Vardocube (Pty) Ltd

Basic Assessment Report

Application for Environmental Authorisation for the Irrigation of Underground Water

October 2020

ABS Africa
Sustainability Advisors

TABLE OF CONTENTS

Contents

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

LIST OF MAPS IN APPENDIX B

LIST OF ACRONYMS AND ABBREVIATIONS

AAA	Astronomy Advantage Areas
AMD	Acid Mine Drainage
BAR	Basic Assessment Report
CBA	Critical Biodiversity Area
DEA	Department of Environmental Affairs
DMR	Department of Mineral Resources
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
ESA	Ecological Support Area
I&APs	Interested and Affected Parties
IDP	Integrated Development Plan
LED	Local Economic Development
Mamsl	Metres above mean sea level
Mm	Millimetre
MPRDA	Minerals and Petroleum Resources Development Act
MR	Mining Right
MRA	Mining Right Application
NEMA	National Environmental Management Act
NEM:AOA	National Environmental Management: Air Quality Act
NEM:WA	National Environmental Management: Waste Act
NHRA	National Heritage Resources Act
NWA	National Water Act
p.a.	Per annum
PCZM	Prieska Copper Zinc Mine
PCZML	Prieska Copper Zinc Mine Limited
PM	Particulate Matter
RO	Reverse Osmosis
SAHRA	South African Heritage Resource Agency
SDF	Spatial Development Framework
SLM	Siyathemba Local Municipality
TSF	Tailings Storage Facility
WSA	Water Services Authority
WSP	Water Services Provider
WWTP	Waste Water Treatment Plant

PART A
BASIC ASSESSMENT REPORT

1.1 DETAILS OF THE EAP WHO PREPARED THE REPORT

NAME OF THE PRACTITIONER:	ABS Africa (Pty) Ltd.
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POSTAL ADDRESS:	PO Box 14003, Vorna Valley, 1686
E-MAIL ADDRESS:	chane@abs-africa.com / louisa@abs-africa.com

1.2 EXPERTISE OF THE EAP

1.2.1 THE QUALIFICATIONS OF THE EAP

Name: Ms. Chané Pretorius

Academic Qualifications:

- Bachelor of Science in Tourism: North West University, 2010
- Bachelor of Science (Honours) in Geography: University of Johannesburg, 2011

Name: Miss. Louisa de Wet

Academic Qualifications:

- Bachelor of Science in Environmental and Biological Sciences: North West University, Potchefstroom, 2018.
- Bachelor of Science (Honours) in Environmental Sciences with Aquatic Ecosystem Health: North West University, Potchefstroom, 2019.

1.2.2 SUMMARY OF THE EAPS PAST EXPERIENCE

ABS Africa (Pty) Ltd is a professional environmental advisory company with a focus on the mining environment. The ABS Africa personnel included in the project team structure for the independent environmental assessment have collectively completed more than 100 EIAs across the African continent.

Much of this experience has been gained in undertaking complex and challenging EIAs involving the management of specialist teams, conducting public participation processes, aligning international standards with in-country legislation and interfacing with project engineering teams.

The EAP responsible for this submission has 7 years' experience in coordinating and managing various environmental studies in the energy, mining and infrastructure sectors.

Her project experience includes the management and compilation of local and international Environmental and Social Impact Assessments, in compliance with in-country and international standards. She has undertaken projects in South Africa, Namibia, Zimbabwe, Mali, Ghana and Mozambique. Please refer to Appendix B for a record of the experience of the EAP.

2 DESCRIPTION OF THE PROPERTY

2.1 OVERVIEW

The Prieska Copper Zinc Mine (PCZM) is situated approximately 3 km south of Copperton and 60 km south-west of the town of Prieska in the Northern Cape Province. The mine falls within the authority of the Siyathemba Local Municipality (Appendix C, MAP 1). The site is accessed via the R357 from Prieska. The mine was owned and operated by Prieska Copper Mine Limited (PCM), a subsidiary of Anglo-Transvaal Consolidated Investment Company Limited (Anglovaal), between 1971 and 1991. The mine operations ceased in 1991 and rehabilitation and closure of the mine was undertaken in accordance with agreements reached with the Department of Mineral and Energy Affairs. A closure certificate was issued by the latter on 19 October 1995. No mining activities have taken place at PCZM since 1991.

Orion Minerals (Orion) through its subsidiary company Prieska Copper Zinc Mine (Pty) Ltd holds a mining Right (NC30/5/1/2/3/2/1/10138 MR) to re-establish operations at the PCZM.

In order to gain access to the ore deposit, approximately 8.7 million m^3 of water must be pumped out from the underground mine which has become flooded since its closure approximately 30 years ago. A portion of the underground water will be evaporated from the Tailings Storage Facility (TSF), while the remaining water will be treated and then irrigated onto a selected area of the adjacent farm (Remaining Extent of Portion 1 of the Farm Vogelstruisbult 104).

Orion, through its subsidiary company Vardocube (Pty) Ltd., is also the holder of a MR (NC30/5/1/2/2/10146 MR) on the Remaining Extent of Portion 1 of the Farm Vogelstruisbult 104.

The existing Vardocube Environmental Authorisation did not consider any surface infrastructure, since mining will only be undertaken underground. The pipelines required for the irrigation of the underground mine water on the Vardocube property triggers new listed activities in terms of Listing Notice 1 and Listing Notice 3 of the Environmental Impact Assessment Regulations (2014) and a Basic Assessment Process is thus required in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA).

TABLE 2-1: DESCRIPTION OF THE PROPERTIES

FARM NAMES:	Remaining Extent of Portion 1 of the Farm Vogelstruisbult 104
APPLICATION AREA (HA):	The MR is1565 Ha and the proposed area for irrigation is 1 100 Ha
MAGISTERIAL DISTRICT:	Prieska, Northern Cape
MUNICIPALITIES	Siyathemba Local Municipality Pixley ka Seme District Municipality
DISTANCE AND DIRECTION TO NEAREST TOWNS	Copperton is situated approximately 3 km north of the proposed underground mining area. Prieska is approximately 60 km to the north-east.

TABLE 2-2: DIGIT SURVEYOR-GENERAL CODE FOR EACH FARM PORTION

FARM NAME	PORTION	TITLE DEED	21 DIGIT SURVEY OR GENERAL CODE FOR EACH FARM PORTION
Vogelstruisbult 104	RE/1	T18939/2003	C06000000000010400001

2.2 LOCALITY MAP

Please refer to Appendix C.

3 DESCRIPTION OF THE SCOPE OF THE PROPOSED OVERALL ACTIVITY

3.1 LISTED AND SPECIFIED ACTIVITIES

NAME OF ACTIVITY (ALL ACTIVITIES INCLUDING ACTIVITIES NOT LISTED) (E.G. EXCAVATIONS, BLASTING, STOCKPILES, DISCARD DUMPS OR DAMS, LOADING, HAULING AND TRANSPORT, WATER SUPPLY DAMS AND BOREHOLES, ACCOMMODATION, OFFICES, ABLUTION, STORES, WORKSHOPS, PROCESSING PLANT, STORM WATER CONTROL, BERMS, ROADS, PIPELINES, POWER LINES, CONVEYORS, ETC…ETC…ETC.)	AERIAL EXTENT OF THE ACTIVITY HA OR M^2	LISTED ACTIVITY MARK WITH AN X WHERE APPLICABLE OR AFFECTED	APPLICABLE LISTING NOTICE (GNR 544, GNR 545 OR GNR 546)/ NOT LISTED	WASTE MANAGEMENT AUTHORISATION (INDICATE WHETHER AN AUTHORISATION IS REQUIRED IN TERMS OF THE WASTE MANAGEMENT ACT). (MARK WITH AN X)
Main pipeline from RO plant and Irrigation feedline (temporary)	Approximately 12 km		• GN R.327 [1(9] • GN R.327 [1(27)] • GN R.324 [3(12)]	

All applicable listed activities from the Listing Notices in the EIA Regulations, 2014 (as amended) requiring Environmental Authorisation are specified in Table 4-2.

4 POLICY AND LEGISLATIVE CONTEXT

Table 4-1 provides a description of the legislation which has particular importance to the BAR process being undertaken for the development.

TABLE 4-1: POLICY AND LEGISLATIVE CONTEXT

APPLICABLE LEGISLATION AND GUIDELINES USED TO COMPILE THE REPORT (A DESCRIPTION OF THE POLICY AND LEGISLATIVE CONTEXT WITHIN WHICH THE DEVELOPMENT IS PROPOSED INCLUDING AN IDENTIFICATION OF ALL LEGISLATION, POLICIES, PLANS, GUIDELINES, SPATIAL TOOLS, MUNICIPAL DEVELOPMENT PLANNING FRAMEWORKS AND INSTRUMENTS THAT ARE APPLICABLE TO THIS ACTIVITY AND ARE TO BE CONSIDERED IN THE ASSESSMENT PROCESS)	REFERENCE WHERE APPLIED
ACTS	
National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA)	NEMA provides 18 specific principles relating to Environmental Management. Of key importance are the precautionary principle and the polluter pays principle. The 18 principles of NEMA are to be recognised during the undertaking of the Impact Assessment Process and play a key role during the decision-making process. Section 24 of NEMA requires environmental authorisation to be obtained for certain activities identified in three listing notices, published on 4 December 2014. The procedure for obtaining an environmental authorisation requires either a basic assessment (activities in Listing Notice 1 and 3) or scoping and Environmental Impact Assessment (activities in Listing Notice 2) process to be undertaken to inform the application for authorisation. **The proposed irrigation activities fall within the ambit of various listed activities in Listing Notice 1 and Listing Notice 3. Since activities in Listing Notice 1 and Listing Notice 3 apply to the proposed pipeline required for the irrigation activities, a Basic Assessment (BA) process is being followed. The BA process is being undertaken in compliance with the requirements of NEMA and the EIA Regulations, 2014.**
Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA)	The MPRDA regulates the acquisition, use and disposal of mineral and petroleum rights. **This Act is not applicable for the proposed irrigation activities.**
National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) (NEM:WA)	The NEM: WA provides for the reform of waste management legislation and repeals or amends the legislation under which waste was previously regulated. Part 4 of the NEM: WA pertains to listed waste management activities. In accordance with section 19(2) of the NEM: WA, the Minister published a schedule of listed waste management activities in Government Notice (GN) 921 of 29 November 2013. These are considered activities that have or are likely to have a detrimental effect on the environment. According to regulation 2 of GN 921, no person may commence, undertake, or conduct a listed waste management activity unless a licence is issued in respect of that activity. **No application in terms of NEM:WA is required for the intended irrigation activities.**
Mine Health and Safety Act, 1996 (Act No. 29 of 1996) (MHSA)	The objective of the Act is to cover all aspects relating to health and safety of employees and other persons on the mine property. The Act places the responsibility on the mine owner for ensuring that the mine

	is designed, constructed and equipped in a manner which allows for a safe and healthy working environment. **This Act is not applicable for the proposed irrigation activities.**
The National Water Act, 1998 (Act No. 36 of 1998) (NWA)	The National Water Act, 1998 (Act No. 36 of 1998), identifies 11 consumptive and non-consumptive water uses, which must be authorised under a tiered authorisation system, which include Scheduled uses, General Authorisations, or Licenses. In terms of the National Water Act, the following water uses are identified: (a) Taking water from a water resource; (b) Storing water; (c) Impeding or diverting the flow of water in a watercourse; (d) Engaging in a stream flow reduction activity contemplated in section 36; (e) Engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1); (f) Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit; (g) Disposing of waste in a manner which may detrimentally impact on a water resource; (h) Disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process; (i) Altering the bed, banks, course or characteristics of a watercourse; (j) Removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and (k) Using water for recreational purposes. **No WUL application has been identified as being necessary for the irrigation activities.**
National Environmental Management: Air Quality Act 2004 (Act No. 39 of 2004) (NEM:AQA)	The main objectives of the National Environmental Management: Air Quality Act 2004 (Act no. 39 of 2004) (NEM: AQA) are to protect the environment by providing reasonable legislative and other measures to: ➲ Prevent air pollution; and ➲ Promote conservation and secure ecologically sustainable development. **This Act is not applicable for the proposed irrigation activities.**
National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA)	The NHRA describes the importance of heritage in the South African context, and designates the South African Heritage Resource Agency (SAHRA) as guardian of the national estate which may include heritage resources of cultural significance that link to biodiversity, such as places to which oral traditions are attached or which are associated with living heritage, historical settlements, landscapes and natural features of cultural significance, archaeological and paleontological sites, graves and burial grounds, or movable objects associated with living heritage. Section 38 of the Act requires a Heritage Impact Assessment (HIA) to be undertaken for various types of development. If the HIA demonstrates that the development will have an impact on a heritage resource, approval from the South African Heritage Resource Agency, or the relevant provincial heritage authority is needed prior to proceeding with the development. **Based on research conducted in the area ESA, MSA and LSA scatters as well as sites can be expected in the larger study area. Heritage artefacts are common in the study area. A chance find procedure is**

	incorporated in the EMPr to ensure that no significant archaeological sites or finds are disturbed or impacted upon.
Astronomy Geographic Advantage Act, 2007 (Act No. 21 of 2007)	Provides for the protection, preservation and maintenance, in respect of radio frequency interference or interference in any other way, of declared astronomy advantage areas. Three Central Astronomy Advantage Areas have been established to date, namely: ➲ The Northern Cape Province, excluding Sol Plaatje Municipality ➲ The Karoo Core AAA ➲ The Karoo Central AAA **The proposed irrigation activities are not expected to interfere with the radio astronomy work.**
GUIDELINES	
Department of Environmental Affairs Guideline Series 7: Public Participation (2012)	The public participation guideline outlines the importance of public participation as well as the minimum legal requirements for the public participation process, the steps to be taken and the guideline for planning a public participation process. **The public participation process for this application has incorporated relevant requirements of the guideline.**
Department of Environmental Affairs Guideline Series 9: Need and Desirability (2012)	The need and desirability guideline highlights the importance of establishing and assessing the need and desirability for a project. The consideration of need and desirability in the EIA decision making process requires the consideration of the strategic importance of the development alongside the broader societal need and public interests. **The need and desirability description for the proposed development has taken cognisance of this guideline.**

4.1 LISTED ACTIVITIES IDENTIFIED IN TERMS OF NEMA, NEM:WA AND NWA

TABLE 4-2: NEMA LISTED ACTIVITIES APPLICABLE TO THE PROPOSED IRRIGATION ACTIVITIES

NEMA LISTED ACTIVITIES		
REGULATION	**ACTIVITY NUMBER**	**SUMMARY DESCRIPTION**
GN R.327, 8 December 2014 (as amended on 7 April 2017) **Listing Notice 1: Basic Assessment**	1(9)	The development of infrastructure exceeding 1 000 metres in length for the bulk transportation of water or storm water— (i) With an internal diameter of 0,36 metres or more; or (ii) With a peak throughput of 120 litres per second or more; excluding where— (a) Such infrastructure is for bulk transportation of water or storm water or storm water drainage inside a road reserve or railway line reserve; or (b) Where such development will occur within an urban area.
GN R.327, 8 December 2014 (as amended on 7 April 2017)	1(27)	The clearance of an area of 1 hectares or more, but less than 20 hectares of indigenous vegetation, except where such clearance of indigenous vegetation is required for— (i) The undertaking of a linear activity; or (ii) Maintenance purposes undertaken in accordance with a maintenance management plan.+

Listing Notice 1: Basic Assessment		
GN R.324, 8 December 2014 (as amended on 7 April 2017) **Listing Notice 3: Basic Assessment**	3(12)	The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan. (g) Northern Cape i. Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004; ii. Within critical biodiversity areas identified in bioregional plans; iii. Within the littoral active zone or 100 metres inland from high water mark of the sea or an estuary, whichever distance is the greater, excluding where such removal will occur behind the development setback line on erven in urban areas; or iv. On land, where, at the time of the coming into effect of this Notice or thereafter such land was zoned open space, conservation or had an equivalent zoning.

5 NEED AND DESIRABILITY OF THE PROPOSED ACTIVITIES

To gain access to the PCZM underground workings, approximately 8.7 million cubic meters of water must be pumped out from the underground mine. Several water management strategies have been considered, and the potential for irrigation is considered favourable in terms of the current land use. The project is temporary, and no permanent infrastructure will remain after closure and rehabilitation. It is thus not anticipated that any significant long term impacts will be cause by the proposed project.

6 MOTIVATION FOR THE PREFERRED DEVELOPMENT FOOTPRINT WITHIN THE APPROVED SITE INCLUDING A FULL DESCRIPTION OF THE PROCESS FOLLOWED TO REACH THE PROPOSED DEVELOPMENT FOOTPRINT WITHIN THE APPROVED SITE

6.1 DETAILS OF THE DEVELOPMENT FOOTPRINT ALTERNATIVES CONSIDERED

6.1.1 THE PROPERTY ON WHICH OR LOCATION WHERE IT IS PROPOSED TO UNDERTAKE THE ACTIVITY

Vardocube is situated on the Remaining Extent of Portion 1 of the Farm Vogelstruisbult 104) located in the Northern Cape Province, approximately 60km south-west of the town of Prieska at Copperton.

6.1.2 THE TYPE OF ACTIVITY TO BE UNDERTAKEN

The proposed activity to be undertaken consists of the utilisation of treated water as irrigation of natural veld as a water management strategy. The water will be pumped out from the PCZM underground mine.

A portion of the underground water will be forced evaporated from the Tailings Storage Facility (TSF), while the remaining water will be treated and then irrigated onto a selected area of the Vardocube property. Water will be delivered from a Reverse Osmosis (RO) Waste Water Treatment Plant (WWTP) into a blended water tank, and will be pumped to a local irrigation water break tank, approximately 6 km away, north-east of Copperton Village. This water will be compliant with the water quality guidelines for irrigation.

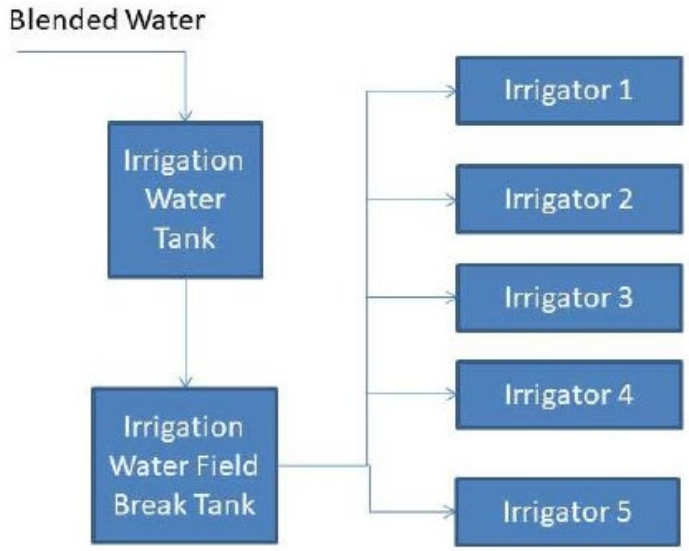


FIGURE 6-1: PROCESS FLOW DIAGRAM

6.1.3 THE DESIGN OR LAYOUT OF THE ACTIVITY

The irrigation system was designed to align with the soil condition, depth and water absorption rates as well as the holding capacity. Further consideration was given for the monthly and annual rainfall in the region so as to prevent any negative impact on the local ecosystem. As such it was determined to irrigate the local fields at a variable rate, between 20 and 40 mm/month, with the average irrigation for the region to be 28.7 mm/month. Each of the individual irrigators has been separately calculated along their respective linear paths, so as to align with the following philosophy:

- 5 mm/pass on minimal soil regions (<10mm Soil)
- 7.5 mm/pass on intermediate soil regions (10 to 20 mm Soil)
- 10 mm/pass on high soil regions (>20 mm Soil)

Copperton typically receives an average of 20 mm per month of rainfall, with February, March and April averaging 40 mm/month.

All the irrigators have been designed to operate on 4 passes per month, with resulting monthly wetting within nominal environmental conditions, between 20 and 40 mm per month.

The irrigation system, being linear irrigators, requires that each of the irrigators is periodically connected to a linear water transfer system as the irrigator moves along its pre-determined line of irrigation. With the average or nominal velocity of the irrigators in the region of 20 m/h, and the take-off points located every 200 m, the system will be periodically switched off and re-started every 10 hours per system. This will by association mean an average switching rate of approximately one system every 2 hours on a continual basis throughout the irrigation process, although at certain stages in the irrigation cycle this may be frequent.

The instantaneous capacity of the total system is currently designed to process a maximum 900 m^3/hr, which is around double the required capacity. With the expected operational requirements of switch-in and exchange every two hours there is sufficient capacity to have one of the five units under long term maintenance (>5 days), with 2 other units in a switching phase. This has been calculated to be statistically certain and as such is a safe estimate based on the feed tank storage capacity.

The selected area for the proposed activity includes temporary pipelines and a total of about 1100 ha to optimise the irrigator design and operation. The area was selected specifically to maximise the area for irrigation while

simultaneously optimising the capital costs of the required equipment and minimising the associated operational expenses.

6.1.4 THE TECHNOLOGY TO BE USED IN THE ACTIVITY

A RO WWTP Plant will be used to treat water to an acceptable level so that it can be irrigated.

The irrigation system will comprise five linear pivots covering approximately 1 250 ha that are all fed from the same irrigation water break tank. The linear pivot will be used to irrigate natural vegetation at a rate that is similar to the annual rainfall in the area. The proposal is to irrigate the natural vegetation at 20 mm per month for a 10 month period in a regular and controlled manner to avoid erosion and promote natural vegetation growth. The proposal is to irrigate 2.7 million m^3 of water in 10 months. This accounts for approximately 31 % of the total underground water which will be pumped out from the flooded mine during the dewatering process.

6.1.5 THE OPTION OF NOT IMPLEMENTING THE ACTIVITY

Several options for water management strategies have been considered. Irrigation of the treated water would be a more beneficial use of the water. If the proposed project is not implemented, this benefit may be lost and other design alternatives would need to be considered, which could potentially increase the impact to the environment.

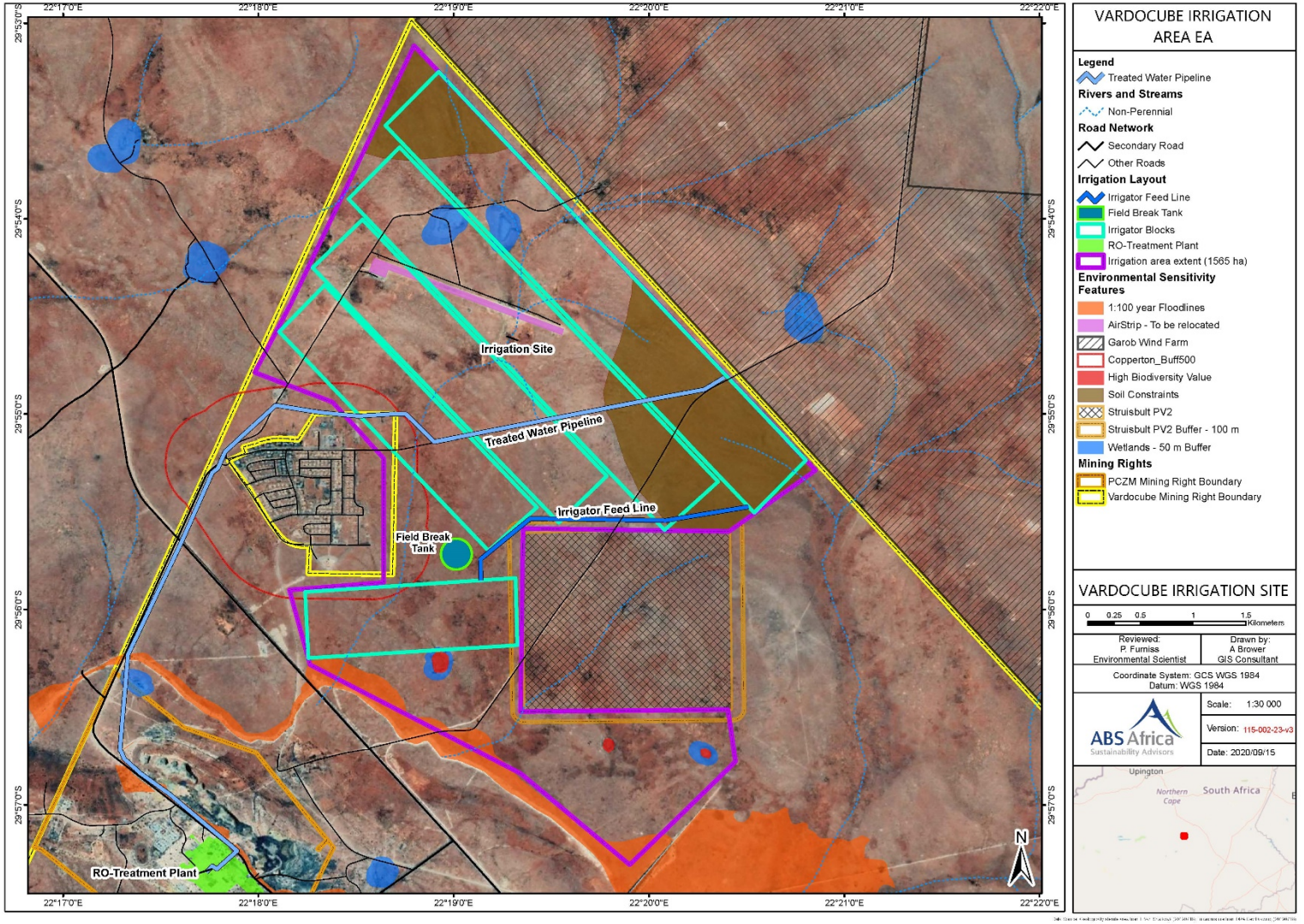


FIGURE 6-2: VARDOCUBE IRRIGARION LAYOUT

7 DETAILS OF PUBLIC PARTICIPATION PROCESS FOLLOWED

The public participation process has been undertaken in accordance with Chapter 6 of the EIA Regulations, 2014 (as amended) and the DEA Public Participation Guidelines.

7.1 NOTIFICATION PHASE

- All I&APs have been notified by the following means of the application for an EA for the proposed irrigation activities Application notification letter;
- Placement of statutory advertisement in the local newspaper; and
- Placement of on-site notice boards at several locations within the study area.

7.2 DRAFT BAR

I&APs were informed in writing and through the site and newspaper notices of the availability of the Draft BAR. The Draft BAR is made available for 30 calendar days and I&APs are encouraged to provide ABS Africa with feedback, comments or concerns regarding the proposed irrigation activities.

7.3 I&AP IDENTIFICATION, CONSULTATION AND DATABASE MANAGEMENT

Throughout the BA Process, the PPP Team has compiled and maintained an electronic database of I&APs that contains a full and complete record of all public participation activities.

All landowners and land occupiers required to be notified in terms of the EIA Regulations, 2014 (as amended) have been identified and requested to participate in the BA Process. This was achieved through the following means:

- Records made available by the Applicant;
- Contacting landowner associations or organised agriculture in the study area; and
- Collating landowner information during field visits, and I&AP discussions including referrals.

7.4 MUNICIPAL COUNCILLORS

In terms of representative democracy and in line with the provisions of the Municipal Systems Act, 2000, Councillors are recognised as the elected representatives of the people. Councillors have a mandate as elected representatives to participate on behalf of and to provide feedback to their constituencies. The relevant municipal councillors for the ward in which the proposed irrigation area is located has been registered on the I&AP database and included in the public participation notifications.

7.5 FINAL BAR

All I&APs will be notified of the submission of the Final BAR and will be provided with access thereto on request.

7.6 NOTIFICATION OF DECISION

Upon receipt of the decision on the EA, the EIA Project Team will assist the applicant in making the application decision available to all registered I&APs and notifying them of the appeal procedure to be followed in terms of the National Appeal Regulations [Government Notice No. R.993 promulgated in terms of section 44(1a) and 43(4) of NEMA].

7.7 SUMMARY OF ISSUES RAISED BY I&APS

Comments and responses received during the PPP phase will be included and responded to in the Final BAR.

8 THE ENVIRONMENTAL ATTRIBUTES ASSOCIATED WITH THE SITES

8.1 CLIMATE

PCZM is situated in the BWh (mild desert climate) of the Köppen Climate Classification System. Climatic conditions are characterised by warm to hot summers, high evaporation and dry warm winters, a mean annual rainfall of 198 mm and a large degree of variability in the monthly rainfall. Potential evaporation is extremely high. The temperatures are highest in January and coldest month in July.

8.1.1 MEAN ANNUAL RAINFALL

Preliminary investigation of the site hydrological characteristics by Peens & Associates (2017) indicate a Mean Annual Rainfall of 198 mm for the site. Rainfall is strongly seasonal with approximately 60% of the yearly rainfall falling in the summer months (October to January) (Table 8-1).

8.1.2 MEAN ANNUAL EVAPORATION

Regional evaporation data obtained from gauging stations operated by the Department of Water and Sanitation (DWS) was used by Peens & Associates (2017) to calculate a Mean Annual Evaporation (MAE) of 2714 mm for the area (Table 8-2).

TABLE 8-1: MEAN MONTHLY AND ANNUAL RAINFALL AND EVAPORATION

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANNUAL
RAINFALL													
MM	26.6	31.2	41.0	23.3	9.3	4.8	5.2	5.5	5.2	12.2	15.3	18.8	**198**
%	13.4	15.7	20.7	11.8	4.7	2.4	2.6	2.8	2.6	6.1	7.7	9.5	100
EVAPORATION													
MM	283	336	380	373	295	241	158	109	82	100	146	211	**2 714**
%	10.4	12.4	14.0	13.7	10.9	8.9	5.8	4.0	3.0	3.7	5.4	7.8	100

Source: Peens & Associates (2017)

8.1.3 TEMPERATURE

High maximum and very low minimum temperatures characterise the environment. The temperatures are highest in January with an average around 26.9°C. July is the coldest month with 9.8°C on average.

TABLE 8-2: MEAN MONTHLY AND ANNUAL TEMPERATURES

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANNUAL
RAINFALL													
MIN	12.1	15	17.8	19.2	18.5	16	11.3	5.9	1.5	1	3.7	7.5	**10.8**
MAX	29.2	31.3	34.1	34.6	33.8	31	26.8	22.3	18.8	18.6	21.7	25.2	**27.3**
AVE	**20.6**	**23.1**	**25.9**	**26.9**	**26.1**	**23.5**	**19**	**14.1**	**10.1**	**9.8**	**12.7**	**16.3**	

Source: South African Weather Service (Prieska Weather Station)

8.1.4 WIND SPEED AND DIRECTION

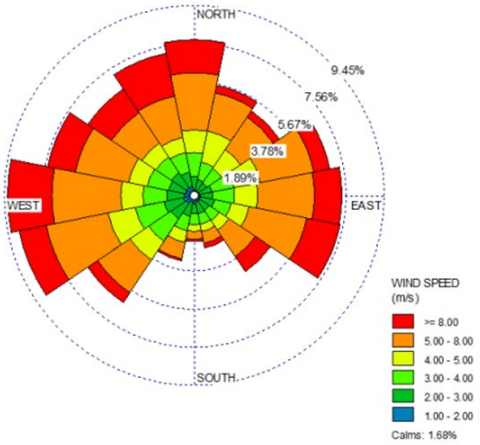
Dominant wind directions and wind speed across the site are presented in Figure 8-1. Seasonal and daytime/night-time variation in wind speeds and direction are also shown.

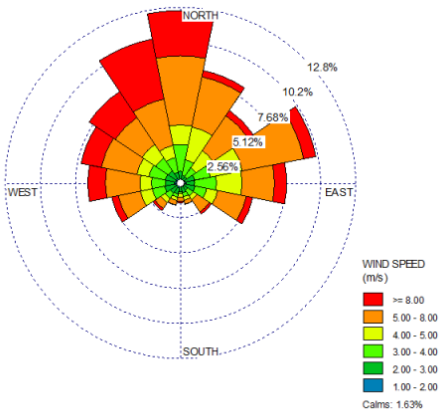
Wind roses comprise 16 spokes, which represent the directions from which the wind blew during a specific period. The colours used in the wind roses reflect the distinct categories of wind speeds; for example, yellow representing winds in between 1.5 and 2 m/s. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories. The frequency with which calms occurred, i.e. periods during which the wind speed was below 1 m/s are also indicated.

Annual average wind direction is dominant from the west and west-west-south. Winds from the north, east and east-east-south are also frequent. Wind is a characteristic of the region, with calm conditions (wind speed less than 1m/s) only being present for 1.58% of the time.

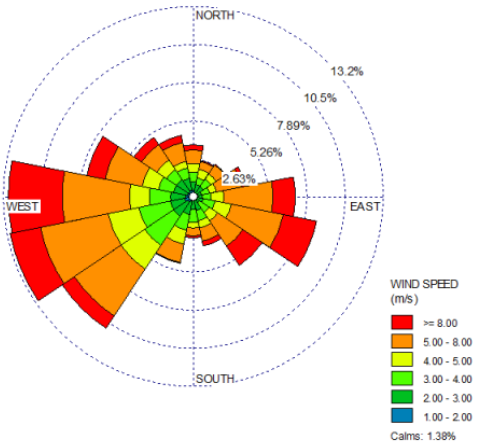
There is a distinct seasonal variation between summer and winter wind direction with predominant winds in winter being from the north and north-north-west. In summer, the predominant wind direction is from the west and west-west-south with south-easterly winds also important. Autumn and spring wind direction is similar to that of winter and summer respectively.

Daytime average wind direction is from the south-west and south-east whereas night-time wind direction is predominantly from a westerly direction. Wind speeds are stronger during night-time compared with daytime conditions.

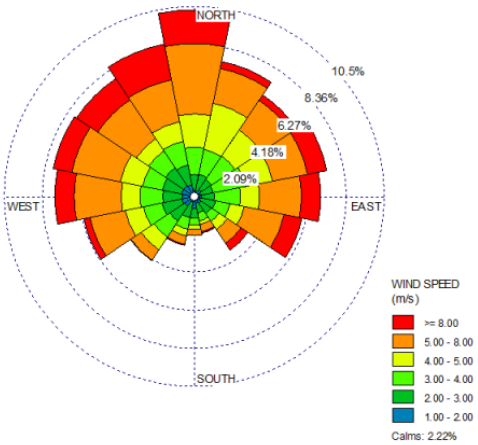


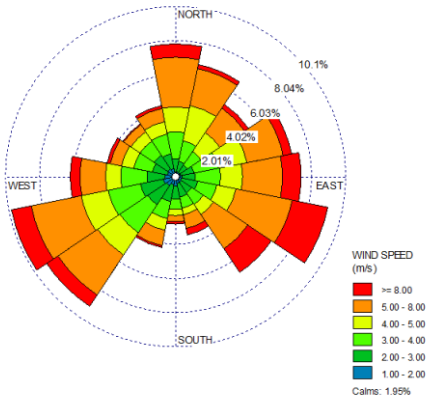
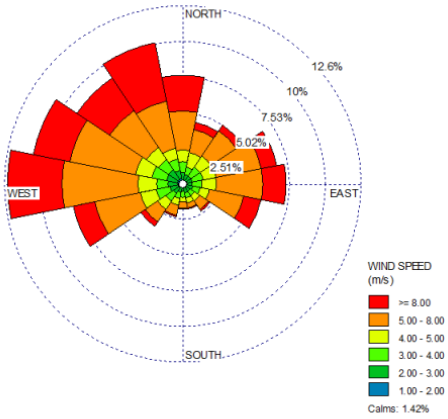


Annual Average



Winter Average



Summer Average	Autumn Average
	
Daytime Average	**Night-time Average**

Source: MM5 Data (2014-2016)

FIGURE 8-1: AVERAGE ANNUAL WIND DIRECTION AND SPEED FOR COPPERTON

8.2 TOPOGRAPHY

The area is flat with no significant natural physiographic features present in the area (Appendix C, MAP 5). The terrain type can be described as slightly irregular plains. Elevation across the site varies from approximately 1100 mamsl (metres above mean sea level) in the east to approximately 1080 mamsl in the west.

8.3 GEOLOGY

The Prieska Orebody is hosted by highly deformed metamorphic rocks of the Copperton Formation of the Areachap Group, which forms part of the Namaqualand Metamorphic Province.

The copper-zinc orebody forms part of a varied sequence of chemical sediments located at the contact between streaky to banded quartz-feldspar-hornblende gneisses and a sequence of varied banded mafic gneisses and amphibolites. Outcrops in the MRA area are sparse and most of the area is covered by thin sand and scree cover and up to 5m thick calcrete. In the southern corner of the MRA surface area tillite, mudstone and shale of the younger Dwyka Formation unconformably overly the rocks of the Copperton Formation.

8.3.1 SOILS AND AGRICULTURAL LAND CAPABILITY

Soils vary significantly in physical composition over different areas. They are strongly influenced by the underlying parent material (geology) from which they were derived and the origin of the parent material (in-situ versus colluvium/alluvium derived), as well as by their position in the landscape (catena). In the area of PCZM-Vardocube the soils are derived from quaternary windblown (alluvium) deposits and residues of the weathering of underlying materials.

The soil forms found on the four PCZM-Vardocube sites are Brandvlei, Coega, Glenrosa, and Plooysburg

- Brandvlei-Br (Orthic A / soft carbonate horizon): The morphology of this soil form indicates calcium or calcium-magnesium carbonates in powder, nodular, honeycomb or boulder form. The carbonate horizon takes dominance over a hydromorphic character.
- Coega-Cg (Orthic A / hardpan carbonate horizon): It is a shallow top soil, generally approximately 30 cm deep, on a lime-cemented calcium carbonate hard bank.

- Glenrosa-Gs (Orthic A / lithocutanic B): The Glenrosa is generally a shallow soil and the underlying material in this case is lithocutanic, which is a tonguing soil/saprolite transition. The tongues penetrate the saprolite and are therefore not continuous. It gradually changes to fractured rock and then to hard rock.
- Plooysburg-Py (Orthic A / red apedal B / hardpan carbonate): The reddish brown colour of these soils is an indication that Iron (Fe) is in an oxidised state (oxygen rich) and that soils have a slightly dryer moisture regime than yellow soils. The B-horizon of these soils does not have significant structure (apedal). The sub soil is a lime-cemented calcium carbonate hard bank. In the case of the observations made in this study the soils of the Plooysburg form are approximately 40 cm deep.

The soils around PCZM-Vardocube are characterized by mainly shallow, calcareous or rocky soils with a high base status or medium deep unconsolidated calcareous materials. Infiltration rates of all the soil forms are high.

According to the land type information the soils of this area can be described as calcareous soils with minimal development, usually shallow on hard or weathering rock. Lime is generally present in part or most of the landscape. The favourable properties and limitations of the broad soil classes have also been investigated from available land type sources. The soils on this site are freely drained, structureless soils and have favourable physical properties, but have restricted soil depth, excessive drainage, and a high erodibility potential, as well as a low natural fertility status.

The soils are generally are between 10 and 20cm deep. The soils of the Vardocube area has a clay content of approximately 6-8% in the topsoil and increasing slightly to 12-14% in the subsoil.

8.4 TERRESTRIAL ECOLOGY

A baseline terrestrial ecology survey was undertaken for the area by Ecorex Consulting Ecologists (2020). This study area included a significant portion of the Vardocube Mining Right Area. A summary of the findings of this survey are presented below.

8.4.1 REGIONAL CONTEXT - NATIONAL VEGETATION TYPES

The study area is situated within the Nama-Karoo Biome. The flora of the Nama-Karoo is not as diverse and rich as the adjacent Succulent Karoo and does not contain any centres of plant endemism. Three geographically distinct bioregions are present within this biome, namely the Bushmanland, Upper Karoo and Lower Karoo. The study area is situated within the Bushmanland Bioregion at the junction of two national vegetation types, namely Bushmanland Arid Grassland (NKb3) and Bushmanland Basin Shrubland (NKb6). (Appendix C, MAP 3).

Bushmanland Arid Grassland has a conservation status of Least Threatened, although only small areas are officially conserved in Augrabies National Park and Goegap Nature Reserve. Bushmanland Basin Shrubland is not represented in any official conservation areas but shows no sign of serious habitat transformation and has a conservation status of Least Threatened.

8.4.2 LOCAL CONTEXT - VEGETATION ASSEMBLAGES

A large proportion of the study area still comprises Natural Habitat that appears to be heavily overgrazed by livestock. This vegetation varies from open grassland to relatively dense shrubland, and is likely to be representative of Bushmanland Basin Shrubland, with elements of Bushmanland Arid Grassland present. This is the vegetation assemblage in which plant species of conservation concern are most likely to be found and is the habitat that is most likely to support populations of fauna species of conservation concern.

Three broad-scale vegetation communities have been identified within the study area, based primarily on analysis of high-resolution satellite imagery.

These are as follows:

- Modified Habitat.

- Undisturbed Natural Habitat; and
- Disturbed Natural Habitat.

All the areas that have been cleared of natural habitat, such as buildings and historical mining facilities, are classified as Modified Habitat.

Undisturbed Natural Habitat was classified into three distinct vegetation communities or assemblages. These are described in Table 8-3.

TABLE 8-3: UNDISTURBED NATURAL HABITAT IN THE STUDY AREA

VEGETATION COMMUNITY	DESCRIPTION	PHOTOGRAPH
Aizoaceae dwarf shrubland on calcrete plains	This vegetation community is found on plains throughout the project area, specifically where calcrete is prominent on the soil surface. It is the vegetation community that is most representative of Bushmanland Basin Shrubland in the project area. Aizoaceae dwarf shrubland differs from *Rhigozum* dwarf shrubland in having noticeably higher diversity of dwarf shrubs and much lower proportional grass cover.	
Rhigozum trichotomum dwarf shrubland on sandy plains	*Rhigozum* dwarf shrubland is found on the deeper, red to reddish brown sands in the project area, usually with little or no evidence of calcrete on the soil surface. While this vegetation community is still representative of Bushmanland Basin Shrubland, it contains elements of Bushmanland Arid Grassland as well, particularly the relative abundance of grass cover.	
Pans	Several circular to sub-circular ephemeral pans are found in the eastern half of the study area, as well as the northern part of the Vardocube portion. None of the pans held any water during fieldwork and comprised either bare soil or heavily grazed seasonal grassland. Species richness appears to be low, but could not be assessed because of the lack of visible above-ground foliage. Most of the plant species present are likely to be habitat specialists adapted to the extremes of flooding and extended drought, justifying an elevated conservation importance for this vegetation assemblage.	

Disturbed Natural Habitat refers to areas of Natural Habitat that have not been transformed by construction of infrastructure such as roads, buildings or tailings storage facilities, but have been degraded through human activity such as movement of heavy machinery or dumping of building rubble.

Alien invasive plant thickets were mapped within the Degraded Natural Habitat mapping unit. These thickets are found most often in areas that have previously been degraded or transformed, as well as around edges of pans

or livestock watering points. The invasive alien tree species *Prosopis glandulosa* is the dominant, while the closely related *Prosopis velutina* is present in small numbers. Species representative of the original Natural Habitat state are usually present, particularly *Rhigozum trichotomum*, which is an indigenous invader of disturbed habitats.

This degraded Natural Habitat still contains a seedbank of the original flora and some original plant cover and has a significantly higher potential for restoration than Modified Habitat does. Most of the areas of degraded Natural Habitat are situated adjacent to Modified Habitat.

8.4.3 Species of Conservation Concern

The vast majority of the plant species occurring in the general vicinity of the study area are currently classified as either Least Concern (661 spp) or Not Evaluated (66 spp).

One species, *Listia minima*, is classified as Data Deficient (Taxonomically Problematic) and cannot be assessed until its taxonomy is resolved (Victor, 2006). The following six species of conservation concern have been confirmed to occur in the quarter-degree grids (QDS):

- *Hoodia officinalis* subsp. *officinalis*;
- *Hoodia gordonii*
- *Phyllobolus amabilis*;
- *Aloidendron dichotomum* (Quiver Tree).
- *Dinteranthus pole-evansii,;* and
- *Tridentea virescens*

8.4.4 Only Hoodia gordonii was located during fieldwork Endemic Plant Species

The Copperton study area is situated at the southern boundary of the Griqualand West Centre of Plant Endemism as defined by Frisby (2016). Five of the 26 endemic or near-endemic GWCPE species have been confirmed to occur in the general vicinity of the study area, namely *Calobota cuspidosa* (Fabaceae), *Justicia thymifolia* (Acanthaceae), *Phyllobolus amabilis* (Aizoaceae), *Putterlickia saxatilis* (Celastraceae) and *Searsia tridactyla* (Anacardiaceae).

Dedicated searches for these and other GWCPE species were conducted in the project area during summer fieldwork but none were located. However, many species were in vegetative state, some without even having leaves present, and it is possible that GWCPE endemics may have been overlooked.

8.4.5 Protected Plant Species

Twelve of the plant species confirmed to occur in the project area during fieldwork are protected. One species is protected under Schedule 1 of the Northern Cape Nature Conservation Act (No. 9 of 2009), namely *Hoodia gordonii*, while nine species are protected under Schedule 2 of the same act. A single species, *Boscia albitrunca*, is protected under the National Forest Act (No. 84 of 1998).

8.4.6 Alien Invasive Plant Species

Two tree species are of particular concern and are classified as Category 3 invasive species in the Northern Cape under the National Environmental Management: Biodiversity Act (No.10 of 2004): Alien and Invasive Species Regulations, 2014: Honey Mesquite (*Prosopis glandulosa*) and Velvet Mesquite (*P. velutina*). *Prosopis glandulosa* is relatively common in the project area and has invaded degraded areas in the vicinity of the mine, at most of the pans, and livestock watering points. *Prosopis velutina* is less common and potentially a lower threat than *P. glandulosa*.

8.4.7 FAUNA

8.4.7.1 Mammals

Numerous small mammal species are endemic to the Namib-Karoo Biome (Friedman & Daly, 2004), such as: Western Rock Sengi (*Elephantulus rupestris*), Round-eared Elephant Shrew (*Macroscelides proboscideus*), Spectacled Dormouse (*Graphiurus ocularis*), Pygmy Rock Mouse (*Petromyscus collinus*), Brukkaros Pygmy Rock Mouse (*P. monticularis*), Bush Vlei Rat (Otomys unisulcatus), Brants's Whistling Rat (Parotomys brantsii), Littledale's Whistling Rat (*P. littledalei*) South African Ground Squirrel (*Xerus inauris*), Suricate (*Suricata suricatta*) and Cape Fox (*Vulpes chama*).

Fifty-six mammal species have been recorded in QDSs in the vicinity of the study area according to distribution maps in Friedman & Daly (2004), nine of which were confirmed to occur in the study area on the basis of visual sightings. A carcass of a sub-adult Brown Hyaena (*Parahyaena brunnea*), which is classified as Near Threatened, was recovered from within the study area during November 2017. This species has large home ranges and is unlikely to be confined to the project area, although it could be resident. No threatened mammals are likely to be present within the project area.

8.4.7.2 Birds

Twenty-three species are listed by Barnes (1998) as being endemic to the Namib-Karoo biome, i.e. not occurring outside of the biome, of which 15 species (65%) have been recorded within the general vicinity of the study area during the second Southern African Bird Atlas Project (SABAP2).

While only four of these species were located in the project area during fieldwork, it is likely that species such as Karoo Long-billed Lark *Certhilauda subcoronata*, Sickle-winged Chat *Cercomela sinuata* and Tractrac Chat *C. tractrac* also occur. A number of near-endemics such as Rufous-eared Warbler *Malcorus pectoralis*, Namaqua Sandgrouse *Pterocles namaqua* and White-throated Canary *Crithagra albogularis* were also observed during fieldwork. Two species that are endemic to the Kalahari-Highveld biome have also been recorded in the same area, both of which were confirmed to occur during fieldwork.

The study area is also situated in a designated secondary Endemic Bird Area, namely the Karoo EBA (s047) (Barnes et al., 2001). There are no Important Bird Areas (IBA) within the vicinity of the study area, the closest being the Platberg-Karoo Conservancy IBA (ZA037), approximately 130 km to the east (Barnes, 1998).

The quarter-degree grids 2922 CD and 3022 AB, in which the study area falls, currently have a combined list of 158 bird species recorded during the ongoing second Southern African Bird Atlas Project (SABAP2), a total probably approaching true species diversity. However, the small size of the study area, homogenous structure of vegetation, high degree of transformation, and the lack of waterbodies make it unlikely that more than 40-50 species occur within the study area.

Six Endangered (EN), five Vulnerable (VU) and five Near Threatened (NT) species have been recorded from the general vicinity of the project area during SABAP2. One of the Endangered species, Ludwig's Bustard *Neotis ludwigii*, was located during the November 2017 fieldwork in shrubland east of Copperton within the study area and is possibly resident in very low numbers. Two Near Threatened species were also located in the project area during fieldwork. Pairs and small groups of Double-banded Courser *Rhinoptilus africanus* and several family groups of Karoo Korhaan *Eupodotis vigorsii* were seen and heard in shrubland. Karoo Korhaan is likely to be a breeding resident in the project area, while Double-banded Courser is more likely to be an irregular breeding visitor. Jenkins (2011) reported regularly active nests of Martial Eagle *Polemaetus bellicosus*, which is classified as Endangered, within 11 km south of the study area (on tower 512 of the HydraKronos 400 kV line), and within 22 km to the south-west (on tower 392 of the AriesKronos 400 kV line). Thus, it is likely that this species regularly forages over the study area.

Two Vulnerable species have a moderate likelihood of occurring in the project area, based on assessment of habitat present in the project area and likelihood of occurring in proximity to disturbance, namely Lanner Falcon (*Falco biarmicus*) and Red Lark (*Calendulauda burra*). Limited nesting habitat is present for Lanner Falcon, but it has fairly large foraging home ranges and is potentially a non-breeding visitor. Red Lark is a habitat specialist that prefers shrublands or grasslands on deep, sandy soils and is a potentially resident species in this habitat in the project area. One Near Threatened species has a moderate likelihood of occurring in the project area based on the above criteria, namely Sclater's Lark (*Spizocorys sclateri*).

8.4.7.3 Herpetofauna (Reptiles and Amphibians)

The desktop study initially revealed that a total of 48 reptile species could be expected to occur within and surrounding the study area, of which three species are endemic and three are considered as near-endemic (Bates et al., 2014). Only seven (15%) of these species were previously observed within the QDS of the study area (ReptileMap, 2017). Refinement of the list of expected species, based on the species and habitats observed within the study area during the November 2017 field survey, decreased the number of expected reptile species to 31 (probability of occurrence either medium or high). This is mostly due to the lack of extensive rocky or ridge habitats excluding strongly rupiculous species (e.g. *Karusasaurus polyzonus*), while the lack of large tracts of sandy soils and the complete absence of Camelthorn trees (*Vachellia erioloba*) excluded fossorial (e.g. *Acontias lineatus*) and arboreal (e.g. *Chamaeleo dilepis*) species respectively.

Reptile activity levels were very low during the November 2017 fieldwork, presumably due to very dry veld conditions, low humidity, cold temperatures, and strong winds brought about by two consecutive cold fronts. A total of 15 reptile species (76 individuals) were observed during the survey. No species of conservation concern were observed.

For amphibians, an initial eleven species were expected to occur within and surrounding the study area of which only one species is considered endemic (Du Preez & Carruthers, 2009). A single species has been observed within the QDS of the study area (FrogMap, 2017). Refinement of the list of expected species, based on the species and habitats observed within the study area during the field survey, decreased the number of expected amphibian species to nine (probability of occurrence either medium or high). No amphibian species were observed in the project area during fieldwork. Additional fieldwork after the ephemeral pans had received some rain would have resulted in a few species being located, but fieldwork timing did not correspond with good rains.

No herpetofauna species currently designated as species of conservation concern have been observed within the focal QDS of the study area (2922CD) or the surrounding 8 QDS's. However, a single species that potentially occurs in the area is of concern and requires discussion. FrogMAP (2017) lists the Giant Bullfrog (*Pyxicephalus adspersus*) as Near Threatened (NT), while Du Preez & Carruthers (2009) list it as Vulnerable (VU) and NEMBA (2004) lists it as Protected. This species breeds in shallow temporary pans which are present within the study area and surroundings, and consequently have elevated biodiversity value. It has been classified as NT as a result of loss of its breeding habitat to urbanisation and agricultural use, as well as being particularly susceptible to collisions with vehicles on roads and is often targeted as a food source by people.

A recent observation of a skink specimen initially identified as a Thin-tailed Legless Skink (*Acontias gracilicauda*) near Postmasburg is believed to represent an undescribed species (W. Conradie [PEM] *pers. comm.*). No suitable habitat for this species was observed within the study area and it is therefore not expected to be influenced by the proposed development.

8.4.7.4 Biodiversity Value Assessment

The Biodiversity Value (BV) of each habitat (modified and natural), determined qualitatively by integrating the Conservation Importance (CI) and Functional Importance (FI) of each community, is indicated in Table 8-4.

TABLE 8-4: BIODIVERSITY VALUE OF HABITATS

VEGETATION ASSEMBLAGES	CONSERVATION IMPORTANCE	FUNCTIONAL IMPORTANCE	BIODIVERSITY VALUE
PANS	High	High	High
NATURAL HABITAT (UNDISTURBED)	Moderate	Moderate	Moderate
NATURAL HABITAT (DEGRADED)	Moderate	Low	Low
MODIFIED HABITAT	Very Low	Very Low	Very Low

The Pan vegetation community was assessed as having High BV on account of high CI score on the basis of a potential for supporting species of conservation concern as well as a high proportion of habitat specialists, and a high FI score. Both *Aizoaceae* dwarf shrubland and *Rhigozum trichotomum* dwarf shrubland were rated as having Moderate BV as a result of moderate CI and FI values.

The Pans and both shrubland vegetation communities represent the untransformed natural habitat in the project area and are key habitats in which negative impacts need to be avoided, and in which no infrastructure should be placed wherever possible. The ecologically compromised state of degraded Natural Habitat has resulted in a Low BV, although it is a habitat that still has some of the original vegetation cover and has a higher potential for restoration than Modified Habitat, which has a Very Low BV.

8.5 SURFACE WATER

The study area falls within the Orange (D) Primary catchment, the D5 Secondary catchment, and the Lower Orange DWS water management area. It falls within the D54D quaternary catchment. The watershed associated with the survey area drains toward the Basterput se Leegte River within the adjacent catchment, which drains northwards into the Hartbees River, which then confluences with the Orange River near the town of Kakamas.

The quaternary sub-catchment's underlying geology consists of tillite, undifferentiated assemblage of compacted sedimentary extrusive and intrusive rocks as well as principally arenaceous strata. The underlying geology is covered with moderate to deep sandy soils with a medium erodibility index and an estimated annual sediment yield of 10 000 tons per annum. The entire catchment area falls with an endoreic area, which is classified as a catchment area that does not contribute to mean annual runoff. Hence, this catchment only produces runoff during major storms.

Several non-perennial rivers and poorly-developed wetland units traverse the surface area (Appendix C, MAP 3). These units are driven by surface water runoff following rainfall events and very limited groundwater interaction occurs. The wetland units tend to have their own catchment areas (endorheic pans). Drainage across the site is generally from east to west.

Prior to its diversion, the historic alignment of one of the non-perennial rivers passed through the area now occupied by the historical mine surface infrastructure and sinkholes on the adjacent Portion 25 and 26 of Vogelstruisbult 104. The non-perennial river is not named; however, it is a tributary of the Hartbeest River, which discharges into the Lower Orange River. This watercourse has an effective catchment area of 259 km^2 and is currently diverted to the north and south of the historical mine surface infrastructure and sinkholes. The diversion consists of an earth channel with a berm on the lower ground side of the channel.

The quaternary catchment of D54D falls within an arid climatic region and therefore irrigated crops are rare. The area is rather dominated by large farms with low-density cattle or sheep farming. Game farming is also commonplace within the region. Wind and solar energy production are becoming increasingly popular in the

area as a viable land use. Isolated mining occurs. The catchment area has retained a relatively good overall Present Ecological State. The major watercourses have been shown to have retained an overall B PES category (Largely Natural state) (SANBI, 2009 & NFEPA, 2010)). The region is shown to have a low mean annual runoff as well as a low groundwater recharge. The main drivers of ecological change of the surface water ecological features would be some exotic vegetation encroachment. *Prosopis glandulosa* is common within watercourses wetlands throughout the Northern Cape Province and some erosion of the watercourses (the vegetation is sparse and therefore sensitive to trampling and overgrazing, which will lead to erosion). Bush encroachment, especially by *Senegalia mellifera* which is largely due to grazing pressure and other land disturbance features.

The irrigation scheme will impact on the wetland units in various ways. The impact analysis and associated proposed mitigation measures have been presented for consideration. It shows the overall impacts to the wetland units to be of low significance. Mitigation measures to reduce the overall significance of the proposed development activities have been proposed and should be taken into consideration.

8.6 SURFACE WATER ECOSYSTEMS

A surface water ecosystems study has been undertaken for the area by Enviross (2020). This study area included a significant portion of the proposed Vardocube Mining Right Area. This study indicated that the region has an arid climate and therefore persistent surface water ecosystems are rare. Poorly-developed watercourses are commonplace, but defined channels are rare due to the generally low volumes of rainfall events. Most watercourses are barely perceptible and convey small volumes of water only during rainfall events, with no permanent aquatic habitat noted throughout the survey site. Watercourses are therefore thought to be limited to stormwater drainage toward more developed watercourses located further downstream of the site.

Few wetland features were observed within the area, which was expected because of the arid climate. There are two wetland units that fall directly within the proposed irrigation area and therefore will be directly impacted by the scheme.

The irrigation scheme will supply the wetland units with an artificial source of water. Supplying these wetland units with an increased amount of water will increase the functionality of the wetland units and allow them to support a greater level of biodiversity whilst the scheme is in operation. This is, however, a temporary feature as the irrigation scheme is only proposed for a period of approximately one year. Therefore, the DWS Risk Assessment calculates to a low overall risk. These impacts are not necessarily negative.

8.7 SOILS

the dominant soil forms, according to the Taxonomical Soil Classification System of South Africa, are mostly Coega, but Brandvlei, Plooysburg and Glenrosa soil forms were also observed. These forms are constituted of an orthic A-horizon overlaying hard carbonate (Coega), soft carbonate (Brandvlei and Plooysberg) or lithocutanic rock (weathered rock: Glenrosa). The effective depth of the soils is mostly between 10 and 30 cm, but some patches are slightly deeper and the deepest soils are 60 cm. Rocky outcrops are found commonly, but are not present in large sheets where no water can infiltrate. The clay content varies very little and is approximately 6 to 10% in the top soil. The agricultural potential under dryland and irrigation conditions of the Coega and Glenrosa soil forms are considered very low under dryland (<300 mm/y rainfall) and irrigation conditions (>10-15mm/week).

8.8 GROUNDWATER

From a geohydrological perspective three aquifers are present. The upper 15 m of the geological succession comprises unconsolidated sand, calcrete and clay, which is expected to be dry except after a rainfall event. The unconsolidated sediments are underlain by a fractured gneiss aquifer, which is estimated to be approximately 100 m thick. Groundwater is associated with fractures and faults. The fieldwork data completed for the mining right application suggests the transmissivity of the gneiss varies between 0,2 and 32 m^2/d. The matrix of this aquifer is expected to have a low transmissivity, probably around 0,2 m^2/d or lower. The average depth to

groundwater in this aquifer is 18 m, but it is dewatered locally around the historical PCZM underground workings. This aquifer is regionally important, as it is used for private groundwater abstraction.

8.9 AIR QUALITY

The existing sources of emissions to the local airshed are expected to be from the following activities:

- Dust entrainment from vehicles using unsurfaced roads and tracks;
- Burning of biomass;
- Windblown dust and particulate emissions from exposed areas, including historical mining structures such as the TSF and WRD; and
- Alkantpan activities.

The irrigation project will not have any significant contribution impact on air quality.

8.10 ENVIRONMENTAL NOISE

A baseline environmental noise survey has been undertaken for the area by Airshed Planning Professionals in 2017. Construction of the Garob and Copperton wind farms has since commenced adding to the baseline environmental noise. A summary of the findings of the 2017 survey are presented below. The Vardocube irrigation project will not have any significant additional noise impacts on sensitive receptors and an update to the study is not necessary.

The following can be noted with respect to the daytime noise measurement results:

- Measurements indicate day-time ambient noise levels that are comparatively quite but influenced by occasional noisy incidents such as vehicle pass-by's;
- On-site drilling (prospecting) activities were clearly audible at on-site survey;
- The measured noise levels are considered typical of rural and suburban areas according to SANS 10103;
- Recorded on-site LAeq's ranged between 31.5 dBA and 48.3 dBA and are therefore in compliance with IFC guidelines for industrial receptors (70 dBA) and residential, institutional and educational receptors (55 dBA);
- At Copperton, LAIeq, LAeq, and LA90 of 47.4 dBA, 43.8 dBA, and 24.5 dBA were recorded respectively. Levels correspond to what is typically expected in rural areas and are currently compliant with the IFC guideline for residential, institutional, and educational receptors (55 dBA); and
- At the Nelspoortjie farmstead entrance, next to the R357, LAIeq, LAeq, and LA90 of 66.5 dBA, 61.3 dBA, and 19.4 dBA were recorded respectively. The large difference in recorded LAIeq, LAeq, and LA90 is attributed to vehicle pass-by's. Levels correspond to what is typically expected in urban areas with main roads and are currently not compliant with the IFC guideline for residential, institutional, and educational receptors (55 dBA).

The following can be noted with respect to the night-time noise measurement results:

- Measurements indicate night-time ambient noise levels that are quiet but influenced by occasional noisy incidents such as vehicle pass-bys;
- On-site drilling activities were audible at all survey sites;
- On-site LAIeq's ranged between 38.4 dBA and 42 dBA which is considered typical of rural and suburban areas according to SANS 10103;

- Recorded on-site LAeq's ranged between 30.3 dBA and 41 dBA and are therefore in compliance with IFC guidelines for industrial receptors (70 dBA) and residential, institutional and educational receptors (45 dBA); and
- At Copperton, LAIeq, LAeq, and LA90 of 36.3 dBA, 31.8 dBA, and 28.7 dBA were recorded respectively. Levels were very low and comparable to what is typically expected in rural areas. They are currently also compliant with the night-time IFC guideline for residential, institutional and educational receptors (45 dBA).
- At the Nelspoortjie entrance, next to the R357, LAIeq, LAeq, and LA90 of 38.4 dBA, 27.6 dBA, and 19.4 dBA were recorded respectively. Levels correspond to what is typically expected in rural areas and are compliant with the night-time IFC guideline for residential, institutional and educational receptors (55 dBA).

8.11 HERITAGE

A heritage and paleontological survey was undertaken for the area by Heritage Contracts and Archaeological Consulting (2020). This report is attached in Appendix E.

8.11.1 LITERATURE REVIEW

Beaumont *et al.* (1995: 240) observed that "thousands of square kilometres of Bushmanland are covered by a low-density lithic scatter". These artefacts are generally very well weathered and mostly pertain to the Early Stone Age (ESA) and Middle Stone Age (MSA). Occasional Late Stone Age (LSA) artefacts are also noted. What is noteworthy of the Northern Cape archaeological record is the presence of pans which frequently display associated archaeological material.

Of interest, is the work of Kiberd (2001, 2005, 2006) who excavated Bundu Pan, some 25 km to 30 km northwest of Copperton. The site yielded ESA, MSA and LSA horizons and the artefacts were accompanied by warthog and equid teeth to name a few (Beaumont *et al.* 1995).

Orton (2011) noted that to the northwest, west and southwest of Copperton sites have been investigated by Beaumont and colleagues (1995), Smith (1995) and Parsons (2003, 2004, 2007, 2008) yielding LSA deposits. Work on these sites led to a distinction between hunter-gatherer and herder sites, based on stone artefact assemblages (Beaumont *et al.* 1995). All these Later Stone Age sites have very few, if any, organic items on them. The only organic material found on sites like these is fragments of ostrich eggshell probably belonging to broken water containers. Such flasks have been widely recorded across the Northern Cape (Morris 1994).

8.11.2 ARCHAEOLOGY

The archaeological importance of pans in the area are now well documented (Kiberd 2006, Kaplan & Wiltshire 2011, Orton 2012) and the two pans (Blomsdampan & Valspan) also mentioned by Kaplan & Wiltshire that occur in the current study area are considered by the authors to be of high heritage significance (Kaplan & Wiltshire 2011:18). Evidence in the form of widespread lithic scatters attest to the use of the wider landscape from the ESA, MSA and the LSA. Raw material from the Dwyka Tillites are readily available manifested in gravel pavements and a suite of raw material (e.g., Jasper, quartzite, banded iron stone etc) was available to the knappers[1]. Several lithics recorded have high percentages of cortex and are found with flake debris with little to no retouch, suggesting expedient knapping on the locally available raw material. Lithics are found through most of the study area easily visible in the surrounding landscape where the gravel pavements are exposed, with higher densities in higher lying areas, often in deflated contexts on top of exposed calcrete. Where aeolian sand cover the calcrete and gravel pavements, artefact counts drop drastically suggesting that the aeolian sands have buried most of the MSA and ESA in these zones as found by Kiberd (2002, 2006). The extent of these gravel pavements with

[1] The working of stone by applying force to its surface - by percussion or pressure - to produce a tool.

lithics were not recorded but waypoints and superficial observations were taken, knapping of exposed outcrops were also noted characterising the heritage signature of the study area.

TABLE 8-5. ARCHAEOLOGICAL OBSERVATION POINTS, WITH HERITAGE SIGNIFICANCE AND FIELD RATING

WAYPOINT NUMBER	DESCRIPTION	HERITAGE FEATURE OR OBSERVATION POINT	SIGNIFICANCE	FIELD RATING	LATITUDE	LONGITUDE
145,146	Wide scatter of MSA and LSA artefacts around Blomsdampan. Sheet erosion. Blades and scrapers and a few cores. Slightly higher concentrations at recorded Waypoints. Artefacts are characterised by blade cores on quartzite, platform thinning flake on quartz and prepared cores. Levallois quartzite points	Feature	Medium Significance	GP B	-29,9007	22,31656
147	Low scatter of MSA flakes on widespread Dwyka tillite	Observation Point	Low Significance	GP C	-29,9058	22,31759
148	Large MSA scraper and few flakes. Scattered over a wide area. Discoid core	Observation Point	Low Significance	GP C	-29,9058	22,31762
149	Few LSA flakes and chert core, large MSA prepared core with point removed	Observation Point	Low Significance	GP C	-29,9054	22,32445
150	Valspan with some MSA and LSA scatters around edge. Levallois cores etc	Feature	Medium Significance	GP B	-29,8987	22,32103
151	Higher lying area with widespread Dwyka tillite. Various MSA and LSA flakes and cores. Range if raw material	Observation Point	Low Significance	GP C	-29,8983	22,32718
152	Low density scatter of mostly isolated MSA artefacts. Flakes and double-sided scrapers	Observation Point	Low Significance	GP C	-29,8982	22,30969
153	Ridge with wide scatter of artefacts and suite of raw material from widespread Dwyka Tillite. MSA blades and cores mostly on quartzite and LSA irregular cores on chert. Some Jasper also used for LSA	Observation Point	Low Significance	GP C	-29,9105	22,32914
154	Isolated ESA hand axe	Observation Point	Low Significance	GP C	-29,9201	22,30141
156	Gravel pavement from Dwyka Tillite on slightly elevated area. Suite of mostly MSA artefacts. Scattered over a wide area with exposed calcrete, in deflated context. Some ESA flakes and	Observation Point	Low Significance	GP C	-29,9168	22,33141

	isolated hand axes as well as LSA lithics mostly on chert. Lithics scattered in low densities over a large area and artefacts are gravitating down slope.					
157	Same as previous description but scattered over a smaller area	Observation Point	Low Significance	GP C	-29,9177	22,32866
158	Lithics in a deflated context scattered over a wide area on exposed calcrete towards a slight rise	Observation Point	Low Significance	GP C	-29,9193	22,32059
159	MSA and LSA lithic scatter on calcrete towards a small rise few formal tools	Observation Point	Low Significance	GP C	-29,9216	22,32075
160	MSA and LSA artefacts scattered over a large area on calcrete in a deflated context. Artefacts gravitating down slope site will extend to higher lying area. ESA material also	Observation Point	Low Significance	GP C	-29,9216	22,32077
161	Isolated ESA LCT on red sands	Observation Point	Low Significance	GP C	-29,9177	22,33608
162	Low density scatter of mainly MSA flakes interestingly some on quartz	Observation Point	Low Significance	GP C	-29,9188	22,34171
163	Low density scatter of MSA lithics, no formal tools	Observation Point	Low Significance	GP C	-29,9207	22,34758
164	Low density of miscellaneous flakes on open area in grass and red sand	Observation Point	Low Significance	GP C	-29,9218	22,34611
165	ESA core/ chopper with a few flakes. MSA blades also present. Located on slight rise	Observation Point	Low Significance	GP C	-29,9219	22,3455
166	ESA core/ chopper with a few flakes. MSA blades also present. Located on slight rise	Observation Point	Low Significance	GP C	-29,924	22,33817
168	Isolated ESA Acheulian hand axe	Observation Point	Low Significance	GP C	-29,9147	22,31962
169	Knapping site with cores, flakes and blades etc. MSA pointed flakes on quartzite, core on quartzite, flakes scattered over a wide area. Several chert irregular cores and blades possibly LSA. Hammer stone	Feature	Medium Significance	GP B	-29.916438	22.318775
185	LSA flakes on chert and possible ESA large flakes on gneiss. Some MSA flakes in wider area	Observation Point	Low Significance	GP C	-29,9167	22,33168

8.11.3 BURIALS AND CEMETERIES

One formal grave site was recorded outside of the study area. Four graves were noted as well as a columbarium. The cemetery is located outside of the impact area of the project and no impact is expected. If any additional graves are located in future, they should ideally be preserved in-situ or alternatively relocated according to existing legislation.

8.11.4 PALAEONTOLOGY

According to the SAHRA paleontological sensitivity map, the area is of moderate sensitivity. The paleontological component was addressed in an independent study (Bamford 2020). The proposed site lies on the Aeolian sands of the Gordonia Formation (Kalahari Group, Quaternary age), and not on the Dwyka Group. Windblown sands seldom preserve fossils and then only in such features as springs or palaeo-pans but no such features are evident. The study concluded that a site visit prior to construction is not required but a Fossil Chance Find Protocol has been added to the EMPr.

8.12 SOCIO-ECONOMIC ENVIRONMENT2

8.12.1 SIYATHEMBA LOCAL MUNICIPALITY

The Vardocube mining right area is located within Ward 4 of the Siyathemba Local Municipality (SLM), which is managed by the Pixley Ka Seme District Municipality, within the Northern Cape Province of South Africa. The towns of Brakbos, Brulpoort, Draghoender, Koegas, Marydale, Niekerkshoop, Prieska, Shamley's Farm, Uitvlug, and Westerberg fall within the boundaries of the SLM (Figure 8-2).

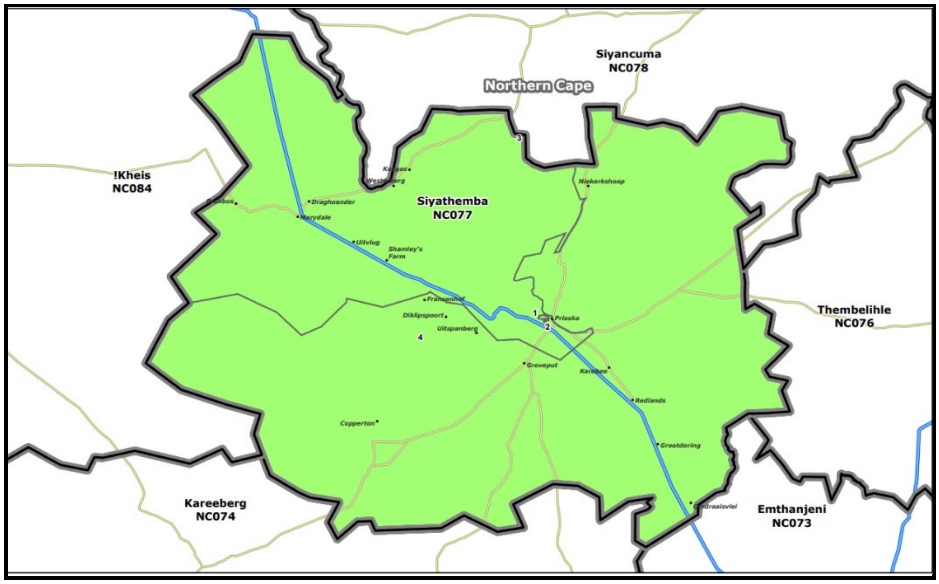


FIGURE 8-2: GEOGRAPHICAL BOUNDARY OF THE SLM

SLM was established in 2001 and is a category B municipality. It is located within the central easterly parts of the Northern Cape Province along the Orange River. It Is approximately 220 km away from the nearest business center of Kimberley. The surface area of the municipality is approximately 8 200 km^2, accounting for 8% of the total district surface area and approximately 3% of the provincial area. Spatial and Regional Development Planning

[2] There is a general lack of recent published demographic and other socio-economic data for the SLM. Except where noted, the information in this section has been summarised from Statistics South Africa Census Data (2011) and the SLM Local Economic Development Strategy (2012)

The SLM Spatial Development Framework (SDF) compiled in 2006 is no longer used for guiding for development planning in the municipality, according to the SLM IDP (2017-2018). No development planning guidelines or objectives have therefore been defined for Copperton.

Similarly, no local or regional development plans for the Copperton area have been proposed.

8.12.2 POPULATION

There are approximately 22 000 people residing in the municipality. This represents approximately 1.9% of the total population in the Northern Cape. The population of Siyathemba contracted by 0.4% on average per annum between 2000 and 2010. The decline of the Siyathemba population was mainly driven by lower fertility rates.

The death rate (the number of deaths per 1,000 people in a year) increased from 11.2 deaths per 1,000 people in 1995 to 11.6 during 2010.

The most dominant population group in the SLM are Coloured individuals, who represent more than 75% of the total population in the municipal area. Black African and White population groups comprise around 12% and 8% of the population respectively. The dominant languages in the SLM are Xhosa and Afrikaans. Afrikaans is the most widely spoken language (78%).

8.12.3 EDUCATIONAL FACILITIES AND EDUCATION

There is a total of 10 schools (3 combined, 6 primary and 1 secondary) within the SLM (SLM IDP 2017-2018).

4.2% of the municipal population has not attended any type of a schooling system, while 48.5% have primary school education. A little over 1700 individuals (4%) have graduated from a University / Technikon.

In Siyathemba, around 14% of adults have a matric certificate compared to 24.7% in the Northern Cape. The percentage of the population with a tertiary education in Siyathemba (5.1%) is also lower than that for the Northern Cape (7.3%).

8.12.4 ACCESS TO WATER, SEWAGE AND SOLID WASTE SERVICES

SLM is the Water Services Authority (WSA) and Water Services Provider (WSP) for the 3 towns within their area of authority. Piped water is accessed by about 98% of the SLM population and about 90% of the municipal population have access to flush toilets[3].

Siyathemba has three water supply schemes. For the Copperton and surrounding areas, water is provided from the Water Treatment Works in Prieska. Water abstraction is from the Orange River. Waterborne sanitation is only available in the urban areas of Prieska.

8.12.5 HOUSING

Within the Pixley Ka Seme District Municipality, 87.2% of households live in formal units, while 12.8% are found in informal housing units.

8.12.6 PUBLIC SAFETY AND SECURITY

There are three police stations within the SLM, situated in Marydale, Niekerkshoop, and Prieska respectively. There is no municipal fire-fighting capability in the SLM and no disaster manager plan for the municipality.

[3] SLM Water Services Development Plan, 2017

8.12.7 COMMUNITY HEALTH AND HEALTH FACILITIES

There is a total of 4 health facilities within the SLM, namely Niekerkshoop Clinic, E'Thembeni Clinic, Marydale PHCC, and Prieska Clinic.

SLM manages 3 cemeteries in Prieska, and 2 cemeteries in Niekerkshoop and Marydale. Expansion of the cemeteries in each of these towns is planned.

8.12.8 ELECTRICITY AND ENERGY

Around 86% of household dwellings found in Siyathemba have access to electricity. This indicator is on par with the provincial average.

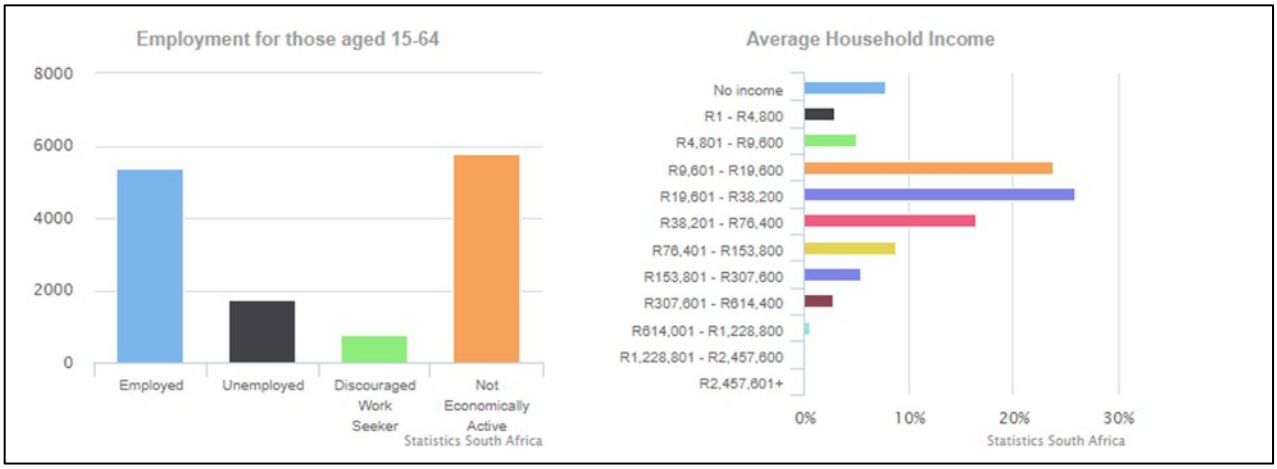
Between 2006 and 2011, there was a general increase in the use of electricity as a primary source of energy. This is due to local electrical infrastructure improvements across the province (SLM IDP, 2016).

8.12.9 EMPLOYMENT[4]

Between 2001 and 2011, there has been a decrease in the number of people employed and a concomitant increase in the number of unemployed people across the Pixley Ka Seme District Municipality.

For Siyathemba, 5 787 individuals remain as being economically inactive, while 5 370 are employed. The unemployment rate in SLM in 2011 was 24.3%.

The average household income is approximately R9 000 – R19 500. Obtaining any form of income generating employment within the municipality has become increasingly difficult in recent years. This is attributed to the lack of education, resulting in the uneducated experiencing the highest incidences of poverty.



Source: Statistics South Africa (2011)

FIGURE 8-3: SUMMARY OF EMPLOYMENT AND INCOME IN SLM

8.12.10 LABOUR

The labour participation rate across the Pixley Ka Seme District Municipality is 50%. The labour dependency ratio for Siyathemba is estimated at 2 (An additional two persons are supported by every person in the labour force).

Other significant labour ratio statistics for SLM are provided in Table 8-6.

[4] SLM IDP (2017-2018)

TABLE 8-6 LABOUR RATIOS FOR SLM

LABOUR PARTICIPATION RATE	LABOUR DEPENDENCY RATIO	LABOUR YOUTH DEPENDENCY RATIO	LABOUR AGED DEPENDENCY RATIO
48	2	0.4	84

Source: SLM IDP (2017-2018)

8.12.11 ECONOMY

The SLM Local Economic Development (LED) Vision is "Ensuring long term economic sustainability through local value addition and social upliftment, as well as integrated community development. We strive towards an economy owned by local people."

The regional and local economy is poorly diversified with a reliance on, in the case of SLM, the government and agriculture sectors. The mining and manufacturing sectors provide very few of the employment opportunities in the SLM.

8.13 DESCRIPTION OF THE CURRENT LAND USES

Current land uses within the MRA surface area are as follows:

- Grazing of livestock;
- An operating 20 MW solar power plant and a proposed solar PV power plant are within the MR surface area boundary;
- Windmills and related agricultural infrastructure;
- Two existing quarry operations;
- The Alkantpan landing strip;
- Road to the Copperton Wind Farm;
- Road to Copperton and Alkantpan from the R357; and
- Disused rail siding.

Land uses on immediately adjacent properties include the following:

- Alkantpan Test Range;
- Various infrastructure associated with the historical PCZM;
- Registered servitude between the historical mineral processing area and the historical TSF;
- Grazing of livestock;
- Residential town of Copperton;
- The Copperton Wind Farm and Garob Wind Farm border the MR surface area boundary in the east. The nearest wind turbines are approximately 6 km from the proposed mining area;
- Several proposed solar PV projects are situated towards the south and south-east of the MR surface area boundary;
- Historical PCZM TSF;
- Eskom Cuprum Substation; and
- Windmills and related agricultural infrastructure.

8.13.1 Existing Surface Land Uses

Copperton is situated to the north of the Vardocube underground mining operation. The town is still in use, though only 40 of the original 300 houses now remain. The full extent of the town is excluded from the proposed Vardocube mining right area. Similarly, Portions 5 and 6 of the Farm Vogelstruisbult 104, are excluded from the MRA. The Eskom Cuprum Substation is located on these properties.

An operating 20 MW solar power plant is situated towards the middle of the MRA surface area boundary.

Other existing infrastructure within the MR surface area includes partially intact stormwater diversion berms constructed by PCML in the 1970s, the access road to Copperton and PCZM from the R357, a disused rail spur and several mine houses used, at present, by contractors.

The remainder of the MRA surface area is largely undisturbed scrubland used for grazing of small livestock (Refer to Appendix C).

There is no registered land claim applicable to Portion 1 of Vogelstruisbult 104.

8.13.2 Surrounding Land Uses

Surrounding landowners and land users comprise of the historical PCZM, private landowners and the Alkantpan Test Range (to the west). Several renewable energy (wind and solar) projects are situated towards the east and south of the MR surface area boundary (Refer to Appendix C).

Most of the buildings and related infrastructure associated with the historical PCZM were demolished when the mine closed in 1991. The western section of the PCZM MRA surface area is characterised by remnants of the demolished infrastructure remaining from the historical mining between 1971 and 1991. Remaining surface infrastructure includes the Hutching Shaft column, crusher bins, flotation dams and a concentrate drying slab.

The historical tailings storage facility containing the residues from the historical mining borders the Vardocube MR surface area in the south-west.

8.14 DESCRIPTION OF SPECIFIC ENVIRONMENTAL FEATURES AND INFRASTRUCTURE ON THE SITE

8.14.1 Surface Water Features and Wetlands

Several non-perennial rivers traverse the Vardocube MR surface area.

In addition to the non-perennial rivers, there are several wetlands (endorheic pans) present within the Vardocube MR surface area. Depression-type wetland habitat units are within the proposed irrigation scheme. These were delineated and conservation buffers of 100 m as a protection factor from the agricultural activities. These are merely low areas within the landscape that would aid in surface water drainage and therefore have been excluded from the sensitive habitat analysis.

8.14.2 Protected Areas

There are no protected areas in close proximity (within 10 km) of the MRA surface area boundary. The nearest protected area is the Witsand Provincial Nature Reserve, located approximately 150 km to the north of the MR surface area boundary.

8.14.3 Critical Biodiversity Area and Ecological Support Area

The Northern Cape spatial biodiversity plan identifies a Critical Biodiversity Area (CBA) across a portion of the MRA. This CBA follows the pre-diversion alignment of a non-perennial watercourse which was diverted as part of the historical mining activities undertaken by PCZM (Refer to Appendix C).

8.14.4 DECLARED KAROO CENTRAL ASTRONOMY ADVANTAGE AREA

8.14.4.1 Background

The Vardocube mining area is situated within two declared Astronomy Advantage Areas (AAA), namely as follows:

- The Northern Cape Province; and
- The Karoo Central AAA.

Specifically, the Vardocube mining area is located within Advantage Area 3 of the Karoo Central AAA.

The AAAs are established in terms of the Astronomy Geographic Advantage Act 21 of 2007. The purpose of establishing the AAAs is to protect the radio astronomy work associated with the Square Kilometre Array (SKA) Project in Carnarvon. The cosmic rays which the SKA radio telescopes receive and interpret are extremely faint and are thus sensitive to interference from other radio devices as well as electromagnetic interference from electrical equipment. The radio interference protection philosophy associated with the AAAs is as follows[5]:

- Maximise the radio frequency spectrum available for the SKA so that the scientific work is not significantly compromised;
- Minimise the impact on local people and residual radio interference, and facilitate access to alternative radio communications;
- Restrictions on sources of radio frequency interference, for where there are no alternative options, will be highest close to the SKA Virtual Centre (or core) but decrease with distance.

The proposed irrigation activities will not have an impact on the SKA.

8.15 ENVIRONMENTAL AND CURRENT LAND USE MAP

The following dominant current land use categories are recognised:

- Agriculture – grazing;
- Residential;
- Historical mining and related infrastructure; and
- Power infrastructure.

The environmental and current land use map is provided in (Appendix C, MAP 4).

9 IMPACTS AND RISKS IDENTIFIED INCLUDING THE NATURE, SIGNIFICANCE, CONSEQUENCE, EXTENT, DURATION AND PROBABILITY

The impacts and risks identified for the proposed activities is summarised in APPENDIX G.

[5] http://www.ska.ac.za/wp-content/uploads/2016/07/ska_sa_gaa_eng.pdf

10 METHODOLOGY USED IN DETERMINING AND RANKING THE NATURE, SIGNIFICANCE, CONSEQUENCES, EXTENT, DURATION AND PROBABILITY OF POTENTIAL ENVIRONMENTAL IMPACTS AND RISKS

10.1 OVERVIEW

The impact assessment methodology comprised of a risk-based impact matrix in which the outcomes, impacts and residual risk of the project activities was determined as follows:

- Step 1: Identify and describe the impact in terms of its nature (negative or positive) and type (direct or indirect);
- Step 2: Assess the impact severity (including reversibility and the potential for irreplaceable loss of resources), impact duration and impact spatial scale (extent);
- Step 3: Assign an impact consequence rating;
- Step 4: Assess the impact probability;
- Step 5: Assign the impact significance rating;
- Step 6: Identify measures and controls by which the impact can be avoided, managed or mitigated; and
- Step: Repeat the impact assessment on the assumption that the mitigation measures are applied and assign the residual impact (post mitigation) significance rating.

The purpose of the impact assessment was not to identify every possible risk and impact which the proposed project activities may have on the receiving social environment. Rather, the assessment was focused on identifying and assessing the most material impacts, commensurate with the nature of the project activity and the characteristics of the receiving social environment.

10.2 APPLICATION OF IMPACT RATING CRITERIA

The various impact rating criteria used and how they were applied are described in the section that follows.

The first phase of impact assessment is the identification of the various project activities which may impact upon the identified environmental categories.

The identification of significant project activities is supported by the identification of the various receiving environmental receptors and resources. These receptors and resources allow for an understanding of the impact pathways and assessment of the sensitivity of the receiving environment to change.

The significance of the impact is then assessed by rating each variable numerically, according to defined criteria as provided in Table 10-1. The purpose of the significance rating of the identified impacts is to develop a clear understanding of the influences and processes associated with each impact.

The severity, spatial scope and duration of the impact together comprise the consequence of the impact; and when summed can obtain a maximum value of 15. The frequency of the activity and the frequency of the impact together comprise the likelihood of the impact and can obtain a maximum value of 10.

The values for likelihood and consequence of the impact are then read from a significance rating matrix as shown in Table 10-1 and Table 10-2.

The model outcome of the impacts is then assessed in terms of impact certainty and consideration of available information. The Precautionary Principle is applied in instances of uncertainty or lack of information by increasing assigned ratings or adjusting final model outcomes. In certain instances, where a variable or outcome requires rational adjustment due to model limitations the model outcomes are adjusted. Arguments and descriptions for

such adjustments, as well as arguments for each specific impact assessments are presented in the text and encapsulated in the assessment summary table linked to each impact discussion.

TABLE 10-1: CRITERIA FOR ASSESSING THE SIGNIFICANCE OF IMPACTS

SEVERITY OF IMPACT	RATING
Insignificant / non-harmful	1
Small / potentially harmful	2
Significant / slightly harmful	3
Great / harmful	4
Disastrous / extremely harmful	5
SPATIAL SCOPE OF IMPACT	**RATING**
Activity specific	1
Area specific	2
Whole project site / local area	3
Regional	4
National/International	5
DURATION OF IMPACT	**RATING**
One day to one month	1
One month to one year	2
One year to ten years	3
Life of operation	4
Post closure / permanent	5
FREQUENCY OF ACTIVITY / DURATION OF ASPECT	**RATING**
Annually or less / low	1
6 monthly / temporary	2
Monthly / infrequent	3
Weekly / life of operation / regularly / likely	4
Daily / permanent / high	5
FREQUENCY OF IMPACT	**RATING**
Almost never / almost impossible	1
Very seldom / highly unlikely	2
Infrequent / unlikely / seldom	3
Often / regularly / likely / possible	4
Daily / highly likely / definitely	5

CONSEQUENCE

LIKELIHOOD

***Activity**: a distinct process or task undertaken by an organisation for which a responsibility can be assigned.*

***Environmental aspect**: an element of an organisation's activities, products or services which can interact with the environment.*

***Environmental impacts**: consequences of these aspects on environmental resources or receptors.*

***Receptors**: comprise, but are not limited to people or man-made structures.*

***Resources**: include components of the biophysical environment.*

***Frequency of activity**: refers to how often the proposed activity will take place.*

***Frequency of impact**: refers to the frequency with which a stressor will impact on the receptor.*

***Severity**: refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.*

***Spatial scope**: refers to the geographical scale of the impact.*

***Duration**: refers to the length of time over which the stressor will cause a change in the resource or receptor.*

TABLE 10-2: SIGNIFICANCE RATING MATRIX

CONSEQUENCE (SEVERITY + SPATIAL SCOPE + DURATION)															
LIKELIHOOD (FREQUENCY OF ACTIVITY + FREQUENCY OF IMPACT)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45
	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90
	7	14	21	28	35	42	49	56	63	70	77	84	91	98	105
	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120
	9	18	27	36	45	54	63	72	81	90	99	108	117	126	135
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150

TABLE 10-3: POSITIVE/NEGATIVE MITIGATION RATINGS

COLOUR CODE	SIGNIFICANCE RATING	VALUE	NEGATIVE IMPACT MANAGEMENT RECOMMENDATION	POSITIVE IMPACT MANAGEMENT RECOMMENDATION
	Very High	126-150	Improve current management	Maintain current management
	High	101-125	Improve current management	Maintain current management
	Medium-High	76-100	Improve current management	Maintain current management
	Low-Medium	51-75	Maintain current management	Improve current management
	Low	26-50	Maintain current management	Improve current management
	Very Low	1-25	Maintain current management	Improve current management

11 THE POSITIVE AND NEGATIVE IMPACTS THAT THE PROPOSED ACTIVITY AND ALTERNATIVES WILL HAVE ON THE ENVIRONMENT AND THE COMMUNITY THAT MAY BE AFFECTED

The positive and negative impacts are presented in the stipulated format in Table 12-1.

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

Proposed mitigation measures are summarised in Table 12-1.

TABLE 12-1: PROPOSED MITIGATION MEASURES

ACTIVITY **whether listed or not listed.**	**POTENTIAL IMPACT**	**ASPECTS AFFECTED**	**PHASE** In which impact is anticipated	**SIGNIFICANCE** if not mitigated	**MITIGATION TYPE**[6]	**SIGNIFICANCE** if mitigated
Summary of Air Quality Impacts and Risks						
PM10 and PM2.5 Concentrations as a result of construction of the pipeline	Impact on human health	Air quality	Construction Phase	Low	Avoid / minimise through design and operational controls	Very Low
Dust Fallout rates as a result of Construction of the Irrigation area	Nuisance impact	Air quality	Construction Phase	Low	Avoid / minimise through design and operational controls During Construction four additional dustfall measurement units should be installed around the irrigation area.	Very Low
Summary of Soils Impacts and Risks						
Establishment of surface pipeline. Assembling of linear draglines	Waterlogging, surface water run-off, compaction and soil capping	Soils	Construction Phase	Very Low	Avoid / minimise through design and operational controls	Very Low
Irrigation Activities	Waterlogging, surface water run-off, compaction, seepage, contamination and soil capping	Soils	Operational	Low-Medium	Avoid / minimise through design and operational controls	Low
Summary of Surface Water Ecosystems Impacts and Risks						
All construction phase activities	Ecologically sensitive habitat (wetland units)	Surface Water	Construction Phase	Low	Avoid / minimise through design and operational controls	Very Low
Destruction of wetland habitat due to irrigation	Ecologically sensitive habitat (wetland units)	Surface Water	Construction/Operations phases	Low	Avoid / minimise through design and operational controls	Very Low

[6] Please refer to the EMPr for details of the mitigation measures

Vegetation alteration due to increased water source	Ecologically sensitive habitat (wetland units)	Surface Water	All phases of project	Low-Medium	Avoid / minimise through design and operational controls	Low-Medium
All construction phase activities	Soil erosion	Surface Water	All phases of project	Very Low	Conservation buffer zones (100 m) designated to the wetland units is sufficient to negate erosion impacts.	Very Low
Routine irrigation	Water quality	Surface Water	All phases of project	Low-Medium	Avoid / minimise through design and operational controls	Very Low
Summary of Terrestrial Ecology Impacts and Risks						
Irrigation of vegetated plains through mine dewatering	Degradation of Natural Habitat of Moderate Ecological Importance	Flora	Preparation, Construction and Operational Phases	Medium-High	No feasible measures can be recommended to reduce the significance of this impact. Even if the vegetation removed for the wheel trenches is replanted elsewhere in the irrigation area, it will still be subject to the same impact of elevated soil moisture throughout the year. Even though the residual impact significance is still Medium-High, the same type of vegetation is widespread on surrounding properties and offset option may not be necessary.	Medium-High
Preparation and operation of the irrigation area.	Loss of Plant Species of Conservation Concern	Flora	Preparation, Construction and Operational Phases	Medium-High	Avoid / minimise through design and operational controls	Low-Medium
Preparation and operation of the irrigation area.	Introduction/proliferation of alien invasive species	Flora	Preparation, Construction and Operational Phases	Medium-High	Avoid / minimise through design and operational controls	Low
Preparing irrigation area, laying of pipelines	Loss of Faunal Habitat	Fauna	Construction - Closure Phase	Medium-High	Avoid / minimise through design and operational controls	Low-Medium
All staff activities that take place outdoors	Illegal utilisation of animal resources as a result of an	Fauna	Construction and Operational Phases	Medium-High '-'	Avoid / minimise through design and operational controls	Low

	influx of people into the study area					
Summary of Heritage Impacts and Risks						
Preparing irrigation area, laying of pipelines	Disturbance/Loss of Significant Archaeological or Cultural Heritage Sites/Remains	Archaeology, palaeontology, and cultural heritage	During the construction phase activities	Low	Due to the low impact no mitigation is required prior to construction. A Chance Find Procedure must be implemented for the project.	Very Low
Summary of Surface Water Impacts and Risks						
All activities	Surface water contamination due to hydrocarbon spills.	Surface Water	All phases	Low	Avoid / minimise through design and operational controls	Very Low
Summary of Groundwater Impacts and Risks						
All activities	Groundwater contamination due to hydrocarbon spills.	Groundwater Water	All phases	Low	Avoid / minimise through design and operational controls	Very Low

13 MOTIVATION WHERE NO ALTERNATIVE SITES WERE CONSIDERED

The proposed irrigation project is an alternative strategy to manage water more effectively from the underground workings. No additional alternatives have been considered. The area was selected for the activity due to the availability of the land within the mining right area. The area has suitable soil to allow maximum seepage. Finally, the absence of additional infrastructure allows for the free movement of proposed irrigation system**.**

14 STATEMENT MOTIVATING THE ALTERNATIVE DEVELOPMENT LOCATION WITHIN THE OVERALL SITE

No alternative development location has been identified.

15 FULL DESCRIPTION OF THE PROCESS UNDERTAKEN TO IDENTIFY, ASSESS AND RANK THE IMPACTS AND RISKS THE ACTIVITY WILL IMPOSE ON THE PREFERRED SITE (IN RESPECT OF THE FINAL SITE LAYOUT PLAN) THROUGH THE LIFE OF THE ACTIVITY

The impact assessment methodology is described in Section 10 of this report.

16 ASSESSMENT OF EACH IDENTIFIED POTENTIALLY SIGNIFICANT IMPACT AND RISK

The assessment is presented in the required format in APPENDIX G.

17 SUMMARY OF SPECIALIST REPORTS

The specialist studies compiled as part of the proposed irrigation project in the Vardocube mining right area have been considered in the BAR and is summarised in the table below.

LIST OF STUDIES UNDERTAKEN	**RECOMMENDATIONS OF SPECIALIST REPORTS**	**SPECIALIST RECOMMENDATIONS THAT HAVE BEEN INCLUDED IN THE EIA REPORT** (Mark with an X where applicable)	**REFERENCE TO APPLICABLE SECTION OF REPORT WHERE SPECIALIST RECOMMENDATIONS HAVE BEEN INCLUDED.**
Soils	The dominant soil forms, according to the Taxonomical Soil Classification System of South Africa, are mostly Coega, but Brandvlei, Plooysburg and Glenrosa soil forms were also observed. These forms are constituted of an orthic A-horizon overlaying hard carbonate (Coega), soft carbonate (Brandvlei and Plooysberg) or lithocutanic rock (weathered rock: Glenrosa). The effective depth of the soils are mostly between 10 and 30 cm, but some areas are slightly deeper with the deepest soils being 60 cm. Rocky outcrops are found commonly, but are not present in large sheets where no water can infiltrate. The clay content is approximately 6 to 10% in the top soil. The agricultural potential under dryland and irrigation conditions of the Coega and Glenrosa soil forms are considered very low under dryland (<300 mm/y rainfall) and irrigation conditions (>10-15mm/week). The areas surrounding the pans must be excluded for irrigation. The project is limited to a short period of time and the impact of the irrigation of the area will not have a permanent effect on the soil as long the irrigation water quality are within the acceptable limits. It is not foreseen that the plant species composition will be altered by the irrigation activities as long as the irrigation time frame is not exceeded.	X	Section 8 Section 18 Part B-EMPr

Surface Water Ecosystems	A field survey was undertaken during August 2020 in order to evaluate the surface water ecosystems associated with the area under investigation for suitability for an irrigation scheme development associated with the Prieska Copper Zinc Project. Following the field survey of the proposed development area, the following salient recommendations can be proposed to aid in the conservation of the overall ecological integrity of the wetlands within the region: • Depression-type wetland habitat units do fall within the area that is proposed for the irrigation scheme. These units were delineated and conservation buffers of 100 m as a protection factor from the agricultural activities (Figure 8). Watercourses on site were barely perceptible and do not represent aquatic or wetland habitat. These are merely low areas within the landscape that would aid in surface water drainage. These have therefore been excluded from the sensitive habitat analysis. Figure 9 presents the wetland delineation mapping and designated conservation buffer of only the wetland habitat units; • The region is considered to have an arid climate and therefore is dominated by non-perennial and poorly-developed wetland units. These units are driven by surface water runoff following rainfall events and very limited groundwater interaction occurs. Biodiversity support functionality pertaining to these units is strongly seasonal. The wetland units do not remain inundated for sufficient periods to support established wetland-dependent flora. Floral indicators of wetland habitat are therefore largely absent; • The irrigation scheme will impact on the wetland units in various ways. The impact analysis and associated proposed mitigation measures have been presented for consideration. It shows the overall impacts to the wetland units to be of low significance; • Mitigation measures to reduce the overall significance of the proposed development activities have been proposed and should be taken into consideration. It should be noted that, in order to conserve the ecological structures within the region, a holistic habitat conservation approach should be adopted. This includes keeping general habitat destruction and construction footprints to an absolute minimum within the terrestrial habitat as well. Conserving the habitat units will ultimately conserve the species communities that depend on it for survival. This can only be achieved by the efforts of the contractor and management teams during the various phases of the project.	X	Section 8 Section 18 Part B-EMPr
Terrestrial Ecology	The PA is situated within at the junction of two national vegetation types (Bushmanland Arid Grassland and Bushmanland Basin Shrubland), both of which are classified as Least Threatened. The PA is also at the southern boundary of the Griqualand West Centre of Plant Endemism, although no species endemic to this centre were located during fieldwork. A significant portion of the PA comprises relatively undisturbed Natural Habitat comprising four vegetation communities: Aizoaceae dwarf shrubland on calcrete plains, Rhigozum trichotomum dwarf shrubland on sandy plains, Pteronia mucronata dwarf shrubland along drainage lines and Ephemeral Pans. One plant SCC was confirmed to occur in the PA, close to the new TSF location, namely Hoodia gordonii, which is classified as Data Deficient. No threatened or NT plant species were located. A previously occupied den and a carcass of a Brown Hyaena (NT) was located on the property during 2017 fieldwork and the species is probably resident in small numbers in the area. One EN bird species, Ludwig's Bustard, was located during November 2017 fieldwork in shrubland east of Copperton within the PA and is possibly resident in very low numbers. Pairs and small groups of Double-banded Courser	X	Section 8 Section 18 Part B-EMPr

	(NT) were frequently seen in shrubland in the vicinity of the new TSF site, while several family groups of Karoo Korhaan (NT) were seen and heard in shrubland in the PA. At least one pair of Martial Eagle (EN) is known to breed within 15 km of the PA and the species is likely to forage over the PA.		
Heritage	The archaeological importance of pans in the area are now well documented (Kiberd 2006, Kaplan & Wiltshire 2011, Orton 2012) and the two pans (Blomsdampan & Valspan) also mentioned by Kaplan & Wiltshire that occur in the current study area are considered by the authors to be of high heritage significance (Kaplan & Wiltshire 2011:18). Evidence in the form of widespread lithic scatters attest to the use of the wider landscape from the ESA, MSA and the LSA. Raw material from the Dwyka Tillites are readily available, manifested in gravel pavements and a suite of raw material (e.g., Jasper, quartzite, banded iron stone etc) was available to the knappers. Several lithics recorded have high percentages of cortex and are found with flake debris with little to no retouch, suggesting expedient knapping on the locally available raw material. Lithics are found through most of the study area easily visible in the surrounding landscape where the gravel pavements are exposed, with higher densities in higher lying areas, often in deflated contexts on top of exposed calcrete. Where aeolian sand cover the calcrete and gravel pavements, artefact counts drop drastically suggesting that the aeolian sands have buried most of the MSA and ESA in these zones as found by Kiberd (2002, 2006). The extent of these gravel pavements with lithics were not recorded but waypoints and superficial observations were taken, knapping of exposed outcrops were also noted characterising the heritage signature of the study area. A formal burial site was recorded during the survey with distinct headstone and the grave of a child but located outside of the study area and will not be impacted on. According to the SAHRA paleontological sensitivity map, the area is of moderate paleontological sensitivity and an independent study was conducted and concluded that it is extremely unlikely that any fossils would be preserved in the Aeolian sands of the Quaternary aged Gordonia Formation but that a Fossil Chance Find Protocol for Quaternary fossils should be added to the EMPr. The anticipated impacts by the irrigation is minimal because the project aims to irrigate the natural vegetation at 20 mm per month for a 10-month period in a regular and controlled manner to avoid erosion and promote natural vegetation growth. Irrigation will be conducted with flexible pipes above surface minimising impacts on resources. The impact of the proposed project on heritage resources can be mitigated to an acceptable level with the correct mitigation measures in place. It is therefore recommended that the proposed project can commence provided that the recommendations in this report are adhered to as part of the EMPr and based on the approval of SAHRA.	X	Section 8 Section 18 Part B-EMPr

18 ENVIRONMENTAL IMPACT STATEMENT

18.1 SUMMARY OF THE KEY FINDINGS OF THE ENVIRONMENTAL IMPACT ASSESSMENT

Key findings of the impact assessment for the proposed activities are as follows:

- Sufficient and appropriate information on the proposed development and the receiving environment was available for conducting the impact assessment;
- With mitigation measures applied, the proposed development is compatible with current land uses; and

- Impacts identified have been assessed to be reversible and can be satisfactorily mitigated.

18.2 FINAL SITE MAP

The final site map has been included in Appendix C.

18.3 SUMMARY OF THE POSITIVE AND NEGATIVE IMPLICATIONS AND RISKS OF THE PROPOSED ACTIVITY AND IDENTIFIED ALTERNATIVES

A summary of the positive and negative impacts and risks associated with the proposed development are provided below:

18.3.1 POSITIVE IMPACTS

- Increase potential for supporting a larger biodiversity for a prolonged period.

18.3.2 NEGATIVE IMPACTS

The potentially negative impacts of the development which were assessed to be of most importance were as follows:

18.3.2.1 Soils

- Disturbance/Loss of Soil Resources Due to Erosion.
- Contamination of soils.

18.3.2.2 Air Quality

- Construction of the irrigation pipeline, located to the north-east of Copperton, could impact negatively on the town due to frequent winds from the east-northeast if unmitigated.

18.3.2.3 Noise

- The proposed irrigation will not have any noise impacts.

18.3.2.4 Surface Water Ecosystems

- Surface water runoff could transport increased silts and sediments into wetland areas, affecting the water quality.
- Increased salinity of the wetland soils could occur through evaporation of poor-quality irrigation water.
- Vegetation alteration due to increased water source.

18.3.2.5 Groundwater and Surface Water

- The proposed irrigation will not contribute to groundwater or surface water impacts, but the potential for small hydrocarbons spills from vehicles remain possible.

18.3.2.6 Terrestrial Ecology

- Loss of natural habitat of moderate ecological importance.
- Degradation of Natural Habitat of Moderate Ecological Importance; Loss of Medicinal / Conservation Important Plant Species.
- Introduction/proliferation of alien invasive Flora.
- Increased utilisation of plant resources as a result of an influx of people into the study area.
- Loss of Faunal Habitat.
- Disturbance/loss of fauna Species of Conservation Concern.
- Introduction/Invasion of Alien Fauna and Spread of Diseases.

18.3.2.7 Archaeology

- Disturbance of surfaces and/or sub-surfaces may destroy, damage, alter, or remove from its original position archaeological material or objects. This impact is however not likely due to the nature of the activity.

18.3.2.8 EM and RF Interference

- The proposed irrigation will not have an impact on the MeerKAT/SKA Observatory.

19 PROPOSED IMPACT MANAGEMENT OBJECTIVES AND THE IMPACT MANAGEMENT OUTCOMES FOR INCLUSION IN THE EMPR

The key objectives of an EMPr are to set out the management and monitoring measures required to both minimise any potentially adverse environmental impacts and enhance the environmental benefits of the proposed activities, and to ensure that responsibilities and appropriate resources are efficiently allocated to implement the plan.

The aspects which are considered to be of most importance to the development, including the respective management objectives and outcomes for the impacts associated with these aspects are provided in Table 19-1.

The management objectives and outcomes will be achieved through the implementation of the management actions in the EMPr.

TABLE 19-1: IMPACT MANAGEMENT OBJECTIVES AND OUTCOMES

ASPECT	MANAGEMENT OBJECTIVE	MANAGEMENT OUTCOME
Soil	➲ Manage suitable onsite soil resources for rehabilitation activities. ➲ Prevent the contamination of soil resources. ➲ Managed response to the clean-up of accidental spillages and leaks.	➲ Soil resources protected from contamination. ➲ Accidental leaks and spillages responded to rapidly and all contamination remediated in accordance with legal requirements.
Air	➲ Control and minimise particulate and dust emissions to air.	➲ Air emissions from the development managed in accordance with legal requirements.
Groundwater	➲ Surrounding land users unaffected by dewatering and other mine activities. ➲ Prevent the contamination of groundwater resources. ➲ Managed response to the clean-up of accidental spillages and leaks. ➲ Monitor groundwater to ensure that any changes in groundwater quality and quantity are identified and investigated	➲ Good stakeholder relations with community members. ➲ Groundwater resources protected from contamination. ➲ Accidental leaks and spillages responded to rapidly and all contamination remediated in accordance with legal requirements.
Health and Safety	➲ Prevent criminal activities onsite. ➲ Prevent occupational and community health and safety incidents.	➲ Secure and safe site.
Noise	➲ Prevent noise impacts from development activities at sensitive noise receptors.	➲ Good stakeholder relations with community members and authorities.

	➲ Complaints which are received are properly investigated and responded to appropriately.	
Heritage	➲ Protection of heritage resources.	➲ No heritage resources damaged or destroyed during construction activities.
Socio-Economic	➲ Support for the development by the local community is enhanced.	➲ Good stakeholder relations with community members and authorities.

20 FINAL PROPOSED ALTERNATIVES

No other alternatives to those identified and assessed through the impact assessment process are proposed for the activities.

21 ASPECTS FOR INCLUSION AS CONDITIONS OF AUTHORISATION

The following conditions should be included in the authorisation:

- The EMPr, including all management and monitoring measures must be implemented.

22 DESCRIPTION OF ANY ASSUMPTIONS, UNCERTAINTIES, AND GAPS IN KNOWLEDGE

Advisory on Business and Sustainability Africa (Pty) Ltd. (ABS Africa) has prepared this report specifically for Vardocube (Pty) Ltd. The contents of this report:

- Are based on the legal requirements for undertaking a Basic Assessment Process, as defined in the National Environmental Management Act, 1998 (Act No. 107 of 1998), the EIA Regulations (2014) and the scope of services as defined within the contractual undertakings between Vardocube (Pty) Ltd and ABS Africa;
- Are specific to the intended development at the proposed site. The report shall not be used nor relied upon neither by any other party nor for any other purpose without the written consent of ABS Africa. ABS Africa accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report;
- Reflect the best judgement of ABS Africa in light of the information available at the time of preparation. The analyses contained in this report has been developed from information provided by Vardocube (Pty) Ltd and other parties. This information is not within the control of ABS Africa and ABS Africa has not audited such information and makes no representations as to the validity or accuracy thereof; and
- The assessment has been based on the project description provided by the Applicant. Changes to this project description may influence the assessment and the mitigation measures in the EMPr.

23 REASONED OPINION AS TO WHETHER THE PROPOSED ACTIVITY SHOULD OR SHOULD NOT BE AUTHORISED

23.1 REASONS WHY THE ACTIVITY SHOULD BE AUTHORISED OR NOT

Based on the findings of the impact assessment, the temporary infrastructure and short terms nature of the project, and with the understanding that the mitigation measures will continue to be implemented throughout the operational period, the EAP is of the opinion that an environmental authorisation for the activities may be granted.

23.2 CONDITIONS THAT MUST BE INCLUDED IN THE AUTHORISATION

23.2.1 SPECIFIC CONDITIONS TO BE INCLUDED INTO THE COMPILATION AND APPROVAL OF EMPR

The Applicant must continue to reassess the risks and impacts of the development throughout its operational life. Should any change in the risk and impact profile of the development be determined, additional management controls and mitigation measures must be implemented and the EMPr amended to reflect these changes.

24 PERIOD FOR WHICH ENVIRONMENTAL AUTHORISATION IS REQUIRED

The environmental authorisation is required for a period of 12 Months.

25 FINANCIAL PROVISION

25.1 DETERMINATION OF THE AMOUNT OF FINANCIAL PROVISION

The project will not add any additional cost to the amount approved by the DMRE as part of the MR application.

25.2 CONFIRM THAT THIS AMOUNT CAN BE DERIVED FROM THE OPERATING EXPENDITURE

As above.

26 OTHER INFORMATION REQUIRED BY THE COMPETENT AUTHORITY

In compliance with the provisions of sections 24(4) (a) and (b) read with section 24 (3) (a) and (7) of the National Environmental Management Act (Act 107 of 1998), the EIA report must include the:

(1) Impact on the socio-economic conditions of any directly affected person.

The proposed activities are not expected to have an impact on the socio-economic conditions.

(2) Impact on any national estate referred to in section 3(2) of the National Heritage Resources Act.

The impact of the proposed irrigation project on heritage resources is considered to be low and can be mitigated to an acceptable level with the correct mitigation measures in place. It is therefore recommended that the proposed project can commence provided that the recommendations in this report are adhered to as part of the EMPr and based on the approval of SAHRA.

Paleontological resources

According to the SAHRA paleontological sensitivity map, the area is of moderate paleontological sensitivity and an independent study was conducted and concluded that it is extremely unlikely that any fossils would be preserved in the Aeolian sands of the Quaternary aged Gordonia Formation but that a Fossil Chance Find Protocol for Quaternary fossils should be added to the EMPr.

Widespread Stone Age scatters (ESA; MSA and LSA) and Burials and Cemeteries

Within the area earmarked for the irrigation project numerous ESA, MSA and to a lesser extent LSA lithics as well as a formal burial site located outside of the impact area were recorded

(3) Other matters required in terms of sections 24(4) (a) and (b) of the Act.

All reasonable and feasible alternatives in terms of site layout, location, public participation, potential impacts and mitigation have been addressed throughout this report.

UNDERTAKING

The EAP herewith confirms

a. the correctness of the information provided in the reports

b. the inclusion of comments and inputs from stakeholders and I&APs

c. the inclusion of inputs and recommendations from the specialist reports where relevant; and

d. the acceptability of the project in relation to the finding of the assessment and level of mitigation proposed.

DISCLAIMER

Advisory on Business and Sustainability Africa (Pty) Ltd. (ABS Africa) has prepared this report specifically for Vardocube (Pty) Ltd.

The contents of this report:

- Are based on the legal requirements for undertaking a Basic Assessment, as defined in the National Environmental Management Act, 1998 (Act No. 107 of 1998) and the scope of services as defined within the contractual undertakings between Vardocube and ABS Africa.
- Are specific to the intended development at the proposed site. The report shall not be used nor relied upon neither by any other party nor for any other purpose without the written consent of ABS Africa. ABS Africa accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.
- Reflect the best judgement of ABS Africa in light of the information available at the time of preparation. The analyses contained in this report has been developed from information provided by Vardocube (Pty) Ltd and other parties. This information is not within the control of ABS Africa and ABS Africa has not audited such information and makes no representations as to the validity or accuracy thereof.

PART B
ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT

27 ENVIRONMENTAL PROGRAMME REPORT

27.1 DETAILS OF THE EAP

Name of the Practitioner:	ABS Africa (Pty) Ltd.
Tel No.:	+27 11 805 0061
E-mail address:	chane.pretorius@abs-africa.com

Details of the EAPs experience and qualifications are provided in Part A, Section 1.

27.2 DESCRIPTION OF THE ASPECTS OF THE ACTIVITY

The description of the aspects of the activity are provided in Part A, Section 3.

28 COMPOSITE MAP

The environmental sensitivity map identifying areas to be avoided by the proposed activities is provided in Appendix C.

29 DESCRIPTION OF IMPACT MANAGEMENT OBJECTIVES INCLUDING MANAGEMENT STATEMENTS

The key objectives of an EMPr are to set out the management and monitoring measures required to both minimise any potentially adverse environmental impacts and enhance the environmental benefits of the Project, and to ensure that responsibilities and appropriate resources are efficiently allocated to implement the plan.

The aspects which are considered to be of most importance to the development, including the respective management objectives and outcomes for the impacts associated with these aspects are provided in Table 19-1.

The management objectives and outcomes will be achieved through the implementation of the management actions in the EMPr.

29.1 DETERMINATION OF CLOSURE OBJECTIVES

The main closure objectives of the proposed activities are:

- To restore the site to its current land capability in a sustainable matter;
- To prevent the establishment of any permanent structures or features, unless otherwise agreed with stakeholders;
- To limit and rehabilitate any erosion features and prevent any permanent impact to the soil capability in areas disturbed by the proposed activities;
- Cleaning up of the sources of possible contamination still present on the site to protect the downstream receiving environment; and
- Cleaning-up and rehabilitating of contaminated soil areas, if applicable.

29.2 VOLUMES AND RATES OF WATER USE REQUIRED FOR THE OPERATION

No water will be sourced or be required from the municipality for the proposed activities.

29.2.1 HAS A WATER USE LICENCE BEEN APPLIED FOR?

Prieska Copper Zinc Mine Limited (PCZML) has an Integrated Water Use Licence (IWUL), however a discussion with the Department of Human Settlement, Water and Sanitation (DHSWS) is underway to confirm whether or not if the proposed activities requires an amendment to the IWUL.

TABLE 29-1: IMPACTS TO BE MITIGATED IN THEIR RESPECTIVE PHASES

ACTIVITY	PHASE	SIZE AND SCALE OF DISTURBANCE	MITIGATION TYPES	COMPLIANCE WITH STANDARDS	TIME PERIOD FOR IMPLEMENTATION
	Administrative Controls				
All mining and associated activities	All phases	Above ground pipeline of approximately. 6 km	➲ The EMPr shall be incorporated into any Environmental Management System (EMS) applicable to the site ➲ All resources required to ensure compliance with the EMPr, including budgetary, personnel and equipment shall be in place for the duration of the project ➲ A signed commitment to ensure compliance with the EMPr shall be obtained from Contractors appointed to undertake any of the activities on behalf of the applicant ➲ An appropriately qualified, trained and experienced person shall be designated to fulfil the compliance monitoring requirements in the EMPr ➲ The following records shall be maintained on Site: ➢ Environmental Authorisation ➢ Approved EMPr ➢ Emergency preparedness and response plan ➢ Documentation concerning compliance monitoring, environmental performance and EMPr implementation ➢ Record of all individuals receiving job-specific and SHE training ➢ Compliance monitoring and auditing data/reports and results of inspections conducted ➢ Approved SHE method statements ➢ Waste management records ➢ Equipment maintenance records	Implementation of the mitigation measures will ensure compliance with NEMA, NEMAQA, NEMWA, MPRDA and the regulations, norms and standards promulgated in terms of these Acts	Mitigation measures are required to be implemented from the commencement of site preparation activities throughout the project

			➢ Maintenance and inspection of all safety equipment e.g. fire extinguishers ➢ A completed and signed environmental incident/non-conformance report in respect of each reported environmental incident or nonconformity ➢ A completed and signed environmental incident/non-conformance register ➢ A completed and up-to-date external complaints and grievances form and register in respect of each external complaint received ➢ Emergency contact register		
Soils and Land Use					
Preparation of the site for irrigation	All phases	As above	➲ Erosion must be controlled in run off areas. During all new development care should be taken not to enhance erosion and it should be controlled as soon as erosion is observed. Surface areas that have been disturbed should not be left bare for extended periods of time, but should always be vegetated as soon as possible. ➲ Traffic on unpaved roads should be limited. Periods of rain, especially heavy rain, may cause erosion on roads. Where erosion trenches are caused due to activities on unpaved roads and /or the wheel tracks of the irrigation system, the trenches should be rehabilitated. Maintenance on the wheel tracks should be done regularly.	NEMA Regulations MHSA Water management measures in compliance with NWA and GN704.	Throughout Activities

Preparation of the site for irrigation	All phases	As above	➲ The impact of droplets through irrigation can cause capping of the soil surface layer. Poor water quality can lead to built-up of salts on the soil surface and acerbate the initial problem. ➲ All land disturbed by the development should be vegetated and left in the condition it was before the construction or disturbance. None of the disturbed areas should be left uncovered to prevent erosion and soil deterioration. ➲ Contamination of presently undisturbed soils should be prevented as far as possible to prevent the impact on downstream water use.	NEMA Regulations MHSA Water management measures in compliance with NWA and GN704.	Throughout Activities
Air Quality					
All activities	All phases	As above	➲ Air quality impacts during construction would be reduced through basic control measures such as limiting the speed of vehicles	NEMA Regulations	Throughout Activities
Groundwater					
All activities	All phases	As above	➲ All construction vehicles, equipment and machinery shall be equipped with drip trays and spill response kits ➲ Hydrocarbon spillages shall be cleaned as soon as possible and no longer than one day after the spillage event ➲ Polluted soils are to be treated with appropriate absorbents or be removed from areas where incidents have occurred. This soil shall be properly contained before being disposed of at appropriately licensed waste management facilities	NEMA principles Water management measures in compliance with NWA	Throughout the project
Surface Water Resources					
All activities	All phases	As above	➲ Spill response kits available for all vehicles / machinery used	NEMA, MHSA	Throughout Activities

Terrestrial Ecology (Flora)					
Placement of pipeline and irrigation activities	Construction phases and operational phase	As above	➲ The footprints of the proposed irrigation area need to be carefully surveyed by an experienced botanist at an optimal time of the year and the location of all significant protected species need to be marked and recorded on a GPS; ➲ Those species that can be removed, e.g. succulents such as Hoodia, Anacampseros or Euphorbia species, should be removed under the supervision of a botanist with horticultural experience and relocated to representative habitat as close to the original location as possible; ➲ Close monitoring of all movements of equipment, site personnel and workers should be carried out so as to minimize unauthorised activities in any part of the project area. ➲ An invasive alien plant management program will need to be set up as part of the mine's Environment and Social Management System (ESMS). The objective of this program should be the continuous eradication of existing invasive populations and the detection of new populations, particularly in newly or constantly disturbed areas such as roadsides. ➲ A small team of labourers should be trained in the identification of the key invasive alien plant species, as well as the safe and effective use of relevant herbicides on these species. ➲ The team should be equipped with adequate equipment such as knapsack sprayers, which should be stored in a safe location with the herbicides. ➲ Careful records should be kept of areas cleared of invasive aliens and the success of follow-up operations, so that the program can be audited as part of overall ESMS audit. ➲ Staff should be accommodated off-site as much as possible, particularly during the construction phase, reducing the risk of illegal harvesting taking place after hours. ➲ Labour supervisors and SHE officials should monitor the activities of labourers when working away from infrastructure in natural habitat.	NEMBA NEMA	Throughout Activities

			➲ Part of staff induction should be awareness of the consequences of being caught harvesting plant resources.		
Terrestrial Ecology (Fauna)					
Placement of pipeline and irrigation activities	Construction phases and operational phase	As above	➲ Continuous Environmental Awareness raising and training to employees and surrounding communities will be crucial; this should involve an induction training program, where appropriate conservation principles, safety procedures, snake bite avoidance and first aid treatment are taught through the use of easy-to-understand study material. Designated staff must be trained to be able to safely capture and relocate potentially dangerous snake species. ➲ Strict measures for speed control should be instituted on all roads within the project area. The measures should include erection of speed control humps in respective areas, installation of traffic signs in selected areas warning drivers of road humps, pedestrian crossings, sharp bends and other accident-prone areas, with regular training and awareness raising of all drivers on site on speed control and enforcing a maximum speed limit of 50 km/h on all mine roads. ➲ All staff operating motor vehicles must undergo an environmental induction training course that includes instruction on the need to comply with speed limits, to respect all forms of wildlife and to prevent accidental road kills of fauna. ➲ Road mortalities should be monitored by both vehicle operators (for personal incidents only) and an Environmental Control Officer (all road kill on periodic monitoring basis as well as specific incidents) with trends being monitored and subject to review as part of the monthly reporting. Monitoring should occur via a logbook system where staff members take note of the date, time and location of the sighting/ incident. This will allow determination of the locations where the greatest likelihood exists of causing a road mortality and to develop mitigations for these areas. ➲ All noise generating activities should be mitigated to be within legal noise limits as part of Noise Control Action Plan; this plan should detail	NEMBA NEMA	Throughout Activities

			monitoring protocols, corrective and preventative measures such as silencers and enclosure of high-noise facilities/infrastructure, as well as the continuous monitoring of these measures to ensure they are effective in minimising disturbance to the surrounding fauna. ➲ Staff should be accommodated off-site as much as possible, particularly during the construction phase, reducing the risk of illegal harvesting taking place after hours. ➲ Labour supervisors and SHE officials should monitor the activities of labourers when working away from infrastructure in natural habitat. ➲ Part of staff induction should be awareness of the consequences of being caught harvesting animal resources.		
Heritage					
All activities	All phases	As above	➲ No infrastructure must occur surrounding Blombospan and Valspan (Waypoint 145, 146 and 150) with a 30 m buffer; ➲ No infrastructure must occur surrounding the knapping and quarrying site (Waypoint 169) with a 30 m buffer; ➲ Implementation of a chance find procedure that include a Fossil Chance Find Protocol for Quaternary fossils. **Chance Find Procedure** If during the any phase of this project, any person employed by the developer, one of its subsidiaries, contractors and subcontractors, or service provider, finds any artefact of cultural significance or heritage site, this person must cease work at the site of the find and report this find to their immediate supervisor, and through their supervisor to the senior on-site manager. It is the responsibility of the senior on-site Manager to make an initial assessment of the extent of the find and confirm the extent of the work stoppage in that area. The senior on-site Manager will inform the ECO of the chance find and its immediate impact on operations. The ECO will then contact a professional archaeologist for an assessment of the finds who will notify the SAHRA.	SAHRA	Throughout Activities

Surface Water Ecosystems					
Movement of irrigators	Operational	As above	➲ To mitigate rutted tracks it is recommended that a type of raised track of stable material be used to protect the soils underneath, as well as to aid in levelling the topography to aid in the centre pivot boom operations. ➲ Once the construction of the infrastructure is completed, the soils should be loosely scarified and vegetation re-established within the impact area. It would be preferable if no heavy machinery enter the wetland areas, but this may be unpractical. ➲ A raised platform could be a raised concrete structure, which could be removed as part of the decommissioning phase of the project. If a raised platform/track is to be established, it is important to ensure freedom of movement of surface water runoff. ➲ If it is found that large amounts of sediment reach the wetland units, especially following high rainfall events, then it should be manually removed	NEMBA NEMA	Throughout Activities

TABLE 29-2: IMPACT MANAGEMENT OUTCOMES

ACTIVITY	POTENTIAL IMPACT	ASPECTS AFFECTED	PHASE	MITIGATION TYPE / MEASURES	COMPLIANCE WITH STANDARDS
Soils and Land Use					
All activities	Disturbance/loss of soil resources disturbances/ losses of soil due to erosion as well as contamination	Soils	All phases	➲ Avoid/ minimise through design and operational controls.	NEMA
Air Quality					
Preparation of irrigation area	Increase in dust fallout rates, PM10 and PM2.5 Concentrations as a result of Construction of the Irrigation area.	Air quality	Construction	➲ Air quality impacts during construction would be reduced through basic control measures such as limiting the speed of vehicles. ➲ During Construction four additional dustfall measurement units should be installed around the irrigation area, with one between the site and Copperton village (to the south-west of the irrigation area), one to the north-west, one north-east and one south-east.	NEMA
Surface Water Resources					
Preparation of irrigation area and irrigation activities	Changes to water quality of wetland units, potential for physical alteration of wetland units and changes to ecological function of wetland units	Surface water ecosystems	All phases	➲ Avoid/ minimise through design and operational controls.	NEMA NEMBA

Terrestrial Ecology					
Preparation of irrigation area and irrigation activities	Loss of Natural Habitat	Terrestrial flora	All phases	➲ Avoid/ minimise through design and operational controls ➲ Environment and Social Management System (ESMS). The objective of this program should be the continuous eradication of existing invasive populations and the detection of new populations, particularly in newly or constantly disturbed areas such as roadsides. ➲ Labour supervisors and SHE officials should monitor the activities of labourers when working away from infrastructure in natural habitat.	NEMA NEMBA
	Loss of Medicinal / Conservation Important Plant Species	Terrestrial flora	All phases		
	Potential degradation of Natural Habitat through irrigation via mine dewatering	Terrestrial flora	Operational		
	Introduction/proliferation of alien invasive species	Terrestrial flora	All phases		
	Illegal utilisation of plant resources	Terrestrial flora	All phases		
	Destruction/ Loss of Faunal Habitat	Terrestrial fauna	All phases		
Heritage					
Preparation of irrigation area and irrigation activities	Disturbance/Loss of Significant Archaeological or Cultural Heritage Sites/Remains	Archaeology, palaeontology, and cultural heritage	All phases	Maintain / monitor through implementation of chance find procedure	SAHRA

TABLE 29-3: IMPACT MANAGEMENT ACTIONS

ACTIVITY	POTENTIAL IMPACT	MITIGATION TYPE / MEASURES	TIMEFRAME FOR IMPLEMENTATION	COMPLIANCE WITH STANDARDS
Soils and Land Use				
Preparation of irrigation area and irrigation activities	Disturbance/loss of soil resources disturbances/ losses of soil due to erosion as well as contamination	Avoid/ minimise through design and operational controls.	Throughout All Phases	NEMA NEMBA
Surface Water Resources				
Preparation of irrigation area and irrigation activities	Surface Water Contamination	Avoid/ minimise through design and operational controls.	Throughout All Phases	NEMA and NWA Regulations.
	Erosion and stormwater management		Throughout All Phases	
Terrestrial Ecology				
Preparation of irrigation area and irrigation activities	Loss of Natural Habitat	Avoid/ minimise through design and operational controls	Throughout Phases	NEMA NEMBA
	Loss of Medicinal / Conservation Important Plant Species		Throughout All Phases	
	Loss of Faunal Habitat		Throughout All Phases	
Heritage				
Preparation of irrigation area and irrigation activities	Disturbance/Loss of Significant Archaeological or Cultural Heritage Sites/Remains	Maintain / monitor through implementation of chance find procedure	Throughout All Phases	SAHRA
Air Quality				
Preparation of irrigation area	Elevated PM10 and PM2.5 Concentrations Elevated dust fall levels	Control through design and operational controls	As above	NEM:AQA NEMA

30 FINANCIAL PROVISION

30.1 DETERMINATION OF THE AMOUNT OF FINANCIAL PROVISION

30.1.1 DESCRIBE THE CLOSURE OBJECTIVES AND THE EXTENT TO WHICH THEY HAVE BEEN ALIGNED TO THE BASELINE ENVIRONMENT DESCRIBED UNDER THE REGULATION.

The main closure objectives of the proposed activities are:

- To restore the site to its current land capability in a sustainable matter;
- To prevent the establishment of any permanent structures or features, unless otherwise agreed with stakeholders;
- To limit and rehabilitate any erosion features and prevent any permanent impact to the soil capability in disturbed areas.
- To close the operation efficiently, cost effectively and in accordance with legal requirements;
- Cleaning up of the sources of possible contamination still present on the site to protect the downstream receiving environment; and
- Cleaning-up and rehabilitating of contaminated soil areas, if applicable.

31 CONFIRM SPECIFICALLY THAT THE ENVIRONMENTAL OBJECTIVES IN RELATION TO CLOSURE HAVE BEEN CONSULTED WITH LANDOWNER AND INTERESTED AND AFFECTED PARTIES

The Applicant has already entered into discussions with potentially affected landowners regarding the proposed activities, including the applicable closure requirements. Landowners, known land users and I&APs were notified of the availability of the Draft BAR report and provided with an opportunity to comment thereon All comments and responses received from landowners have been included in this Final BAR.

32 PROVIDE A REHABILITATION PLAN THAT DESCRIBES AND SHOWS THE SCALE AND AERIAL EXTENT OF THE MAIN MINING ACTIVITIES, INCLUDING THE ANTICIPATED MINING AREA AT THE TIME OF CLOSURE.

32.1 SITE REHABILITATION

- All disturbed surfaces will be revegetated.
- The Contractor shall ensure that all weeds and alien/invasive species cleared for activities are removed from site.

32.2 EXPLAIN WHY IT CAN BE CONFIRMED THAT THE REHABILITATION PLAN IS COMPATIBLE WITH THE CLOSURE OBJECTIVES

The objective of the rehabilitation process is to restore as much as possible of the area disturbed to its previous land use. The rehabilitation activities proposed in the above rehabilitation plan will ensure that the land reverts back to its original state upon closure of activities.

32.3 CALCULATE AND STATE THE QUANTUM OF THE FINANCIAL PROVISIONS REQUIRED TO MANAGE AND REHABILITATE THE ENVIRONMENT IN ACCORDANCE WITH THE APPLICABLE GUIDELINE

The project will not add any additional cost to the amount approved by the DMRE as part of the MR application.

32.4 CONFIRM THAT THE FINANCIAL PROVISION WILL BE APPROVED AS DETERMINED

The project will not add any additional cost to the amount approved by the DMRE as part of the MR application.

TABLE 32-1: MECHANISM FOR MONITORING COMPLIANCE WITH AND PERFORMANCE ASSESSMENT AGAINST THE ENVIRONMENTAL MANAGEMENT PROGRAMME AND REPORTING THEREON

Activity	Impacts Requiring Monitoring Programmes	Functional Requirements	Roles and Responsibilities	Implementation / Compliance Monitoring Mechanism	Monitoring and Reporting Frequency
All activities	General site management and compliance monitoring	Inspections	ECO / SHE Representatives – day to day inspections, compliance monitoring and sampling as may be required	Daily and weekly inspections	Ongoing
All activities	Introduction/proliferation of alien invasive species due to construction and operational activities at the mine	Careful records should be kept of areas cleared of invasive aliens and the success of follow-up operations, so that the program can be audited as part of the overall EMP audit.	ECO / SHE Representatives	Day to day inspections, compliance monitoring and sampling as may be required	Ongoing
All activities	Fauna road mortalities	Road mortalities should be monitored by both vehicle operators (for personal incidents only) and an Environmental Control Officer (all road kill on periodic monitoring basis as well as specific incidents) with trends being monitored and subject to review as part of the monthly reporting	ECO / SHE Representatives	Monitoring should occur via a logbook system where staff members take note of the date, time and location of the sighting/ incident. This will allow determination of the locations where the greatest likelihood exists of causing a road mortality and to develop mitigations for these areas.	Ongoing
All activities	Contamination of surface water, groundwater and soil through hydrocarbon spills	Compliance monitoring function assigned and appropriately resourced	ECO / SHE Representatives	Water quality testing by an accredited laboratory	Daily / weekly Quarterly

All activities	Erosion and compaction of soils	Compliance monitoring function assigned and appropriately resourced	ECO / SHE Representatives	• Monitoring and quality control of the wheel tracks and installation of the pipeline • Ad Hoc inspections after severe rainfall to determine soil loss and vegetative cover. • Remediating actions like reseeding etc. to re-establish basal cover. • Sampling for chemical analysis to monitor possible chemical impact during the high and low rainfall seasons.	Daily / weekly Bi-annually

32.5 INDICATE THE FREQUENCY OF THE SUBMISSIONS OF THE PERFORMANCE REPORT

The proposed project is temporary with minimal impact and will require an annual performance report after closure and rehabilitation. Daily site inspection will be implemented by the ECO during all phases of the project.

32.6 MANNER IN WHICH THE APPLICANT INTENDS TO INFORM HIS OR HER EMPLOYEES OF ANY ENVIRONMENTAL RISK WHICH MAY RESULT FROM THEIR WORK

Vardocube (Pty) Ltd will be responsible for ensuring implementation of the EMPr for the proposed activities.

The Company is committed to ensuring that the Occupation Health & Safety (OHS) and Environment Departments' staffs are appropriately qualified for implementing their assigned responsibilities effectively. In order to fulfil this requirement, the Company shall recruit competent individuals and put in place a continuous training and skills upgrading program. Typical duties and responsibilities for the OHS and Environment staff will include, inter alia to:

- Ensure that environmental monitoring programs are carried out on schedule and correctly;
- Review environmental data and recommend appropriate actions;
- Monitor environmental compliance of all operations;
- Train others in the team and general personnel on related environmental issues; and
- Ensure commitments listed in the EMPr are met.

32.7 MANNER IN WHICH RISK WILL BE DEALT WITH IN ORDER TO AVOID POLLUTION OR THE DEGRADATION OF THE ENVIRONMENT

Potential risk associated with the proposed project has been assessed in Part A of the BAR and the implementation of the management measures in the EMPr will reduce the risk posed to the environment.

32.8 SPECIFIC INFORMATION REQUIRED BY THE COMPETENT AUTHORITY

In compliance with the provisions of sections 24(4) (a) and (b) read with section 24 (3) (a) and (7) of the National Environmental Management Act (Act 107 of 1998), the EIA report must include the:

In compliance with the provisions of sections 24(4) (a) and (b) read with section 24 (3) (a) and (7) of the National Environmental Management Act (Act 107 of 1998), the EIA report must include the:

(1) Impact on the socio-economic conditions of any directly affected person.

The proposed activities are not expected to have an impact on the socio-economic conditions.

(2) Impact on any national estate referred to in section 3(2) of the National Heritage Resources Act.

The impact of the proposed irrigation project on heritage resources is considered to be low and can be mitigated to an acceptable level with the correct mitigation measures in place. It is therefore recommended that the proposed project can commence provided that the recommendations in this report are adhered to as part of the EMPr and based on the approval of SAHRA.

Paleontological resources

According to the SAHRA paleontological sensitivity map, the area is of moderate paleontological sensitivity and an independent study was conducted and concluded that it is extremely unlikely that any fossils would be preserved in the Aeolian sands of the Quaternary aged Gordonia Formation but that a Fossil Chance Find Protocol for Quaternary fossils should be added to the EMPr.

Widespread Stone Age scatters (ESA; MSA and LSA) and Burials and Cemeteries

Within the area earmarked for the irrigation project numerous ESA, MSA and to a lesser extent LSA lithics as well as a formal burial site located outside of the impact area were recorded

(3) Other matters required in terms of sections 24(4) (a) and (b) of the Act.

All reasonable and feasible alternatives in terms of site layout, location, public participation, potential impacts and mitigation have been addressed throughout this report.

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Beaumont, P.B., Smith, A.B. & Vogel, J.C. 1995. Before the Einiqua: the archaeology of the frontier zone. In: Smith, A.B. (ed.) Einiqualand: studies of the Orange River frontier: 236-264. Cape Town: University of Cape Town Press Reports International Series 207.

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Northern Cape Province

Sivest, 2015. Proposed Construction of the Helena 1 75MW Solar Photovoltaic (PV) Energy Facility near Copperton, Northern Cape Province. Draft Scoping Report

Siyathemba Local Municipality, 2006. Spatial Development Framework

Siyathemba Local Municipality, 2017. Integrated Development Plan 2017 - 2018

33 UNDERTAKING

The EAP herewith confirms:

(a) The correctness of the information provided in this report

(b) The inclusion of comments and inputs from stakeholders and I&APs

(c) The inclusion of inputs and recommendations from the specialist reports where relevant, and

(d) The acceptability of the project in relation to the fining of the assessment and the level of mitigation proposed,

APPENDIX A: LEGISLATION REQUIREMENTS AS PER NEMA GNR APPENDIX 1 AND 4

CORRELATION WITH GNR 982	LEGISLATIVE REQUIREMENTS	RELEVANT REPORT SECTION
APPENDIX 1		
3(1)(a)(i) & (ii)	Details of the environmental assessment practitioner (EAP).	1.1 Details of The EAP Who Prepared the Report Expertise of the EAP and CV have been included in Appendix B
3(1)(b)(i-iii)	Location of the activity	2 Description of The Property & Map 1
3(1)(c)	A plan which locates the proposed activity or activities applied for as well as associated structures and infrastructure at an appropriate scale;	2 Description of The Property 2.2 Locality Map
3(1)(d)(ii)	A description of the activities to be undertaken.	3 Description of The Scope of The Proposed Overall Activity
3(1)(f)	A motivation for the need and desirability of the proposed development.	5 Need and Desirability Of The Proposed Activities
3(1)(g)	A motivation for the preferred site, activity and technology alternative.	6. Motivation For The Preferred Development Footprint Within The Approved Site Including A Full Description Of The Process Followed To Reach The Proposed Development Footprint Within The Approved Site 13 Motivation Where No Alternative Sites Were Considered
3(1)(h)(i),(ix)&(x)	Details of the alternatives considered and outcomes of the site selection matrix.	20 Final Proposed Alternatives
3(1)(h)(xi)	A concluding statement indicating the preferred alternatives and preferred location of the activity.	13 Motivation Where No Alternative Sites Were Considered
3(d)(i)	Description of the listed and specified activities triggered and being applied for.	4.1 Listed Activities Identified in Terms Of NEMA, NEM:WA and NWA
3(1)(h)(iv) & 3(1)(k)	Environmental attributes associated with the alternatives focusing on the geographical, physical, biological, social,	8. The Environmental Attributes Associated with The Sites

	economic, heritage and cultural aspects.	
3(1)(e)(i) & (ii)	A description of the policy and legislative context within which the development is proposed.	4 Policy and Legislative Context
3(1)(h)(ii)	Details of the public participation process undertaken.	7 Details of Public Participation Process Followed
3(1)(h)(v)	The impacts and risks identified for each alternative.	9 Impacts And Risks Identified Including The Nature, Significance, Consequence, Extent, Duration And Probability
3(1)(h)(vi)	Methodology used to rank the impacts.	10 Methodology Used In Determining And Ranking The Nature, Significance, Consequences, Extent, Duration And Probability Of Potential Environmental Impacts And Risks
3(1)(h)(iii) & (vii)	Positive and negative impacts associated with the proposed project.	11 The Positive And Negative Impacts That The Proposed Activity And Alternatives Will Have On The Environment And The Community That May Be Affected
3(1)(h)(viii)	Proposed mitigation measures (also included in appendix F in the environmental management programme (EMPR)).	12 The Possible Mitigation Measures That Could Be Applied and The Level Of Risk
3(1)(i)(i)&(ii)	Full description of the process used to identify and rank the impacts through the life of the project.	15 Full Description Of The Process Undertaken To Identify, Assess And Rank The Impacts And Risks The Activity Will Impose On The Preferred Site (In Respect Of The Final Site Layout Plan) Through The Life Of The Activity
3(1)(j)(i-vii)	An assessment of each identified potentially significant impact and risk.	16 Assessment of Each Identified Potentially Significant Impact And Risk
3(1)(l)(i-iii)	An environmental impact statement.	18 Environmental Impact Statement
3(1)(m)	Impact management measures.	19 Proposed Impact Management Objectives and The Impact Management Outcomes for Inclusion in The EMPr These Are Also Included in The EMPR In Section 27
3(1)(n)	Aspects to be included in conditions of authorisation. These are also described in the mitigation and management	21 Aspects for Inclusion as Conditions Of Authorisation

	measures contained within the EMPr	
3(1)(q)	Where the proposed activity does not include operational aspects, the period for which the environmental authorisation is required, the date on which the activity will be concluded, and the post construction monitoring requirements finalised;	20. Period for Which Environmental Authorisation Is Required
3(1)(o)	Statement on what has been excluded from the basic assessment process and the reasoning thereof.	22 Description of Any Assumptions, Uncertainties, And Gaps In Knowledge
3(1)(p)	Opinion as to whether the proposed activity should be authorised or not.	23 Reasoned Opinion As To Whether The Proposed Activity Should Or Should Not Be Authorised
3(1)(r)(i-iv)	Undertaking under oath or affirmation of the EAP	33 Undertaking
3(1)(t)	I&APS Identification, consultation and Management	7. Details of Public Participation Process Followed
APPENDIX 4		
(1)(a)	Details of:	
	(i) the EAP who prepared the EMPr; and	27.1 Details of the EAPAP
	(ii) the expertise of that EAP to prepare an EMPr, including a curriculum vitae;	1.2 Expertise of the EAP & APPENDIX B
(1)(b)	A detailed description of the aspects of the activity that are covered by the EMPr as identified by the project description;	27.2 Description of the Aspects of the Activity
(1)(c)	A map at an appropriate scale which superimposes the proposed activity, its associated structures, and infrastructure on the environmental sensitivities of the preferred site, indicating any areas that should be avoided, including buffers;	28 Composite Map Map 2
(1)(d)	A description of the impact management outcomes, including management statements, identifying the impacts and risks	29 Description of Impact Management Objectives Including Management Statements

	that need to be avoided, managed and mitigated as identified through the environmental impact assessment process for all phases of the development including	
	(i) planning and design;	
	(ii) pre-construction activities;	
	(iii) construction activities;	
	(iv) rehabilitation of the environment after construction and where applicable post closure; and	
	(v) where relevant, operation activities;	
(1)(f)	A description of proposed impact management actions, identifying the manner in which the impact management outcomes contemplated in paragraphs (d) will be achieved, and must, where applicable, include actions to -	29 Description of Impact Management Objectives Including Management Statements Part B
	(i) avoid, modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation;	
	(ii) comply with any prescribed environmental management standards or practices;	
	(iii) comply with any applicable provisions of the Act regarding closure, where applicable; and	
	(iv) comply with any provisions of the Act regarding financial provisions for rehabilitation, where applicable;	
(1)(g)	The method of monitoring the implementation of the impact management actions contemplated in paragraph (f);	Table 32-1
(1)(h)	The frequency of monitoring the implementation of the impact management actions contemplated in paragraph (f);	Table 32-1

(1)(i)	An indication of the persons who will be responsible for the implementation of the impact management actions;	Table 32-1 Table 29-3
(1)(j)	The time periods within which the impact management actions contemplated in paragraph (f) must be implemented;	Table 32-1
(1)(k)	The mechanism for monitoring compliance with the impact management actions contemplated in paragraph (f);	Table 32-1
(1)(l)	A program for reporting on compliance, taking into account the requirements as prescribed by the regulations;	32.5 Indicate the Frequency of the Submissions of the Performance Report Table 32-1
(1)(m)	An environmental awareness plan describing the manner in which -	32.6 Manner in which the Applicant Intends to Inform his or her Employees of any Environmental Risk which may Result from their Work
	(i) the applicant intends to inform his or her employees of any environmental risk which may result from their work; and	
	(ii) risks must be dealt with in order to avoid pollution or the degradation of the environment; and	32.7 Manner in which Risk will be Dealt with in order to Avoid Pollution or the Degradation of the Environment
(1)(n)	Any specific information that may be required by the competent authority.	32.8 Specific Information Required by the Competent Authority
(2)	Where a government notice gazetted by the minister provides for a generic EMPr, such generic EMPr as indicated in such notice will apply.	N/A

APPENDIX B: EAP EXPERIENCE

APPENDIX C: MAPS

MAP 1: REGIONAL LOCALITY MAP

MAP 2: SENSITIVITY

MAP 3: CRITICAL BIODIVERSITY AND ECOLOGICAL SUPPORT AREAS

MAP 4: CURRENT LANDUSES

MAP 5: HYDROLOGY

MAP 6: VEGETATION COMMUNITIES

MAP 7: SOILS

MAP 8: SURROUNDING LANDOWNERS AND LANDUSERS

MAP 9: HERITAGE

APPENDIX D: PUBLIC PARTICIPATION MATERIALS

APPENDIX D 1: STAKEHOLDER NOTIFICATION LETTER

APPENDIX D 2: ADVERT

APPENDIX D 3: SITE NOTICE

APPENDIX E: SPECIALIST REPORTS

APPENDIX F: ENVIRONMENTAL SCREENING REPORT

APPENDIX G: IMPACT ASSESSMENT MATRIX

SOILS								
Project Activity		Soils	Likelihood		Consequence			Significance Rating
Establishment of surface pipeline. Assembling of linear draglines. Traffic	Phase of Project	Construction Phase	Frequency of Activity	Frequency of Impact	Severity	Spatial Scope	Duration	
	Impact Classification	Direct Impact	Significance Pre-Mitigation					
	Resulting Impact from Activity	Disturbance, compaction	1	3	2	2	1	20
			Significance Post-Mitigation					
			1	2	1	2	1	12
-								
Project Activity		Soils	Likelihood		Consequence			Significance Rating
Continued Activities. Irrigation. Wheel tracks. Traffic	Phase of Project	Resulting Impact from Activity	Frequency of Activity	Frequency of Impact	Severity	Spatial Scope	Duration	
	Impact Classification	Cumulative. Direct	Significance Pre-Mitigation					
	Resulting Impact from Activity	Waterlogging, surface water run-off, compaction, seepage, contamination and soil capping	4	4	2	3	2	56
			Significance Post-Mitigation					
			2	2	2	2	3	28
Project Activity		Soils	Likelihood		Consequence			Significance Rating
Rehabilitation of wheel tracks, reseeding of disturbed soil removal of surface irrigation equipment, Traffic	Phase of Project	Closure	Frequency of Activity	Frequency of Impact	Severity	Spatial Scope	Duration	
	Impact Classification	Direct	Significance Pre-Mitigation					
	Resulting Impact from Activity	Improved biomass, less erosion, improved seedbank	3	3	3	2	3	48
			Significance Post-Mitigation					

			4	4	3	3	3	72

LAND CAPABILITY AND LAND USE								
Project Activity		Soils	Likelihood		Consequence			Significance Rating
Establishment of surface pipeline. Assembling of linear draglines and irrigation	Phase of Project	Preparation, Construction and operational phases	Frequency of Activity	Frequency of Impact	Severity	Spatial Scope	Duration	
	Impact Classification	Secondary Impact	Significance Pre-Mitigation					
	Resulting Impact from Activity	Waterlogging, surface water run-off, compaction and soil capping	1	2	2	2	1	15
			Significance Post-Mitigation					
			1	2	1	2	1	12

Project Activity		Soils	Likelihood		Consequence			Significance Rating
Rehabilitation of wheel tracks, reseeding of disturbed soil removal of surface irrigation equipment. Traffic	Phase of Project	Preparation -Post-Closure Phases	Frequency of Activity	Frequency of Impact	Severity	Spatial Scope	Duration	
	Impact Classification	Cumulative Impact	Significance Pre-Mitigation					
	Resulting Impact from Activity	Improved biomass, less erosion, improved seedbank	2	3	3	2	3	40
			Significance Post-Mitigation					
			2	4	4	2	3	54

WETLAND SOILS								
Project Activity		Soil Erosion	Likelihood		Consequence			
All construction phase activities	Phase of Project	All phases of project	Frequency of Activity	Frequency of Impact	Severity	Spatial Scope	Duration	Significance Rating
	Impact Classification	Secondary & Cumulative Impact	Significance Pre-Mitigation					
			2	2	2	2	2	24

	Resulting Impact from Activity	Conservation buffer zones (100 m) designated to the wetland units is sufficient to negate erosion impacts.	Significance Post-Mitigation					
			1	1	1	1	1	6

AIR QUALITY								
Project Activity	Air Quality		Likelihood		Consequence			
PM10 and PM2.5 Concentrations as a result of Construction of the Irrigation area	Phase of Project	Construction Phase	Frequency of Activity	Frequency of Impact	Severity	Spatial Scope	Duration	Significance Rating
	Impact Classification	Direct Impact	Significance Pre-Mitigation					
	Resulting Impact from Activity	Impact on human health	3	3	2	3	1	36
			Significance Post- Mitigation					
			3	1	3	2	1	24

Project Activity	Air Quality		Likelihood		Consequence			
Dust Fallout rates as a result of Construction of the Irrigation area	Phase of Project	Construction Phase	Frequency of Activity	Frequency of Impact	Severity	Spatial Scope	Duration	Significance Rating
	Impact Classification	Direct Impact	Significance Pre-Mitigation					
	Resulting Impact from Activity	Nuisance impact	3	3	2	2	1	30
			Significance Post- Mitigation					
			3	1	2	2	1	20
ECOLOGICAL SENSITIVE HABITAT (WETLAND UNITS)								
Project Activity	Ecologically sensitive habitat (wetland units)		Likelihood		Consequence			
All construction phase activities	Phase of Project	Construction phase	Frequency of Activity	Frequency of Impact	Severity	Spatial Scope	Duration	Significance Rating
	Impact Classification	Direct Impact	Significance Pre-Mitigation					
			3	2	2	2	2	30

	Resulting Impact from Activity	Destruction of wetland habitat due to irrigation	Significance Post-Mitigation					
			1	1	1	1	1	6

Project Activity	Ecologically sensitive habitat (wetland units)		Likelihood		Consequence			
Destruction of wetland habitat due to irrigation	Phase of Project	Construction/Operations phases	Frequency of Activity	Frequency of Impact	Severity	Spatial Scope	Duration	Significance Rating
	Impact Classification	Secondary Impact	Significance Pre-Mitigation					
	Resulting Impact from Activity	Destruction of wetland habitat due to irrigation	3	2	2	2	2	30
			Significance Post-Mitigation					
			1	1	1	1	1	6

Project Activity	Ecologically sensitive habitat (wetland units)		Likelihood		Consequence			
Vegetation alteration due to increased water source	Phase of Project	All phases of the project	Frequency of Activity	Frequency of Impact	Severity	Spatial Scope	Duration	Significance Rating
	Impact Classification	Secondary & Cumulative Impact	Significance Pre-Mitigation					
	Resulting Impact from Activity	Disturbances that induce invasion of exotic flora	4	4	2	2	4	64
			Significance Post-Mitigation					
			4	4	1	2	4	56

WATER QUALITY

Project Activity	Surface Water Resources		Likelihood		Consequence			
Construction phase activities and routine irrigation	Phase of Project	All phases of the project	Frequency of Activity	Frequency of Impact	Severity	Spatial Scope	Duration	Significance Rating
	Impact Classification	Direct, Secondary & Cumulative Impact	Significance Pre-Mitigation					
	Resulting Impact from Activity	Surface water runoff could transport increased silts and sediments into wetland	4	4	2	2	5	72
			Significance Post-Mitigation					

		areas; Increased salinity of the wetland soils could occur through evaporation of poor-quality irrigation water.	1	1	2	1	1	8
SURFACE WATER								
Project Activity	Surface Water Resources		Likelihood		Consequence			
Construction phase activities and routine irrigation	Phase of Project	All phases of the project	Frequency of Activity	Frequency of Impact	Severity	Spatial Scope	Duration	Significance Rating
	Impact Classification	Direct, Secondary & Cumulative Impact	Significance Pre-Mitigation					
	Resulting Impact from Activity	Surface water contamination due to hydrocarbon spills.	4	3	3	2	1	42
			Significance Post-Mitigation					
			4	1	1	2	1	20
FLORA								
Project Activity	Flora		Likelihood		Consequence			
Irrigation of vegetated plains through mine dewatering	Phase of Project	Preparation, Construction and Operational Phases	Frequency of Activity	Frequency of Impact	Severity	Spatial Scope	Duration	Significance Rating
	Impact Classification	Direct Impact	Significance Pre-Mitigation					
	Resulting Impact from Activity	Degradation of Natural Habitat of Moderate Ecological Importance	3	4	4	2	5	77
			Significance Post- Mitigation					
			3	4	4	2	5	77
Project Activity	Flora		Likelihood		Consequence			
Clearing of vegetation for construction of infrastructure	Phase of Project	Preparation, Construction and Operational Phases	Frequency of Activity	Frequency of Impact	Severity	Spatial Scope	Duration	Significance Rating

	Impact Classification	Direct Impact	Significance Pre-Mitigation					
	Resulting Impact from Activity	Loss of Plant Species of Conservation Concern	5	5	3	2	5	100
			Significance Post- Mitigation					
			3	3	3	2	5	60
Project Activity	Flora		Likelihood		Consequence			
Clearing of vegetation for construction of infrastructure	Phase of Project	Preparation, Construction and Operational Phases	Frequency of Activity	Frequency of Impact	Severity	Spatial Scope	Duration	Significance Rating
	Impact Classification	Direct Impact	Significance Pre-Mitigation					
	Resulting Impact from Activity	Introduction/proliferation of alien invasive species	4	4	4	3	5	96
			Significance Post- Mitigation					
			3	3	2	2	5	54
Project Activity	Flora		Likelihood		Consequence			
Clearing of vegetation for construction of infrastructure	Phase of Project	Preparation, Construction and Operational Phases	Frequency of Activity	Frequency of Impact	Severity	Spatial Scope	Duration	Significance Rating
	Impact Classification	Indirect Impact	Significance Pre-Mitigation					
	Resulting Impact from Activity	Increased utilisation of plant resources as a result of an influx of people into the study area	3	3	3	3	5	66
			Significance Post- Mitigation					
			2	2	1	2	4	28
FAUNA								
Project Activity		Fauna	Likelihood		Consequence			
Construction/ Operation activities (Disturbances, vegetation Clearing, Accidents, Access Roads)	Phase of Project	Construction - Closure Phase	Frequency of Activity	Frequency of Impact	Severity	Spatial Scope	Duration	Significance Rating
	Impact Classification	Direct Impact	Significance Pre-Mitigation					
		Loss of Faunal Habitat	5	5	3	2	5	100

	Resulting Impact from Activity		Significance Post-Mitigation					
			4	4	2	2	5	72
Project Activity		Fauna	Likelihood		Consequence			
All staff activities that take place outdoors	Phase of Project	Construction and Operational Phases	Frequency of Activity	Frequency of Impact	Severity	Spatial Scope	Duration	Significance Rating
	Impact Classification	Indirect Impact	Significance Pre-Mitigation					
	Resulting Impact from Activity	Illegal utilisation of animal resources as a result of an influx of people into the study area	4	4	4	3	5	96
			Significance Post-Mitigation					
			2	2	2	3	5	40
ARCHAEOLOGY AND CULTURAL RESOURCES								
Project Activity		Archaeology & Cultural Heritage	Likelihood		Consequence			
In regard to Archaeological Scatters, disturbance of surfaces and/or sub-surfaces may destroy, damage, alter, or remove from its original position archaeological material or objects.	Phase of Project	Construction phase	Frequency of Activity	Frequency of Impact	Severity	Spatial Scope	Duration	Significance Rating
	Impact Classification	Direct Impact	Significance Pre-Mitigation					
	Resulting Impact from Activity	Disturbance/Loss of Significant Archaeological or Cultural Heritage Sites/Remains	1	1	2	1	5	16
			Significance Post-Mitigation					
			1	1	2	1	5	16
Project Activity		Archaeology & Cultural Heritage	Likelihood		Consequence			Significance Rating
In regard to Archaeological Sites, disturbance of surfaces and/or sub-surfaces may destroy, damage, alter, or remove from its original position archaeological material or objects.	Phase of Project	Construction phase	Frequency of Activity	Frequency of Impact	Severity	Spatial Scope	Duration	
	Impact Classification	Direct Impact	Significance Pre-Mitigation					
	Resulting Impact from Activity	Disturbance/Loss of Significant Archaeological or Cultural Heritage Sites/Remains	3	1	3	1	5	36
			Significance Post-Mitigation					
			1	1	2	1	5	16

GROUNDWATER								
Project Activity	Groundwater		Likelihood		Consequence			
Construction phase activities and routine irrigation	Phase of Project	All phases of the project	Frequency of Activity	Frequency of Impact	Severity	Spatial Scope	Duration	Significance Rating
	Impact Classification	Direct, Secondary & Cumulative Impact	Significance Pre-Mitigation					
	Resulting Impact from Activity	Groundwater contamination due to hydrocarbon spills.	4	3	3	2	1	42
			Significance Post-Mitigation					
			4	1	1	2	1	20

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