Appendix E: Specialists Reports

Appendix E1: Ecological Baseline Assessment

ECOLOGICAL BASELINE ASSESSMENT

FOR

PROPOSED BENTONITE AND ZEOLITE MINING RIGHT

ON

REMAINING EXTENT OF FARM UITSPANSKRAAL NR 585 HEIDELBERG, WESTERN CAPE

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Date: September 2017

PROJECT DETAILS

eco impact	**Title:** Ecological Baseline Assessment for Proposed Mining Right on Remaining Extent of Farm Uitspanskraal Nr 585 Heidelberg, Western Cape	
Eco Impact No: 09/2017	**Date:** September 2017	**Report Status:** Final
Carried Out By: Eco Impact Legal Consulting (Pty) Ltd P.O. Box 45070 Claremont 7735 Tel: 021 671 1660 Fax: 088 021 671 1660 Email: admin@ecoimpact.co.za	**Client:** Imerys Refractory Minerals South Africa (Pty) Ltd: Cape Bentonite Mine Tel: 028 722 2011 Email: helmut.gemurr@imerys.com	
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Verification	Capacity	Name	Signature	Date
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Executive Summary

Imerys Refractory Minerals South Africa (Pty) Ltd t/a Cape Bentonite Mine is an existing Bentonite and Zeolite mining company operating on various farms in close proximity to the towns of Heidelberg and Riversdale that fall within the Hessequa Local Municipality and Eden District Municipality in the Western Cape Province.

Cape Bentonite Mine proposes to mine bentonite and zeolite deposits on cultivated agricultural land on the Remaining Extent of Farm Uitspanskraal Nr 585 near Heidelberg in the Western Cape. Eco Impact has been appointed to conduct an ecological baseline assessment to determine the potential impacts of the proposed mining activities on the terrestrial and aquatic ecological features as identified on the proposed mining sites and surrounds and to provide impact avoidance and/or mitigation measures as and if required.

Mining is conducted "in-house" by means of excavators, front-end loaders and 15T dumper trucks. The mining and method comprise relatively shallow opencast quarrying. The topsoil and overburden are removed and stockpiled separately adjacent to the mining area. The bentonite as it is being mined is trucked to the processing plant at the head offices on Erf 1412, Heidelberg.

The mine provides direct employment for at least 43 local persons and compensation to the landowner. The operation further creates indirect employment opportunities in equipment supply industries, transport and bentonite mining, and the mining environment.

Cape Bentonite Mine provided Eco Impact with a map of the proposed mining areas and a total area of approximately 151ha was surveyed for this assessment. (Refer to Map 3)

Sensitive environmental features that were identified on the site and surrounds as surveyed include non-perennial secondary drainage lines with associated indigenous vegetation areas that are present adjacent to the proposed mining areas due to the undulating nature of the landscape, which has also been identified as Aquatic Critical Biodiversity Areas and with associated buffer and Ecological Support Areas. The drainage lines feed into lower lying man-made farm dams and the Duiwenhoks River catchment area. The only surface water run-off that is occasionally present in the drainage lines is storm water runoff during heavy rains. The indigenous vegetation remnants, which exists throughout the property mainly associated with the non-perennial drainage line areas too steep to plough for cultivation, consists of Critically Endangered - Eastern Ruens Shale Renosterveld and Cape Lowlands Alluvial Vegetation and Endangered – Swellendam Silcrete Fynbos also identified as Terrestrial Critical Biodiversity Areas ("CBA") as according to the Western Cape Biodiversity Spatial Plan (2017) for Hessequa. (Refer to Maps 4.1; 4.2 and 5).

Some of the proposed mining activities areas partially fall within mapped Ecological Support Areas (Res) *Category 1: ESA 2 Restore from other land use*. These ESAs are not essential for meeting biodiversity targets, but play an important role in supporting the functioning of the CBAs and are important in maintaining ecosystem services i.e.

drainage systems. The objectives for these areas are to restore and/or manage to minimise impacts on ecological processes. Due to these areas already being historical and ongoing cultivated agricultural lands restoration will not be feasible or reasonable, but the areas must and can be managed to maintain current ecological processes. With the implementation of proper buffer and stormwater management measures as proposed the mining activities will not have a significant detrimental impact on these ESAs and surrounding CBAs.

Alien vegetation encroachment on site is mainly limited to weeds associated with cultivated lands.

Potential significant direct impacts occur primarily during the mining excavation stage, and the nature of these impacts is temporary loss of agricultural land and potential erosion of proposed mining areas and surrounds. The extent in this case is local. Indirect impacts occur mostly during the rehabilitation phase and in this case the nature would vary from the introduction of alien vegetation to partial disruption of ecological processes due to the effects of the alien species. The extent of the indirect impact in this case is local.

Site specific stormwater management measure must be designed and implemented for each proposed quarry area to prevent accumulation of stormwater in the quarries and allow current stormwater run-off conditions to continue as is. Where no existing gravel roads exists as buffer areas an 8m buffer area in-between any excavations and the edge of indigenous vegetation areas as present along the existing edge of the cultivated agricultural lands is proposed to ensure protection and maintain current ecological functioning of associated runoff areas/drainage lines. The only activities allowed within the proposed 8m buffer areas, as measured from the edge of the indigenous vegetation areas along the edge of the cultivated lands, are continued use as informal gravel roads or for placement of storm water berms (no excavations or trenching allowed).

From the survey conducted it was concluded that the proposed mining activities areas are located on completely transformed and cultivated agricultural land, previously and continually impacted upon by cultivation and heavy livestock grazing. The proposed mining sites are therefore considered suitable for bentonite and zeolite mining in terms of avoiding potential detrimental environmental impacts and the potential impacts identified would be adequately managed and effectively mitigated through the implementation of the recommendations outlined in this report to be incorporated into the mine Environmental Management Programme (EMP). It was also concluded that the proposed mining activities will not have a significant negative environmental impact mainly because the proposed mining activities areas are all located on completely transformed cultivated agricultural land and the socio-economic benefits of the proposed bentonite and zeolite mining outweigh the potential negative impact on the environment if specialist and EMP recommendations are effectively implemented.

No fatal flaws were identified during the assessment that will lead to unacceptable environmental degradation during the proposed mining activities.

IMPORTANT NOTE: Proposed mining activities as referred to throughout the report include all activities associated with the proposed bentonite and zeolite mining

development such as any explorations required, site establishment, demarcations, any excavations, any vehicular movements, any access and internal road construction, topsoil and overburden storage, implementation of rehabilitation measures etc.

1. Background & Competency

This ecological baseline assessment is presented by Eco Impact Legal Consulting (Pty) Ltd ("Eco Impact").

Eco Impact has been appointed as the independent ecological impact assessment specialist for this project.

Eco Impact is independent and does not have any interest in the business nor receive any payment other than fair remuneration for services rendered as required in terms of the regulations.

Johmandie Pienaar (Giliomee) of Eco Impact holds a Baccalaureus Technologiae Degree (cum laude) in Nature Conservation from the Cape Peninsula University of Technology (2008).

She has completed the following short courses at the Centre for Environmental Management;

- Implementing Environmental Management Systems (ISO 14001)(2009);
- Occupational Health and Safety Law for Managers (2010);
- Implementing an OHS Management System based on OHSAS 18001 (2010)
- Occupational Health and Safety Management System OHSAS 18001 Audit: A Lead Auditor Course Based on ISO 19011 and ISO 17021 (2011).

Johmandie has trained as an Environmental Assessment Practitioner since March 2009 and has been involved in the compilation, coordination and management of Basic Assessment Reports, Environmental Impact Assessments, Environmental Management Programmes, Waste Licence Applications, Water Use Licence Applications, Rehabilitation Plans and Baseline Biodiversity and Freshwater Ecosystems Surveys for numerous clients.

Nicolaas Hanekom has 26 years' experience working as an ecologist for nature conservation organizations. He has extensive field experience and botanical knowledge, some knowledge of wetlands ecology, is knowledgeable of the region in which they are working and exercises sound and unbiased scientific and professional judgment. He is a qualified Environmental Assessment Practitioner and a registered Professional Natural Scientist (Ecologist) with the SACNASP who holds a M. Tech, Nature Conservation from the Cape Peninsula University of Technology. This master's thesis focussed on the impact of different land uses on the Phytodiversity ("Botany/ plants") of the West Coast Strandveld in and around Rocherpan Nature Reserve.

Hanekom further qualified in Environmental Management Systems ISO 14001:2004, at the Centre for Environmental Management, North-West University, as well as Environmental Management Systems ISO 14001:2004 Audit: Internal Auditors Course to ISO 19011:2011 level, from the Centre for Environmental Management, North-West

University qualifying him to audit to ISO/SANS environmental compliance and EMS standards.

He has also completed the suite of Greener Governance courses with certificates in:

- An Overview of Environmental Management at the Local Government Level, Centre for Environmental Management, North-West University;
- Greener Governance for Local Authorities, Centre for Environmental Management, North-West University;
- Tools for Integrated Environmental Management and Governance, Centre for Environmental Management, North-West University.

Hanekom attended and obtained a certificate on Integrated Protected Area Planning at the Centre for Environmental Development, University of KwaZulu Natal and a certificate in Project Management (Theory and Practical), through CS Holdings. He has lectured in two subjects at the Cape Peninsula University of Technology. He has 14 years of environmental planning experience, working for Free State and Western Cape departments of environmental affairs, where he reviewed and commented on development (EIA) applications in the West Coast region.

Hanekom has been responsible for many environmental impact assessments and several EIA applications, waste license and atmospheric emission license applications as well as being involved in the implementation of several environmental management systems.

2. Conditions Relating to this Report

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. Eco Impact and its staff reserve the right to modify aspects of the report including the recommendations if and when new information may become available from on-going research or further work in this field, as pertaining to this investigation.

This report may not be altered or added to without the prior written consent of the author. This restraint also refers to electronic copies of this report which are supplied as sub portion of other reports, including main reports. Similarly, any recommendations, statements, or conclusions drawn from or based on this report must specifically refer to this report. If such comments form part of a main report for this investigation, the base line report must be included in its entirety as an appendix or separate section to the main report.

3. Scope and Terms of Reference for the Study

Cape Bentonite Mine appointed Eco Impact Legal Consulting (Pty) Ltd to conduct an ecological baseline assessment to determine the significance of potential impacts that the proposed mining activities may have on the biodiversity and freshwater ecosystems of the applicable sites and surrounds.

The basic terms of reference (TOR) for this study were the Cape Nature recommended TOR for biodiversity specialists, and are as follows:

- Produce a baseline analysis of the botanical attributes of the study area as a whole.

- This report should clearly indicate any constraints that would need to be taken into account in considering the development proposals further.

- The baseline report must include a map of the identified sensitive areas as well as indications of important constraints on the property. It must also:

- Describe 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.

- In terms of biodiversity pattern, identify or describe:

  Community and ecosystem level
  - The main vegetation type, its aerial extent and interaction with neighbouring types, soil or topography;
  - The types of plant communities that occur in the vicinity of the site
  - Threatened or vulnerable ecosystems (*cf. SA vegetation map/National Spatial Biodiversity Assessment, etc.*)

  Species level
  - Red Data Book species of conservation concern (RDBSCC) - (provide location)
  - The viability of and estimated population size of the RDBSCC that are present (include degree of confidence in prediction based on availability of information and specialist knowledge, i.e. High = 70-100% confident, Medium 40-70% confident, Low 0-40% confident)
  - The likelihood of other RDBSCC species occurring within the vicinity (include degree of confidence)

  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
  - The condition of the site in terms of current or previous land uses

- In terms of biodiversity process, identify or describe:
  - 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 the vicinity i.e. watercourses, biome boundaries, migration

routes etc.
    - Any possible changes in key processes e.g. increase fire frequency or drainage/artificial recharge of aquatic systems.

- Describe what is the significance of the potential impact of the proposed project – with and without mitigation – on biodiversity pattern and process at the site, landscape, and regional scales.

- Recommend actions that should be taken to prevent or mitigate impacts. Indicated how these should be scheduled to ensure long-term protection, management and restoration of affected ecosystems and biodiversity.

- Indicate limitations and assumptions, particularly in relation to seasonality.

4. Limitations, Assumptions and Methodology

Johmandie Pienaar and Nicolaas Hanekom surveyed the sites on 31 March 2016 and 26 June 2017.

A total area of ±151ha on farm Uitspanskraal RE/585 was surveyed for this assessment, including an overview of the surrounding indigenous vegetation and drainage line areas.

The study area was accessed via vehicle and walked where possible and the natural vegetation areas and other sensitive environmental features such as secondary non-perennial drainage lines, man-made and natural dams with associated wetland characteristics and indigenous vegetation areas were delineated and prominent indigenous vegetation types and alien invasive species were recorded if present on the proposed development/mining sites.

The latest available GIS based South African National Biodiversity Institute (SANBI) land use planning maps were consulted, along with the available regional conservation plans (CAPE), and the National Spatial Biodiversity Assessment (NSBA; Rouget *et al* 2004), and a conclusion was drawn based on this documentation, professional experience in the area and the survey conducted. Where applicable SANBI – Red List of South African Plants website was also referred to.

It is assumed that the study area is an accurate representation of the proposed mining activities area (Refer to Map 3), as provided by Cape Bentonite Mine. For purposes of this assessment "mining" is assumed to mean all mining related activities, and the No-Go/No-Development alternative is assumed to be a continuation of the current status quo, which in this case means annual cultivation and heavy livestock grazing. It is assumed that the post mining landuse in the study area will be cultivation and/or livestock grazing.

One of the primary assumptions of this study is that sufficient botanical and ecosystem characteristics information could be gathered during the visit and desktop study done to make accurate conclusions regarding the suitability of the area for the proposed activities and potential impacts of the mining activities as proposed. Habitats (type,

quality, rarity, characteristics) rather than species are used to inform mapping and decision making in this case.

5. Broad ecological characteristics of the Site and Surrounds

5.1 Topography

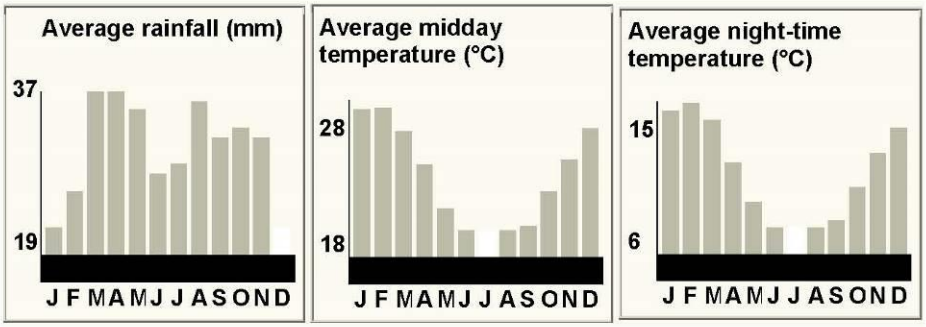
The farm is characterised by its undulating landscape with associated steep slopes, drainage lines and gorges which limits the extent of cultivation to moderate slopes and more flat lying areas.

The highest elevation of the property is located north being 310m above mean sea level and the lowest in the middle at 120m above mean sea level.

Several non-perennial drainage lines with associated man-made and natural dams occurs throughout the property which drains mainly towards the R322 in the middle of the property and which eventually feeds the Duiwenhoks tributary within Heidelberg.

5.2 Climate

Heidelberg (WC) normally receives about 366mm of rain per year, with rainfall occurring throughout the year. The chart below (lower left) shows the average rainfall values for Heidelberg (WC) per month. It receives the lowest rainfall (19mm) in December and the highest (37mm) in March. The monthly distribution of average daily maximum temperatures (centre chart below) shows that the average midday temperatures for Heidelberg (wc) range from 18°C in July to 27.5°C in February. The region is the coldest during July when the mercury drops to 5.8°C on average during the night. Consult the chart below (lower right) for an indication of the monthly variation of average minimum daily temperatures.



5.3 Geology

The Heidelberg/Riversdale area is dominated by the Enon Conglomerate formation of the Bokkeveld Group. The Bokkeveld Group consists of sandstone, shale, siltstone and

mudstone. The Enon Conglomerate consists of large boulders of Cape Sandstone originally in a matrix with lenses of mudstone and siltstone.

Bentonite occurs as three main horizons in the area, each horizon comprising several layers in the Kirkwood Formation, overlain by conglomerate and sandstone of the Buffelskloof Formation. The Grahamstone Formation silcrete occurs at the top of the sequence in some places, whereas the Enon conglomerate forms the floor.

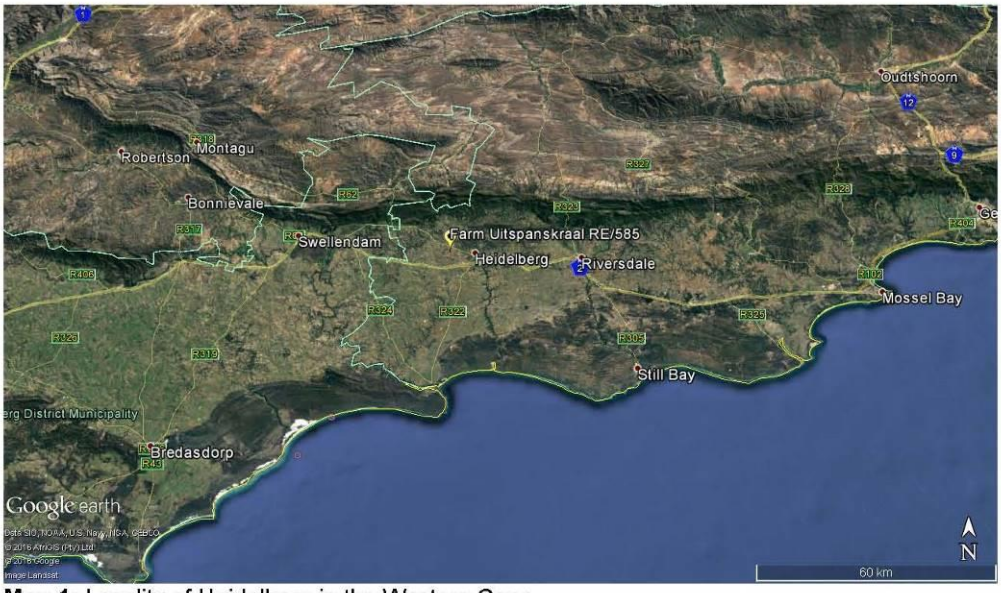
5.4 Vegetation at a Regional and National Context

The study area is part of the Fynbos biome, located within what is now known as the Core Region of the Greater Cape Floristic Region (GCFR; Manning & Goldblatt 2012). The GCFR is one of only six Floristic Regions in the world, and is the only one largely confined to a single country (the Succulent Karoo component extends into southern Namibia). It is also by far the smallest floristic region, occupying only 0.2% of the world's land surface, and supporting about 11500 plant species, over half of all the plant species in South Africa (on 12% of the land area). At least 70% of all the species in the Cape region do not occur elsewhere, and many have very small home ranges (these are known as narrow endemics). Many of the lowland habitats are under pressure from agriculture, urbanisation and alien plants, and thus many of the range restricted species are also under severe threat of extinction, as habitat is reduced to extremely small fragments. Data from the nationwide plant Red Listing project indicate that 67% of the threatened plant species in the country occur only in the southwestern Cape, and these total over 1800 species (Raimondo *et al* 2009)! It should thus be clear that the southwestern Cape is a major national and global conservation priority, and is quite unlike anywhere else in the country in terms of the number of threatened plant species.

The study area lies within the East Coast Renosterveld bioregion (Mucina & Rutherford 2006). This bioregion has a moderately distinct flora, and high numbers of plant Species of Conservation Concern, with the main pressures being extensive habitat loss, due mainly to agriculture, followed by alien invasive vegetation, quarrying and urbanisation, and habitat modification due to lack of appropriate fire regimes.

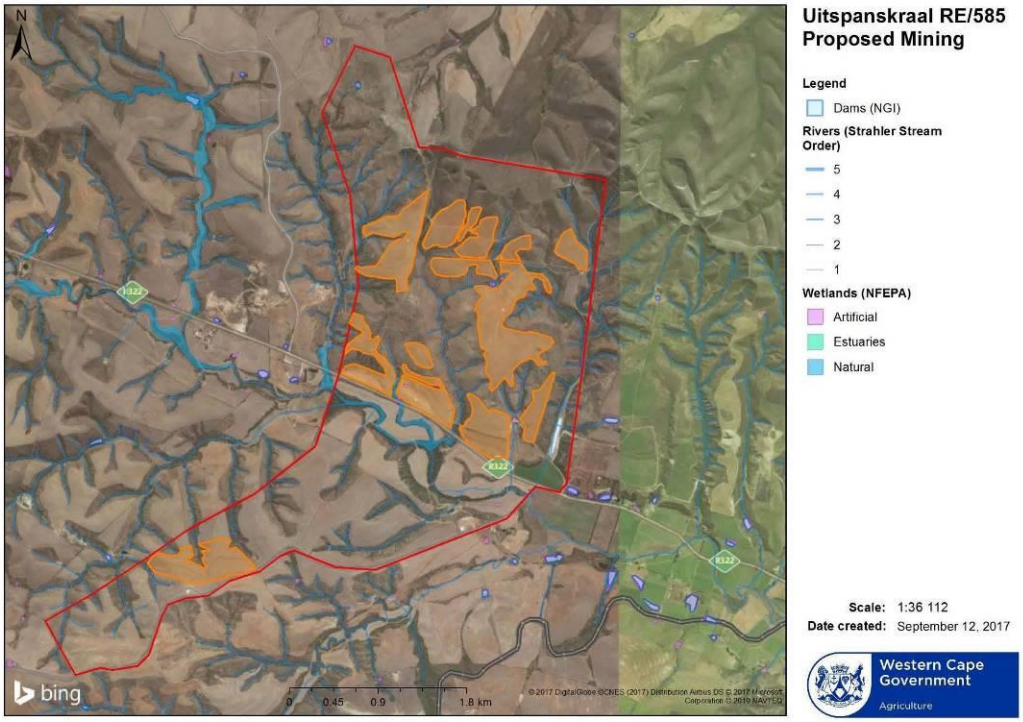
The study area falls within the planning domain of the Hessequa Municipality. The Western Cape Biodiversity Spatial Plans has identified Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) for the Western Cape which aims to guide sustainable development by providing a synthesis of biodiversity information to decision makers. It serves as the common reference for all multi-sectoral planning procedures, advising which areas can be lost to development, and which areas of critical biodiversity value and their support zones should be protected against any impacts. The CBAs and ESAs as mapped for the relevant study sites are shown in Maps 4.1 and 4.2. The primary reason for selection of these areas as terrestrial and/or aquatic CBAs and/or ESAs is that it helps meet the national conservation target for threatened vegetation types, and ancillary reasons are that it offers opportunities for continuation of ecological connectivity especially related to the hydrological connectivity of the drainage lines.

See study area maps below and site photographs attached as Appendix D.

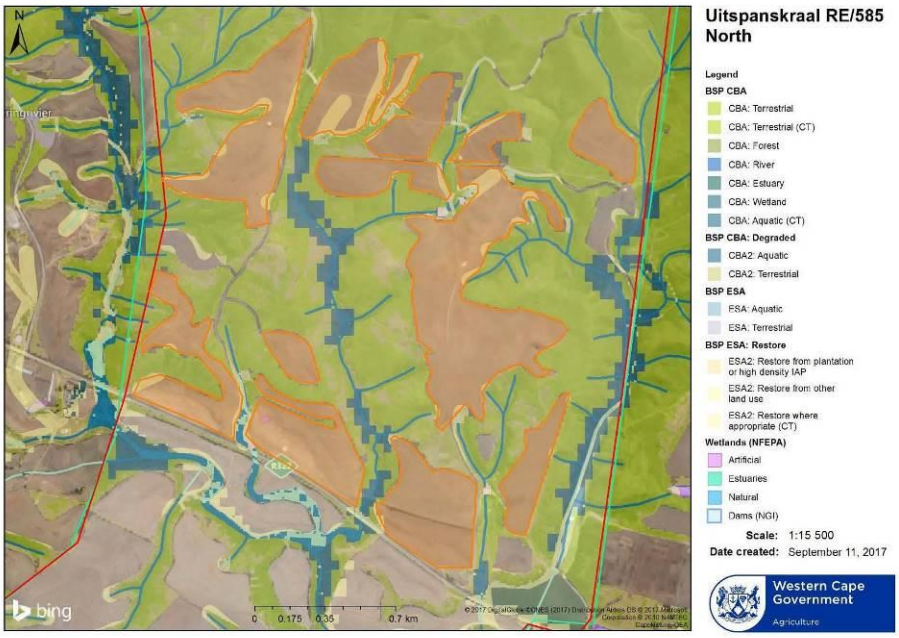


Map 1: Locality of Heidelberg in the Western Cape.

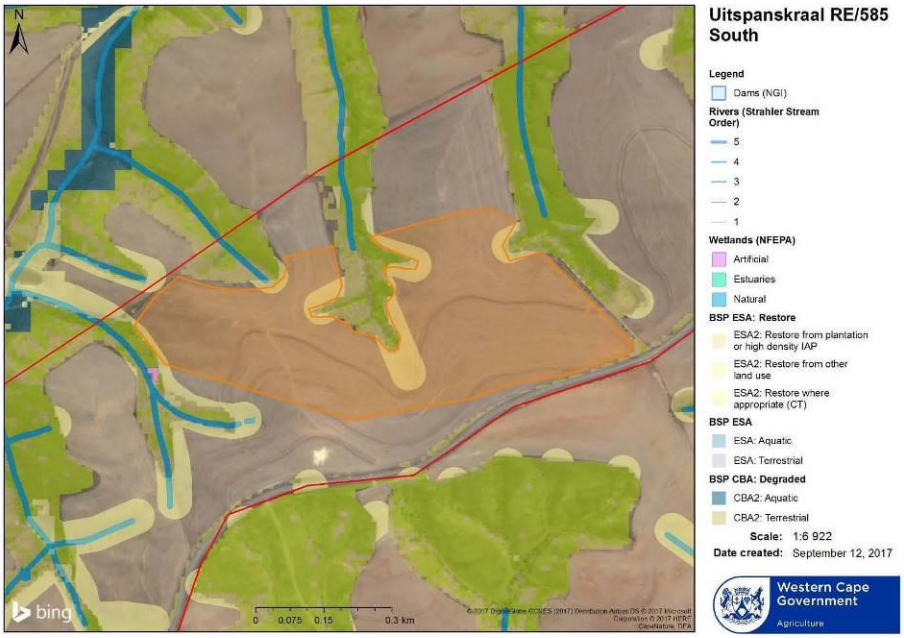
Map 2: Locality of the Farm Uitspanskraal RE/585 near Heidelberg in the Western Cape. GPS co-ordinate for "middle" of surveyed site - 34° 04' 2.49"S
20° 53' 57.36"E



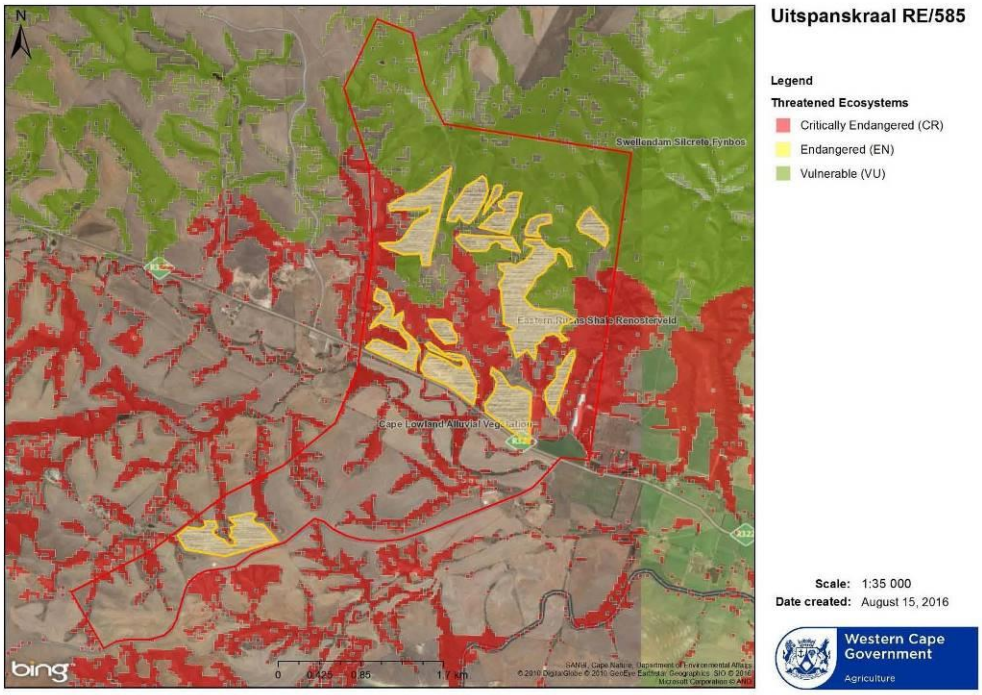
Map 3: Boundary of Farm Uitspanskraal RE/585 and proposed mining activities area of 151ha as surveyed.



Map 4.1: Biodiversity GIS ("BGIS") land use map indicating mapped terrestrial and aquatic Critical Biodiversity Areas ("CBA"), Ecological Support Areas ("ESA") and associated buffer areas as according to the WCBSP (2017) for Hessequa in relation to the proposed mining activities areas on transformed cultivated agricultural land (as outlined in orange) on Farm Uitspanskraal RE/585-North.



Map 4.2: Biodiversity GIS ("BGIS") land use map indicating mapped terrestrial and aquatic Critical Biodiversity Areas ("CBA"), Ecological Support Areas ("ESA") and associated buffer areas as according to the WCBSP (2017) for Hessequa in relation to the proposed mining activities areas on transformed cultivated agricultural land (as outlined in orange) on Farm Uitspanskraal RE/585-South.



Map 5: Remaining indigenous vegetation areas in relation to proposed mining activities areas on Farm Uitspanskraal RE/585. (Note: Swellendam Silcrete Fynbos is currenly classified as *Endangered* and not as *Vulnerable)*

6. Observations and Findings Relative to the Terms of Reference

6.1 In terms of biodiversity pattern, identify or describe, at a community and ecosystem level-

6.1.1 The main vegetation type and plant communities that occur on and/or in the vicinity of the site:

As according to Mucina and Rutherford (2006) the remnants of natural vegetation occurring on this property are classified as Eastern Ruens Shale Renosterveld (*Critically Endangered*), Cape Lowland Alluvial Vegetation (*Critically Endangered*) and Swellendam Silcrete Fynbos (*Endangered*) as part of the Fynbos biome.

Note: Detailed recordings and descriptions of these vegetation types were not included in the report, because none of the remaining indigenous vegetation areas will be impacted upon or affected by the proposed mining activities.

Observations and Findings:

Due to the undulating topography of the property and surrounds the remaining indigenous vegetation remnants are located along the steep slopes of the gorges and associated with near natural non-perennial secondary drainage lines in-between the transformed cultivated areas.

From the site survey conducted, recent and historical google earth map images it is evident that the proposed mining activities area as surveyed has been ploughed and cultivated annually for a number of years. No natural, near natural or rehabilitating indigenous vegetation remnants are located on the proposed mining activities area. Also refer to Map 5 above.

The proposed mining activities areas as delineated in orange on Maps 4.1; 4.2 and 5 have been completely transformed due to ongoing annual agricultural cultivation and there are no remaining indigenous vegetation species on these areas or associated drainage line and/or wetland characteristics.

6.1.2 Threatened and vulnerable ecosystems:

Most of the indigenous vegetation remnants associated with the non-perennial drainage lines along the steep slopes and gorges surrounding the proposed mining area as surveyed have been identified as terrestrial and aquatic Critical Biodiversity Areas. The proposed mining activities will not have an impact on any of these CBAs and no indigenous vegetation remains on the proposed mining activities areas.

As can be seen on maps 4.1 and 4.2 some of the proposed mining activities areas fall within mapped Ecological Support Areas (Res) *Category 1: ESA 2 Restore from other land use*. These ESAs are not essential for meeting biodiversity targets, but play an important role in supporting the functioning of the CBAs and are important in maintaining ecosystem services i.e. drainage systems. The objectives for these areas are to restore and/or manage to minimise impacts on ecological processes.

Due to these areas already being historical and ongoing cultivated agricultural lands restoration will not be feasible or reasonable, but the areas must and can be managed to maintain current ecological processes. With the implementation of proper buffer and stormwater management measures as proposed the mining activities will not have a significant detrimental impact on these ESAs and surrounding CBAs.

6.1.3 The types of animal communities (fish, invertebrates, avifauna, mammals, reptiles):

Fish

Observations and Findings:

Neither fish species nor their associated habitats are present on the proposed mining area. Some freshwater fish species may be present within the man-made dams as located on the property, but will not be impacted upon.

Invertebrates

Observations and Findings:

It is expected that the area has a rich and diverse invertebrate life especially within the remaining indigenous vegetation areas. The proposed mining activities, if restricted to recommended cultivated areas, will not have significant detrimental impact on invertebrate species within the sensitive indigenous vegetation and drainage line areas as identified on the property.

Birds (Avifauna)

Approximately 164 species are known to occur in the bigger area (Hockey et al 2006).

Observations and Findings:

No bird species of conservation concern ("SCC") or their associated habitats were observed on the proposed mining area at the time of the survey.

If recommendations as provided in this report are adhered to it is not expected that the proposed mining activities on cultivated agricultural land will have a significant detrimental impact on any bird SCC or their habitat.

Mammals

As reported in Smithers (1983) small buck e.g. common duiker, steenbok and grysbok, bushbuck, rodents such as mole rats, field mice and hares, as well as carnivores such as genets, mongoose and caracal are likely to inhabit the area.

Some 70 mammal species are known to occur in the bigger area (Smithers 1983).

Observations and Findings:

No mammal SCC or their associated habitats were observed on the proposed mining area at the time of the survey.

If recommendations as provided in this report are adhered to it is not expected that the proposed development will have a significant detrimental impact on any mammal SCC concern or their habitat.

Amphibians and Reptiles (Herpetofauna)

With respect to amphibians, Minter et al (2004) state that "habitat loss or modification as a result of agriculture and other forms of human activity remains the most important single threat to the survival of amphibian populations. The scale of these changes and their relative permanence are the major cause. At greatest risk are species that have limited distributions."

As reported in Alexander et al (2007) 26 reptile species are likely to inhabit the area.

Observations and Findings:

No amphibian or reptile SCC or their associated habitats were observed on the proposed mining area at the time of the survey.

If recommendations as provided in this report are adhered to it is not expected that the proposed development will have a significant detrimental impact on any amphibian or reptile SCC concern or their habitats.

6.2 In terms of biodiversity pattern, identify or describe, at species level- (Show the degree of confidence in predictions based on the availability of information and specialist knowledge, i.e. High 70 -100% confident, Medium 40 - 70% confident, Low 0 - 40% confident. Assess the likelihood of other RDB species, or species of conservation concern, occurring in the vicinity. Reflect this in degree of confidence indicator).

6.2.1 The viability of, and estimated population size of the TOPS and RDB species of conservation concern that are present.

Red Data Listed or species listed under TOPS regulation (Vegetation)

As according to Mucina and Rutherford (2006) the remnants of natural vegetation occurring on this property are classified as Eastern Ruens Shale Renosterveld (*Critically Endangered*) as part of the Fynbos biome.

Observations and Findings:
(High 100% confident):

It is expected that several vegetation SCC may be located within the remaining natural to near natural areas on the property however all proposed mining activities

areas as delineated in orange on Map 5 of the report have been completely transformed due to agricultural cultivation and there are no remaining indigenous vegetation species on these areas.

Red Data Listed or species listed under TOPS regulation (Reptiles and Amphibians)

Observation and Findings:
(High 90% confident):

No SCC amphibian or reptile species are known to occur on the proposed mining activities areas and no rare or localized species were recorded at the time of the survey.

Red Data Listed or species listed under TOPS regulation (Mammals)

The following table lists the Red Data mammal species (including their status) which are predicted, or confirmed to occur in the general area and possibly within the study area (Friedman & Daly, 2004):

RED DATA MAMMAL SPECIES				
	COMMON NAME	**SCIENTIFIC NAME**	**RED DATA CATEGORY**	**PREDICTED OCCURENCE**
1	Lesueur's Wing-gland Bat	Cistugo lesueuri	Near threatened	Unlikely
2	Long-tailed Serotine Bat	*Eptesicus hottentotus*	Least Concern	Unlikely
3	Schreibers' Long-fingered Bat	*Miniopterus schreibersii*	Near Threatened	Possible
4	Temminck's Hairy Bat	*Myotis tricolor*	Near Threatened	Possible
5	Cape Serotine Bat	*Neoromicia capensis*	Least Concern	Possible
6	Egyptian Split Faced Bat	*Nycteris thebaica*	Near threatened	Possible
7	Cape horseshoe bat	*Rhinolophus capensis*	Near threatened	Possible
8	Geoffroy's horseshoe bat	*Rhinolophus clivosus*	Near threatened	Possible
9	Egyptian Fruit Bat	*Rousettus aegyptiacus*	Least Concern	Possible
10	Egyptian Free-tailed Bat	*Tadarida aegyptiaca*	Least Concern	Possible
11	Rock Hyrax	*Procavia capensis*	Least Concern	Unlikely
12	Cape Clawless Otter	*Aonyx capensis*	Least Concern	Unlikely
13	Water Mongoose	*Atilax paludinosus*	Least Concern	Possible
14	Black-backed Jackal	*Canis mesomelas*	Least Concern	Unlikely
15	Caracal	*Caracal caracal*	Least Concern	Likely
16	Yellow Mongoose	*Cynictis penicillata*	Least Concern	Possible
17	African Wild Cat	*Felis silvestris*	Least Concern	Unlikely
18	Small Grey Mongoose	*Galerella pulverulenta*	Least Concern	Possible
19	Small-spotted Genet	*Genetta genetta*	Least Concern	Unlikely

20	Large-spotted Genet	*Genetta tigrina*	Least Concern	Unlikely
21	Large Grey Mongoose	*Herpestes ichneumon*	Least Concern	Possible
22	Striped Polecat	*Ictonyx striatus*	Least Concern	Unlikely
23	Honey badger	*Mellivora capensis*	Near threatened	Unlikely
24	Bat-eared Fox	*Otocyon megalotis*	Least Concern	Likely
25	Leopard	*Panthera pardus*	Least Concern	Unlikely
26	African Weasel	*Poecilogale albinucha*	Data deficient	Unlikely
27	Aardwolf	*Proteles cristatus*	Least Concern	Unlikely
28	Cape Fox	*Vulpes chama*	Least Concern	Unlikely
29	Red Hartebeest	*Alcelaphus buselaphus*	Least Concern	Unlikely
30	Springbok	*Antidorcas marsupialis*	Least Concern	Unlikely
31	Klipspringer	*Oreotragus oreotragus*	Least Concern	Unlikely
32	Grey Rhebok	*Palea capreolus*	Least Concern	Unlikely
33	Steenbok	*Raphicerus campestris*	Least Concern	Likely
34	Cape Grysbok	*Raphicerus melanotis*	Least Concern	Unlikely
35	Common Duiker	*Sylvicapra grimmia*	Least Concern	Possible
36	Eland	*Taurotragus oryx*	Least Concern	Unlikely
37	Bushbuck	*Tragelaphus scriptus*	Least Concern	Possibe
38	Fynbos golden mole	*Amblysomus corriae*	Near threatened	Possible
39	Cape golden mole	*Chrysochloris asiatica*	Data deficient	Possible
40	Reddish-grey Musk Shrew	*Crocidura cyanea*	Data Deficient	Unlikely
41	Greater Musk Shrew	*Crocidura flavescens*	Data Deficient	Unlikely
42	Forest shrew	*Myosorex varius*	Data deficient	Unlikely
43	Lesser Dwarf Shrew	*Suncus varilla*	Data Deficient	Unlikely
44	Cape Hare	*Lepus capensis*	Least Concern	Likely
45	Scrub Hare	*Lepus saxatilis*	Least Concern	Possible
46	Chacma Baboon	*Papio ursinus*	Least Concern	Unlikely
47	Cape Spiny Mouse	*Acomys subspinosus*	Least Threatened	Possible
48	Namaqua Rock Mouse	*Aethomys namaquensis*	Least Threatened	Unlikely
49	Cape Dune Mole Rat	*Bathyergus suillus*	Least Concern	Possible
50	Common Mole Rat	*Cryptomys hottentotus*	Least Concern	Possible
51	Grey Climbing Mouse	*Dendromus melanotis*	Least Concern	Possible
52	Brant's Climbing Mouse	*Dendromus mesomelas*	Least Concern	Unlikely
53	Short-tailed Gerbil	*Desmodillus auricularis*	Least Concern	Possible
54	Cape Mole Rat	*Georychus capensis*	Least Concern	Unlikely
55	Hairy Footed Gerbil	*Gerbillurus paeba*	Least Concern	Possible
56	Spectacled Dormouse	*Graphiurus ocularis*	Least Concern	Possible
57	Porcupine	*Hystrix africaeaustralis*	Least Concern	Likely
58	Pygmy Mouse	*Mus minutoides*	Least Concern	Unlikely
59	Verreaux's Mouse	*Myomyscus verreauxi*	Least Concern	Unlikely
60	White-Tailed Rat	*Mystromys albicaudatus*	Endangered	Unlikely
61	Vlei Rat	*Otomys irroratus*	Least Concern	Unlikely

62	Laminate Vlei Rat	*Otomys laminatus*	Least Concern	Unlikely
63	Saunders Vlei Rat	*Otomys saundersiae*	Least Concern	Unlikely
64	Karoo Bush Rat	*Otomys unisulcatus*	Least Concern	Unlikely
65	Striped Mouse	*Rhabdomys pumilio*	Least Concern	Likely
66	Pouched Mouse	*Saccostomus campestris*	Least Concern	Unlikely
67	Kreb's Fat Mouse	*Steatomys krebsii*	Least Concern	Possible
68	Cape Gerbil	*Tatera afra*	Least Concern	Possible
69	Cape Rock Elephant-shrew	*Elephantulus edwardii*	Least Concern	Unlikely
70	Aardvark	*Orycteropus afer*	Least Concern	Unlikely

Observations and Findings:
(High 90% confident):

No SCC mammal species as listed were observed during the survey of the proposed mining areas and if they are present on the property they are expected to only occasionally visit the proposed mining areas.

Red Data Listed or species listed under TOPS regulation (Avifauna)

The only avifauna species of special significance likely to occur within the vicinity of the site are:

- Giant Eagle Owl *Bubo lacteus* (vulnerable and vagrant species)
- Stanley's Bustard *Neotis denhami* (Vulnerable)
- Blue Crane *Anthropoides paradiscus* (Vulnerable)
- Chestnut Banded Plover *Charadrius pallidus* (Near Threatened)
- Cape Vulture *Gyps coprotheres* (vulnerable)
- African Marsh Harrier *Circus ranivorus* (Vulnerable)
- Black Harrier *Circus maurus* (Near Threatened)
- Martial Eagle *Polemaetus bellicosus* (Vulnerable)
- Lesser Kestrel *Falco naumanni* (Vulnerable)
- Lanner Falcon *Falco biarmicus* (Near Threatened)
- Peregrine falcon *Falco peregrinus* (Near Threatened)
  (Barnes 2000)

Observations and Findings:
(High 90% confident):

None of the above species were observed on or near site the proposed mining areas during the survey and are more likely to only occasionally visit the proposed mining areas and do not breed there.

6.3 Other pattern issues-

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

Other sensitive environmental and landscape features identified on the property include secondary drainage lines, man-made and natural dams with associated wetland characteristics mostly connected to remaining indigenous remnants, also classified as Critical Biodiversity Areas ("CBA") and Ecological Support Areas ("ESA') and National Wetland Freshwater Ecosystems Priority Areas ("NFEPA"). Refer to Maps 4.1 and 4.2.

The proposed mining activities will however not have any significant detrimental impacts on these sensitive environmental and landscape features as it is recommended that mining activities are restricted to the completely transformed cultivated agricultural areas in-between and adjacent to these features as identified and delineated in this report.

Some of the proposed mining activities areas partially fall within mapped Ecological Support Areas (Res) *Category 1: ESA 2 Restore from other land use*. These ESAs are not essential for meeting biodiversity targets, but play an important role in supporting the functioning of the CBAs and are important in maintaining ecosystem services i.e. drainage systems. The objectives for these areas are to restore and/or manage to minimise impacts on ecological processes. Due to these areas already being historical and ongoing cultivated agricultural lands restoration will not be feasible or reasonable, but the areas must and can be managed to maintain current ecological processes. With the implementation of proper buffer and stormwater management measures as proposed the mining activities will not have a significant detrimental impact on these ESAs and surrounding CBAs.

6.4 The extent of alien plant cover on the site:

The only significant woody invasive alien vegetation in the study area is *Acacia mearnsii* (black wattle), which occurs along the untransformed drainage line areas, where it is locally common.

Numerous weed herbs and grasses associated with cultivation occur on the proposed cultivated mining activities areas.

6.5 The condition of the site/s in terms of current or previous land uses:

From the site survey conducted, recent and historical google earth map images it is evident that the proposed mining activities areas as surveyed have been ploughed and cultivated annually for a number of years. No natural, near natural or rehabilitating indigenous vegetation remnants are located on the proposed mining activities area.

The proposed mining activities areas as delineated in orange on Maps 4.1 and 4.2 have been completely transformed due to ongoing annual agricultural cultivation and there are no remaining indigenous vegetation species on these areas or associated drainage line and/or wetland characteristics.

6.6 In terms of biodiversity process, identify or describe:

6.6.1. The key ecological "drivers" and/or environmental gradients of ecosystems on the site and in the vicinity.

Key ecological drivers identified on the property are the non-perennial secondary lines and dams with associated wetland characteristics, as well as the existing indigenous vegetation remnants for which fire is a key ecological driver all which occurs outside of the proposed mining activities areas.

Key environmental gradients present on the site are associated with the variable slopes and elevation of the site which leads to a transition from terrestrial indigenous vegetation on the steeper slopes of the property to terrestrial and aquatic indigenous vegetation associated with non-perennial drainage lines and dams along the ravines of the site.

6.6.2 Any possible changes in key processes e.g. increased fire frequency or drainage/artificial recharge of aquatic systems.

Proposed mining activities may cause erosion on the site and surrounds due to excavation of agricultural land, topsoil and overburden storage etc. which in turn may lead to increase in surface water runoff speed. The establishment of quarries may also lead to accumulation of stormwater. Therefore site specific storm water management measures must be incorporated into the proposed mining activities layout, to direct storm water runoff away from the proposed quarry; topsoil and overburden stockpiles but still draining into adjacent non-perennial drainage lines as according to current status quo.

With the implementation of appropriate storm water management and erosion preventions measures, no significant changes in key processes are foreseen to occur on site or adjacent to the site due to the proposed mining activities.

6.6.3 The condition and functioning of rivers and wetlands (if present) in terms of possible changes to the channel, flow regime and naturally-occurring riparian vegetation.

Secondary non-perennial drainage lines are present throughout the relevant property along steep slopes and gorges due to the undulating nature of the landscape. The only surface water run-off that is occasionally present in the drainage lines is storm water runoff during heavy rains. An 8m buffer area in-between any excavations and the edge of indigenous vegetation areas associated with the drainage lines, as present along the existing edge of the cultivated agricultural lands, is proposed to ensure protection and maintain current ecological functioning as is. The only activities allowed within the proposed 8m buffer areas, as measured from the edge of the indigenous vegetation areas, are continued use as informal gravel roads or for placement of storm water berms (no excavations or trenching allowed).

With the implementation of appropriate demarcation, storm water management and erosion preventions measures, the condition and functioning of the adjacent drainage lines and dams will not be impacted upon by the proposed mining activities.

6.6.4 Would the conservation of the site lead to greater viability of the adjacent ecosystem by securing any of the functional factors listed?

Conservation of the non-perennial secondary drainage lines and remaining indigenous vegetation areas are important in terms of securing ecological functioning of the site and surrounds, however mining activities are not proposed on any of the significant environmental and landscape features as identified on the property and will therefore not have an detrimental impact on the functional environmental factors of the site and surrounds. After mining activities have ceased the site will be rehabilitated to its previous cultivated agricultural state.

6.6.5 Does the site or neighbouring properties potentially contribute to meeting regional conservation targets for both biodiversity pattern and ecological processes?

Conservation of indigenous vegetation remnants on the property will potentially contribute to meeting regional conservation targets, but none of these remnants are present on or will be impacted by the mining activities as proposed on transformed cultivated agricultural land.

6.6.6 Is this a potential candidate site for conservation stewardship?

If deemed viable the indigenous vegetation remnants remaining on the property is a potential candidate for conservation stewardship if the landowner should wish to pursue such a matter, but the mining areas as proposed on transformed cultivated agricultural land are not.

7. Ecological Impact Assessment with Associated Mitigation and Rehabilitation Measures to be implemented

Ecological impacts may be both direct and indirect, with the former occurring mostly at the mining excavation stage and the latter mostly at the rehabilitation stage. All potential environmental impacts identified are however expected to be of a short term and temporary nature.

Significant direct impacts potentially associated with the mining excavation phase are direct loss of indigenous terrestrial and aquatic vegetation and disturbance of soil which may lead to partial disruption of ecological processes due to fragmentation of habitat and erosion. The extent in this case would be local. Indirect impacts would occur mostly during the rehabilitation phase and in this case the nature would vary from the introduction of alien vegetation to partial disruption of ecological processes due to the effects of the alien species encroachment and/or erosion. The extent of the potential indirect impacts in this case would be local.

For purposes of this assessment "mining" is assumed to mean all mining related activities, and the No-Go/No-Development alternative is assumed to be a continuation of the status quo, which in this case means annual cultivation and heavy livestock grazing. It is assumed that the post mining landuse in the study area will be ongoing cultivation and/or livestock grazing.

The No-Go/No-Development alternative will result in the site remaining as is which will therefore have no further ecological impact and current status quo will persist.

(See Appendix B attached for Impact Assessment Methodology used)

Mining Operational Phase:

Nature of potential impact: Impact of proposed mining activities on terrestrial indigenous vegetation areas as associated with mapped terrestrial CBAs, ESAs and associated buffer areas
Discussion: Indigenous vegetation remnants are present throughout the surrounding areas and adjacent to the mining activities areas as proposed on transformed cultivated agricultural land. To prevent any potential direct or indirect detrimental impacts on these remnants mitigation measures as listed must be implemented throughout the proposed mining activities.
Cumulative impacts: Erosion, loss of conservation worthy species and natural vegetation habitat during mining activities.
Mitigation: • Clearly demarcate the 8m wide buffer areas proposed as measured from the edge of all remaining indigenous vegetation areas and undertake mining activities only in identified and specifically demarcated areas as proposed on completely transformed and cultivated areas. Demarcation method to be approved by an Environmental Control Officer (ECO). The proposed buffer areas to be located within existing cultivated land may only be used as roads and for stormwater management and no other activities associated with the proposed mining of the site may occur within the buffer areas. • Remove and conserve topsoil layer and overburden material for rehabilitation after mining activities have ceased • No disturbance should be allowed within the remaining indigenous vegetation areas. This includes no dumping of fill, no roads, and all forms of temporary disturbance. No natural vegetation areas edges may be cleared or impacted upon by the proposed mining activities. • Implement site specific erosion and storm water runoff management measures as according to EMP requirements to prevent (or if prevention is not possible limit) any erosion from occurring on the mining activity areas and surrounds.

Criteria	Without Mitigation	With Mitigation
Extent	2	1
Duration	5	1
Magnitude	10	2
Probability	5	2
Significance	85 - High	8 - Low
Status	High Negative Significance without Mitigation	Low Negative Significance with Mitigation
Reversibility	100% Reversible	100% Reversible
Irreplaceable loss of resources	2-Partial loss of resources but can be rehabilitated	1 – Resource will not be lost
Degree to which impact can be mitigated	1 – Can be completely mitigated	

Nature of potential impact:
Impact of proposed mining activities on secondary drainage lines and dams with associated wetland characteristics and aquatic vegetation as associated with mapped aquatic CBAs, ESAs and associated buffer areas

Discussion:
To prevent potential edge effects a buffer area of at least 8m as measured from the edge of the sensitive environmental and landscape features and located on completely transformed cultivated land must be maintained throughout the mining activities phase. The proposed buffer areas may only be used as roads and for stormwater management and no other activities associated with the proposed prospecting of the site may occur within the buffer areas.

If recommended buffer areas are incorporated into the proposed layout and all excavations and trenching mining activities are therefore restricted to the area outside of the buffer areas then mining activities will not have a potential significant negative impact on the identified drainage lines and hydrological processes.

Cumulative impacts:
Disturbance and transformation of drainage lines or wetland areas during prospecting activities.

Mitigation:
- Undertake mining activities only in identified and specifically demarcated areas as proposed on completely transformed and cultivated areas at least 8m from the edge of the any drainage lines, indigenous vegetation and dams with associated wetland characteristics and aquatic vegetation.
- No disturbance should be allowed within the drainage line or wetland areas. This includes no dumping of fill, no roads, and all forms of temporary disturbance.
- No drainage line or wetland areas edges may be disturbed or impacted upon by the proposed mining activities.
- Storm water and erosion control measures to be implemented as per an EMP must be conducted and monitored to prevent siltation or erosion of sensitive environmental and landscape features as identified on site.
- No mining activities may occur within 100m from any drainage line or wetland without determining requirement for water use authorisation from Department of Water and Sanitation or the Breede Gouritz Catchment Management Agency

Criteria	Without Mitigation	With Mitigation
Extent	2	1
Duration	5	1
Magnitude	10	2
Probability	5	2
Significance	85 - High	8 - Low
Status	High Negative Significance without Mitigation	Low Negative Significance with Mitigation
Reversibility	100% Reversible	100% Reversible
Irreplaceable loss of resources	2-Partial loss of resources but can be rehabilitated	1 – Resource will not be lost
Degree to which impact can be mitigated	1 – Can be completely mitigated	

Nature of potential impact:
Potential erosion and accumulation of stormwater due to proposed mining activities along steep slopes

Discussion:
Proposed mining activities may cause erosion on the site and surrounds due to excavation of agricultural land, topsoil and overburden storage etc. which in turn may lead to increase in surface water runoff speed. The establishment of quarries may also lead to accumulation of stormwater. Therefore site specific storm water management measures must be incorporated into the proposed mining activities layout, to direct storm water runoff away from the proposed quarry; topsoil and overburden stockpiles but still draining into adjacent non-perennial drainage lines as according to current status quo.

Cumulative impacts:
Erosion of the excavation areas, topsoil and overburden storage areas, roads and surrounding environments.

Mitigation:

- Undertake mining activities only in identified and specifically demarcated areas as proposed
- Implement site specific erosion and storm water runoff management measures as according to EMP requirements to prevent (or if prevention is not possible limit) any erosion or stormwater accumulation from occurring on the mining activity areas and surrounds.

Criteria	Without Mitigation	With Mitigation
Extent	2	1
Duration	3	1
Magnitude	6	2
Probability	4	2
Significance	44 – Medium	8 - Low
Status	Medium Negative Significance without Mitigation	Low Negative Significance with Mitigation
Reversibility	100% Reversible	100% Reversible
Irreplaceable loss of resources	2-Partial loss of resources but can be rehabilitated	1 – Resource will not be lost
Degree to which impact can be mitigated	1 – Can be completely mitigated	

Rehabilitation Phase:

Nature of potential impact:
Introduction of alien and weed plant species during rehabilitation

Discussion:
Indirect impacts occur mostly during the rehabilitation phase and in this case the nature would vary from the introduction of alien and weed vegetation, to partial disruption of ecological processes due to the effects of the alien and weed species. The extent of the indirect impact in this case will be local.

Cumulative impacts:
Disturbance of the site due to proposed mining activities may lead to introduction of alien and weed vegetation encroachment during rehabilitation, which may in turn lead to infestation of surrounding remaining natural areas and drainage lines resulting in disruption and destruction of ecological processes.

Mitigation:

- Only use topsoil and excavated material as derived and conserved from the proposed mining site to backfill and rehabilitate impacted areas.
- Alien invasive and weed vegetation monitoring and removal must be undertaken for at least a year after mining activities have ceased and the site has been rehabilitated or until the landowner starts with the annual cultivation activities on the affected land. This must be done by the applicant, landowner or their appointed contractor, using CapeNature approved methodology depending on the contract agreement that the applicant has with the landowner.

Criteria	Without Mitigation	With Mitigation
Extent	3	1
Duration	5	1
Magnitude	6	2
Probability	4	2
Significance	56 - Medium	8 - Low
Status	Medium Negative Significance without Mitigation	Low Negative Significance with Mitigation
Reversibility	100% Reversible	100% Reversible
Irreplaceable loss of resources	2-Partial loss of resources but can be rehabilitated	1 – Resource will not be lost
Degree to which impact can be mitigated	1 – Can be completely mitigated	

Nature of potential impact:
Potential erosion of the site and surrounds during rehabilitation phase

Discussion:
Soil erosion can occur due to wind (wind erosion cause dust pollution); and due to overland storm water flow should heavy rains fall on disturbed and rehabilitated areas.

Cumulative impacts:
Exposing and disturbing soil may lead to erosion of site and surrounds if not mitigated.

Mitigation:

- Infill and topsoil material as removed during mining excavation must be replaced and existing agricultural land contour structures must be reinstated immediately after mining activities completion.
- Implement erosion and storm water runoff management measures as according to EMP requirements to prevent (or if prevention is not possible limit) any erosion from occurring on the rehabilitated mining areas and surrounds until the landowner starts with the annual cultivation activities on the affected land.

Criteria	Without Mitigation	With Mitigation
Extent	2	1
Duration	3	1
Magnitude	6	2
Probability	4	2
Significance	44 – Medium	8 - Low
Status	Medium Negative Significance without Mitigation	Low Negative Significance with Mitigation

Reversibility	100% Reversible	100% Reversible
Irreplaceable loss of resources	2-Partial loss of resources but can be rehabilitated	1 – Resource will not be lost
Degree to which impact can be mitigated	1 – Can be completely mitigated	

8. Concluding Remarks and Summary of Impact Mitigation and Rehabilitation Measures Proposed before, during and after Mining Activities

If strict adherence is kept to the recommendations as set out in this report and incorporated into the Environmental Management Programme, the proposed development will not have a significant impact on any listed flora, fauna or avifauna species of conservation concern, their habitats or any sensitive environment and landscape features as identified on the site and surrounds.

- All proposed mining activities to be located on completely transformed and cultivated agricultural areas as identified on Maps 4.1 and 4.2 of this report.

- Clearly demarcate the 8m wide buffer areas proposed as measured from the edge of all remaining indigenous vegetation areas and undertake mining activities only in identified and specifically demarcated areas as proposed on completely transformed and cultivated areas. Demarcation method to be approved by an Environmental Control Officer (ECO). The proposed buffer areas to be located within existing cultivated land may only be used as roads and for stormwater management and no other activities associated with the proposed mining of the site may occur within the buffer areas.

- Compile and implement a site specific stormwater management plan which aims to prevent (and if prevention is not possible to mitigate and rehabilitate) erosion of the site and surrounds and accumulation of stormwater in excavation areas. Site specific storm water management measures must be incorporated into the proposed mining activities layout, to direct storm water runoff away from the proposed quarry; topsoil and overburden stockpiles but still draining into adjacent non-perennial drainage lines as according to current status quo.

- No disturbance should be allowed within the remaining indigenous vegetation, drainage lines and wetland areas. This includes no dumping of fill, no roads, and all forms of temporary disturbance.

- No natural vegetation, drainage lines or wetland areas edges may be cleared or impacted upon by the proposed mining activities.

- Topsoil and overburden materials must be removed and stored separately adjacent to the mining areas on transformed agricultural land with effective storm water runoff and erosion prevention measures to be implemented in order to protect the materials for use during rehabilitation phase.

- As the excavation of the quarry advances the stored overburden material must be replaced to backfill the excavations. The backfilled area must then be contoured according to existing surrounding contours of the cultivated land to prevent erosion. After contouring has been completed the stored topsoil material must be spread over the backfilled area. Only use topsoil as derived and conserved from the proposed mining area to be rehabilitated after mining activities have ceased on the property. The topsoil must not be compacted after spreading to allow the disturbed area to be restored. The site must be monitored regularly during the mining operational/excavation phase (at least 3 monthly and after heavy rains) for signs of erosion which if detected must be immediately rectified and alien vegetation removed to prevent potential siltation, erosion and alien encroachment of the site and surrounds.

- No mining activities may occur within 100m from any drainage line or wetland without determining requirement for water use authorisation from Department of Water and Sanitation or the Breede Gouritz Catchment Management Agency.

- Alien invasive and weed vegetation monitoring and removal must be undertaken for at least a year after mining activities have ceased and the site has been rehabilitated or until the landowner starts with the annual cultivation activities on the affected land. This must be done by the applicant, landowner or their appointed contractor, using CapeNature approved methodology depending on the contract agreement that the applicant has with the landowner.

- The project implementation process should be subject to standard Environmental Management Programme (EMP) prescripts and conditions, including the recommendations as provided in this report and only proceed under supervision of a competent and diligent Environmental Control Officer, both during the operational/excavation and rehabilitation phases.

Eco Impact is of the opinion, and based on the survey and desk study done, that if the proposed mining activities remains on the completely transformed cultivated agricultural areas of the site as indicated on Maps 4.1 and 4.2 of this report and the specialist recommendations as listed in this report are adhered to and incorporated into the mining EMP that the proposed mining activities will not have any significant detrimental environmental impacts on any of the sensitive environmental and landscape features as identified on the site and surrounds.

9. References

Alexander G Marais J. 2007. a Guide To The Reptiles Of Southern Africa.

Barnes K.N. 2000. The Eskom Red Data book of birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Johannesburg.

Branch W.R. (ed.) 1988. South African Red Data book – reptiles and amphibians.

SA National Scientific programmes Report No. 151. CSIR, Pretoria.

Brownlie S. 2005. Guideline for involving biodiversity specialists in EIA processes: Edition 1. CSIR Report No. ENV-S-C 2005 053 C. Republic of South Africa, Provincial Government of theWestern Cape, Department of Environmental Affairs and Development Planning, Cape Town

De Villiers C.C., Driver A., Brownlie S., Clark B., Day E.G., Euston-Brown D.I.W., Helme N.A., Holmes P.M., Job N., & Rebelo A.B. 2005. Fynbos Forum ecosystem guidelines for environmental assessment in the Western Cape. Fynbos Forum, c/o Botanical Society of South Africa: Conservation Unit, Kirstenbosch, Cape Town.

Driver A., Cowling R.M., & Maze K. 2003. Planning for living landscapes: perspectives and lessons from South Africa. Center for Applied Biodiversity Science at Conservation International, Washington DC; Botanical Society of South Africa, Cape Town.

Friedmann Y. & Daly B. (eds) 2004. Red Data Book of the mammals of South Africa: a conservation assessment. CBSG Southern Africa, Conservation Breeding Specialist Group (SSC/IUCN), Endangered Wildlife Trust, South Africa.

Goldblatt P. & Manning J. 2000. Cape Plants – a conspectus of the Cape flora of South Africa. Strelitzia 9. National Botanical Institute, Pretoria.

Hockey PAR., Dean WRJ & Ryan PG. 2006. Roberts Birds Of Southern Africa. VIIth Edition.

Hilton-Taylor, C. 1996. Red data list of southern African plants. Sterlitzia 4. SABVU, Pretoria.

International Association for Impact Assessment 2005. Biodiversity in impact assessment. IAIA Special Publication Series No. 3. IAIA, North Dakota.

Minter L.R., Burger M., Harrison J.A., Braack H.H., Bishop P.J. and Kloepfer D. 2004. Atlas and Red Data book of the frogs of South Africa, Lesotho and Swaziland. Smithsonian Institution, Washington D.C.

Mucina L & Rutherford M.C. (eds.) 2006. Vegetation Map of South Africa, Lesotho and Swaziland: Shapefiles of basic mapping units. Beta version 4.0, February 2004, National Botanical Institute, Cape Town.

Pence G.Q.K. 2008 (in prep). C.A.P.E. Fine-Scale Systematic Conservation Planning Assessment: Technical Report. Produced for CapeNature. Cape Town, South Africa.

Rouget M., Reyers B., Jonas Z., Desmet P., Driver A., Maze K., Egoh B., Cowling R.M., Mucina L. & Rutherford M.C. 2005. South African National Spatial Biodiversity Assessment 2004: Technical Report. Vol. 1: Terrestrial Component. South African National Biodiversity Institute, Pretoria.

Smithers RHN. 1983. Land Mammals Of Southern Africa. A field Guide.

Vlok, J. and R. de Villiers. 2007. Vegetation mapping component of Fine Scale Mapping Project for Riversdale Plain. Unpublished report for CapeNature. Regalis Environmental Services, Oudtshoorn.

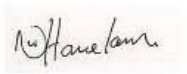
APPENDIX A: Declaration of Independence

THE INDEPENDENT PERSON WHO COMPILED OR REVIEWED A SPECIALIST REPORT OR UNDERTOOK A SPECIALIST PROCESS

I **Nicolaas Willem Hanekom**, as the appointed independent specialist hereby declare that I:

- act/ed as the independent specialist in this application;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- have and will not have no vested interest in the proposed activity proceeding;
- have disclosed, to the applicant, EAP and competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- am fully aware of and meet the responsibilities in terms of NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act, and that failure to comply with these requirements may constitute and result in disqualification;
- have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- have ensured that the names of all interested and affected parties that participated in terms of the specialist input/study were recorded in the register of interested and affected parties who participated in the public participation process;
- have provided the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not; and terms of regulation 71 of GN No. R. 543.

Eco Impact is independent and does not have an interest in the business nor receive any payment other than fair remuneration for services rendered as required in terms of regulations.



Pri.Sci.Nat (Ecological Science) 400274/11

Signature of the specialist:
Name of company: Eco Impact
Date: 12 September 2017

APPENDIX B: Impact Assessment Methodology

Below is the assessment methodology utilized in determining the significance of the potential mining impacts on the biophysical environment, and where applicable the possible alternatives. The methodology is broadly consistent with that described in the Department of Environmental Affairs' Guideline Document on the EIA Regulations (1998) and as provided by the Shangoni Management Services.

For each potential impact, the significance is determined by specified factors as in Table 1. Significance is described prior to mitigation as well as with the most effective mitigation measure(s) in place.

The mitigation described in the document represents the full range of plausible and pragmatic measures that must be implemented.

Despite the attempts at providing a completely objective and impartial assessment of the environmental implications of proposed activities, the specialist can never completely escape the subjectivity inherent in attempting to define significance.

Recognising this, potential subjectivity in the current process is addressed as follows:

- Be clear about the difficulty of being completely objective in the determination of significance;
- Develop an explicit methodology for assigning significance to impacts and outlining this methodology in detail. Having an explicit methodology not only forces the assessor to come to terms with the various facets contributing toward determination of significance, thereby avoiding arbitrary assignment, but also provides the reader of the report with a clear summary of how the assessor derived the assigned significance; and
- Wherever possible, differentiating between the likely significance of potential environmental impacts as experienced by the various affected parties.

Although these measures may not totally eliminate subjectivity, they do provide an explicit context within which to review the assessment of impacts.

Table 1: Assessment criteria for the evaluation of impacts

Criteria	Description		
Nature	a description of what causes the effect, what will be affected, and how it will be affected.		
	Type	**Score**	**Description**
Extent (E)	None (No)	1	Footprint
	Site (S)	2	On site or within 100 m of the site
	Local (L)	3	Within a 20 km radius of the centre of the site
	Regional (R)	4	Beyond a 20 km radius of the site
	National (Na)	5	Crossing provincial boundaries or on a national / land wide scale
Duration (D)	Short term (S)	1	0 – 1 years
	Short to medium (S-M)	2	2 – 5 years
	Medium term (M)	3	5 – 15 years
	Long term (L)	4	> 15 years

Criteria	Description		
	Permanent(P)	5	Will not cease
Magnitude (M)	Small (S)	0	will have no effect on the environment
	Minor (Mi)	2	will not result in an impact on processes
	Low (L)	4	will cause a slight impact on processes
	Moderate (Mo)	6	processes continuing but in a modified way
	High (H)	8	processes are altered to the extent that they temporarily cease
	Very high (VH)	10	results in complete destruction of patterns and permanent cessation of processes.
Probability (P) the likelihood of the impact actually occurring. Probability is estimated on a scale, and a score assigned	Very improbable (VP)	1	probably will not happen
	Improbable (I)	2	some possibility, but low likelihood
	Probable (P)	3	distinct possibility
	Highly probable (HP)	4	most likely
	Definite (D)	5	impact will occur regardless of any prevention measures
Significance (S)	Determined through a synthesis of the characteristics described above: **S = (E+D+M) x P** Significance can be assessed as low, medium or high		
Low: < 30 points:	The impact would not have a direct influence on the decision to develop in the area		
Medium: 30 – 60 points:	The impact could influence the decision to develop in the area unless it is effectively mitigated		
High: < 60 points:	The impact must have an influence on the decision process to develop in the area		
No significance	When no impact will occur or the impact will not affect the environment		
Status	Positive (+)		Negative (-)
The degree to which the impact can be reversed	Completely reversible (R)	90-100%	The impact can be mostly to completely reversed with the implementation of the correct mitigation and rehabilitation measures.
	Partly reversible (PR)	6-89%	The impact can be partly reversed providing that mitigation measures as stipulated in the EMP are implemented and rehabilitation measures are undertaken
	Irreversible (IR)	0-5%	The impact cannot be reversed, regardless of the mitigation or rehabilitation measures taking place
The degree to which the impact may cause irreplaceable loss of resources	Resource will not be lost (R)	1	The resource will not be lost or destroyed provided that mitigation and rehabilitation measures as stipulated in the EMP are implemented
	Resource may be partly destroyed (PR)	2	Partial loss or destruction of the resources will occur even though all management and mitigation measures as stipulated in the EMP are implemented
	Resource cannot be replaced (IR)	3	The resource cannot be replaced no matter which management or mitigation measures are implemented.
The degree to which the impact can be mitigated	Completely mitigatible (CM)	1	The impact can be completely mitigated providing that all management and mitigation measures as stipulated in the EMP are implemented
	Partly mitigatible (PM)	2	The impact cannot be completely mitigated even though all management and mitigation measures as stipulated in the EMP are implemented. Implementation of these measures will provide a measure of mitigatibility
	Un-mitigatible (UM)	3	The impact cannot be mitigated no matter which management or mitigation measures are implemented.

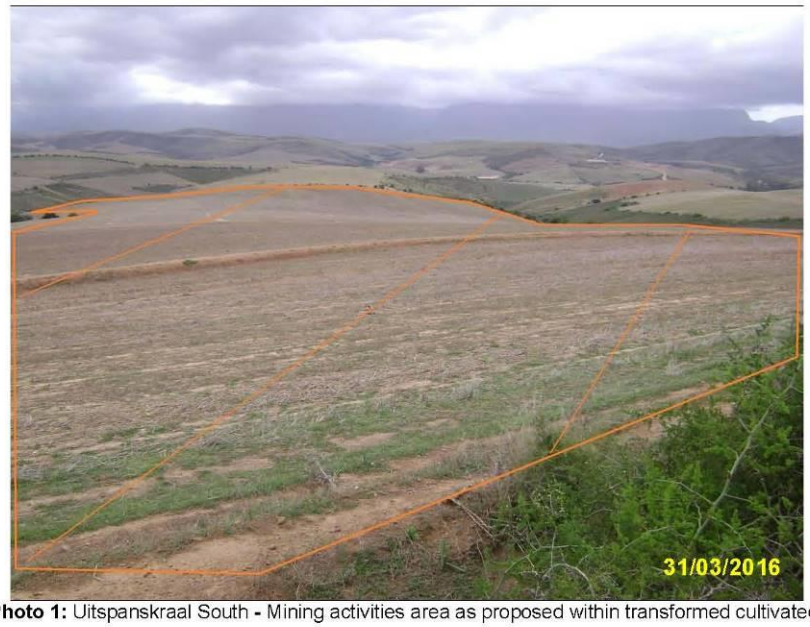
APPENDIX C: Relevant Environmental Legislation Considered

Agricultural Pests Act 36 of 1983
Atmospheric Pollution Prevention Act 45 of 1965 (regulations only)
Conservation of Agricultural Resources Act 43 of 1983
Constitution of the Republic of South Africa 1996
Environment Conservation Act 73 of 1989
Fencing Act 31 of 1963
Fertilizers Farm Feeds Agricultural Remedies and Stock Remedies Act 36 of 1947
Mineral and Petroleum Resources Development Act 28 of 2002
National Environmental Management Act 107 of 1998
National Environmental Management: Air Quality Act 39 of 2004
National Environmental Management: Biodiversity Act 10 of 2004
National Environmental Management: Protected Areas Act 57 of 2003
National Environmental Management: Waste Act 59 of 2008
National Forests Act 84 of 1998
National Veld and Forrest Fire Act 101 of 1998
National Water Act 36 of 1998

Hessequa local municipality air pollution control by-law
Hessequa local municipality fences and fencing by-law
Hessequa local municipality storm water management by-laws
Hessequa local municipality solid waste disposal by-law
Hessequa local municipality by-law relating to water supply, sanitation services and industrial effluent
Hessequa local municipality by-law relating to roads and streets
Hessequa local municipality by-law relating to the prevention of public nuisances and nuisances arising from the keeping of animals

Eden district municipality air quality management by-law
Eden district municipality municipal health by-laws

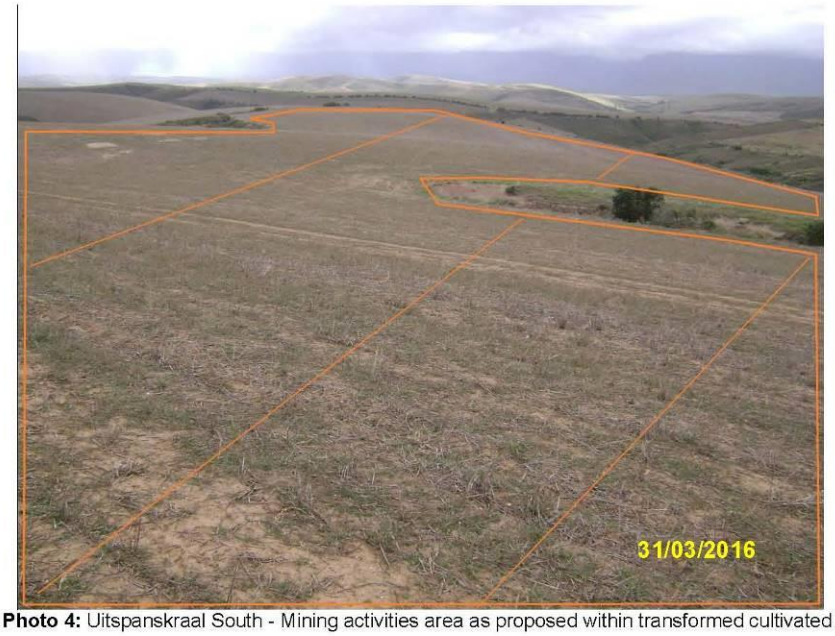
APPENDIX D: Site photos of proposed mining activities area on cultivated agricultural land on Farm Uitspanskraal RE/585



Site Photo 1: Uitspanskraal South - Mining activities area as proposed within transformed cultivated land.

Site Photo 2: Uitspanskraal South - Mining activities area as proposed within transformed cultivated land

Site Photo 3: Uitspanskraal South - Mining activities area as proposed within transformed cultivated land.



Site Photo 4: Uitspanskraal South - Mining activities area as proposed within transformed cultivated land.

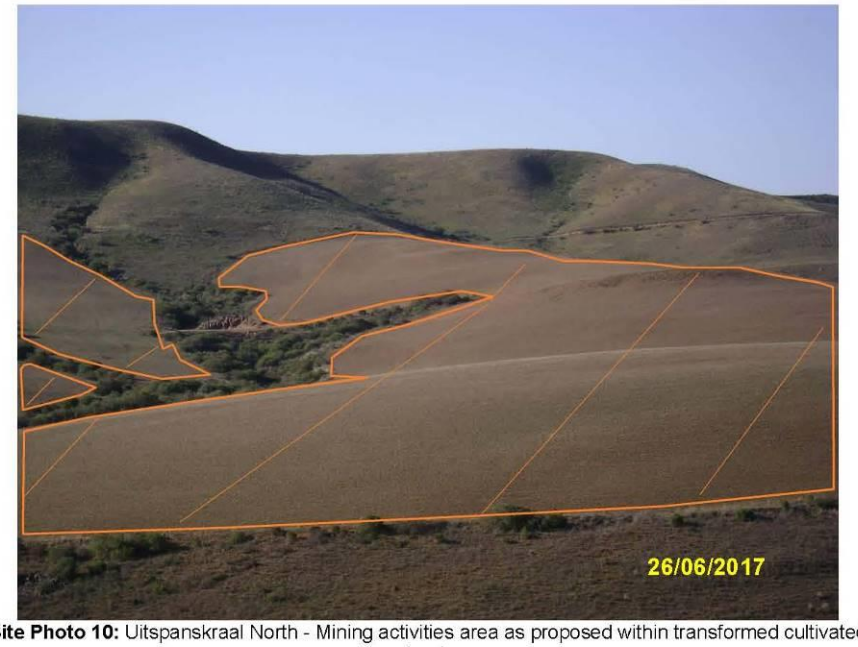
Site Photo 5: Uitspanskraal North - Mining activities area as proposed within transformed cultivated land.

Site Photo 6: Uitspanskraal North - Mining activities area as proposed within transformed cultivated land.

Site Photo 7: Uitspanskraal North - Mining activities area as proposed within transformed cultivated land.

Site Photo 8: Uitspanskraal North - Mining activities area as proposed within transformed cultivated land.

Site Photo 9: Uitspanskraal North - Mining activities area as proposed within transformed cultivated land.

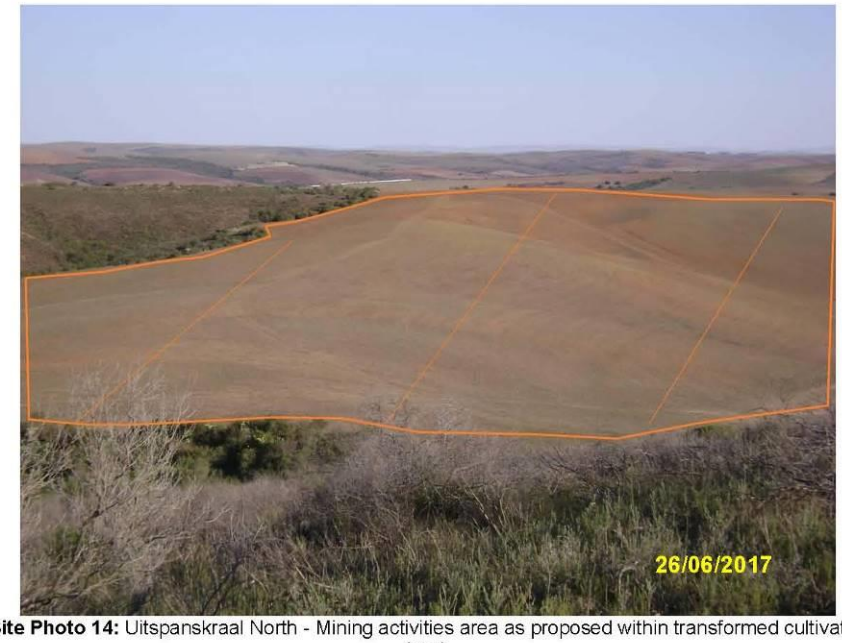


Site Photo 10: Uitspanskraal North - Mining activities area as proposed within transformed cultivated land.

Site Photo 11: Uitspanskraal North - Mining activities area as proposed within transformed cultivated land.

Site Photo 12: Uitspanskraal North - Mining activities area as proposed within transformed cultivated land.

Site Photo 13: Uitspanskraal North - Mining activities area as proposed within transformed cultivated land.



Site Photo 14: Uitspanskraal North - Mining activities area as proposed within transformed cultivated land.

Appendix E2: Heritage Western Cape Notice of Intent to Develop

iLifa leMveli leNtshona Koloni
Erfenis Wes-Kaap
Heritage Western Cape

NOTIFICATION OF INTENT TO DEVELOP

Completion of this form is required by Heritage Western Cape for the initiation of all impact assessment processes under Section 38(1) & (8) of the National Heritage Resources Act (NHRA).

Whilst it is not a requirement, it may expedite processes and in particular avoid calls for additional information if certain of the information required in this form is provided by a heritage specialist/s with the necessary qualifications, skills and experience.

A. APPLICABILITY OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT (NEMA)

HWC Case Number:	DEADP Reference Number: NA DEA&DP is not the decision making authority for this EA application the Department of Mineral Resources is.
NOTE 1:	An HWC case number must be obtained and application fee paid in advance of submission of this form.
NOTE 2:	A DEADP (W Cape Dept. Environment Affairs & Development Planning) reference number must be included in all NHRA Section 38(8) processes where DEADP is the decision making authority under NEMA. The effect of this requirement is that the NEMA process must be initiated with DEADP prior to the NHRA process with HWC.
If a DEADP reference number is not entered above please check one of the following boxes:	
☒	This application is made in terms of Section 38(8) of the NHRA and an application under NEMA has been made to the following authority: Department of Mineral Resources -SAMRAD Ref Nr 170222
☐	This development will not require a NEMA application.
NOTE 3:	Making an incorrect statement or providing incorrect information in this part of the form may result in all or part of the application having to be reconsidered by HWC in the future, or submission of a new application.

B. BASIC DETAILS

PROPERTY DETAILS:

Name of property: Remaining Extent of Farm Uitspanskraal Nr 585	
Street address or location (eg: off R44): The farm is situated ±4km northwest of the town Heidelberg in the Western Cape and can be accessed via gravel roads leading of f the R322 towards Barrydale/Suurbraak.	
Erf or farm number/s: Remaining Extent of Farm Uitspanskraal Nr 585	Coordinates: 34 04' 44.83"S 20 52' 47.06"E (A logical centre point. Format based on WGS84.)
Town or District: Heidelberg	Responsible Municipality: Hessequa Municipality
Extent of property: 858.496ha	Current use: Agricultural/Farming
Predominant land use/s of surrounding properties: Cultivated agricultural land	

REGISTERED OWNER OF PROPERTY:

Name Stephen Keyser Familie Trust		
Address PO Box 225 Klein Braak Rivier 6503		
Telephone -	Cell 082 344 1572	E-mail -
By the submission of this form and all material submitted in support of this notification (ie: 'the material'), all applicant parties acknowledge that they are aware that the material and/or parts thereof will be put to the following uses and consent to such use being made: filing as a public record; presentations to committees, etc; inclusion in databases; inclusion on and downloading from websites; distribution to committee members and other stakeholders and any other use required in terms of powers, functions, duties and responsibilities allocated to Heritage Western Cape under the terms of the National Heritage Resources Act. Should restrictions on such use apply or if it is not possible to copy or lift information from any part of the digital version of the material, the material will be returned unprocessed.		
I confirm that I enclose with this form four hardcopies of all material submitted together with a CD ROM containing digital versions of all of the same.		

Signature of owner or authorised agent
(Agents must attach copy of power of attorney to this form.)

Date / / 20

DEVELOPMENT DETAILS:

Please indicate below which of the following Sections of the National Heritage Resources Act, or other legislation has triggered the need for notification of intent to develop.

☐ S38(1)(a) Construction of a road, wall, powerline, pipeline, canal or other similar form of linear development or barrier over 300m in length.	S38(1)(c) Any development or activity that will change the character of a site -
☐ S38(1)(b) Construction of a bridge or similar structure exceeding 50m in length.	☒ (i) exceeding 5 000m^2 in extent;
☐ S38(1)(d) Rezoning of a site exceeding 10 000m^2 in extent.	☐ (ii) involving three or more existing erven or subdivisions thereof;
☒ Other triggers, eg: in terms of other legislation, (ie: National Environment Management Act, etc.) Please set out details: Environmenatl Authorisation in terms of National Environmental Management Act, 1998 (Act No. 107 of 1998)	☐ (iii) involving three or more erven or divisions thereof which have been consolidated within the past five years.
	If you have checked any of the three boxes above, describe how the proposed development will change the character of the site: Bentonite and Zeolite mining activities as propsoed on completely transformed and cultivated agricultural land of 151ha (quarry size = 38.32ha).

If an impact assessment process has also been / will be initiated in terms of other legislation please provide the following information:

Authority / government department (ie: consenting authority) to which information has been /will be submitted for final decision: Department of Mineral Resources AND Department of Water and Sanitation/Breede-Gouritz Catchment Management Agency

Present phase at which the process with that authority stands: Application for EIA Environmental Authorisation AND Water Use Authorisation to be submitted.

Provide a full description of the nature and extent of the proposed development or activity including its potential impacts (eg: changes in land use, envisaged timeframes, provision of additional bulk services, excavations, landscaping, total floor area, height of development, etc. etc.): Imerys Refractory Minerals South Africa t/a Cape Bentonite Mine is an existing Bentonite and Zeolite mining company operating on various farms in close proximity to the towns of Heidelberg and Riversdale that fall within the Hessequa Local Municipality and Eden District Municipality in the Western Cape Province.

Imerys Refractory Minerals South Africa proposes to mine bentonite and zeolite deposits on cultivated agricultural land on the Remaining Extent of Farm Uitspanskraal Nr 585 near Heidelberg in the Western Cape. The mining activities areas are proposed on completely transforemd agricultural land of 151ha and the actual quarry sizes and phase will be:

Uitspanskraal South:
Phase 1 Quarry – 0.9ha
Phase 2 Quarry – 1.3ha

Uitspanskraal North:
Phase 1 Quarry – 2.81ha
Phase 2 Quarry – 1.82ha
Phase 3 Quarry – 0.11ha
Phase 4 Quarry – 2.51ha
Phase 5 Quarry – 1.24ha
Phase 6 Quarry – 3.46ha
Phase 7 Quarry – 1.18ha
Phase 8 Quarry - 1.24ha
Phase 9 Quarry - 2.51ha
Phase 10 Quarry – 4.31ha
Phase 11 Quarry – 1.13ha
Phase 12 Quarry – 0.97ha
Phase 13 Quarry – 2.20ha
Phase 14 Quarry – 2.41ha
Phase 15 Quarry – 2.54ha
Phase 16 Quarry -1.20ha
Phase 17 Quarry – 2.54ha
Phase 18 Quarry – 1.20ha
Phase 19 Quarry – 0.74ha

Total quarries size as proposed for the property – 38.32ha

Mining is conducted "in-house" by means of excavators, front-end loaders and 15T dumper trucks. The mining and method comprise relatively shallow opencast quarrying. The topsoil and overburden are removed and stockpiled separately adjacent to the mining area. The bentonite as it is being mined is trucked to the processing plant at the head offices on Erf 1412, Heidelberg.

The mine provides direct employment for at least 43 local persons and compensation to the

landowner. The operation further creates indirect employment opportunities in equipment supply industries, transport and bentonite mining, and the mining environment.

Cape Bentonite Mine provided Eco Impact with a map of the proposed mining areas and a total area of approximately 151ha was surveyed for this assessment.

Sensitive environmental features that were identified on the site and surrounds as surveyed include non-perennial secondary drainage lines with associated indigenous vegetation areas that are present adjacent to the proposed mining areas due to the undulating nature of the landscape, which has also been identified as Aquatic Critical Biodiversity Areas and with associated buffer and Ecological Support Areas. The drainage lines feed into lower lying man-made farm dams and the Duiwenhoks River catchment area. The only surface water run-off that is occasionally present in the drainage lines is storm water runoff during heavy rains. The indigenous vegetation remnants, which exists throughout the property mainly associated with the non-perennial drainage line areas too steep to plough for cultivation, consists of Critically Endangered - Eastern Ruens Shale Renosterveld and Cape Lowlands Alluvial Vegetation and Endangered – Swellendam Silcrete Fynbos also identified as Terrestrial Critical Biodiversity Areas ("CBA") as according to the Western Cape Biodiversity Spatial Plan (2017) for Hessequa.

Some of the proposed mining activities areas partially fall within mapped Ecological Support Areas (Res) Category 1: ESA 2 Restore from other land use. These ESAs are not essential for meeting biodiversity targets, but play an important role in supporting the functioning of the CBAs and are important in maintaining ecosystem services i.e. drainage systems. The objectives for these areas are to restore and/or manage to minimise impacts on ecological processes. Due to these areas already being historical and ongoing cultivated agricultural lands restoration will not be feasible or reasonable, but the areas must and can be managed to maintain current ecological processes. With the implementation of proper buffer and stormwater management measures as proposed the mining activities will not have a significant detrimental impact on these ESAs and surrounding CBAs.

Alien vegetation encroachment on site is mainly limited to weeds associated with cultivated lands.

Potential significant direct impacts occur primarily during the mining excavation stage, and the nature of these impacts is temporary loss of agricultural land and potential erosion of proposed mining areas and surrounds. The extent in this case is local. Indirect impacts occur mostly during the rehabilitation phase and in this case the nature would vary from the introduction of alien vegetation to partial disruption of ecological processes due to the effects of the alien species. The extent of the indirect impact in this case is local.

Site specific stormwater management measure must be designed and implemented for each proposed quarry area to prevent accumulation of stormwater in the quarries and allow current stormwater run-off conditions to continue as is. Where no existing gravel roads exists as buffer areas an 8m buffer area in-between any excavations and the edge of indigenous vegetation areas as present along the existing edge of the cultivated agricultural lands is proposed to ensure protection and maintain current ecological functioning of associated runoff areas/drainage lines. The only activities allowed within the proposed 8m buffer areas, as measured from the edge of the indigenous vegetation areas along the edge of the cultivated lands, are continued use as informal gravel roads or for placement of storm water berms (no excavations or trenching allowed).

From the survey conducted it was concluded that the proposed mining activities areas are located on completely transformed and cultivated agricultural land, previously and continually impacted upon by cultivation and heavy livestock grazing. The proposed mining sites are therefore considered suitable for bentonite and zeolite mining in terms of avoiding potential detrimental environmental impacts and the potential impacts identified would be adequately managed and effectively mitigated through the implementation of the recommendations outlined in this report to be incorporated into the mine Environmental Management Programme (EMP). It was also concluded that the proposed mining

activities will not have a significant negative environmental impact mainly because the proposed mining activities areas are all located on completely transformed cultivated agricultural land and the socio-economic benefits of the proposed bentonite and zeolite mining outweigh the potential negative impact on the environment if specialist and EMP recommendations are effectively implemented.

No fatal flaws were identified during the assessment that will lead to unacceptable environmental degradation during the proposed mining activities.

(Reference: N Hanekom and J Piennar. September 2017.Ecological Baseline Assessment for Proposed Mining Right on Remaining Extent of Farm Uitspanskraal Nr 585 Heidelberg, Western Cape)

C. HERITAGE RESOURCES AND IMPACTS THEREUPON

Section 3 of the National Heritage Resources Act sets out the following categories of heritage resource as forming part of the national estate. Please indicate the known presence of any of these by checking the box alongside and then providing a description of each occurrence, including nature, location, size, type

Failure to provide sufficient detail or to anticipate the likely presence of heritage resources on the site may lead to a request for more detailed specialist information.

(The assistance of relevant heritage professionals is particularly relevant in completing this section.)

Provide a short history of the site and its environs (Include sources where available): The farm is characterised by its undulating landscape with associated steep slopes, drainage lines and gorges which limits the extent of cultivation to moderate slopes and more flat lying areas.

The highest elevation of the property is located north being 310m above mean sea level and the lowest in the middle at 120m above mean sea level.

Several non-perennial drainage lines with associated man-made and natural dams occurs throughout the property which drains mainly towards the R322 in the middle of the property and which eventually feeds the Duiwenhoks tributary within Heidelberg.

The Heidelberg/Riversdale area is dominated by the Enon Conglomerate formation of the Bokkeveld Group. The Bokkeveld Group consists of sandstone, shale, siltstone and mudstone. The Enon Conglomerate consists of large boulders of Cape Sandstone originally in a matrix with lenses of mudstone and siltstone.

Bentonite occurs as three main horizons in the area, each horizon comprising several layers in the Kirkwood Formation, overlain by conglomerate and sandstone of the Buffelskloof Formation. The Grahamstone Formation silcrete occurs at the top of the sequence in some places, whereas the Enon conglomerate forms the floor.

The study area lies within the East Coast Renosterveld bioregion (Mucina & Rutherford 2006). This bioregion has a moderately distinct flora, and high numbers of plant Species of Conservation Concern, with the main pressures being extensive habitat loss, due mainly to agriculture, followed by alien invasive vegetation, quarrying and urbanisation, and habitat modification due to lack of appropriate fire regimes.

The study area falls within the planning domain of the Hessequa Municipality. The Western Cape Biodiversity Spatial Plans has identified Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) for the Western Cape which aims to guide sustainable development by providing a synthesis of biodiversity information to decision makers. It serves as the common reference for all multi-sectoral planning procedures, advising which areas can be lost to development, and which areas

of critical biodiversity value and their support zones should be protected against any impacts. The primary reason for selection of these areas as terrestrial and/or aquatic CBAs and/or ESAs is that it helps meet the national conservation target for threatened vegetation types, and ancillary reasons are that it offers opportunities for continuation of ecological connectivity especially related to the hydrological connectivity of the drainage lines.

As according to Mucina and Rutherford (2006) the remnants of natural vegetation occurring on this property are classified as Eastern Ruens Shale Renosterveld (Critically Endangered), Cape Lowland Alluvial Vegetation (Critically Endangered) and Swellendam Silcrete Fynbos (Endangered) as part of the Fynbos biome.

Most of the indigenous vegetation remnants associated with the non-perennial drainage lines along the steep slopes and gorges surrounding the proposed mining area as surveyed have been identified as terrestrial and aquatic Critical Biodiversity Areas. The proposed mining activities will not have an impact on any of these CBAs and no indigenous vegetation remains on the proposed mining activities areas.

Some of the proposed mining activities areas fall within mapped Ecological Support Areas (Res) Category 1: ESA 2 Restore from other land use. These ESAs are not essential for meeting biodiversity targets, but play an important role in supporting the functioning of the CBAs and are important in maintaining ecosystem services i.e. drainage systems. The objectives for these areas are to restore and/or manage to minimise impacts on ecological processes. Due to these areas already being historical and ongoing cultivated agricultural lands restoration will not be feasible or reasonable, but the areas must and can be managed to maintain current ecological processes. With the implementation of proper buffer and stormwater management measures as proposed the mining activities will not have a significant detrimental impact on these ESAs and surrounding CBAs.

Eco Impact is of the opinion, and based on the survey and desk study done, that if the proposed mining activities remains on the completely transformed cultivated agricultural areas of the site as proposed and the specialist recommendations as listed in this report are adhered to and incorporated into the mining EMP that the proposed mining activities will not have any significant detrimental environmental impacts on any of the sensitive environmental and landscape features as identified on the site and surrounds.

(Reference: N Hanekom and J Piennar. September 2017.Ecological Baseline Assessment for Proposed Mining Right on Remaining Extent of Farm Uitspanskraal Nr 585 Heidelberg, Western Cape)

Please indicate which heritage resources exist on the site and in its environs, describe them and indicate the nature of any impact upon them:

☐	**Places, buildings, structures and equipment of cultural significance** Description of resource: Description of impact on heritage resource:
☐	**Places to which oral traditions are attached or which are associated with living heritage** Description of resource: Description of impact on heritage resource:
☐	**Historical settlements and townscapes** Description of resource: Description of impact on heritage resource:

	Landscapes and natural features of cultural significance Description of resource: Indigenous vegetation areas and drainage lines Description of impact on heritage resource: All potential direct and indirect impacts as associated with proposed mining activities can be mitigated to such a extent that it will not cause significant ditremental environmental impacts. Significant direct impacts potentially associated with the mining phase are direct loss of indigenous terrestrial and aquatic vegetation and disturbance of soil which may lead to partial disruption of ecological processes due to fragmentation of habitat and erosion. The extent in this case would be local. Indirect impacts would occur mostly during the rehabilitation phase and in this case the nature would vary from the introduction of alien vegetation to partial disruption of ecological processes due to the effects of the alien species encroachment and/or erosion. The extent of the potential indirect impacts in this case would be local. The following impact mitigation and management measures must be implemented: • All proposed mining activities to be located on completely transformed and cultivated agricultural areas as indicated. • Clearly demarcate the 8m wide buffer areas proposed as measured from the edge of all remaining indigenous vegetation areas and undertake mining activities only in identified and specifically demarcated areas as proposed on completely transformed and cultivated areas. Demarcation method to be approved by an Environmental Control Officer (ECO). The proposed buffer areas to be located within existing cultivated land may only be used as roads and for stormwater management and no other activities associated with the proposed mining of the site may occur within the buffer areas.
☒	• Compile and implement a site specific stormwater management plan which aims to prevent (and if prevention is not possible to mitigate and rehabilitate) erosion of the site and surrounds and accumulation of stormwater in excavation areas. Site specific storm water management measures must be incorporated into the proposed mining activities layout, to direct storm water runoff away from the proposed quarry; topsoil and overburden stockpiles but still draining into adjacent non-perennial drainage lines as according to current status quo. • No disturbance should be allowed within the remaining indigenous vegetation, drainage lines and wetland areas. This includes no dumping of fill, no roads, and all forms of temporary disturbance. • No natural vegetation, drainage lines or wetland areas edges may be cleared or impacted upon by the proposed mining activities. • Topsoil and overburden materials must be removed and stored separately adjacent to the mining areas on transformed agricultural land with effective storm water runoff and erosion prevention measures to be implemented in order to protect the materials for use during rehabilitation phase. • As the excavation of the quarry advances the stored overburden material must be replaced to backfill the excavations. The backfilled area must then be contoured according to existing surrounding contours of the cultivated land to prevent erosion. After contouring has been completed the stored topsoil material must be spread over the backfilled area. Only use topsoil as derived and conserved from the proposed mining area to be rehabilitated after mining activities have ceased on the property. The topsoil must not be compacted after spreading to allow the disturbed area to be restored. The site must be monitored regularly during the mining operational/excavation phase (at least 3 monthly and after heavy rains) for signs of erosion which if detected must be immediately rectified and alien vegetation removed to prevent

	potential siltation, erosion and alien encroachment of the site and surrounds. • No mining activities may occur within 100m from any drainage line or wetland without determining requirement for water use authorisation from Department of Water and Sanitation or the Breede Gouritz Catchment Management Agency. • Alien invasive and weed vegetation monitoring and removal must be undertaken for at least a year after mining activities have ceased and the site has been rehabilitated or until the landowner starts with the annual cultivation activities on the affected land. This must be done by the applicant, landowner or their appointed contractor, using CapeNature approved methodology depending on the contract agreement that the applicant has with the landowner. • The project implementation process should be subject to standard Environmental Management Programme (EMP) prescripts and conditions, including the recommendations as provided in this report and only proceed under supervision of a competent and diligent Environmental Control Officer, both during the operational/excavation and rehabilitation phases. The ecological baseline assessment concluded that if the proposed mining activities remains on the completely transformed cultivated agricultural areas of the property and the specialist recommendations are adhered to that the proposed mining activities will not have any significant detrimental environmental impacts on any of the sensitive environmental and landscape features as present on the site and surrounds. An ecological baseline assessment has been conducted in this regard
☐	**Geological resources of scientific or cultural importance** Description of resource: Description of impact on heritage resource:
☐	**Archaeological resources** (Including archaeological sites and material, rock art, battlefields & wrecks)**:** Description of resource: Description of impact on heritage resource:
☐	**Palaeontological resources** (ie: fossils)**:** Description of resource: Description of impact on heritage resource:
☐	**Graves and burial grounds** (eg: ancestral graves, graves of victims of conflict, historical graves & cemeteries)**:** Description of Resource: Description of Impact on Heritage Resource:
☐	**Other human remains:** Description of resource: Description of impact on heritage resource:
☐	**Sites of significance relating to the history of slavery in South Africa:** Description of resource: Description of impact on heritage resource:
☐	**Other heritage resources:** Description of resource: Description of impact on heritage resource:

Describe elements in the environs of the site that could be deemed to be heritage resources: Listed above Description of impacts on heritage resources in the environs of the site: Impacts on possible heritge resource as listed above.

Summary of anticipated impacts on heritage resources: Listed above.

ILLUSTRATIVE MATERIAL (This form will not be processed unless the following are included):

Attach to this form a minimum A4 sized locality plan showing the boundaries of the area affected by the proposed development, its environs, property boundaries and a scale. The plan must be of a scale and size that is appropriate to creating a clear understanding of the development.
Attach also other relevant graphic material such as maps, site plans, satellite photographs and photographs of the site and the heritage resources on it and in its environs. These are essential to the processing of this notification.
Please provide all graphic material on paper of appropriate size and on CD ROM in JPEG format. It is essential that graphic material be annotated via titles on the photographs, map names and numbers, names of files and/or provision of a numbered list describing what is visible in each image.

D. RECOMMENDATION

In your opinion do you believe that a heritage impact assessment is required? ☐ Yes ☒ No
Recommendation made by: Name Johmandie Pienaar Capacity Environmental Assessment Practitioner
PLEASE NOTE: No Heritage Impact Assessment should be submitted with this form or conducted until Heritage Western Cape has expressed its opinion on the need for such and the nature thereof.

E. INFORMATION TO BE PROVIDED AND STUDIES TO BE CONDUCTED AS PART OF THE HERITAGE IMPACT ASSESSMENT (HIA)

If it is recommended that an HIA is required please complete this section of the form.

DETAILS OF HERITAGE PRACTITIONERS AND SPECIALISTS INTENDING TO CONDUCT THE HIA:

1.	Name of individual: Name of Practice: Area of specialisation: Qualifications: Experience: Standing in heritage resource management: E-mail Address: Telephone: Cell:

2.	Name of individual: Name of Practice: Area of specialisation: Qualifications: Experience: Standing in heritage resource management: E-mail Address: Telephone: Cell:
3.	Name of individual: Name of Practice: Area of specialisation: Qualifications: Experience: Standing in heritage resource management: E-mail Address: Telephone: Cell:
4.	Name of individual: Name of Practice: Area of specialisation: Qualifications: Experience: Standing in heritage resource management: E-mail Address: Telephone: Cell:
5.	Name of individual: Name of Practice: Area of specialisation: Qualifications: Experience: Standing in heritage resource management: E-mail Address: Telephone: Cell:

If this submission is made in terms of Section 38(8) of the National Heritage Resources Act indicate below the particulars of the principle environmental consultant on the project.

Name of individual: Johmandie Pienaar Name of Practice: Eco Impact Legal Consulting Area of specialisation: Environmental Assessment Practitioner and Biodiversity Specialist

E-mail Address: johmandie@ecoimpact.co.za & admin@ecoimpact.co.za Telephone: 021 671 1660 Fax: 021 671 9976 Cell: 072 240 3092

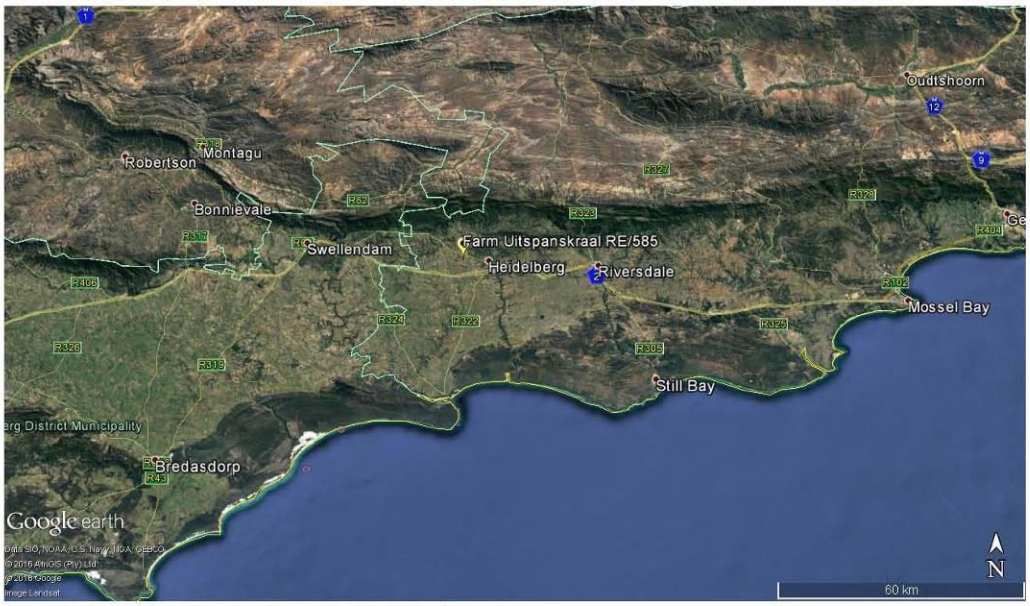
Postal Address: PO Box 45070 Claremont South Africa 7735

DETAILS OF STUDIES TO BE CONDUCTED IN THE INTENDED HIA

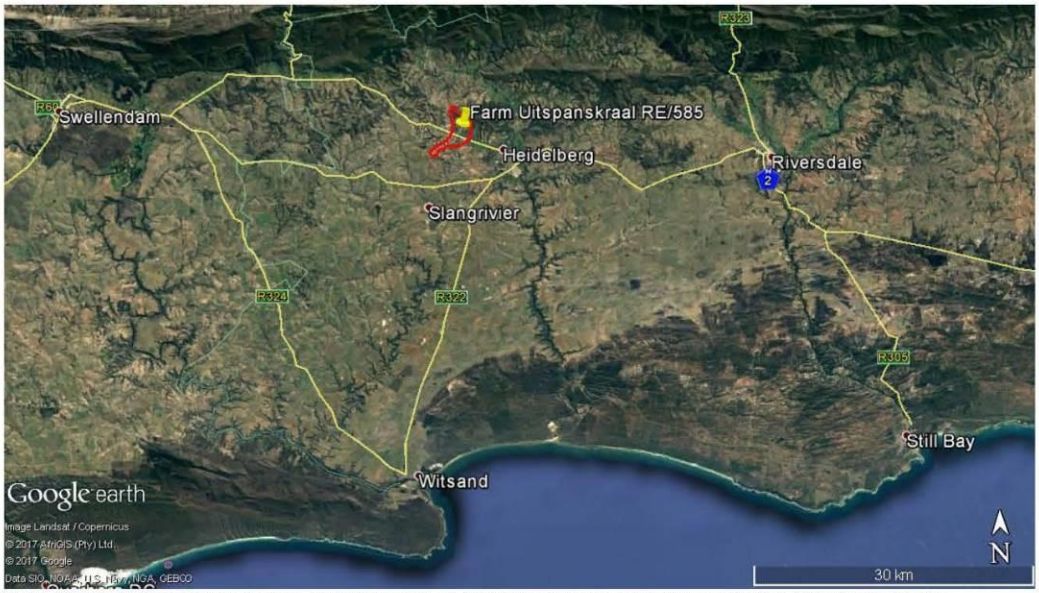
In addition to the requirements set out in Section 38(3) of the NHRA, indicate envisaged studies:	
☐	Heritage resource-related guidelines and policies.
☐	Local authority planning and other laws and policies.
☐	Details of parties, communities, etc. to be consulted.

☐	Specialist studies, eg: archaeology, palaeontology, architecture, townscape, visual impact, etc. Provide details:
☐	Other. Provide details:
PLEASE NOTE: Any further studies which Heritage Western Cape may resolve should be submitted must be in the form of a single, consolidated report with a single set of recommendations. Specialist studies must be incorporated in full, either as chapters of the report, or as annexures thereto.	

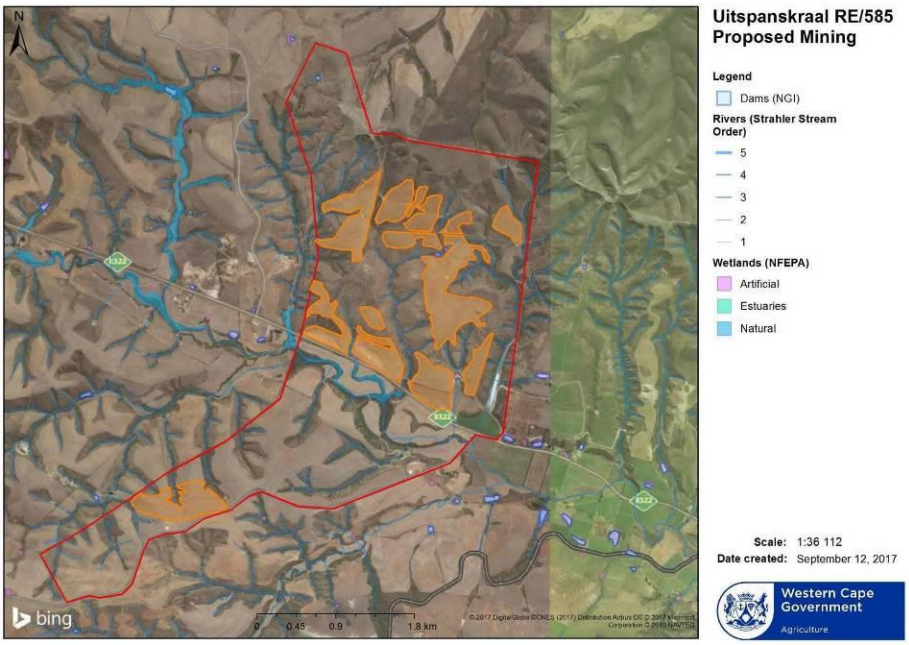
MAPS



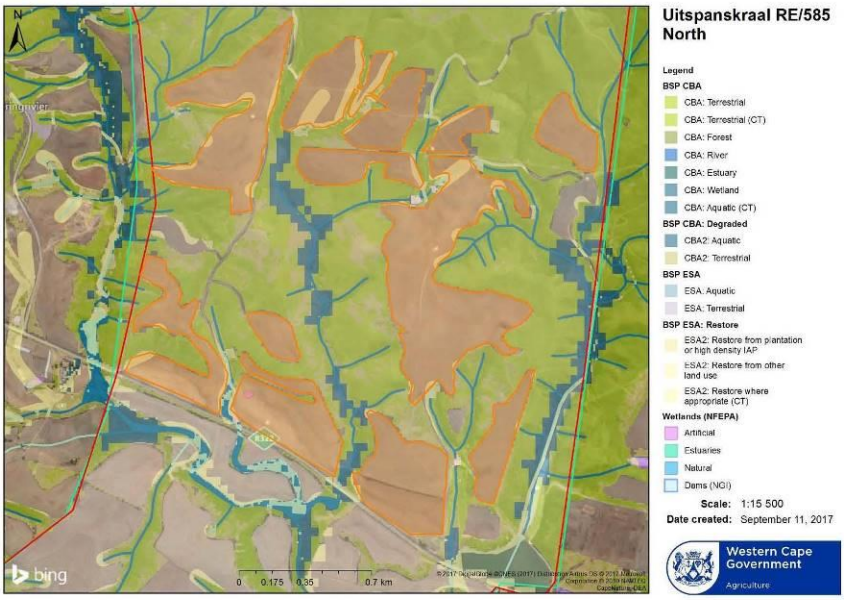
Map 1: Locality of Heidelberg in the Western Cape.



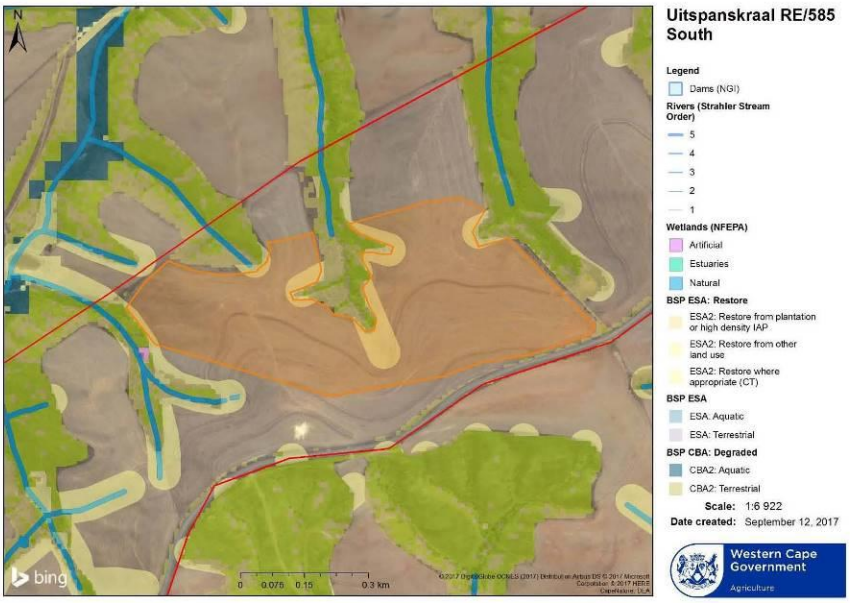
Map 2: Locality of the Farm Uitspanskraal RE/585 near Heidelberg in the Western Cape.
GPS co-ordinate for "middle" of surveyed site - 34° 04' 2.49"S
20° 53' 57.36"E



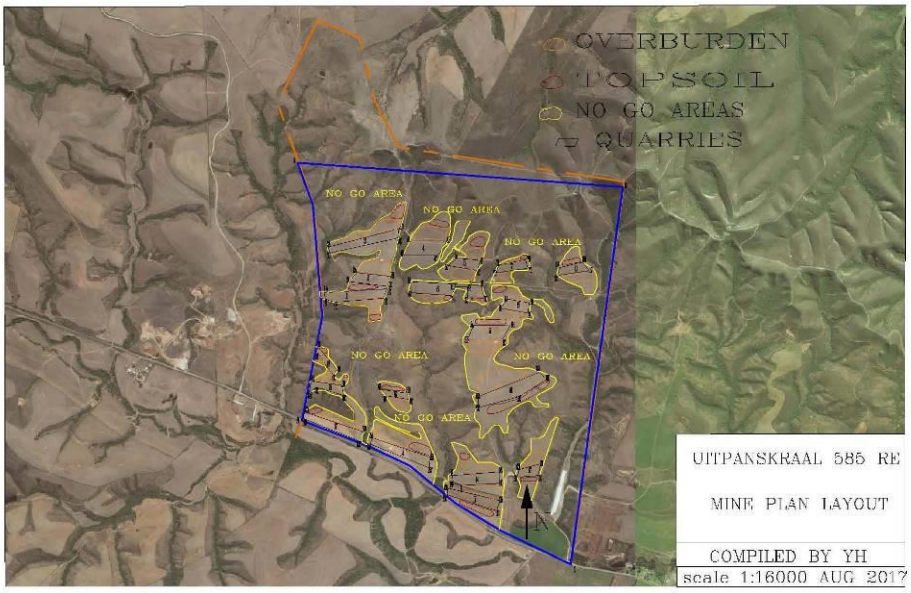
Map 3: Boundary of Farm Uitspanskraal RE/585 and proposed mining activities area sof 151ha as surveyed (outlined in orange).



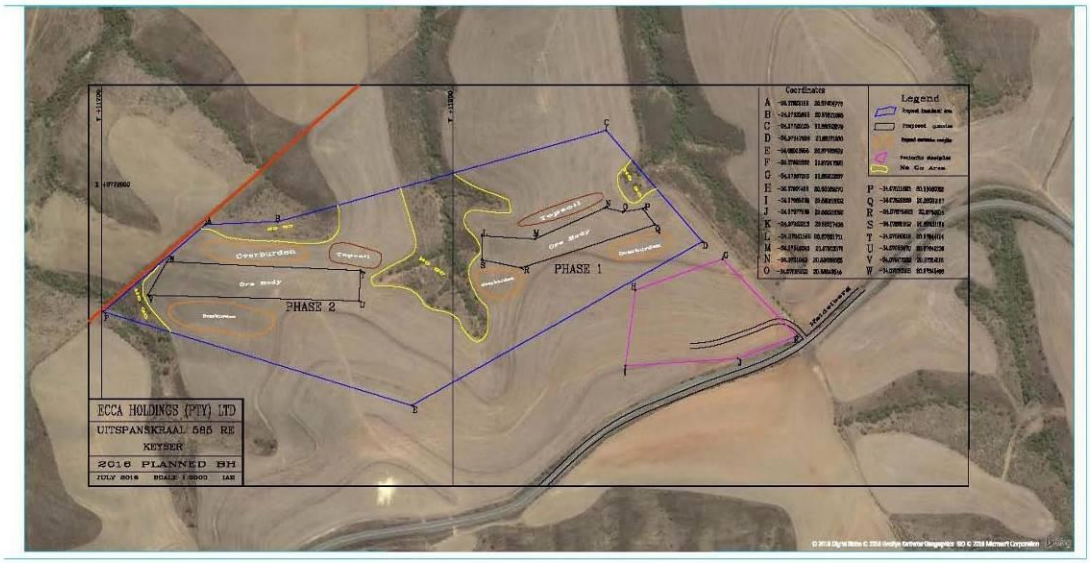
Map 4.1: Biodiversity GIS ("BGIS") land use map indicating mapped terrestrial and aquatic Critical Biodiversity Areas ("CBA"), Ecological Support Areas ("ESA") and associated buffer areas as according to the WCBSP (2017) for Hessequa in relation to the proposed mining activities areas on transformed cultivated agricultural land (as outlined in orange) on Farm Uitspanskraal RE/585-North.



Map 4.2: Biodiversity GIS ("BGIS") land use map indicating mapped terrestrial and aquatic Critical Biodiversity Areas ("CBA"), Ecological Support Areas ("ESA") and associated buffer areas as according to the WCBSP (2017) for Hessequa in relation to the proposed mining activities areas on transformed cultivated agricultural land (as outlined in orange) on Farm Uitspanskraal RE/585-South.



Map 5.1: Proposed mining layout plan on Farm Uitspanskraal RE/585 - North.



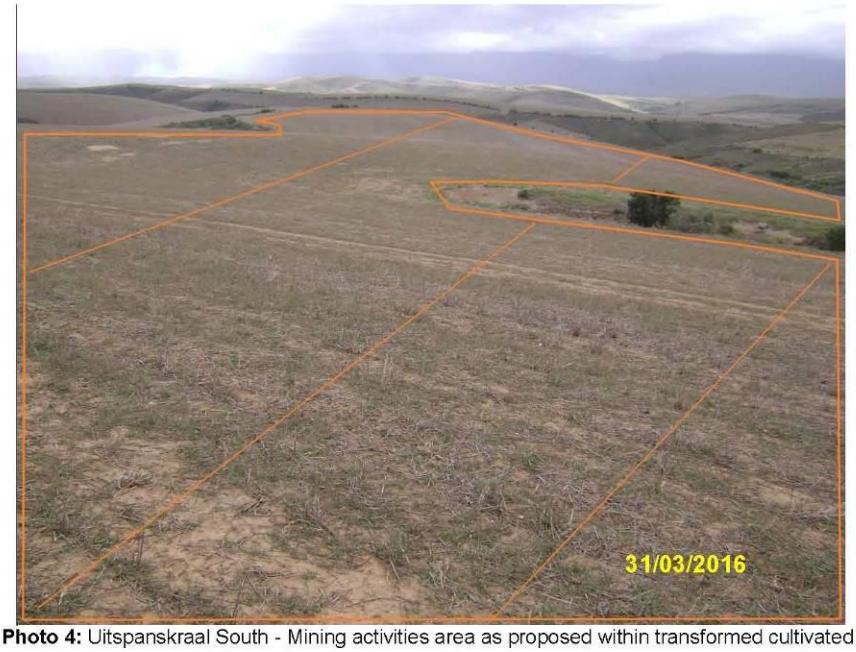
Map 5.2: Proposed mining layout plan on Farm Uitspanskraal RE/585 - South.

SITE PHOTOS

Site Photo 1: Uitspanskraal South **-** Mining activities area as proposed within transformed cultivated land.

Site Photo 2: Uitspanskraal South - Mining activities area as proposed within transformed cultivated land

Site Photo 3: Uitspanskraal South **-** Mining activities area as proposed within transformed cultivated land.



Site Photo 4: Uitspanskraal South - Mining activities area as proposed within transformed cultivated land.

Site Photo 5: Uitspanskraal North - Mining activities area as proposed within transformed cultivated land.

Site Photo 6: Uitspanskraal North - Mining activities area as proposed within transformed cultivated land.

Site Photo 7: Uitspanskraal North - Mining activities area as proposed within transformed cultivated land.

Site Photo 8: Uitspanskraal North - Mining activities area as proposed within transformed cultivated land.

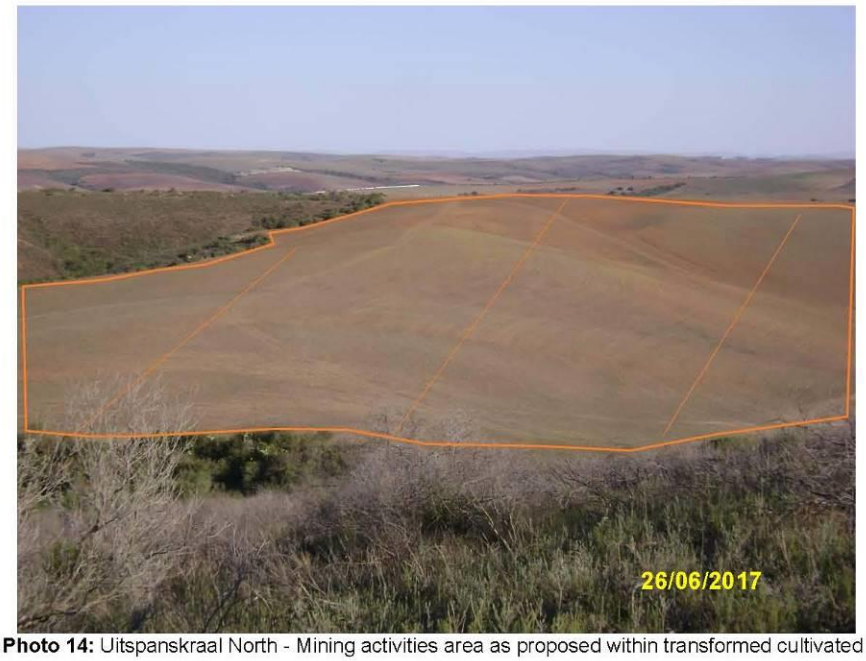
Site Photo 9: Uitspanskraal North - Mining activities area as proposed within transformed cultivated land.

Site Photo 10: Uitspanskraal North - Mining activities area as proposed within transformed cultivated land.

Site Photo 11: Uitspanskraal North - Mining activities area as proposed within transformed cultivated land.

Site Photo 12: Uitspanskraal North - Mining activities area as proposed within transformed cultivated land.

Site Photo 13: Uitspanskraal North - Mining activities area as proposed within transformed cultivated land.



Site Photo 14: Uitspanskraal North - Mining activities area as proposed within transformed cultivated land.

Appendix E3: Agricultural Impact Assessment

Johann Lanz
Soil Scientist (Pri.Sci.Nat.)
Reg. no. 400268/12

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South Africa

AGRICULTURAL IMPACT ASSESSMENT FOR PROPOSED BENTONITE MINE ON REMAINING EXTENT OF FARM UITPANSKRAAL NR 585 NEAR HEIDELBERG WESTERN CAPE

EIA REPORT

Report by
Johann Lanz

Prepared for
Eco Impact
P.O. Box 45070
Claremont
7735
South Africa

July 2018

Johann Lanz
Professional profile

Education

• M.Sc. (Environmental Geochemistry)	University of Cape Town	1996 - June 1997
• B.Sc. Agriculture (Soil Science, Chemistry)	University of Stellenbosch	1992 - 1995
• BA (English, Environmental & Geographical Science)	University of Cape Town	1989 - 1991
• Matric Exemption	Wynberg Boy's High School	1983

Professional work experience

I am registered as a Professional Natural Scientist (Pri.Sci.Nat.) in the field of soil science, registration number 400268/12, and am a member of the Soil Science Society of South Africa.

- **Soil Science Consultant** **Self employed** **2002 - present**

  I run a soil science consulting business, servicing clients in both the environmental and agricultural industries. Typical consulting projects involve:

- Soil specialist study inputs to EIA's, SEA's and EMPR's. These have focused on impact assessments and rehabilitation on agricultural land, rehabilitation and re-vegetation of mining and industrially disturbed and contaminated soils, as well as more general aspects of soil resource management. Recent clients include: CSIR; SRK Consulting; Aurecon; Mainstream Renewable Power; SiVEST; Savannah Environmental; Subsolar; Red Cap Investments; MBB Consulting Engineers; Enviroworks; Sharples Environmental Services; Haw & Inglis; BioTherm Energy; Tiptrans.
- Soil resource evaluations and mapping for agricultural land use planning and management. Recent clients include: Cederberg Wines; Unit for Technical Assistance - Western Cape Department of Agriculture; Wedderwill Estate; Goedgedacht Olives; Zewenwacht Wine Estate, Lourensford Fruit Company; Kaarsten Boerdery; Thelema Mountain Vineyards; Rudera Wines; Flagstone Wines; Solms Delta Wines; Dornier Wines.

- **Soil Science Consultant** **Agricultural Consultors International (Tinie du Preez)** **1998 - end 2001**

  Responsible for providing all aspects of a soil science technical consulting service directly to clients in the wine, fruit and environmental industries all over South Africa, and in Chile, South America.

- **Contracting Soil Scientist** **De Beers Namaqualand Mines** **July 1997 - Jan 1998**

  Completed a contract to make recommendations on soil rehabilitation and re-vegetation of mined areas.

Publications

- Lanz, J. 2012. Soil health: sustaining Stellenbosch's roots. In: M Swilling, B Sebitosi & R Loots (eds). *Sustainable Stellenbosch: opening dialogues*. Stellenbosch: SunMedia.
- Lanz, J. 2010. Soil health indicators: physical and chemical. *South African Fruit Journal*, April / May 2010 issue.
- Lanz, J. 2009. Soil health constraints. *South African Fruit Journal*, August / September 2009 issue.
- Lanz, J. 2009. Soil carbon research. *AgriProbe*, Department of Agriculture.
- Lanz, J. 2005. Special Report: Soils and wine quality. *Wineland Magazine.*

I am a reviewing scientist for the *South African Journal of Plant and Soil*.

Specialist Declaration

I, Johann Lanz, as the appointed independent specialist, in terms of the 2014 EIA Regulations, hereby declare that I:

- I act as the independent specialist in this application;
- I perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I have no vested interest in the proposed activity proceeding;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

Name of company: Johann Lanz – Soil Scientist

Professional Registration (including number): SACNASP Reg. no. 400268/12

Date: 11 July 2018

Table of Contents

EXECUTIVE SUMMARY

The most important aim and focus of this investigation was to assess the risk of the mining and rehabilitation process causing a reduction in the long term potential of the soil for crop production.

The key findings of this study are:

- The soils are all shallow soils on underlying clay. The most common soil form is Valsrivier. Klapmuts and Swartland soils are also common.
- Despite the different soil forms identified, the soil conditions and their agricultural potential are very uniform across the proposed quarry areas.
- The land is suitable for crop production. All the land of the proposed quarries is used for dryland cultivation of small grains (oats, barley and wheat) in rotation with lucerne.
- The thin topsoil with underlying clay means that the soils are particularly sensitive to disturbance and their agricultural potential can be drastically reduced by the mining process, if they are not well rehabilitated.
- Specific factors that lead to this sensitivity are that the critical layer of topsoil is very thin; that it varies in thickness which makes effective stripping difficult; that it is underlain by clay, that if included in the stripping depth, significantly reduces the quality of the topsoil; and that deeper underlying material brought to within the root zone by mining is likely to have detrimental impacts on crop growth due to salinity.
- The mining and current rehabilitation process that strips and then re-spreads a layer of topsoil is likely to lead to some reduction in long term soil potential. Extra rehabilitation steps are therefore justified.
- The recommended extra steps are double stripping, addition of extra topsoil to the rehabilitated land, and extra fertilisation.
- Double stripping will alleviate the problem of deeper, saline material being in contact with crop roots.
- Additions of topsoil will alleviate lack of topsoil and reduction in the quality of the topsoil caused by mining.
- If the additional recommended rehabilitation steps are included into the soil rehabilitation program, and effectively implemented, the mining process is assessed as not having any long term detrimental impact on soil potential. All the proposed quarries will be able to be returned to agricultural use, at the same level of productivity as pre-mining.
- Compensation paid by the mine is likely to more than compensate any direct loss of income from farming the land, but the purpose of compensation should not be to cover any loss of soil potential and loss of future income as a result of lost soil potential. The mine must take responsibility for and incur all costs associated with fully returning the soil potential to at least pre-mining levels.
- The result of the impact assessment is that without mitigation the significance of the negative potential impact of long term reduction in soil potential will be high, but with mitigation it will be low.

1 INTRODUCTION

Cape Bentonite Mine are proposing a bentonite mine on Remaining Extent of Farm Uitspanskraal Nr 585 near Heidelberg. The location of the farm is shown in Figure 1. The mine comprises 21 separate open pit quarries, with a combined surface area of 38 hectares, distributed across mostly the higher lying ground on the northern part of the farm, but with two quarries in the south.

The objectives of this study are to identify and assess all potential impacts of the proposed development on agricultural resources and agricultural production potential, and to provide recommended mitigation measures and rehabilitation guidelines for all identified impacts. The most important aim and focus of this investigation is to assess the risk of the mining and rehabilitation process causing a reduction in the long term soil potential for crop production. Johann Lanz was appointed by Eco Impact as an independent specialist to conduct this Agricultural Impact Assessment.

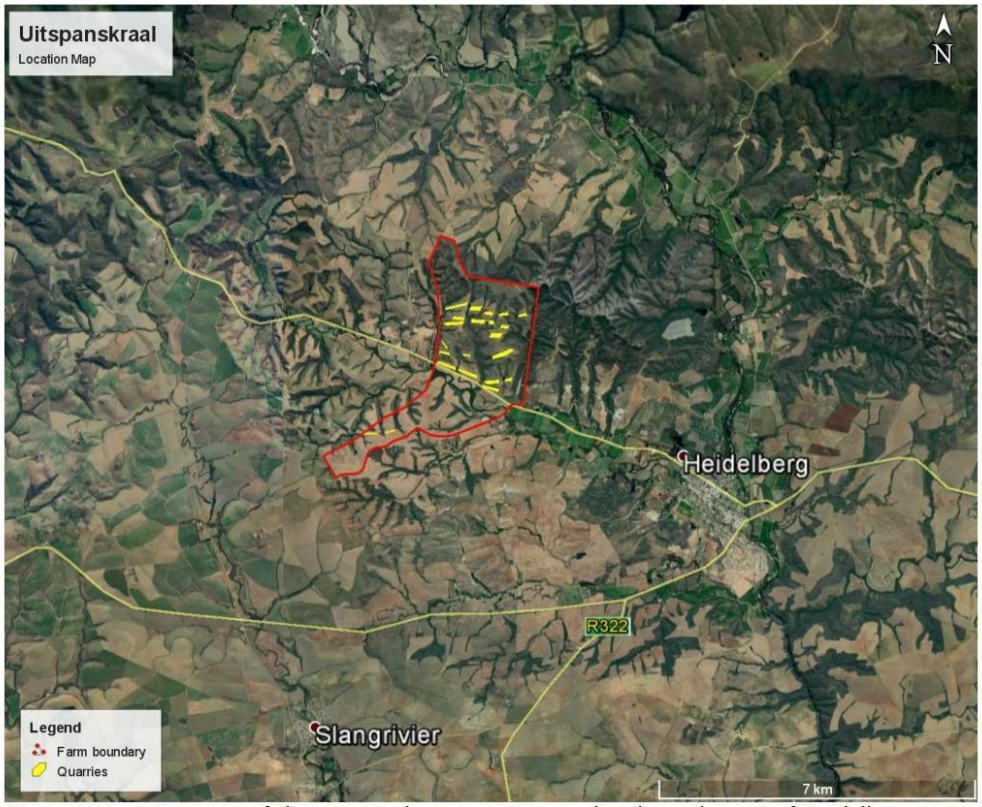

Figure 1: Location map of the proposed mine on Uitspanskraal, north-west of Heidelberg.

2 TERMS OF REFERENCE

The following terms of reference apply to this study:

- Identify and assess all potential impacts (direct, indirect and cumulative) of the proposed development on soils, agricultural potential and agricultural production.
- Assess whether or not the socio-economic benefits of the proposed bentonite mining on the property will outweigh the significance of potential negative impacts on the agricultural potential of the property.
- Describe and map soil types (soil forms and families) and characteristics (soil depth, soil colour, limiting factors, and clay content of the top and sub soil layers).
- Map soil survey points
- Describe the topography of the site.
- Describe climate as it pertains to agricultural potential
- Summarise available water sources for agriculture
- Describe historical and current land use and agricultural infrastructure.
- Determine and map the agricultural potential across the site.
- Determine and map the agricultural sensitivity to development across the site.
- Provide recommended mitigation measures, monitoring requirements, and rehabilitation guidelines for all identified impacts and for rehabilitating the land for agricultural use after mining.
- Indicate what the return value of the land would be after the rehabilitation process is completed (i.e. what percentage of the proposed mining area [if any] will not be able to be reused for agricultural purposes).

3 METHODOLOGY OF STUDY

The pre-fieldwork assessment was based on existing data. Soil data was sourced from the land type data set, of the Department of Agriculture, Forestry and Fisheries (DAFF, 2002). This data set originates from the land type survey that was conducted from the 1970's until 2002. It is the most reliable and comprehensive national database of soil information in South Africa and although the data was collected some time ago, it is still entirely relevant as the soil characteristics included in the land type data do not change within time scales of hundreds of years.

Soils are described in this data set according to an older version of the South African soil classification system, as documented in Soil Working Group (1991). It is a two tier system of classification. Soil forms are the first level of division. All soil forms are given a South African place name. Soils are divided into forms based on the sequence of diagnostic soil horizons in the soil profile. A particular sequence, defines a particular soil form, for example A horizon – Red apedal B horizon is a Hutton soil form and A horizon – Yellow-brown apedal B horizon – Hard plinthic B horizon is a Glencoe soil form.

Land capability data was sourced from the 2017 National land capability evaluation raster data

layer produced by the Department of Agriculture, Forestry and Fisheries (DAFF, 2017).

Satellite imagery of the study area, available on Google Earth (historic and current), was also used for the assessment.

The consulting of existing data was followed by a field soil survey of the proposed quarry areas. The soil survey made use of test pits excavated by a back actor digger. As there were agricultural crops on the land, test pits were confined to the edges of agricultural fields. Test pits were positioned to be distributed across the area containing the proposed quarries in such a way as to take account of the likely affect of topography on soil conditions and to give adequate cover across the area. Each test pit was classified in terms of the South African soil classification system (Soil Working Group, 1991) and data on soil depth, clay content and agricultural potential were recorded. The number of test pits used in the soil survey was entirely sufficient to provide the required soil information for the purposes of this study.

The field investigation included an investigation of existing Cape Bentonite quarries as well as agricultural land that was in various stages of post mining rehabilitation, on neighbouring farms. The field survey was done on 14 and 15 June 2018, during winter. An assessment of soils (soil mapping) and long term agricultural potential is in no way affected by the season in which the assessment is made, and the timing of the assessment therefore has no bearing on its results. The investigation of mining and rehabilitation was also not affected by the season.

The farmer and land owner, Mikael John Keyser, was consulted on farming experience on the farm as well as the experience of farming on bentonite mining rehabilitated lands on neighbouring farms. The mining geologist, Yoann Hoibian was consulted on the rehabilitation process that is being used on Cape Bentonite mines.

4 CONSTRAINTS AND LIMITATIONS OF STUDY

The following limitations are identified:

- The success of rehabilitation is highly dependent on the level of care that is taken to rehabilitate effectively. This is difficult to stipulate or predict and therefore introduces an element of uncertainty into the prediction of impacts on soil potential.
- No soil samples were assessed of the deeper overburden material, so the likelihood of it being saline was assumed, based on experience from other environments.
- The concept of soil potential cannot be determined in an absolute and definitive way. There is no way to measure potential in the way that, for example, soil pH can be measured. It is therefore not necessarily possible to definitively determine whether a reduction in soil potential has occurred or is likely to occur. The conclusions of this report in this regard are therefore based on logical deduction and contain an element of uncertainty.
- Test pits could not be accessed close to the quarry areas in the south because of crops on the land. However, the uniformity of soil conditions in terms of the purposes of this report,

means that the investigated test pits give sufficient indication of soil conditions in those quarry areas.

There are no other specific assumptions, constraints, uncertainties and gaps in knowledge for this study.

5 BASELINE ASSESSMENT OF THE SOILS AND AGRICULTURAL CAPABILITY

5.1 Climate and water availability

Rainfall for the study area is given as 542 mm per annum (The World Bank Climate Change Knowledge Portal, 2015). The average monthly distribution of rainfall is shown in Figure 2. Rainfall and resultant moisture availability is sufficient to support viable, rainfed cultivation of small grains and lucerne.

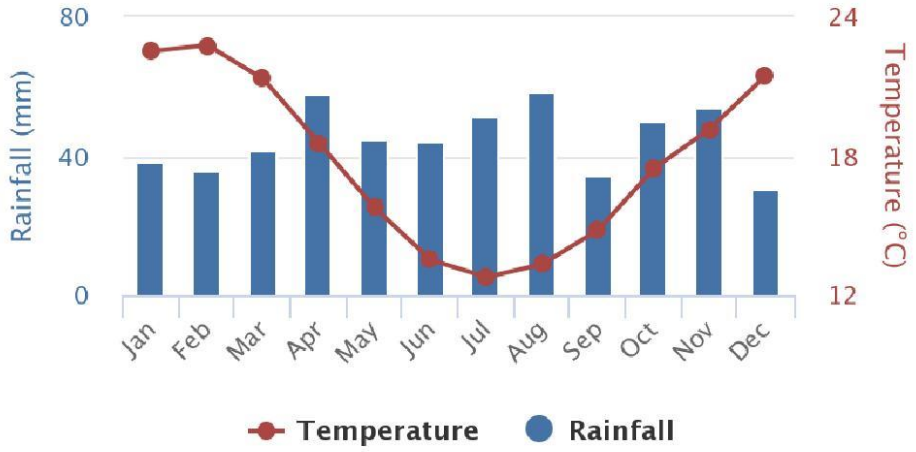

Figure 2: Average monthly temperature and rainfall for location (-34.06; 20.90), which is in the centre of the project area, from 1991 to 2015 (The World Bank Climate Change Knowledge Portal. 2015).

There are small farm dams across the project area. The neighbouring farm portion owned by the same family receives irrigation water from the Duiwenhoks Dam, and irrigates 40 hectares of land on the flat floodplains in the valley bottom. There is no irrigation land on the farm portion on which the proposed mine is located.

5.2 Terrain, topography and drainage

Photographs of landscape and soil conditions are shown in Figures 5 to 10.

The project is located across typical ridges and hilly terrain of the Southern cape grain areas. There are numerous small valleys between ridges with a wide range of slope steepness. Proposed quarries are predominantly confined to the flatter agricultural land on the convex spurs, with the valleys running between them. The quarries are mostly across the south facing slopes of an east west running ridge line that is elevated about 190 metres above the valley bottom.

The underlying geology of the project area is mainly conglomerate, sandstone and mudstone of the Uitenhage Group, partly overlain by Tertiary terrace gravel and silcrete.

5.3 Soils

As background information to the soil survey the land type data was consulted. The land type classification is a nationwide survey that groups areas of similar soil, terrain and climatic conditions into different land types. The proposed mine is mostly on a single land type, Db14, although some of the lower lying quarries near the valley bottom extend into a second land type, Dc32.

Soils of both land types are fairly similar, although Dc32 occurs in the valleys and generally has deeper soils. The soils are predominantly shallow, duplex soils on underlying, dense clay. The dominant soil forms of these land types are Valsrivier and Sterkspruit. Some shallow soils on underlying rock (Mispah soil form) also occur. A summary detailing soil data for the land types is provided in Appendix 1, Table 2.

The field soil survey confirmed that shallow soils on underlying clay dominate the investigated area. Data from each investigated test pit is provided in Appendix 1, Table 3. Valsrivier is the most commonly identified soil form. Klapmuts and Swartland soils are also common. Despite the different soil forms identified, the soil conditions and their agricultural potential are very uniform across most of the proposed quarry areas. Only the few, lower lying, flatter lands in the valley bottom, adjacent to the R322 tar road, have slightly deeper soils. These are still underlain by clay. Identified soil forms and depths are shown in the maps in Figures 3 and 4.

There is a high stone content in the topsoil and on the surface across almost all parts of the area. The high stone content originates from the relic, elevated gravel terraces that are common in this landscape.

All the quarry areas are on cultivated land and the topsoil has therefore been ploughed to a depth of about 30cm, making the effective depth across the lands fairly uniform.

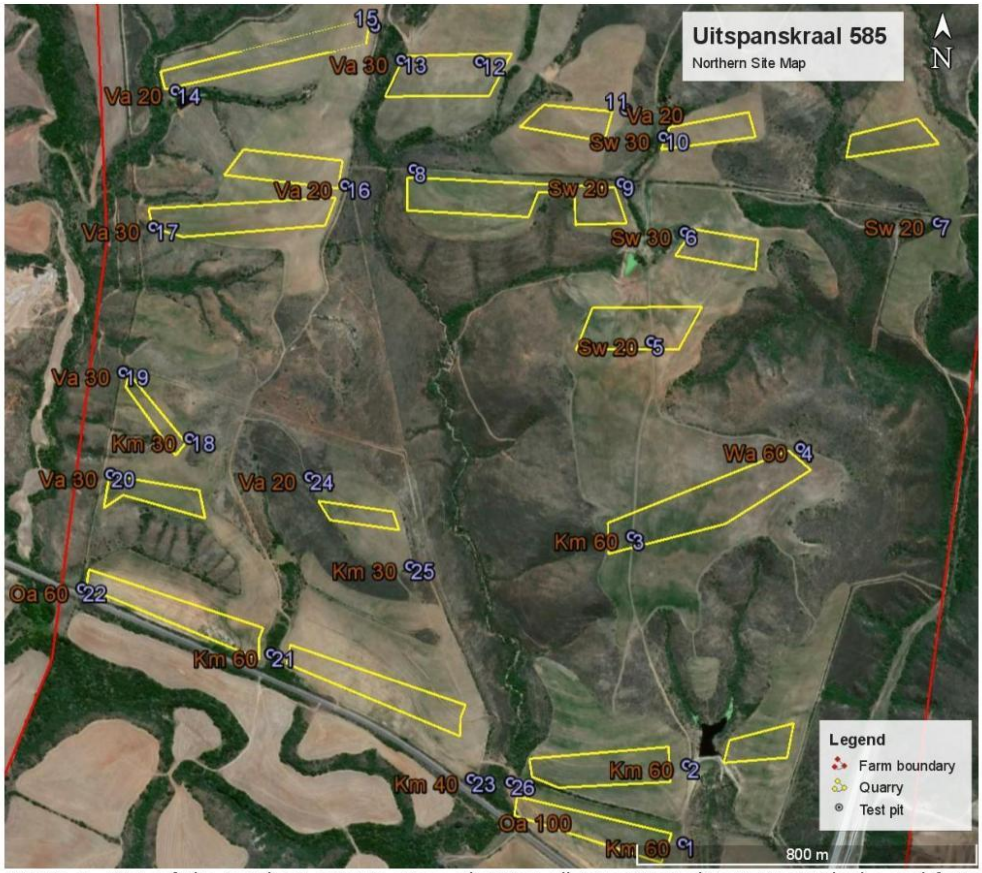

Figure 3: Map of the northern quarry areas showing all investigated test pits with the soil form abbreviation and the effective soil depth in cm. Gs = Glenrosa; Km = Klapmuts; Oa = Oakleaf; Sw = Swartland: Va = Valsrivier: Wa = Wasbank.

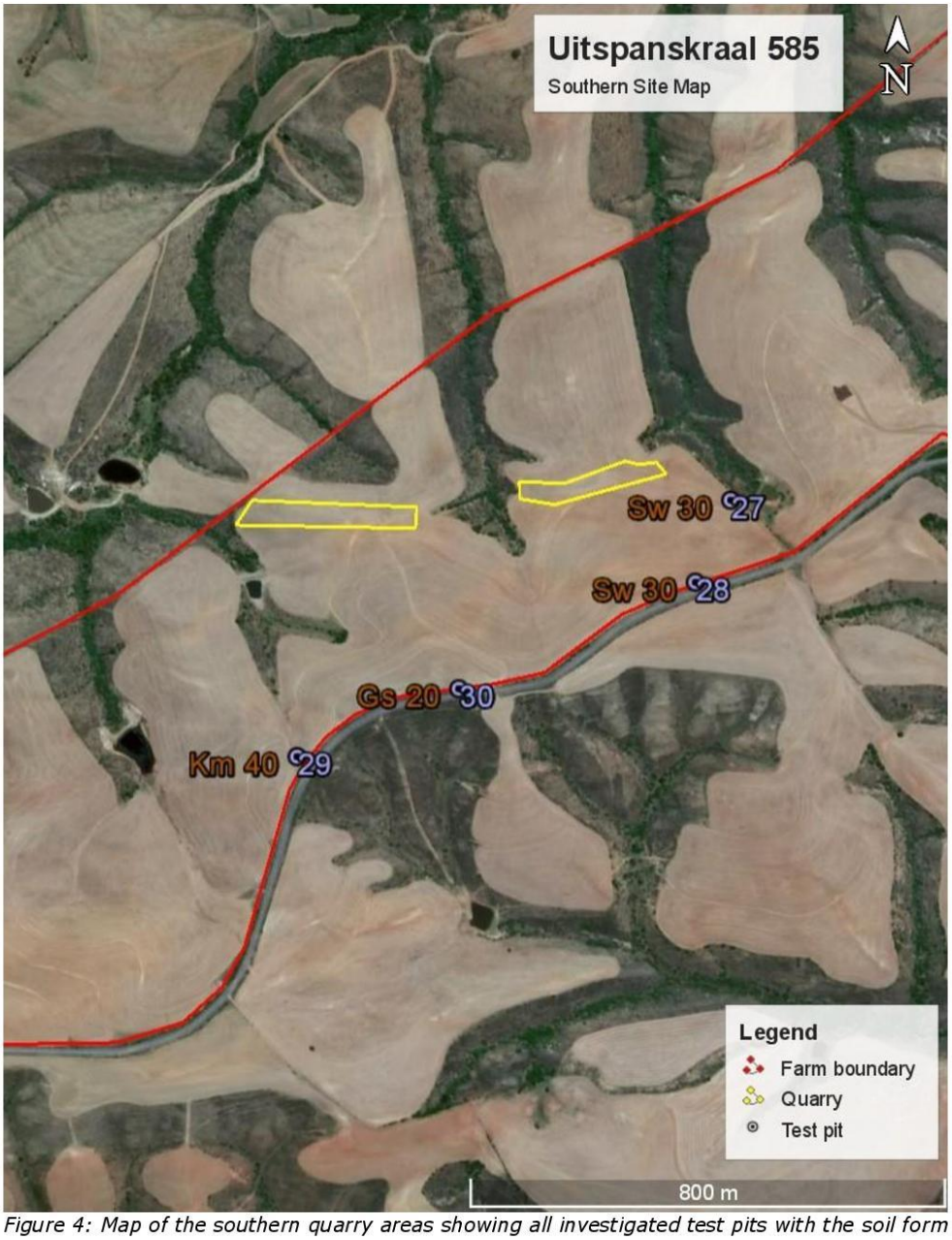

Figure 4: Map of the southern quarry areas showing all investigated test pits with the soil form abbreviation and the effective soil depth in cm. Gs = Glenrosa; Km = Klapmuts; Sw = Swartland.

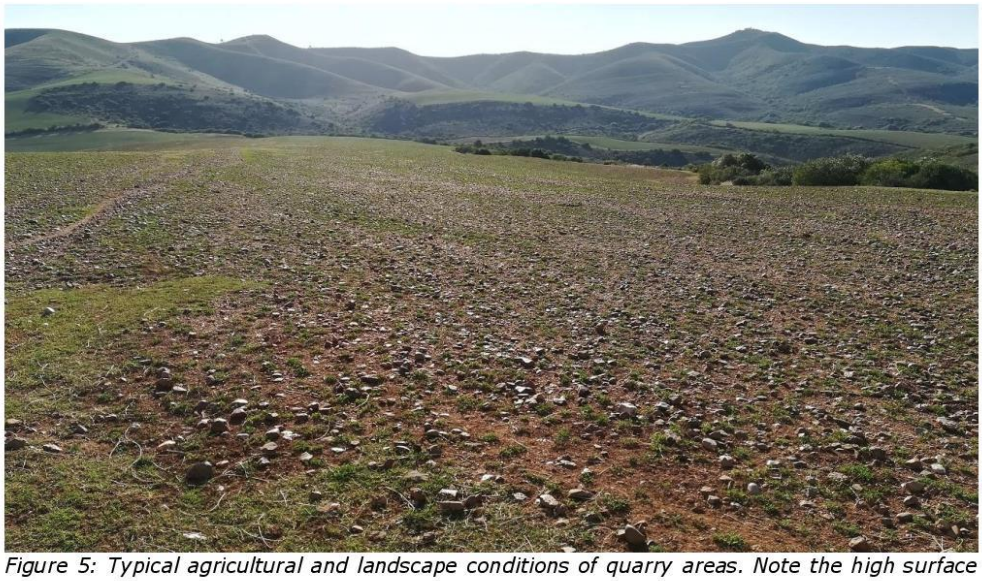

Figure 5: Typical agricultural and landscape conditions of quarry areas. Note the high surface rock content.

Figure 6: Typical soil profile from site with clay layer at 30cm.

Figure 7: Typical soil profile from site with clav laver at 25cm.

Figure 8: Rehabilitation in progress with spread topsoil on left over profiled overburden on right. Note how thin the topsoil layer is.

Figure 9: Topsoil stockpile showing contamination with underlying clay, which would

Figure 10: Clear distinction between rehabilitated soil in foreground, on which crop performance is poor, and unmined soil in background. The rehabilitated topsoil shows clay contamination within it.

5.4 Agricultural capability

Land capability is defined as the combination of soil, climate and terrain suitability factors for supporting rainfed agricultural production. It is an indication of what level and type of agricultural production can sustainably be achieved on any land. The higher land capability classes are suitable as arable land for the production of cultivated crops, while the lower suitability classes are only suitable as non-arable grazing land. In 2017 DAFF released updated and refined land capability mapping across the whole of South Africa. This has greatly improved the accuracy of the land capability rating for any particular piece of land anywhere in the country. The new land capability mapping divides land capability into 15 different categories with 1 being the lowest and 15 being the highest. Detail of this land capability scale is shown in Table 2.

The northern quarry areas in elevated positions as well as the two in the south are classified with land capability evaluation values of 5-6, with some small areas of value 4. Those in the flatter, lower lying positions alongside the R322 have land capability evaluation values of 6-7, with some small areas of value 8.

Soil limitations of shallow depth and high stone content, as well as the relatively low rainfall of the area result in the low land capability rating. However the specific site conditions make the area suitable for viable production of small grains, which only require shallow soil depth.

Despite the clay limitation in the subsoil, lucerne roots are able to penetrate and make use of the subsoil and lucerne can also be effectively produced on these soils.

Table 1: Details of the 2017 Land Capability classification for South Africa.

Land capability evaluation value	Description
1	Very Low
2	
3	Very Low to Low
4	
5	Low
6	Low to Moderate
7	
8	Moderate
9	Moderate to High
10	
11	High
12	High to Very High
13	
14	Very High
15	

5.5 Land use and development on and surrounding the site

All the land of the proposed quarries is used for dryland cultivation of small grains (oats, barley and wheat) in rotation with lucerne. The farming system utilises a 6 or 7 year lucerne cycle with a 5 year grain cycle.

5.6 Agricultural sensitivity

Agricultural sensitivity within an environmental impact assessment context is a function of the soil potential, because the higher the soil potential, the more agriculturally valuable it is and therefore the higher is the agricultural significance of any impact to that soil. A general assessment of agricultural sensitivity, in terms of loss of agricultural land in South Africa, considers arable land that can support viable production of cultivated crops, to have high sensitivity. This is because there is a scarcity of such land in South Africa, in terms of how much is required for food security. Land that is only suitable as grazing land is not considered to have high agricultural sensitivity.

The soils of the proposed mining area are suitable for crop production and therefore have high agricultural sensitivity. In addition, the thin topsoils mean that the soils are particularly sensitive to disturbance and their agricultural potential can be drastically reduced by a process such as mining, if they are not well rehabilitated.

As noted above, soil conditions and soil potential are uniform across the proposed mining areas and the agricultural sensitivity is therefore also uniform.

6 IDENTIFICATION AND ASSESSMENT OF IMPACTS ON AGRICULTURE

6.1 Discussion

The defining question of this assessment is whether the capacity of the soil to support crop production will be reduced by the mining and rehabilitation process or not. In other words, will the soil potential of the rehabilitated land be any less than it was prior to the mining disturbance.

To answer this question this study investigated the pre-mining soil conditions of the proposed mine. It also investigated the mining and rehabilitation processes as well as agricultural lands where rehabilitation has been completed for different periods of time.

The standard rehabilitation that is and has been applied by Cape Bentonite is to strip and stockpile a relatively thin layer of topsoil before any mining disturbance. The mining pit is excavated to varying depths to a maximum of 30 metres in order to extract thin layers of bentonite. All overburden is backfilled directly into the pit, behind the bentonite extraction. Once all bentonite has been extracted and the pit has been completely backfilled and profiled, the stockpiled topsoil is re-spread across the surface.

The important characteristics of the soil conditions that have relevance for answering the above question are the following:

1. The topsoil (A horizon) of most of the mining area is very thin. It varies between 20 and 40 cm in thickness. The topsoil is the most critical component of soil potential and any loss of or change to the quality of topsoil can therefore have a significant effect on soil potential.
2. Over most of the mining area the thin topsoil is directly underlain by a dense clay layer. This dense clay layer is much less suitable than the topsoil for supporting root development of crop plants.
3. Deeper overburden material that is excavated during the mining process is likely to be even less suitable for root development than the shallower subsoil. It is highly likely to have higher salinity than the shallow subsoils and to have salinity levels that impede root development of crop plants.

As a result of these characteristics of the soil, the mining and rehabilitation process poses a significant risk of reducing the soil potential of the rehabilitated soil to some extent. Given that the topsoil layer is so thin, and that it varies in thickness, it is almost impossible to strip it effectively without either including some underlying clay, where stripping is slightly deeper than the topsoil layer (see Figures 9 and 10), or losing some topsoil below the stripping depth, where this is slightly shallower than the topsoil layer. Both of these will compromise the topsoil to some extent and lead to some reduction in the agricultural potential of the rehabilitated soil. Inclusion of the clay layer in the topsoil causes water infiltration and moisture supply problems for the crop. A reduction in soil potential, by either of the above two mechanisms, will have long lasting impacts, and the soil will not restore itself within decades.

In summary, the mining and current rehabilitation process that simply strips and then re-spreads a layer of topsoil is likely to lead to some reduction in soil potential.

6.2 Mitigation measures

It is unfair to expect the mine to have to improve on the pre-mining soil potential. But it is also unfair and environmentally unsound for the mine to rehabilitate to a lower soil potential. Because of the likelihood of the mechanisms identified above, to reduce the soil potential, it is fair to expect the mine to take extra steps to ensure that soil potential is not compromised. Where there is some uncertainty, the precautionary principle requires that it will be better to err on the side of improved soil potential than on the side of reduced soil potential.

The following are the sequence of soil rehabilitation steps that are currently part of the Environmental Management Program. Some comments are made on certain of these.

1. Soil sampling before mining. No sampling depth is specified. Samples should be taken from the surface to a depth of 25cm so as to include equal amounts of soil over the full depth range between 0 and 25cm.
2. Protection of topsoil stockpiles.
3. Profiling of overburden surface.
4. Prevention of any surface depressions.
5. Spreading of topsoil. The current EMP states that a depth of 50cm of potential root zone should be available. However, because of the thin topsoil, this will be less than 50cm in many cases.
6. Reconstruction of any erosion control contour banks that existed before mining. The integrity of the contour system as a whole and the way that water flows from or to adjacent un-mined land must be maintained.
7. Sampling and chemical correction. Samples should be taken in the same way as pre-mining samples to a depth of 25cm. Soil chemical deficiencies must be corrected, based on these samples. A chemical analysis from an agricultural laboratory will include a recommendation of the appropriate quantities of chemical ameliorants (for example lime, phosphate etc) that should be applied to optimize the soil chemistry for the relevant crop. Any chemical ameliorants should be spread on the soil before loosening

or ploughing or should be done as part of the farmer's planting program.

8. Loosening of the soil. If ripping is required to loosen compaction, this should be done to a depth of at least 30cm, and in such a way that no mixing of the subsoil into the topsoil layer occurs.
9. Alien invasive and weed control.
10. Erosion control.

The following additional steps in the rehabilitation process are recommended to ensure maintenance of soil potential:

1. Double stripping. Double stripping is a rehabilitation technique that is recommended by the Chamber of Mines (2007). It involves stripping a layer of topsoil, and then a second additional layer below the topsoil. Both of these layers are stockpiled separately and during rehabilitation are spread on the surface in their original sequence. In other words, the subsoil layer is spread immediately on top of the profiled overburden, and the topsoil layer is then spread on top of that. The topsoil layer should be stripped to approximately 30cm depth. Care must be taken by the stripping operator to strip as great a depth of topsoil as possible (up to a maximum of 30cm) without including any of the underlying clay layer as part of the topsoil. So where the clay layer occurs at a shallower depth than 30cm, the stripping must only occur to that shallower depth. The second subsoil stripping should be done to an additional depth of 30cm below the depth to which the subsoil was stripped. The double stripping ensures that the rehabilitated profile contains the original soil material to a depth of 60cm, and that none of the deeper underlying material, that is likely to be too saline to be part of the root zone, occurs within it.
2. Additional topsoil. To overcome the compromise to the topsoil discussed above, additional topsoil should be added to the rehabilitated land. In order for this to be feasible, additional topsoil will need to be sourced. One possible source is from the numerous, small, man made farm dams on the farm. However, the clearing of sediments, even from a man made dam, is subject to environmental authorisation, which may not be possible to get in this case, even though it is technically a very suitable choice and constitutes a win-win in terms of improving topsoil as well as improving the water storage capacity of the dams. It is therefore worth fully investigating the feasibility of this option. If the dams are not a feasible source of topsoil, an alternative and economically feasible source will need to be found. Commercial sources may not be feasible in terms of costs and available quantities. If no feasible source exists in the area, it will not be possible to implement this rehabilitation measure, and long term soil production potential will therefore be compromised to some extent. If additional topsoil can be sourced, it should be spread over the surface, once the stripped and stockpiled topsoil has already been spread. This additional layer of topsoil should be added at a minimum rate of 200 cubic metres per hectare, which is the equivalent of a 2 cm thick layer on the surface.
3. The crop that is sown on the first season of the rehabilitated soil should be a hardy, annual crop that is sown primarily for soil stabilisation and biomass and not necessarily

for production. It should be dosed with a high level of nitrogen fertilser in order to maximise vegetative growth and therefore biomass production (both above and below ground). This is likely to be a higher level of fertilisation than would be determined for economic viability in terms of input costs versus production. The increased fertilisation costs should therefore be borne by the mine's rehabilitation budget, and not by the farmer.

6.3 Impact assessment

From an environmental impact assessment point of view the potential negative impact of mining is to reduce the soil potential. This is a direct impact that can last long term, but that can be completely mitigated through effective rehabilitation. Without mitigation the significance of the impact will be high, but with mitigation it will be low.

If the additional recommended rehabilitation steps are included into the soil rehabilitation program, and effectively implemented, the mining process is assessed as not having any long term detrimental impact on soil potential. All the proposed quarries will be able to be returned to agricultural use, at the same level of productivity as pre-mining.

6.4 Socio-economic impacts

The mine compensates the farmer for loss of income due to the fact that the land cannot be farmed from when mining begins until mining and rehabilitation have been completed. The compensation is paid per ton of mineral extracted and is likely to more than compensate any direct loss of income from farming the land.

The purpose of the compensation is not to cover any loss of soil potential and loss of future income as a result of lost soil potential. The mine must take responsibility for and incur all costs associated with fully returning the soil potential to at least pre-mining levels.

6.5 Cumulative impact

The environmental impact assessment process requires the assessment of cumulative impacts. The cumulative impact of a development is the impact that development will have when its impact is considered together with the impacts of other proposed developments that will affect the same environment. The most important concept related to a cumulative impact is that of an acceptable level of change to an environment. A cumulative impact only becomes relevant when the sum of proposed developments that impact an environment will cause an acceptable level of change to be exceeded.

There are numerous Cape Bentonite quarries in the vicinity of the proposed mine. These could potentially impact a large area of arable land and exceed the acceptable level of arable land loss. However, the agricultural potential of the land can be completely restored, if effectively rehabilitated. If this is done, there is zero cumulative, long term impact of mining on

agricultural potential in the area.

7 CONCLUSIONS AND RECOMMENDATIONS

Although the soil is shallow and the topsoil is very thin, the land is suitable for production of specific crops. The important potential impact of mining is a long term loss of soil potential, which is of high significance because the land is suitable for crop production. The thin topsoil with underlying clay means that the soils are particularly sensitive to disturbance and their agricultural potential can be drastically reduced by the mining process, if they are not well rehabilitated. The mining and current rehabilitation process that strips and then re-spreads a layer of topsoil is likely to lead to some reduction in long term soil potential. Extra rehabilitation steps are therefore justified. The recommended extra steps are double stripping, addition of extra topsoil to the rehabilitated land, and extra fertilisation.

From an environmental impact assessment point of view the potential negative impact of long term reduction in soil potential can be completely mitigated through effective rehabilitation. Without mitigation the significance of the impact will be high, but with mitigation it will be low.

If the additional recommended rehabilitation steps are included into the soil rehabilitation program, and effectively implemented, the mining process is assessed as not having any long term detrimental impact on soil potential. All the proposed quarries will be able to be returned to agricultural use, at the same level of productivity as pre-mining.

8 REFERENCES

Chamber Of Mines of South Africa/Coaltech. 2007. Guidelines for the rehabilitation of mined land.

Department of Agriculture, Forestry and Fisheries, 2017. National land capability evaluation raster data layer, 2017. Pretoria.

Department of Agriculture, Forestry and Fisheries, 2002. National land type inventories data set. Pretoria.

Soil Classification Working Group. 1991. Soil classification: a taxonomic system for South Africa. Soil and Irrigation Research Institute, Department of Agricultural Development, Pretoria.

The World Bank Climate Change Knowledge Portal available at http://sdwebx.worldbank.org/climateportal/

APPENDIX 1: SOIL DATA

Table 2: Land type soil data for the site.

Land type	Soil series (forms)	Depth (mm)	Clay % A horizon	Clay % B horizon	Depth limiting layer	% of land type
Db14	Terraces					25.0
Db14	Valsrivier	200 - 350	6 - 15	> 40	vp	16.9
Db14	Sterkspruit	200 - 350	6 - 15	> 40	pr	11.8
Db14	Mispah	< 100	6 - 15		si	11.3
Db14	Estcourt	250 - 400	6 - 15	> 40	pr	10.6
Db14	Valsrivier	200 - 350	6 - 15	> 40	vp	7.3
Db14	Rock outcrop					4.4
Db14	Mispah	< 100	6 - 15		hp	3.8
Db14	Oakleaf	> 1000	6 - 15	15 - 35	U	3.0
Db14	Estcourt	250 - 400	6 - 15	> 40	pr	2.5
Db14	dundee	> 1000	6 - 15		U	1.2
Db14	Westleigh	200 - 300	6 - 15	15 - 35	sp	0.9
Db14	Swartland	200 - 350	15 - 20	35 > 55	vp,so	0.9
Db14	Glenrosa	200 - 300	6 - 15	20 - 30	so,R	0.7
Dc32	Valsrivier	400 - 450	15 - 35	40 > 55	vr,ca	18.3
Dc32	Ahortlands	500 - 700	20 - 35	35 - 55	R	14.0
Dc32	Mispah	400 - 500	15 - 35		R,ka	13.6
Dc32	Sterkspruit	350 - 400	15 - 35	> 40	pr	11.3
Dc32	Valsrivier	400 - 450	15 - 35	40 > 55	vp,ca	10.7
Dc32	Sterkspruit	350 - 400	15 - 35	> 40	pr	8.8
Dc32	Terraces					7.5
Dc32	Hutton	1000 - 1100	20 - 35	20 - 35	R	6.0
Dc32	Glenrosa	300 - 450	15 - 35	20 - 35	so,R	3.0
Dc32	Oakleaf	> 1200	6 - 15	6 - 15		1.9
Dc32	Oakleaf	> 1200	6 - 15	6 - 15		1.4
Dc32	Hutton	1000 - 1100	20 - 35	20 - 35	R	1.3
Dc32	Dundee	> 1200	6 - 15			1.1
Dc32	Valsrivier	400 - 450	15 - 35	40 > 55	vp,ca	0.4
Dc32	Valsrivier	400 - 450	15 - 35	40 > 55	vr,ca	0.2

Dc32	Sterkspruit	350 - 400	15 - 35	> 40	pr	0.2
Dc32	Sterkspruit	350 - 400	15 - 35	> 40	pr	0.1

Depth limiting layers: R = hard rock; so = partially weathered bedrock; lo = partially weathered bedrock (softer); ca = soft carbonate; ka = hardpan carbonate; db = dorbank hardpan; hp = cemented hardpan plinthite (laterite); sp = soft plinthic horizon; pr = dense, prismatic clay layer; vp = dense, structured clay layer; vr = dense, red, structured clay layer; gc = dense clay horizon that is frequently saturated; pd = podzol horizon; U = alluvium.

Table 3: Soil data from all investigated test pits.

Test pit no.	Effective depth (depth to limiting horizon) (cm)	Soil form	Soil family	Limiting horizon	Clay %		GPS Position Lat/Lon hddd.ddddd° WGS84	
					top soil	sub soil	latitude	longitude
1	60	Km	2110	vp	12	45	-34.0701918863	20.9061304852
2	60	Km	2110	vp	12	45	-34.0685353708	20.9062255360
3	60	Km	2110	vp	12	45	-34.0637050476	20.9048195556
4	60	Wa	2000	hp	13	15	-34.0618337039	20.9091281053
5	20	Sw	2111	vp	16	45	-34.0595918801	20.9053158481
6	30	Sw	2111	vp	16	45	-34.0572724398	20.9061745740
7	20	Sw	2111	vp	20	45	-34.0570672508	20.9126292262
8	40	Km	2110	vp	15	45	-34.0559363645	20.8992553968
9	20	Sw	1110	vp	20	45	-34.0562309884	20.9045592975
10	30	Sw	1110	vp	18	45	-34.0552555025	20.9056279901
11	20	Va	2111	vp	18	45	-34.0546913166	20.9046717826
12	30	Va	2111	vp	16	45	-34.0536642820	20.9009478707
13	30	Va	2111	vp	16	45	-34.0536296647	20.8989413269
14	20	Va	2111	vp	16	45	-34.0542819444	20.8931801096
15	30	Va	2121	vp	16	45	-34.0529302787	20.8982739598
16	20	Va	2111	vp	16	45	-34.0562762506	20.8975065127
17	30	Va	2111	vp	16	45	-34.0571617149	20.8926151693
18	30	Km	2120	vp	14	45	-34.0616298560	20.8935408667
19	30	Va	2111	vp	14	45	-34.0602325927	20.8918487281
20	30	Va	2121	vp	14	45	-34.0623897593	20.8915212471
21	60	Km	2110	vp	12	45	-34.0661847498	20.8956137113
22	60	Oa	2110	vp	14	45	-34.0648039989	20.8907938655

Test pit no.	Effective depth (depth to limiting horizon) (cm)	Soil form	Soil family	Limiting horizon	Clay %		GPS Position Lat/Lon hddd.ddddd° WGS84	
					top soil	sub soil	latitude	longitude
23	40	Km	2110	vp	12	45	-34.0688303299	20.9007320367
24	20	Va	2111	vp	16	45	-34.0624475107	20.8965995070
25	30	Km	2120	vp	14	45	-34.0643319301	20.8991675545
26	100	Oa	2110	vp	16	45	-34.0688978042	20.9017290641
27	30	Sw	2110	vp	18	45	-34.0787008591	20.8822197653
28	30	Sw	2110	vp	18	45	-34.0799416322	20.8815756161
29	40	Km	1110	vp	18	45	-34.0825787466	20.8742997050
30	20	Gs	2211	so	15	30	-34.0815522987	20.8772532362