long term Low consequence with a regional extent and long-term duration
Low	High consequence with a site-specific extent and short-term duration Medium consequence with a site-specific extent and short-term duration Low consequence with any combination of extent and duration except site-specific and short-term Very low consequence with a regional extent and long-term duration
Very low	Low consequence with a site-specific extent and short-term duration Very low consequence with any combination of extent and duration except regional and long term
Neutral	Zero consequence with any combination of extent and duration

Table 24.1.3 Significance Rating

Significance Rating	Description
High	High consequence with a regional extent and long-term duration High consequence with either a regional extent and medium-term duration or a local extent and long-term duration Medium consequence with a regional extent and a long-term duration
Medium	High with a local extent and medium-term duration High consequence with a regional extent and short-term duration or a site-specific extent and long-term duration High consequence with either local extent and short-term duration or a site-specific extent with a medium-term duration Medium consequence with any combination of extent and duration except site-specific and short-term or regional and long term Low consequence with a regional extent and long-term duration
Low	High consequence with a site-specific extent and short-term duration Medium consequence with a site-specific extent and short-term duration Low consequence with any combination of extent and duration except site-specific and short-term Very low consequence with a regional extent and long-term duration
Very low	Low consequence with a site-specific extent and short-term duration Very low consequence with any combination of extent and duration except regional and long term
Neutral	Zero consequence with any combination of extent and duration

Table 24.2 Risk Matrix Methodology

RISK ASSESSMENT KEY (Referenced from DWA RISK-BASED WATER USE AUTHORISATION APPROACH AND DELEGATION GUIDELINES)

Negative Rating

TABLE 1- SEVERITY

How severe does the aspects impact on the environment and resource quality characterisitics (flow regime, water quality, geomorfology, biota, habitat)

Insignificant / non-harmful	1
Small / potentially harmful	2
Significant / slightly harmful	3
Great / harmful	4
Disastrous / extremely harmful and/or wetland(s) involved	5
Where "or wetland(s) are involved" it means	

TABLE 2 – SPATIAL SCALE

How big is the area that the aspect is impacting on?

Area specific (at impact site)	1
Whole site (entire surface right)	2
Regional / neighbouring areas (downstream within quaternary catc	3
National (impacting beyond seconday catchment or provinces)	4
Global (impacting beyond SA boundary)	5

TABLE 3 – DURATION

How long does the aspect impact on the environment and resource quality?

One day to one month, PES, EIS and/or REC not impacted
One month to one year, PES, EIS and/or REC impacted but no change in status
One year to 10 years, PES, EIS and/or REC impacted to a lower status but can be improved over this period through mitigation
Life of the activity, PES, EIS and/or REC permanently lowered
More than life of the organisation/facility, PES and EIS scores, a E or F

TABLE 4 – FREQUENCY OF THE ACTIVITY

How often do you do the specific activity?

Annually or less	1
6 monthly	2
Monthly	3
Weekly	4
Daily	5

TABLE 5 – FREQUENCY OF THE INCIDENT/IMPACT

How often does the activity impact on the environment?

Almost never / almost impossible / >20%	1
Very seldom / highly unlikely / >40%	2
Infrequent / unlikely / seldom / >60%	3
Often / regularly / likely / possible / >80%	4
Daily / highly likely / definitely / >100%	5

TABLE 6 – LEGAL ISSUES

How is the activity governed by legislation?

No legislation
Fully covered by legislation (wetlands are legally governed)
Located within the regulated areas

TABLE 7 – DETECTION

How quickly can the impacts/risks of the activity be observed on the environment (water resourc

Immediately
Without much effort
Need some effort
Remote and difficult to observe
Covered

TABLE 8: RATING CLASSES

RATING	CLASS	MANAGEMENT DESCRIPTION
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated. Wetlands may be excluded.
56 – 169	M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and
170 – 300	(H) High Risk	Always involves wetlands. Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale

A low risk class must be obtained for all activities to be considered for a GA