The most striking impression from investigation of the botanical aspects of the study area between Mitchell's Bay and Koingnaas is the dramatic negative impact of mining on the natural environment. Past mining activities were driven by production and paid little heed to the environment. Very little restoration was undertaken, apart from a few areas where netting was implemented to minimize wind-blown sand and to attempt to restore the vegetation. The open-cast diamond mining has left a fragmented landscape in its wake. Lessons must be learnt from the former lack of restoration and the *modus operandi* employed in the past should not be repeated. In addition, areas requiring rehabilitation should still be attended to within the context of the renewed mining activities.

The area north of Koingnaas and particularly at Samson's Bak that is earmarked for future mining, is less disturbed than in the southern areas from Somnaas southwards. Opportunity therefore nexists in the areas where future mining is proposed, e.g. at Samson's Bak, to ensure that best environmental practice is observed. Spoil should not be randomly dumped but should only be deposited in approved spoil areas, preferably where there is already disturbance. Loss of undisturbed vegetation and habitat should be avoided wherever possible. Also, wherever possible existing roads should be used and new roads should only be constructed with discretion.

It is important that an environmental officer (ECO) should be appointed to be involved with planning from the outset. Such a person should advise on the alignment of new roads, placement of spoil and general environmental best practice. The ECO should also be responsible for monitoring the status of the habitat in the mining rights area, determination of sensitive habitats, overseeing translocation of important plant species where necessary and should be in charge of rehabilitation / restoration activities.

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APPENDIX A1: Preliminary plant species checklist for the area of the WCR Mining Rights between Mitchell's Bay (south) and Samson's Bak (north) (Source: SIBIS Portal - http://sibis.sanbi.org/ - Note – this source is under revision by SANBI)

LC= Least concern; VU = Vulnerable; DDD = Data deficient, declining; DDT – Data deficient – taxon uncertain; NT= Near threatened; RARE = rare species; ?? = Status unknown

Family Name	Species Name	Status
AIZOACEAE	Galenia crystallina var. crystallina	LC
AIZOACEAE	Galenia fruticosa	LC
AIZOACEAE	Galenia sarcophylla	LC
AIZOACEAE	Galenia secunda	LC
AIZOACEAE	Malephora crocea var. crocea	LC
AIZOACEAE	Mesembryanthemum serotinum	??
AIZOACEAE	Tetragonia distorta	DDT
AIZOACEAE	Tetragonia fruticosa	LC
AIZOACEAE	Tetragonia microptera	LC
AIZOACEAE	Tetragonia pillansii	VU
AIZOACEAE	Tetragonia sarcophylla	LC
AIZOACEAE	Tetragonia spicata	LC
AIZOACEAE	Tetragonia virgata	LC
AMARYLLIDACEAE	Brunsvigia bosmaniae	LC
AMARYLLIDACEAE	Gethyllis britteniana subsp. britteniana	LC
AMARYLLIDACEAE	Gethyllis grandiflora	VU
AMARYLLIDACEAE	Haemanthus coccineus	LC
AMARYLLIDACEAE	Haemanthus pubescens subsp. arenicola	RARE
AMARYLLIDACEAE	Haemanthus unifoliatus	LC
ANACARDIACEAE	Searsia glauca	LC
ANACARDIACEAE	Searsia incisa var. incisa	LC
ANACARDIACEAE	Searsia undulata	LC
ANTHERICACEAE	Chlorophytum undulatum	LC
APIACEAE	Cynorhiza typica	DDT
APOCYNACEAE	Ceropegia occidentalis	NT
APOCYNACEAE	Microloma namaquense	LC
APOCYNACEAE	Microloma sagittatum	LC
APOCYNACEAE	Microloma tenuifolium	LC
APOCYNACEAE	Quaqua armata subsp. maritima	LC
APOCYNACEAE	Quaqua parviflora subsp. parviflora	LC
ASPARAGACEAE	Asparagus capensis	LC
ASPARAGACEAE	Asparagus capensis var. litoralis	LC
ASPHODELACEAE	Aloe arenicola	NT
ASPHODELACEAE	Aloe krapohliana	DDD
ASPHODELACEAE	Aloe melanacantha	LC

Family Name	Species Name	Status
ASPHODELACEAE	Aloe microstigma subsp. framesii	NT
ASPHODELACEAE	Gasteria sp.	
ASTERACEAE	Amellus alternifolius subsp. alternifolius	LC
ASTERACEAE	Amellus flosculosus	LC
ASTERACEAE	Amellus microglossus	LC
ASTERACEAE	Amellus sp.	
ASTERACEAE	Amellus tenuifolius	LC
ASTERACEAE	Arctotheca calendula	LC
ASTERACEAE	Arctotis auriculata	LC
ASTERACEAE	Arctotis decurrens	DDT
ASTERACEAE	Arctotis diffusa	LC
ASTERACEAE	Arctotis fastuosa	LC
ASTERACEAE	Arctotis revoluta	LC
ASTERACEAE	Arctotis sp.	
ASTERACEAE	Athanasia flexuosa	LC
ASTERACEAE	Berkheya fruticosa	LC
ASTERACEAE	Chrysanthemoides incana	LC
ASTERACEAE	Chrysocoma ciliata	LC
ASTERACEAE	Chrysocoma longifolia	LC
ASTERACEAE	Chrysocoma schlechteri	LC
ASTERACEAE	Cotula coronopifolia	LC
ASTERACEAE	Cotula leptalea	LC
ASTERACEAE	Didelta carnosa var. carnosa	LC
ASTERACEAE	Dimorphotheca pluvialis	LC
ASTERACEAE	Dimorphotheca sinuata	LC
ASTERACEAE	Eriocephalus microphyllus var. pubescens	LC
ASTERACEAE	Eriocephalus racemosus var. affinis	LC
ASTERACEAE	Eriocephalus racemosus var. racemosus	LC
ASTERACEAE	Euryops dregeanus	LC
ASTERACEAE	Felicia dregei	LC
ASTERACEAE	Felicia dubia	LC
ASTERACEAE	Felicia merxmuelleri	LC
ASTERACEAE	Gazania leiopoda	LC
ASTERACEAE	Gazania rigida	LC
ASTERACEAE	Gazania sp.	
ASTERACEAE	Gorteria diffusa subsp. diffusa	LC
ASTERACEAE	Helichrysum hebelepis	LC
ASTERACEAE	Helichrysum marmarolepis	NT
ASTERACEAE	Helichrysum micropoides	LC
ASTERACEAE	Hirpicium echinus	LC
ASTERACEAE	Lasiopogon muscoides	LC
ASTERACEAE	Leucoptera nodosa	VU
ASTERACEAE	Leysera gnaphalodes	LC
ASTERACEAE	Leysera tenella	LC
ASTERACEAE	Monoculus hyoseroides	LC

Family Name	Species Name	Status
ASTERACEAE	Monoculus monstrosus	LC
ASTERACEAE	Norlindhia amplectens	LC
ASTERACEAE	Oncosiphon grandiflorum	LC
ASTERACEAE	Oncosiphon suffruticosum	LC
ASTERACEAE	Osteospermum grandiflorum	LC
ASTERACEAE	Othonna carnosa	LC
ASTERACEAE	Othonna coronopifolia	LC
ASTERACEAE	Crassothonna cylindrica	LC
ASTERACEAE	Othonna floribunda	LC
ASTERACEAE	Othonna perfoliata	LC
ASTERACEAE	Othonna retrorsa var. spektakelensis	RARE
ASTERACEAE	Crassothonna sedifolia	LC
ASTERACEAE	Pteronia divaricata	LC
ASTERACEAE	Pteronia glabrata	LC
ASTERACEAE	Pteronia incana	LC
ASTERACEAE	Pteronia onobromoides	LC
ASTERACEAE	Pteronia undulata	LC
ASTERACEAE	Rhynchopsidium pumilum	LC
ASTERACEAE	Senecio abbreviatus	LC
ASTERACEAE	Senecio aloides	LC
ASTERACEAE	Senecio cakilefolius	LC
ASTERACEAE	Senecio corymbiferus	??
ASTERACEAE	Senecio laxus	LC
ASTERACEAE	Senecio sarcoides	LC
ASTERACEAE	Senecio scapiflorus	LC
ASTERACEAE	Tripteris microcarpa subsp. microcarpa	LC
ASTERACEAE	Osteospermum oppositifolium	LC
ASTERACEAE	Ursinia calenduliflora	LC
ASTERACEAE	Ursinia chrysanthemoides	LC
BORAGINACEAE	Lobostemon pearsonii	LC
BRASSICACEAE	Brassica tournefortii	??
BRASSICACEAE	Heliophila arenaria var. glabrescens	LC
BRASSICACEAE	Heliophila juncea (was Brachycarpaea juncea)	LC
BRASSICACEAE	Heliophila lactea	LC
BRASSICACEAE	Heliophila seselifolia var. seselifolia	LC
CAMPANULACEAE	Wahlenbergia annularis	LC
CAMPANULACEAE	Wahlenbergia capensis	LC
CAMPANULACEAE	Wahlenbergia oxyphylla	LC
CAMPANULACEAE	Wahlenbergia thunbergiana	LC
CARYOPHYLLACEAE	Dianthus namaensis	LC
CARYOPHYLLACEAE	Dianthus namaensis var. dinteri	LC
CARYOPHYLLACEAE	Dianthus namaensis var. junceus	LC
CARYOPHYLLACEAE	Silene burchellii var. angustifolia	??
CARYOPHYLLACEAE	Silene cretica	??
CARYOPHYLLACEAE	Spergularia media	??

Family Name	Species Name	Status
CELASTRACEAE	Gymnosporia buxifolia	LC
CHENOPODIACEAE	Atriplex cinerea subsp. bolusii var. adamsonii	LC
CHENOPODIACEAE	Atriplex cinerea subsp. bolusii var. genuina	??
CHENOPODIACEAE	Atriplex eardleyae	??
CHENOPODIACEAE	Atriplex lindleyi subsp. inflata	??
CHENOPODIACEAE	Atriplex semibaccata var. appendiculata	LC
CHENOPODIACEAE	Atriplex vestita var. appendiculata	LC
CHENOPODIACEAE	Chenopodium murale var. murale	??
CHENOPODIACEAE	Manochlamys albicans	LC
CHENOPODIACEAE	Salsola aphylla	LC
CHENOPODIACEAE	Salsola sericata	LC
CHENOPODIACEAE	Salsola sp.	
CHENOPODIACEAE	Salsola zeyheri	LC
CHENOPODIACEAE	Sarcocornia natalensis var. natalensis	LC
CHENOPODIACEAE	Sarcocornia pillansii var. pillansii	LC
CRASSULACEAE	Adromischus alstonii	LC
CRASSULACEAE	Cotyledon cuneata	LC
CRASSULACEAE	Cotyledon orbiculata var. orbiculata	LC
CRASSULACEAE	Crassula brevifolia subsp. brevifolia	LC
CRASSULACEAE	Crassula campestris	LC
CRASSULACEAE	Crassula elegans	LC
CRASSULACEAE	Crassula elegans subsp. elegans	LC
CRASSULACEAE	Crassula expansa subsp. expansa	LC
CRASSULACEAE	Crassula expansa subsp. pyrifolia	LC
CRASSULACEAE	Crassula nudicaulis var. herrei	LC
CRASSULACEAE	Crassula subaphylla var. subaphylla	LC
CRASSULACEAE	Crassula tomentosa var. tomentosa	LC
CRASSULACEAE	Crassula whiteheadii	LC
CRASSULACEAE	Tylecodon buchholzianus subsp. buchholzianus	LC
CRASSULACEAE	Tylecodon decipiens	RARE
CRASSULACEAE	Tylecodon pygmaea	THR*
CRASSULACEAE	Tylecodon racemosus	LC
CRASSULACEAE	Tylecodon reticulatus subsp. phyllopodium	??
CRASSULACEAE	Tylecodon reticulatus subsp. reticulatus	LC
CYPERACEAE	Ficinia sp.	
EBENACEAE	Euclea tomentosa	LC
EUPHORBIACEAE	Euphorbia chersina	LC
EUPHORBIACEAE	Euphorbia decussata	LC
EUPHORBIACEAE	Euphorbia ramiglans	LC
EUPHORBIACEAE	Euphorbia rectirama	LC
EUPHORBIACEAE	Euphorbia sp.	
EUPHORBIACEAE	Euphorbia tuberculata var. tuberculata	LC
FABACEAE	Acacia karroo	LC
FABACEAE	Argyrolobium velutinum	EN
FABACEAE	Calobota angustifolia	??

Family Name	Species Name	Status
FABACEAE	Calobota halenbergensis	??
FABACEAE	Calobota lotononoides	??
FABACEAE	Crotalaria excisa subsp. excisa	LC
FABACEAE	Indigofera nigromontana	LC
FABACEAE	Lebeckia sericea	LC
FABACEAE	Lessertia diffusa	LC
FABACEAE	Lessertia falciformis	LC
Fabaceae	Lessertia frutescens (syn. Sutherlandia frutescens)	LC
FABACEAE	Lessertia sp.	
FABACEAE	Medicago laciniata var. laciniata	??
FABACEAE	Melolobium adenodes	LC
FABACEAE	Sutherlandia frutescens	LC
FABACEAE	Wiborgia monoptera	LC
FABACEAE	Wiborgia sericea	LC
FRANKENIACEAE	Frankenia repens	LC
GERANIACEAE	Erodium cicutarium	??
GERANIACEAE	Erodium moschatum	??
GERANIACEAE	Pelargonium adriaanii	??
GERANIACEAE	Pelargonium crithmifolium	LC
GERANIACEAE	Pelargonium dasyphyllum	LC
GERANIACEAE	Pelargonium echinatum	LC
GERANIACEAE	Pelargonium fulgidum	LC
GERANIACEAE	Pelargonium gibbosum	LC
GERANIACEAE	Pelargonium pulchellum	LC
HYACINTHACEAE	Albuca namaquensis	LC
HYACINTHACEAE	Albuca sp.	
HYACINTHACEAE	Albuca spiralis	LC
HYACINTHACEAE	Lachenalia anguinea	LC
HYACINTHACEAE	Lachenalia barkeriana	RARE
HYACINTHACEAE	Lachenalia sp.	
HYACINTHACEAE	Lachenalia valeriae	RARE
HYACINTHACEAE	Lachenalia violacea var. violacea	LC
HYACINTHACEAE	Lachenalia xerophila	LC
HYACINTHACEAE	Ornithogalum canadense (syn. Albuca canadensis)	LC
HYACINTHACEAE	Ornithogalum pruinosum	LC
HYACINTHACEAE	Ornithogalum unifolium	LC
HYACINTHACEAE	Veltheimia capensis	LC
IRIDACEAE	Babiana curviscapa	LC
IRIDACEAE	Babiana hirsuta	??
IRIDACEAE	Babiana lanata	VU
IRIDACEAE	Babiana namaquensis	LC
IRIDACEAE	Babiana sp	
IRIDACEAE	Babiana thunbergii	NT
IRIDACEAE	Ferraria divaricata subsp. divaricata	LC
IRIDACEAE	Ferraria schaeferi	LC

Family Name	Species Name	Status
IRIDACEAE	Ferraria variabilis	LC
IRIDACEAE	Gladiolus scullyi	LC
IRIDACEAE	Gladiolus sp	
IRIDACEAE	Lapeirousia macrospatha	LC
IRIDACEAE	Lapeirousia silenoides	LC
IRIDACEAE	Lapeirousia tenuis	RARE
IRIDACEAE	Moraea gawleri	LC
IRIDACEAE	Moraea miniata	LC
IRIDACEAE	Moraea rivulicola	RARE
JUNCACEAE	Juncus acutus subsp. leopoldii	LC
LAMIACEAE	Ballota africana	LC
LAMIACEAE	Salvia africana-lutea	LC
LAMIACEAE	Salvia dentata	LC
LAMIACEAE	Salvia lanceolata	LC
LOBELIACEAE	Monopsis debilis var. gracilis	LC
LORANTHACEAE	Tapinanthus oleifolius	LC
LYTHRACEAE	Nesaea sp.	??
MALVACEAE	Hermannia amoena	LC
MALVACEAE	Hermannia cuneifolia var. cuneifolia	LC
MALVACEAE	Hermannia disermifolia	LC
MALVACEAE	Hermannia incana	LC
MALVACEAE	Hermannia pfeilii	LC
MALVACEAE	Hermannia trifurca	LC
MELIANTHACEAE	Melianthus elongatus	LC
MESEMBRYANTHEMACEAE	Amphibolia laevis	LC
MESEMBRYANTHEMACEAE	Amphibolia rupis-arcuatae	LC
MESEMBRYANTHEMACEAE	Amphibolia succulenta	LC
MESEMBRYANTHEMACEAE	Antimima compacta	LC
MESEMBRYANTHEMACEAE	Antimima dolomitica	??
MESEMBRYANTHEMACEAE	Antimima maleolens	LC
MESEMBRYANTHEMACEAE	Antimima sp.	
MESEMBRYANTHEMACEAE	Aridaria brevicarpa	LC
MESEMBRYANTHEMACEAE	Aspazoma amplectens	LC
MESEMBRYANTHEMACEAE	Astridia cf. citrina	LC
MESEMBRYANTHEMACEAE	Astridia sp.	
MESEMBRYANTHEMACEAE	Brownanthus sp.	??
MESEMBRYANTHEMACEAE	Cephalophyllum ebracteatum	LC
MESEMBRYANTHEMACEAE	Cephalophyllum fulleri	RARE
MESEMBRYANTHEMACEAE	Cephalophyllum herrei	LC
MESEMBRYANTHEMACEAE	Cephalophyllum inaequale	LC
MESEMBRYANTHEMACEAE	Cephalophyllum rigidum	LC
MESEMBRYANTHEMACEAE	Cephalophyllum sp.	
MESEMBRYANTHEMACEAE	Cheiridopsis denticulata	LC
MESEMBRYANTHEMACEAE	Cheiridopsis namaquensis	LC
MESEMBRYANTHEMACEAE	Cheiridopsis robusta	LC

Family Name	Species Name	Status
MESEMBRYANTHEMACEAE	Cheiridopsis sp.	
MESEMBRYANTHEMACEAE	Conicosia elongata	LC
MESEMBRYANTHEMACEAE	Conicosia pugioniformis subsp. alborosea	LC
MESEMBRYANTHEMACEAE	Conophytum bilobum subsp. bilobum	LC
MESEMBRYANTHEMACEAE	Conophytum flavum subsp. flavum	LC
MESEMBRYANTHEMACEAE	Conophytum hians	LC
MESEMBRYANTHEMACEAE	Conophytum meyeri	RARE
MESEMBRYANTHEMACEAE	Conophytum sp.	
MESEMBRYANTHEMACEAE	Drosanthemum floribundum	LC
MESEMBRYANTHEMACEAE	Drosanthemum luederitzii	LC
MESEMBRYANTHEMACEAE	Drosanthemum oculatum	LC
MESEMBRYANTHEMACEAE	Drosanthemum sp.	
MESEMBRYANTHEMACEAE	Eberlanzia dichotoma	LC
MESEMBRYANTHEMACEAE	Fenestraria rhopalophylla subsp. aurantiaca	LC
MESEMBRYANTHEMACEAE	Jordaaniella cuprea	LC
MESEMBRYANTHEMACEAE	Jordaaniella spongiosa	LC
MESEMBRYANTHEMACEAE	Lampranthus brachyandrus	DDT
MESEMBRYANTHEMACEAE	Lampranthus suavissimus	DDT
MESEMBRYANTHEMACEAE	Lampranthus uniflorus	LC
MESEMBRYANTHEMACEAE	Leipoldtia frutescens	VU
MESEMBRYANTHEMACEAE	Leipoldtia sp.	
MESEMBRYANTHEMACEAE	Malephora framesii	LC
MESEMBRYANTHEMACEAE	Mesembryanthemum amplectens	Not listed
MESEMBRYANTHEMACEAE	Mesembryanthemum arenosum	Not listed
MESEMBRYANTHEMACEAE	Mesembryanthemum hypertrophicum	LC
MESEMBRYANTHEMACEAE	Mesembryanthemum nodiflorum	LC
MESEMBRYANTHEMACEAE	Mesembryanthemum pellitum	LC
MESEMBRYANTHEMACEAE	Mesembryanthemum sp.	
MESEMBRYANTHEMACEAE	Meyerophytum meyeri	LC
MESEMBRYANTHEMACEAE	Mitrophyllum clivorum	LC
MESEMBRYANTHEMACEAE	Mitrophyllum dissitum	LC
MESEMBRYANTHEMACEAE	Mitrophyllum sp.	
MESEMBRYANTHEMACEAE	Phyllobolus sinuosus	LC
MESEMBRYANTHEMACEAE	Phyllobolus spinuliferus	LC
MESEMBRYANTHEMACEAE	Phyllobolus trichotomus	LC
MESEMBRYANTHEMACEAE	Psilocaulon dinteri	LC
MESEMBRYANTHEMACEAE	Psilocaulon foliosum	LC
MESEMBRYANTHEMACEAE	Psilocaulon subnodosum	LC
MESEMBRYANTHEMACEAE	Ruschia cymosa	LC
MESEMBRYANTHEMACEAE	Ruschia festiva	??
MESEMBRYANTHEMACEAE	Ruschia fugitans	DDT
MESEMBRYANTHEMACEAE	Ruschia muelleri	LC
MESEMBRYANTHEMACEAE	Ruschia paripetala	LC
MESEMBRYANTHEMACEAE	Ruschia sp.	
MESEMBRYANTHEMACEAE	Ruschia versicolor	LC

Family Name	Species Name	Status
MESEMBRYANTHEMACEAE	Ruschia viridifolia	LC
MESEMBRYANTHEMACEAE	Stoeberia beetzii	LC
MESEMBRYANTHEMACEAE	Stoeberia frutescens	LC
MESEMBRYANTHEMACEAE	Stoeberia utilis	LC
MESEMBRYANTHEMACEAE	Vanzijlia annulata	LC
MESEMBRYANTHEMACEAE	Wooleya farinosa	VU
MOLLUGINACEAE	Adenogramma glomerata	LC
MOLLUGINACEAE	Hypertelis salsoloides	LC
MOLLUGINACEAE	Hypertelis salsoloides var. salsoloides	LC
MOLLUGINACEAE	Hypertelis sp.	
MOLLUGINACEAE	Limeum africanum subsp. africanum	LC
MOLLUGINACEAE	Limeum africanum subsp. canescens	LC
MOLLUGINACEAE	Pharnaceum albens	LC
MOLLUGINACEAE	Pharnaceum confertum var. confertum	LC
MOLLUGINACEAE	Pharnaceum microphyllum var. microphyllum	LC
MORACEAE	Ficus ilicina	LC
NEURADACEAE	Grielum grandiflorum	LC
NEURADACEAE	Grielum humifusum var. humifusum	LC
NEURADACEAE	Grielum sinuatum	LC
OROBANCHACEAE	Hyobanche glabrata	LC
OROBANCHACEAE	Hyobanche sanguinea	LC
PLUMBAGINACEAE	Limonium dregeanum	LC
POACEAE	Bromus sp.	??
POACEAE	Chaetobromus involucratus subsp. dregeanus	LC
POACEAE	Chaetobromus involucratus subsp. involucratus	LC
POACEAE	Chaetobromus involucratus subsp. sericeus	LC
POACEAE	Cladoraphis cyperoides	LC
POACEAE	Cladoraphis spinosa	LC
POACEAE	Ehrharta brevifolia var. cuspidata	LC
POACEAE	Ehrharta delicatula	LC
POACEAE	Ehrharta longiflora	LC
POACEAE	Ehrharta longifolia	LC
POACEAE	Eragrostis curvula	LC
POACEAE	Fingerhuthia africana	LC
POACEAE	Hordeum murinum subsp. glaucum	??
POACEAE	Karroochloa schismoides	LC
POACEAE	Pentaschistis tomentella	LC
POACEAE	Phalaris minor	??
POACEAE	Phragmites australis	LC
POACEAE	Schismus barbatus	LC
POACEAE	Schmidtia kalahariensis	LC
POACEAE	Sporobolus virginicus	LC
POACEAE	Stipagrostis ciliata var. capensis	LC
POACEAE	Stipagrostis geminifolia	LC
POLYGONACEAE	Emex australis	??

Family Name	Species Name	Status
PORTULACACEAE	Anacampseros albissima	??
PORTULACACEAE	Anacampseros filamentosa subsp. namaquensis	LC
PTYCHOMITRIACEAE	Ptychomitrium crispatum	??
RUBIACEAE	Galium spurium-aparine	LC
RUBIACEAE	Nenax arenicola	LC
RUTACEAE	Diosma acmaeophylla	LC
SANTALACEAE	Thesium lineatum	LC
SAPINDACEAE	Dodonaea angustifolia	LC
SCROPHULARIACEAE	Diascia batteniana	LC
SCROPHULARIACEAE	Hebenstretia repens	LC
SCROPHULARIACEAE	Hebenstretia sp.	
SCROPHULARIACEAE	Jamesbrittenia fruticosa	LC
SCROPHULARIACEAE	Jamesbrittenia merxmuelleri	LC
SCROPHULARIACEAE	Lyperia tristis	LC
SCROPHULARIACEAE	Nemesia bicornis	LC
SCROPHULARIACEAE	Nemesia sp.	
SCROPHULARIACEAE	Peliostomum virgatum	LC
SCROPHULARIACEAE	Phyllopodium pumilum	LC
SCROPHULARIACEAE	Zaluzianskya affinis	LC
SCROPHULARIACEAE	Zaluzianskya benthamiana	LC
SOLANACEAE	Lycium amoenum	LC
SOLANACEAE	Lycium cinereum	LC
SOLANACEAE	Lycium decumbens	??
SOLANACEAE	Nicotiana glauca	EXOTIC
TECOPHILAEACEAE	Cyanella hyacinthoides	LC
TELOSCHISTACEAE	Xanthoria flammea	??
THYMELAEACEAE	Passerina truncata subsp. truncata	LC
URTICACEAE	Forsskaolea candida	LC
VISCACEAE	Viscum capense	LC
ZYGOPHYLLACEAE	Sisyndite spartea	LC
ZYGOPHYLLACEAE	Zygophyllum cordifolium	LC
ZYGOPHYLLACEAE	Zygophyllum morgsana	LC
ZYGOPHYLLACEAE	Zygophyllum spinosum	LC

APPENDIX A2: Curriculum Vitae

Dr David Jury McDonald Pr.Sci.Nat.

Name of Company: Bergwind Botanical Surveys & Tours CC. (Independent consultant)

Work and Home Address: 14 A Thomson Road, Claremont, 7708

Tel: (021) 671-4056 **Mobile:** 082-8764051 **Fax:** 086-517-3806

E-mail: dave@bergwind.co.za

Website: www.bergwind.co.za

Profession: Botanist / Vegetation Ecologist / Consultant / Tour Guide

Date of Birth: 7 August 1956

Employment history:

- 19 years with National Botanical Institute (now SA National Biodiversity Institute) as researcher in vegetation ecology.
- Five years as Deputy Director / Director Botanical & Communication Programmes of the Botanical Society of South Africa
- Ten years as private independent Botanical Specialist consultant (Bergwind Botanical Surveys & Tours CC)

Nationality: South African (ID No. 560807 5018 080)
Languages: English (home language) – speak, read and write
Afrikaans – speak, read and write

Membership in Professional Societies:

- South Africa Association of Botanists
- International Association for Impact Assessment (SA)
- South African Council for Natural Scientific Professions (**Ecological Science, Registration No. 400094/06**)
- Field Guides Association of Southern Africa

Key Qualifications:

- Qualified with a M. Sc. (1983) in Botany and a PhD in Botany (Vegetation Ecology) (1995) at the University of Cape Town.
- Research in Cape fynbos eco systems and more specifically mountain ecosystems.
- From 1995 to 2000 managed the Vegetation Map of South Africa Project (National Botanical Institute)
- Conducted botanical survey work for AfriDev Consultants for the Mohale and Katse Dam projects in Lesotho from 1995 to 2002. A large component of this work was the analysis of data collected by teams of botanists.
- **Director: Botanical & Communication Programmes** of the Botanical Society of South Africa (2000—2005), responsible for communications and publications;

involved with conservation advocacy particularly with respect to impacts of development on centres of plant endemism.

- Further tasks involved the day-to-day management of a large non-profit environmental organisation.
- **Independent botanical consultant** (2005 – to present) over 300 projects have been completed related to environmental impact assessments in the Western, Southern and Northern Cape, Karoo and Lesotho. A list of reports (or selected reports for scrutiny) is available on request.

Higher Education

Degrees obtained
and major subjects passed:

B.Sc. (1977), University of Natal, Pietermaritzburg
Botany III
Entomology II (Third year course)

B.Sc. Hons. (1978) University of Natal, Pietermaritzburg
Botany (Ecology /Physiology)

M.Sc - (Botany), University of Cape Town, 1983.
Thesis title: 'The vegetation of Swartboschkloof, Jonkershoek, Cape Province'.

PhD (Botany), University of Cape Town, 1995.
Thesis title: 'Phytogeography endemism and diversity of the fynbos of the southern Langeberg'.

Certificate of Tourism: Guiding (Culture: Local)
Level : 4 Code: TGC7 (Registered Tour Guide: WC 2969).

Employment Record :

January 2006 – present: Independent specialist botanical consultant and tour guide in own company: **Bergwind Botanical Surveys & Tours CC**
August 2000 - 2005 : Deputy Director, later Director Botanical & Communication Programmes, Botanical Society of South Africa
January 1981 – July 2000 : Research Scientist (Vegetation Ecology) at National Botanical Institute
January 1979—Dec 1980 : National Military Service

Further information is available on my company website: www.bergwind.co.za

B. FAUNAL ASSESSMENT OF THE KOINGNAAS MINING RIGHTS AREAS

Authors: Simon Todd, Christy Bragg and Eric Herrmann

B1. Study Approach

B1.1 Assessment Approach & Philosophy

The assessment was conducted according to the EIA Regulations, published by the Department of Environmental Affairs (2014) as well as within the best-practice guidelines and principles for biodiversity assessment as outlined by Brownlie (2005) and De Villiers *et al.* (2005). The requirements of the Department of Environment and Nature Conservation of the Northern Cape Province were observed and particular note was taken of the Northern Cape Conservation Act, 2009 (Act No. 9 of 2009) and Regulations (2011).

This includes adherence to the following broad principles:

- That a precautionary and risk-averse approach be adopted towards projects which may result in substantial detrimental impacts on biodiversity and ecosystems, especially the irreversible loss of habitat and ecological functioning in threatened ecosystems or designated sensitive areas: i.e. Critical Biodiversity Areas (as identified by systematic conservation plans, Biodiversity Sector Plans or Bioregional Plans) and Freshwater Ecosystem Priority Areas.
- Demonstrate how the proponent intends complying with the principles contained in section 2 of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended (NEMA), which, amongst other things, indicates that environmental management should.
    - In order of priority aim to: avoid, minimise or remedy disturbance of ecosystems and loss of biodiversity;
    - Avoid degradation of the environment;
    - Avoid jeopardising ecosystem integrity;
    - Pursue the best practicable environmental option by means of integrated environmental management;
    - Protect the environment as the people's common heritage;
    - Control and minimise environmental damage; and

- Pay specific attention to management and planning procedures pertaining to sensitive, vulnerable, highly dynamic or stressed ecosystems.

These principles serve as guidelines for all decision-making concerning matters that may affect the environment. As such, it is incumbent upon the proponent to show how proposed activities would comply with these principles and thereby contribute towards the achievement of sustainable development as defined by the NEMA.

In order to adhere to the above principles and best-practice guidelines, the following approach forms the basis for the study approach and assessment philosophy:

The study will include data searches, desktop studies, site walkovers / field survey of the property and baseline data collection, describing:

- A description of the broad ecological characteristics of the site and its surrounds in terms of any mapped spatial components of ecological processes and/or patchiness, patch size, relative isolation of patches, connectivity, corridors, disturbance regimes, ecotones, buffering, viability, etc.

Fauna

- Describe and assess the terrestrial fauna present in the area that will be affected by the proposed development.
- Conduct a faunal assessment that can be integrated into the ecological study.
- Describe the existing impacts of current land use as they affect the fauna.
- Clarify species of special concern (SSC) and that are known to be:
    - endemic to the region;
    - that are considered to be of conservational concern;
    - that are in commercial trade (CITES listed species);
    - or, are of cultural significance.
- Provide monitoring requirements as input into the Environmental Management Plan (EMP) for faunal related issues.

Other pattern issues

- Any significant landscape features or rare or important vegetation associations such as seasonal wetlands, alluvium, seeps, quartz patches or salt marshes in the vicinity.

- The extent of alien plant cover of the site, and whether the infestation is the result of prior soil disturbance such as ploughing or quarrying (alien cover resulting from disturbance is generally more difficult to restore than infestation of undisturbed sites).
- The condition of the site in terms of current or previous land uses.

In terms of **process**, the following will be identified or described:

- The key ecological "drivers" of ecosystems on the site and in the vicinity, such as fire.
- Any mapped spatial component of an ecological process that may occur at the site or in its vicinity (i.e. *corridors* such as watercourses, upland-lowland gradients, migration routes, coastal linkages or inland-trending dunes, and *vegetation boundaries* such as edaphic interfaces, upland-lowland interfaces or biome boundaries)
- Any possible changes in key processes, e.g. increased fire frequency or drainage/artificial recharge of aquatic systems.
- Furthermore, any further studies that may be required during or after the EIA process will be outlined.
- All relevant legislation, permits and standards that would apply to the development will be identified.
- The opportunities and constraints for development will be described and shown graphically on an aerial photograph, satellite image or map delineated at an appropriate level of spatial accuracy.

B1.2 Relevant Aspects of the Development

B 1.2.1 Limitations & Assumptions

The site visit for the current study took place during the spring season, during an optimal time of year as the vegetation was on a good state following the winter rains and this is when the majority of fauna of the area are active. However, as the site visit was only of a few days duration, only a small fraction of those species present could be confirmed present. However, as it can take months or even years to confirm the presence of rare fauna within an area, the lists of fauna are those observed on site, as well as those known to occur in the wider area based on their known distributions and

habitat preferences. This represents a sufficiently conservative and cautious approach which takes the study limitations into account.

B2. METHODOLOGY

B2.1 DATA SOURCING AND REVIEW

Data sources from the literature consulted and used where necessary in the study includes the following:

- Information on animal species recorded for the Quarter Degree Squares (QDS) 3220DB 3220DD 3221CA 3221CC was extracted from the SABIF/SIBIS database hosted by SANBI. This is a considerably larger area than the study area, but this is necessary to ensure a conservative approach as well as counter the fact that the site itself has probably not been well sampled in the past.
- Important catchments and protected areas expansion areas were extracted from the National Protected Areas Expansion Strategy 2008 (NPAES).
- Lists of mammals, reptiles and amphibians which are likely to occur at the site were derived based on distribution records from the literature and the ADU databases http://vmus.adu.org.za.
- Literature consulted includes Branch (1988) and Alexander and Marais (2007) for reptiles, Du Preez and Carruthers (2009) for amphibians, Friedmann and Daly (2004) and Skinner and Chimimba (2005) for mammals.
- The faunal species lists provided are based on species which are known to occur in the broad geographical area, as well as a preliminary assessment of the availability and quality of suitable habitat at the site.
- The conservation status of each species is also listed, based on the IUCN Red List Categories and Criteria 2016 (See Figure 1) and where species have not been assessed under these criteria, the CITES status is reported where possible. These lists are adequate for mammals and amphibians, the majority of which have been assessed, however the majority of reptiles have not been assessed and therefore, it is not adequate to assess the potential impact of the development on reptiles, based on those with a listed conservation status alone. In order to address this shortcoming, the distribution of reptiles was also taken into account such that any narrow endemics or species with highly specialized habitat requirements occurring at the site were noted.

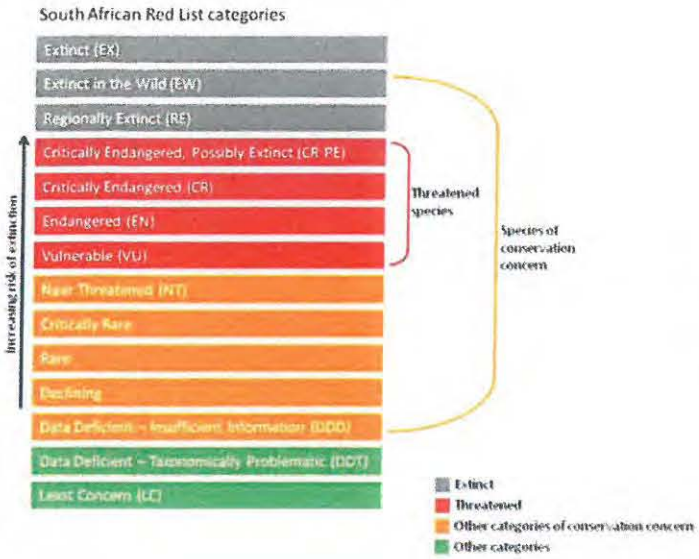

Figure 1. Schematic representation of the South African Red List categories. Taken from http://redlist.sanbi.org/redcat.php

A number of data sources were consulted for the compilation of the avifaunal information, pertaining to the distribution (Harrison *et al.*, 1997), biology (Hockey *et al.*, 2005) and conservation status (Taylor *et al.*, 2015) of relevant species.

- The Southern African Bird Atlas Project 1 (SABAP 1; Harrison *et al.*, 1997) was consulted to determine the bird species likely to occur within the study area and the broader impact zone. The relevant quarter-degree squares that cover the study area are as follows: 3017AA and 3017AB (11 cards, 92 species) and 3017AD (21 cards, 119 species). More recent distribution data (SABAP 2; http://sabap2.adu.org.za/index.php) were obtained for the following pentads: 3005_1710 (9 cards, 75 species), 3010_1710 (1 card, 18 species), 3010_1715 (18 cards, 91 species), 3015_1715 (15 cards, 97 species), 3020_1715 (2 cards, 24 species), and 3025_1720 (6 cards, 68 species).
- The Important Bird Areas of South Africa (IBA; Marnewick *et al.*, 2015) was consulted to determine the location of the nearest IBAs to the study area.
- The data from the Coordinated Avifaunal Roadcounts (CAR; Young *et al.*, 2003) were consulted to determine the location of the nearest CAR routes to the study area.
- The data from the Coordinated Waterbird Counts (CWAC; Taylor *et al.*, 1999) were consulted to determine the location of the nearest CWAC sites to the study area.

- The conservation status (Red Listing) and endemism of all species recorded for the study area and surrounds was obtained from the most recent avifaunal red list for South Africa (Taylor *et al,*. 2015).
- The description of vegetation types occurring within the study area were obtained from Mucina & Rutherford (2006).
- The Red List assessment for South Africa's mammal species, compiled by the Endangered Wildlife Trust (EWT; https://www.ewt.org.za/Reddata/accessment.html) was consulted to determine the Red Listing for mammal species.

B2.2 Site Visit

The site was visited from 29 June to 1 July 2016 and again from 20-21 August 2016. During the site visit, the different fauna-related biodiversity features, habitat, and landscape units present at the site were identified and mapped in the field. Specific features visible on the satellite imagery of the site were also marked for field inspection and were verified and assessed during the site visit. Walk-through-surveys were conducted within representative areas across the different habitats units identified and terrestrial fauna species directly or indirectly (spoor, scat etc) observed were recorded. Active searches for reptiles and amphibians were also conducted within habitats likely to harbour or be important for such species. Observations of birds both on the shore and offshore were made from regular vantage points using binoculars. All marine bird species identified were also counted, with special attention paid to group sizes of communal roosts. Geographical coordinates were taken of notable features, such as seal haul outs and large cormorant roosts. The presence of sensitive habitats such as wetlands or pans and unique edaphic environments such as rocky outcrops or quartz patches were noted in the field if present and recorded on a GPS for mapping if necessary.

B3. Description of the Affected Environment

B3.1Faunal Communities

Mammals

Approximately 40 mammal species potentially occur at the site (Appendix 2). Larger mammals observed or likely to occur at the site include Steenbok *Raphicerus campestris*, Common Duiker *Sylvicapra grimmia*, Jackal *Canis mesomelas*, Caracal *Caracal caracaI,*

Porcupine *Hystrix africaeaustralis* and Aardvark *Orycteropus afer*. Due to the mobility and broad habitat tolerances of these species, they are not likely to be highly sensitive to the development of the area. Three listed species, the Brown Hyaena *Hyaena brunnea* (Near Threatened), Honey Badger *Mellivora capensis* (Near Threatened) and Black-footed cat *Felis nigripes* (Vulnerable) may occur in the area. As parts of the site are used for extensive sheep farming, predators are usually persecuted under these circumstances and so it is unlikely that the Brown Hyaena is abundant within the site. The Honey Badger and Black-footed Cat may occur at the site, but the loss of habitat that may result from the development would not be highly significant given the wide distribution of this species.

The site contains a diverse small mammal community and a relatively large number of rodents, shrews, moles and mole rats occur in the area. Common species observed within the site include Brants's Whistling Rat *Parotomys brantsii*, Namaqua Rock Mouse *Micaelamys namaquensis* and the Bush Vlei Rat *Otomys unisulcatus*. These species are important agents of disturbance in the area due to their high densities and burrowing activities. Golden mole tracks were common across most of the site and belong to either the endemic Cape Golden Mole *Chrysochloris asiatica* or Grant's Golden Mole *Eremitalpa granti* (Vulnerable). Mining has been identified as one of the major threats to Grant's Golden Mole and as it is restricted to soft sands along the coastal strip it is vulnerable to habitat fragmentation due to mining activities and the current mining expansion will likely further fragment the habitat for this species. Similarly, the Namaqua Dune Molerat *Bathyergus janetta* (Near Threatened) is also known from the area, and numerous mole-rat mounds were observed at the site, mainly within the areas of white sands. Based on their large size, these mounds are most likely from the Namaqua Dune Molerat as they were too larger for the smaller South African Mole Rat *Cryptomys hottentotus* which also occurs in the area. As this species has relatively specialized habitat requirements and is endemic to the Namaqualand area, it is vulnerable to habitat loss and fragmentation.

Overall, the impact of the current mining expansion activities on mammals are likely to be relatively low, due largely to the highly disturbed nature of the area already and any remaining species are likely to be habituated to or tolerant of mining activity. Restricted access to the area is also likely to be favourable for some species which are either persecuted on farmland or are sensitive to the presence of livestock and may benefit from the exclusion of livestock from the mining areas. However, overall the impact is likely to be negative and manifested as habitat loss, fragmentation and additional disturbance to fauna in the area.

Reptiles

As many as 60 different reptiles are known from the wider area around the site. However some of these are associated with habitats that are not found at the site and the actual number of species present is likely to be about half this number. This does however include several listed species as well as a number of narrow endemics. The most important habitats for reptiles within the site are likely to be the rocky areas along the coastal zone which provide refuge for geckos and other species associated with rocky shelter and then the areas of soft sands which are likely to be important for the legless skinks which occur in the area, including the listed Lomi's Blind Legless Skink *Typhlosaurus lomiae* as well as the endemic Pink Blind Legless Skink *Typhlosaurus vermis*.

Species observed at the site include the Variable Skink *Mabuya varia*, Giant Desert Lizard *Meroles ctenodactylus* and Angulate Tortoise *Chersina angulata* which were common throughout the site, while the Spotted Desert Lizard *Meroles suborbitalis* was common on the firmer lowland substrates slightly further away from the coast. Other species observed in the area include the Namaqua Day Gecko *Phelsuma ocellata*, Namaqua Gecko *Pachydactylus namaquensis* and Southern Rock Agama *Agama atra*, all of which were associated with rocky outcrops.

Table 2. Reptile species of conservation concern which may occur in the vicinity of the study site.

Scientific Name	Common Name	Distribution	Status	Likelihood
Homopus signatus	Speckled Padloper	Endemic	Vulnerable	High
Typhlosaurus lomiae	Lomi's Blind Legless Skink	Narrow Endemic	NT	High
Cordylus macropholis	Large-scaled Girdled Lizard	Endemic	NT	High

In general, the predominant potential impact associated with the additional mining development would be habitat loss and fragmentation for reptiles. Some of these impacts are likely to extend beyond the direct footprint of the development as some species such as the legless skinks are sensitive to soils vibrations are and likely to move away from areas with heavy machinery operating.

The Giant Desert Lizard *Meroles ctenodactylus* is a common endemic lizard from the study area, which favours sandy areas along the coastline and in the Strandveld.

Amphibians

The site lies within the known distribution range of seven frog and toad species. However as there is very little perennial water in the area, many of these are not likely to occur at the site. Although the Swartlintjies River runs through the site, the water in this area is generally very saline and is not likely to be used by amphibians for breeding purposes and most species present are likely to be independent of water or able to use pools in rocky outcrops or similar ephemeral environments. Species likely to be present include the Desert Rain Frog *Breviceps macrops*, Namaqua Rain Frog *Breviceps namaquensis* and Karoo Toad *Vandijkophrynus gariepensis*. The Desert Rain Frog occurs along the coast, in Strandveld vegetation up to 10 km from the coastline and is listed as Vulnerable due in large part to habitat loss from mining activities. The current development will contribute to some additional habitat loss and disturbance in the area. However, given the existing disturbance at the site, amphibian abundance is likely to be low in most of the disturbed parts of the site and the extent of additional impact is likely to be relatively low. The greatest threat to amphibians associated with the development is probably chemical and fuel/oil spills related to mining activities and the operation of heavy machinery.

Avifauna

A total of 154 terrestrial and coastal bird species have been recorded in the study area and surrounds (Table 1), based on data obtained from the Southern African Bird Atlas Project 1 (SABAP 1; Harrison *et al.*, 1997), and more recently the Southern African Bird Atlas Project 2 (SABAP 2, http://sabap2.adu.org.za/). Of these, 11 are listed as threatened and five as near-threatened, while 18 species are considered endemic and 38 near-endemic to South Africa (Taylor *et al.*, 2015). During the site visit, a total of 71 bird species were recorded within the study area.

The overall landscape of the area is dominated by a flat to slightly undulating coastal peneplain, bordered to the west by the cold Benguela coast. Three avifaunal habitats could be distinguished based on the primary habitat preferences by birds, namely (i) the coastal shore (high-water mark to the offshore surf), (ii) succulent shrubland of the interior sandy plains, and (iii) small pans and water bodies (mostly artificial slimes dams and rain-filled mining voids).

The interior plains of the study area support a succulent-dominated shrubland, described as Namaqualand Coastal Duneveld (Mucina & Rutherford, 2006). Within the study area, this habitat has been largely altered by mining, with numerous mining voids, tailings and slimes dams scattered throughout. Nonetheless, this habitat still supports a significant diversity of bird species (102) comprising mostly small passerines (63 species). While none of these passerines are Red Listed, 14 species are endemic and 22 are near-endemic to South Africa (Taylor *et al.*, 2015). The most commonly encountered and typical species include the following: Pied Starling (*Lamprotornis bicolor*), African Stonechat (*Saxicola torquatus*), Bokmakierie (*Telophorus zeylonus*), Yellow Canary (*Crithagra flaviventris*), Karoo Scrub-robin (*Cercotrichas coryphoeus*), Anteating Chat (*Myrmecocichla formicivora*), Grey-backed Cisticola (*Cisticola subruficapilla*), Cape Long-billed Lark (*Certhilauda curvirostris*), Karoo Prinia (*Prinia maculosa*), Malachite Sunbird (*Nectarinia famosa*), Southern Double-collared Sunbird (*Cinnyris chalybeus*), White-throated Canary (*Crithagra albogularis*), Cape Bunting (*Emberiza capensis*), Tractrac Chat (*Cercomela tractrac*), Cape Weaver (*Ploceus capensis*), Cape Bulbul (*Pycnonotus capensis*), Karoo Lark (*Calendulauda albescens*), and Chat Flycatcher (*Bradornis infuscatus*).

Species of special concern within the succulent shrubland include large terrestrial birds (5 species) and raptors (11 species), with the following species being of particular importance (with Red List status): the Endangered Ludwig's Bustard (*Neotis ludwigii*), Martial Eagle (*Polemaetus bellicosus*), Black Harrier (*Circus maurus*), the Vulnerable Secretarybird (*Sagittarius serpentarius*), Lanner Falcon (*Falco biarmicus*), Southern

Black Korhaan (*Afrotis afra*), and the Near-threatened Kori Bustard (*Ardeotis kori*). Besides Ludwig's Bustard and Southern Black Korhaan, these species all appear to be rare to uncommon in the study area owing to low SABAP 2 reporting rates. Kori Bustard, for example, was only recorded during the SABAP 1 period and not during SABAP 2. Further, no sensitive avifaunal areas such as communal breeding or foraging sites were identified within this shrubland habitat.

The study area is rather distant from the nearest Important Bird Areas (Marnewick *et al.*, 2015), Coordinated Avifaunal Roadcount routes (CAR; Young *et al.*, 2003) and Coordinated Waterbird Count sites (CWAC; Taylor *et al.*, 1999). However, much of the area's shrubland lies within the Critical Biodiversity Area Two of the Northern Cape Critical Biodiversity Map (Oosthuysen & Holness, 2016). The areas surrounding Hondeklip Bay and Noup fall within the Critical Biodiversity Area One, and are therefore considered to be of an even higher conservation priority.

The coastal shore is characterized mainly by low rocky shores and associated kelp beds, interspersed by a number of small sandy beaches and a small bay (Rooiwal/Mitchell's Bay). A very narrow strip of Namaqualand Seashore Vegetation (Mucina & Rutherford, 2006) exists between the high-tide zone and the Namaqualand Coastal Duneveld. This upper-beach habitat occupies shell beds and low dunes, and is composed of hummock-forming and spreading dwarf succulent shrubs and herbs. A portion of this vegetation is included in the Namaqua National Park, and while only 5% has been previously transformed, coastal diamond mining still remains a threat (Mucina & Rutherford, 2006). The most common bird species include African Stonechat, Mountain Wheatear (*Oenanthe monticola*), Cape Wagtail (*Motacilla capensis*) and White-fronted Plover (*Charadrius marginatus*).

Approximately 35 species of birds are almost exclusively associated with the coastal shore, including cormorants, gulls, terns, and resident and migratory shorebirds. The most commonly encountered species throughout the year include the Endangered Cape Cormorant (*Phalacrocorax capensis*) and Bank Cormorant (*Phalacrocorax neglectus*), the Vulnerable Cape Gannet (*Morus capensis*), the Near Threatened Crowned Cormorant (*Phalacrocorax coronatus*), and several species that are not red listed, such as White-breasted Cormorant (*Phalacrocorax carbo*), Hartlaub's Gull (*Larus hartlaubii*), Kelp Gull (*Larus dominicanus*), White-fronted Plover (*Charadrius marginatus*), Swift Tern (*Sterna bergii*), Grey Heron (*Ardea cinerea*), and African Black Oystercatcher (*Haematopus moquini*). The latter is no longer red listed as numbers have increased by 37% since 1980, while its population has experienced an eastward range expansion (Taylor *et al.*, 2015). In summer the local avifauna is augmented by a number of migratory shorebirds, the most common being Little Stint (*Calidris minuta*), Sanderling (*Calidris alba*), Curlew Sandpiper (*Calidris ferruginea*), Ruddy Turnstone (*Arenaria interpres*), and Ruff (*Philomachus pugnax*).

Red listed species such as the Critically Endangered Damara Tern (*Sterna balaenarum*), the Endangered African penguin (*Spheniscus demersus*), and the Vulnerable Caspian Tern (*Sterna caspia*) have no nearby breeding colonies (Taylor *et al.*, 2015). The former has never been recorded in the region, though it was known as a very low density breeder near Kleinzee in the past (Taylor *et al.*, 2015). The other species have not been recorded in the study area during the SABAP 2, which suggests that they rare to uncommon temporary visitors to the shores of the study area, and may therefore remain unaffected by changes to the coastal habitat.

There are no known breeding colonies for any of the three cormorant species in the vicinity of the study area (Taylor *et al.*, 2015), with the closest colonies being located near Kleinzee to the north. Cormorant roosts noted during the site visit were recorded mostly on low rocks near breaking waves. Only five notable cormorant roosts were detected, with an average of 32 birds (range 15 to 50), with Cape Cormorant being more numerous than Crowned Cormorant. No Bank Cormorants were observed roosting on rocks, but a few individuals were possibly detected flying with Cape Cormorants just offshore. No highly sensitive avifaunal habitats therefore appear to exist within the coastal zone, particularly with respect to breeding sites. Most large coastal birds appear to use the coast for foraging and roosting. The absence of large boulders, separated from the mainland by inter-tidal waters at low tide, is perhaps the primary reason for the absence of cormorant breeding sites in the study area.

At the southern end of the coastal zone of the study area is a small embayment/indentation known as Rooiwal (also referred to as Mitchell's Bay). Considering that bays and indentations along the mostly linear west coast of South Africa are uncommon (Talkenberg, 1982), it may be probable that the Rooiwal Bay represents a unique ecological feature. The mouth of the bay is over 600 m wide, flanked to the north and south by rocky platforms, and over 600 m deep, culminating in a small beach backed by a steep red-soiled sand cliff (hence the name "Rooiwal"). Although no sensitive avifaunal features could be identified during the site visit, aside from a small cormorant roost on the south side of the bay mouth, the potential value of Rooiwal Bay should not be dismissed. The area lies within a coastal upwelling cell, at the extreme north of a spawning zone for common pelagic fish species (Hutchings *et al.*, 2002). The embayment may therefore serve as an important spawning or nursery microhabitat for fish, and hence foraging habitat for coastal birds at certain times of the year.

Three primary types of inland water bodies occur at the site, these being natural salt pans, slimes dams, and rain-filled mining voids. Only one natural pan is known from

within the study area, located at the mouth of the Swartlintjies River. This pan is the only representative of the vegetation type known as Arid Estuarine Salt Marshes (Mucina & Rutherford, 2005), which is considered Least Threatened despite 15% being transformed by cultivation and mining. The most abundant water bodies in the study area were the partially filled mining voids, which supported very low numbers of South African Shelduck (*Tadorna cana*) and Black-necked Grebe (*Podiceps nigricollis*). Additional species such as Pied Avocet (*Recurvirostra avosetta*), Black-winged Stilt (*Himantopus himantopus*), Blacksmith Lapwing (*Vanellus armatus*), and the Near Threatened Greater Flamingo (*Phoenicopterus ruber*) and Lesser Flamingo (*Phoenicopterus minor*) were only present at a few operational slimes dams. These slimes dams were located in highly disturbed areas, surrounded by mine tailings, voids and back-filling, suggesting that birds were accustomed to disturbances caused by general mining operations. No evidence was found to suggest that any of these species breed colonially in the area, and hence no sensitive avifaunal microhabitats were identified.

B3.2 Faunal Habitats

In this section the different faunal habitats prevalent at the site are described and illustrated.

Rocky Shore

The coastline within the study area is largely a rocky shore with occasional sandy beaches. The rocky shore below the highwater mark, is important for birds as well as such some mammals such as seals which come to shore in some areas along the coast. It is considered relatively resistant and resilient to impact as the rocky shore itself is not easily impacted and wave action tends to restore the character of these areas once disturbed. Large changes in the amount of sand and sediment availability and movement due to beach and bay-mining activities can however create significant impact up to several kilometres from the impact source. Increases in sediment deposition rates can smother marine life and impact the value of these areas for shore-based birds and marine mammals. Within context of the site, Mitchell's Bay is considered to be sensitive area that is well-used by birds and probably mammals as well and mining of the bay will be certain to significantly change the character of this area and probably its long-term biodiversity value as well.

The rocky shore at Mitchell's Bay, showing the rocky shoreline as well as the 'Rooiwal' which is not unique and similar coastal embankments are relatively common on the West Coast.

Terrestrial Rocky Habitat

At the site, terrestrial rocky habitats are restricted to above the shoreline and its immediate vicinity. These areas are important for fauna associated with rocky habitats, including many reptiles and small mammals. As this is a restricted habitat that is not widely available and is likely to contain several listed species, it is considered relatively sensitive. Although some parts of this habitat have been significantly impacted by mining activities, some areas, such as in the vicinity of Mitchell's Bay are still largely intact. Apart from direct habitat loss, this habitat is relatively resilient to disturbance provided that the structure of the rocks is maintained. In addition, large rocks are often extracted from the mining voids and placed in mounds creating artificial habitats similar to the rocky areas. These areas are likely to be colonised by some of the same species, especially is they are big enough.

The rocky shore near to Mitchell's Bay. Such rocky habitats above the shoreline are not common at the site and restricted to the vicinity of the coastline.

Namaqualand Coastal Duneveld

The majority of the affected area consists of Namaqualand Coastal Duneveld, dominated by low and medium-height succulent shrubs, with a high seasonal abundance of annuals and geophytes. This is generally a fairly homogenous habitat with moderate faunal species richness. There are however several areas of more mobile coastal sands of marine origin that can be recognised by the white rather than red sands. These areas are considered more sensitive than the areas of red sands as the loose sands are favourable for a variety of subterranean species such as legless skinks, golden moles and molerats. The activity of such species was noticeably higher in these areas than in the areas of red sands. It is possible that beach mining activities can significantly impact these areas given the marine origin of the sands. The sand in these areas is constantly supplied from the sea and changes to the local currents or supply of sand could significantly alter the character and nature of these areas, either because the amount of sand increases significantly or if it is reduced.

Typical Namaqualand Coastal Duneveld at the site, which is considered moderate sensitivity from a faunal perspective as the faunal community in these areas is generally dominated by fairly common and widespread species.

Namaqualand Coastal Duneveld on sands of recent marine origin. Soil mounds made by the Namaqua Dune Molerat are conspicuous and indicate the high levels of activity in this area. These areas are considered more important for fauna than the more typical duneveld illustrated above.

Namaqualand Strandveld

Away from the coast on more stable soils, the vegetation consists of Namaqualand Strandveld. As the structure of these areas is largely similar to the coastal duneveld, the majority of fauna present is also similar and consists largely of more common and widespread species such as steenbok, gerbils and bush rats. However, these areas have not been impacted to the same extent as the areas towards the coast and at a broad level are still largely intact. Although there are sensitive areas present within the strandveld, there are few such areas present within the study area and the majority of the affected area is considered moderate sensitivity. The potential for disruption of ecological processes in these areas is significantly less than along the coast itself as the strandveld extends for some distance inland and the connectivity of this habitat has not been significantly disrupted.

Typical Namaqualand Strandveld within the site, this is generally lower and more open than the coastal duneveld.

Disturbed & Mined Areas

Large parts of the site consist of mine dumps, mining voids and other recent and historical mining-related disturbance. While there is some active rehabilitation at the site which contributes to restoring some biodiversity value to these areas, the majority of the mining footprint remains impacted. The value of most of these areas for fauna is very low. The slimes dams and water-filled mining voids are however used by water birds and waders and as such have some value in this regard. However, these are far in excess of what might be considered to contribute to local habitat diversity and are generally considered negative features of the landscape in that they disrupt connectivity of the landscape and probably also have negative hydrological effects on the surrounding areas.

Typical mining void, partially filled with water and being used by flamingos. The water in these voids is generally fairly saline and is not used by amphibians, although some mammals and birds appear to drink from these areas.

B4. Critical Biodiversity Areas & Broad Scale Ecological Processes

The entire study area is located within an Ecological Support Area within the Namakwa District Biodiversity Sector Plan (Desmet & Marsh 2006). Connectivity along the coastline is of primary concern as there are many species present in the area that are restricted to the coastline and mining development is the main contributing cause of habitat fragmentation in the area. Although the connectivity of the coastal strip is naturally fragmented to some extent by rivers and other features, these are of limited extent and mining along the coastline has significantly fragmented the coastal strip for associated species. The additional contribution of the current developments would be relatively low, given the large amount of existing disturbance within the site. The cumulative impact of all the existing and planned disturbance is however likely to be high for some species at least. The major opportunity to reduce this impact would be to improve the condition of habitat within the site, through rehabilitation of disturbed areas. There are many unnecessary roads and unfilled mining voids present at the site and some connectivity within the site can be restored through remedial measures and rehabilitation of these areas.

Linkages between the marine and terrestrial environment are important as illustrated by this picture, showing large amounts of sand being blown inland from the sea. This creates specific habitats inland that are important for fauna, many of which are listed and local endemics.

B5. Impacts and Issues Identification

B5.1 Identification of Potential Impacts

The likely impacts on the faunal ecology of the site resulting from the development of the additional mining activity are identified and discussed below with reference to the characteristics and features of the site. The major risk factors and contributing activities associated with the development are identified and briefly outlined and summarized below before the impacts are assessed

Impact 1. *Direct Faunal Impacts*

The development will result in the transformation and loss of currently intact faunal habitat, while increased levels of noise, pollution, disturbance and human presence during mining will be detrimental to fauna. Sensitive and shy fauna are likely to move away from the area during the mining as a result of the noise and human activities present, while some slow-moving species would not be able to avoid the mining activities and might be killed if proper management and monitoring is not in place. Increased traffic at the site would pose a risk of collisions with fauna. Slower types such as tortoises, snakes and amphibians would be most susceptible.

Cumulative Impact 1. *Impacts on Critical Biodiversity Areas and broad-scale ecological processes*

The site lies within an Ecological Support Area aimed at ensuring the connectivity of the landscape along the coastline. Extensive development within these areas would impact this function of the ESA. Apart from direct habitat loss, the presence and associated disturbance created by the mining activity at the site would deter certain species from the area, increasing the extent of habitat loss and fragmentation for such species. It is also possible that beach mining activities will impact on broad-scale physical and ecological processes such as sand movement corridors with resulting degradation or changes in habitat quality and character.