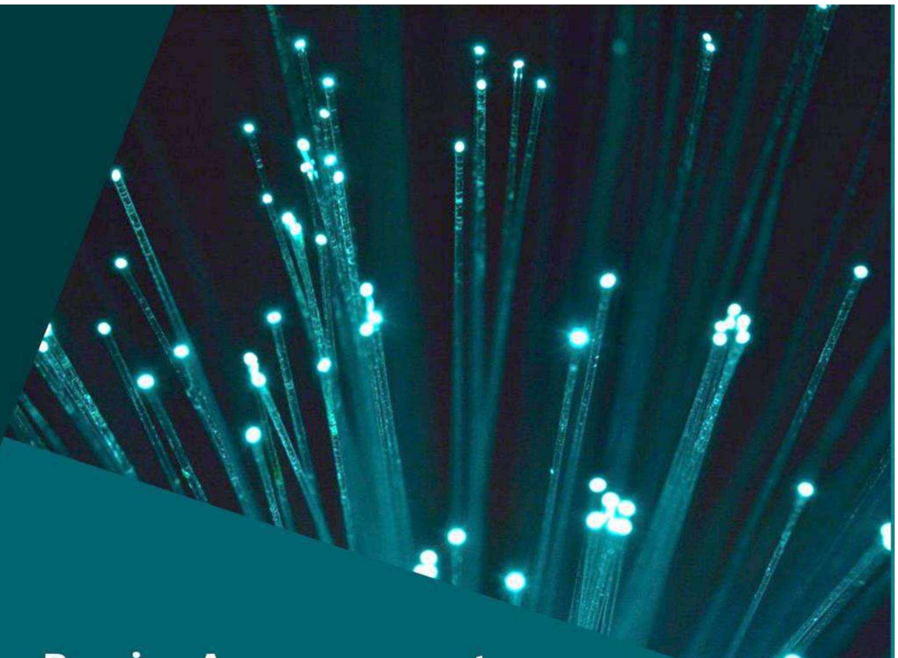
Basic Assessment Report
Appendices volume



Basic Assessment for the proposed Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon

Applicant:
South African National Research Network

Prepared by:
CSIR Environmental Management Services

Reviewed by:
SLR Consulting South Africa

Version:
Draft for comment

Date:
August 2021

CSIR
Touching lives through innovation

SANReN
South African National Research Network

SKA AFRICA
SQUARE KILOMETRE ARRAY

Title:	*Basic Assessment for the proposed Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon.* *Part A: Basic Assessment Report.* *Appendices volume.*
DFFE reference number:	To be assigned
Applicant:	South African National Research Network (SANReN)
Prepared by:	Council for Scientific and Industrial Research (CSIR) Environmental Management Services (EMS) ems@csir.co.za
Lead author / Environmental Assessment Practitioner: BAR mapping:	Luanita Snyman-van der Walt, Pr. Sci. Nat (400128/16)
Specialist authors:	Terrestrial ecology: Dr. Noel van Rooyen & Prof. Gretel van Rooyen (Ekotrust) Aquatic ecology: Dr. Brian Colloty (EnviroSci) Heritage, archaeology & palaeontology: Jenna Lavin & Dewald Wilken (CTS Heritage) Visual and aesthetic resources (overhead sections): Quinton Lawson (qarc) & Bernard Oberholzer (BOLA)
Internal CSIR review:	Paul Lochner, Pr. EAP (2019/745) Rohaida Abed, Pr.Sci.Nat. (400247/14)
Independent peer review EAP:	Edward Perry, Pr. EAP (2019/1210) (SLR Consulting SA)
SAHRIS case ID:	15577
HWC case number:	20200206SB1006E
GA reference number:	WU18079
CSIR report number:	CSIR/SPLA/SECO/IR/2021/0015/A
CSIR project number:	EEMS035
Version:	Draft for comment
Date:	August 2021
To be cited as:	CSIR. 2021. Basic Assessment for the proposed Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon. Part A: Basic Assessment Report. CSIR/SPLA/SECO/IR/2021/0015/A. CSIR: Stellenbosch.

Contents

Appendix 1 SIP confirmation

From: Dorette Loggenberg <DoretteL@idc.co.za>
To: Luanita Snyman-Van der Walt <LvdWalt1@csir.co.za>
Date: 01 Oct 2020 08:46
Subject: RE: SKA Fibre Optic Cable - SIP Confirmation Letter

Good morning Luanita,

I trust this message finds you well. I acknowledge the background and additional information provided in the trailing email below. As the SIP Lead for SIP 16 SKA & MeerKAT, I can confirm that the SKA Fibre Optic Cable does form part of SIP 16. In line with the Infrastructure Development Act, the application for this project will be expedited by the National Department of Environmental Affairs.

Ms Millecent Solomons is our contact person at the department and has assisted us tremendously in the past with these applications. To my knowledge she is aware of this application. We do not generally provide letters as confirmation of projects as part of the SIP. In most cases the attachment of the email confirmation to the application is sufficient.

Kind regards,

Dorette Loggenberg
SIP Lead
Presidential Infrastructure Coordinating Commission (PICC)
Cell: +27 72 476 4280
Email: DoretteL@idc.co.za

presidential infrastructure coordinating commission
Department:
The Presidency
REPUBLIC OF SOUTH AFRICA

Appendix 2 Specialist assessment: Terrestrial Ecology, Biodiversity and Species

BASIC ASSESSMENT FOR THE PROPOSED SQUARE KILOMETRE ARRAY (SKA) FIBRE-OPTIC CABLE ROUTE BETWEEN BEAUFORT WEST AND CARNARVON

TERRESTRIAL ECOLOGY, BIODIVERSITY AND SPECIES: SPECIALIST ASSESSMENT

Report prepared for:	*Report prepared by:*
CSIR – Environmental Management Services	Ekotrust cc
P O Box 320	7 St George Street
Stellenbosch	Lionviham,
7599	Somerset West 7130
South Africa	South Africa

Version: Draft, v2

Date: 14 January 2021

Contents

EXECUTIVE SUMMARY

Background

The South African Radio Astronomy Observatory (SARAO) leads South Africa's activities in the Square Kilometre Array (SKA) Radio Telescope. To transport the data for the SKA project a fibre-optic cable connection must be built between Carnarvon and Beaufort West to connect SKA to Cape Town. The results of an Environmental Screening Study by the CSIR indicated that, *inter alia*, a Basic Assessment (BA) procedure is required to obtain Environmental Authorisation for the proposed fibre-optic route. This report is in adherence to the *Procedures for the assessment and minimum requirements for reporting on identified environmental themes* in terms of Sections 24(5) (a) and (h) and 44 of the National Environmental Management Act, (Act No. 107 of 1998).

Terms of reference

The terms of reference are to provide a specialist assessment on the terrestrial ecology and biodiversity of the proposed SKA fibre-optic cable project between Beaufort West in the Western Cape and Carnarvon in the Northern Cape, a distance of 181 km. The cable will be installed 1 m from the fence of the adjacent private land and the route covers the road reserves of the R381 and R63. Surveys (fauna and flora) were conducted along the route for the classification of the vegetation into habitats, identification of sensitive habitats, compiling of species lists and at the same time to search for Species of Conservation Concern (SCC). The report presents the findings of the site survey and an evaluation of the significance of the impacts of the proposed development.

Environment

The Nuweveld Mountains of the Great Escarpment dominate the area north of the plains around Beaufort West, with plains and dolerite koppies, butts and mesas characteristic south of Loxton. The terrain north of Loxton is flat to gently sloping with isolated hills. The mean annual rainfall in the region ranges from 236 mm at Beaufort West, 249 mm at Carnarvon and 253 mm at Victoria West. The dominant geology consists of mudstone of the Ecca and Beaufort Groups, with dolerite intrusions forming koppies and high mountains. Alluvium occurs along the drainage lines.

Vegetation and habitat types

The route falls in the Nama-Karoo Biome and more specifically in the Upper Karoo Bioregion (NKu) from north of Beaufort West to Carnarvon. The plains around Beaufort West in the south lie in the Lower Karoo Bioregion (NKl). Six broad-scale vegetation types occur along the route: Gamka Karoo (NKl 1); Western Upper Karoo (NKu 1); Upper Karoo Hardeveld (NKu 2); Northern Upper Karoo (NKu 3); Eastern Upper Karoo (NKu 4); and Southern Karoo Riviere (AZi 6).

Based on the topography of the area, the following habitat types were distinguished along the route:

- Drainage lines (watercourses: channels, streams, rivers) and their associated banks;
- Bottomlands on the plains (broad floodplains, leegtes, vloere);
- Plains;
- Valleys in the mountains (bottomlands or valley floors);
- Low hills;
- Footslopes of koppies and mountains;
- Midslopes of mountains, usually steep;
- Plateaux in the mountains; and

- Mountains often comprising a mixture of upper slopes, scarps and crests.

These habitats and their dominant species are briefly described in the report. A checklist of the flora and fauna observed during the site survey as well as the flora and fauna reported to occur in the region were compiled from various sources.

Flora

During the field surveys along the fibre-optic cable route for the current investigation, 356 plant species were recorded. Combined, the NewPosa list and the list for the current study yielded 854 species, which could potentially occur in the environs of the fibre-optic route.

- None of the red list threatened species were recorded during the site survey;
- Fifty-eight species listed as Schedule 4 protected species in The Western Cape were recorded during the site survey in September/October 2020. Most of these protected species belonged to the Aizoaceae.
- Five species listed as Schedule 1 specially protected species and 90 species listed as Schedule 2 protected species in the Northern Cape were recorded during the site survey. Most of these species belonged to the Aizoaceae or Crassulaceae.
- No plant species, classified as threatened or protected (ToPS)) is listed for the study area.
- Twenty-one CITES Appendix II species are listed for the region including mostly *Anacampseros* species*, Aloe* species and *Euphorbia* species. Thirteen species listed by CITES were recorded during the site survey.
- Ten alien invasive species were observed along the fibre-optic cable route.

Fauna

The route falls within the distribution range of 82 terrestrial mammal species. Three IUCN threatened mammal species could occur in the environs of the fibre-optic cable route :

Riverine rabbit	*Bunolagus monticularis*	CR
Mountain reedbuck	*Redunca fulvorufula fulvorufula*	EN
Black-footed cat	*Felis nigripes*	VU

The roan antelope, sable antelope and bontebok listed in Appendix B also have an IUCN threatened status, but have been introduced in the area. These species as well as the mountain reedbuck are likely to occur only in the Karoo National Park or private nature reserves and should not be impacted by the fibre-optic cable project. The riverine rabbit is Critically Endangered due to fragmentation of its habitat in the semi-arid central Karoo region of South Africa. The area south of Loxton is regarded as prime riverine rabbit habitat, in particular around the Sak and Brak Rivers. It is associated with dense, discontinuous vegetation fringing the seasonal rivers of the central Karoo. In general the habitat in the road reserve and at stream crossings is not suitable habitat for the riverine rabbit and traffic and other activities would deter them from making burrows in the road reserve. Furthermore, the animals are nocturnal and thus not active while construction work will be in progress.

The southern mountain reedbuck is listed as Endangered due to large population declines in all protected areas for which long-term count data are available. The mountain reedbuck is present in the Karoo National Park where it seems to have been introduced. They may occur in the mountainous section of the fibre-optic cable route north of Beaufort West and next to the Karoo National Park. It is believed that the overhead cable infrastructure in the road reserve along the route will not interfere with the behaviour of the mountain reedbuck.

The black-footed cat has a very wide distribution and habitat preference and it is likely that they can/do occur within the region. However, they are usually sparsely distributed. Furthermore, the black-footed cat is nocturnal, which would reduce interaction with human activity in the area.

Fifty-seven reptile species are listed for the fibre-optic cable route and these comprise eight tortoises and terrapins; 15 snakes; and 34 lizards. Important habitats for reptiles include the drainage lines, cliffs and rocky outcrops. The Karoo dwarf tortoise *Chersobius boulengeri* has an IUCN threatened status (Endangered) and is endemic to the region.

Fourteen frog species are listed for the study area. Although none of the frog species listed in Appendix B has an IUCN threatened status.

In total 262 bird species are known to occur along the route of the fibre-optic cable. Of these species four are listed as Endangered and six as Vulnerable (IUCN status RSA):

Circus maurus	Black harrier	EN
Mycteria ibis	Yellow-billed stork	EN
Neotis ludwigii	Ludwig's bustard	EN
Polemaetus bellicosus	Martial eagle	EN
Afrotis afra	Southern black korhaan	VU
Aquila verreauxii	Verreaux's eagle	VU
Ciconia nigra	Black stork	VU
Cursorius rufus	Burchell's courser	VU
Falco biarmicus	Lanner falcon	VU
Sagittarius serpentarius	Secretarybird	VU

Wherever the proposed cabling is to be buried, it will not pose a risk to birds. It is also unlikely that nesting sites would be found in the road reserve. On the overhead sections, birds may use the poles as perches, but there will be no risk of electrocution. Overhead cables are restricted to the mountainous sections of the route and collisions by mountain dwelling species may occur. Plains species such as the Ludwig’s bustard should therefore not be compromised. Nevertheless, it is recommended that bird collisions with the overhead cables are monitored after the erection of the cable.

The protected status of the fauna is provided in Appendix B.

Conservation

Vegetation types: All six vegetation types on site are listed as "least threatened".

Protected Areas: Except for a small section, the study area is not located in a protected area although it follows the eastern boundary of the Karoo National Park along the R381 route. In order to traverse the topographically and geologically difficult terrain of the Molteno Pass at the eastern side of the Karoo National Park, it is proposed that the fibre-optic cabling (overhead) be installed in the Park in a corridor where Eskom and Telkom infrastructure has already been established and currently still exists.

National Protected Areas Expansion Strategy (NPAES): The route of the fibre-optic cable does traverse areas earmarked by NPAES for future expansion of the Karoo National Park, but will not interfere with the protected areas expansion strategy, since it is confined to road reserves along existing roads that will not be closed for the purpose of park expansion.

Critical Biodiversity Areas (CBAs): CBAs are regarded as areas of high biodiversity and ecological value and need to be kept in a natural or near-natural state, with no further loss of habitat or species. The proposed construction of the fibre-optic cable will take place in the road reserve, a highly transformed habitat that is not representative of the adjacent land on which the CBA identification was based. Consequently, the classification of the road reserve as CBA1 cannot be upheld.

- Additionally, the proposed SKA fibre-optic cable does not constitute any of the land uses considered to be undesirable in a CBA according to Pool-Stanvliet *et al*. (2017).
- Since the development will primarily take place in the road reserve it will have little impact on existing protected areas and it will also not affect the NPAES.
- Furthermore, the classification of the road reserve as CBA is questionable from a vegetation standpoint, although it might still be marginal riverine rabbit habitat. According to the definition of CBAs1, such areas should be “Areas that are irreplaceable for meeting biodiversity targets. There are no other options for conserving the ecosystems, species or ecological processes in these areas”. A road reserve does not comply with these conditions. The definition of CBAs2 refers to “Areas that are the best option for meeting biodiversity targets, in the smallest area, while avoiding conflict with other land uses” and road reserves are not the best option to meet biodiversity targets.

Ecological Support Areas (ESAs): ESAs need to be maintained in at least a functional and often natural state, but some limited habitat loss may be acceptable.

- Ecological processes that operate within or across ESAs will not be altered by the fibre-optic cable project;
- The extent of the development is small and will not have a negative impact on the functionality of the broader ESA;
- Cable installation will not sever ecological corridors or introduce additional permanent barriers that impede migration and movement of flora and fauna. Thus, no loss of ecological connectivity in relation to the broader landscape is likely.

Ecological processes, function and drivers

These processes will temporarily be altered by the clearing of the vegetation for the trenches and poles. The impact is expected to be fairly small in relation to the adjacent landscape where no change to the ecological processes is anticipated. Overall, it is unlikely that the fibre-optic cable will contribute to the disruption of broad-scale ecological processes such as dispersal, migration or the ability of fauna to respond to fluctuations in climate or other conditions.

Road reserves often act as conduits for alien invasive species and the disturbance caused by the construction of the fibre-optic cable will inevitably create conditions favourable for invasion by alien species. Although the level of infestation along the route was fairly low, an alien invasive plant species monitoring and control programme, nevertheless, needs to be initiated to control alien invasive species.

Fire in this arid part of the Nama-Karoo is rare as a result of the high grazing pressure and variable rainfall and not considered as an important driver of vegetation dynamics.

Ecological sensitivity

An overall sensitivity model was applied to the data for each habitat within the vegetation types on site. The mountains, midslopes, mountain plateaux, mountain valleys and low hills were assigned a moderate sensitivity, meaning a sensitivity rating that is real and sufficiently important to require management, e.g. mitigation measures, management or protection of the rare/threatened fauna and flora, protection of a specific habitat on the property and/or rehabilitation. The sensitivity of the bottomlands, plains and footslopes was low, meaning the sensitivity should not have an influence on the decision about the project. A low sensitivity is usually applicable to habitats that have been transformed, especially by human activities. No buffers are applicable to the development, except along the watercourses, which will be dealt with by the aquatic specialist assessment.

Although none of the habitats were rated as highly sensitive from a vegetation point of view, construction activities in the specific locations of known riverine rabbit occupancy should proceed with the utmost care and consideration for these animals. None of the threatened plant species, which could potentially occur in the region, were encountered during the site survey. Furthermore, although none of the habitats were rated as highly sensitive from a vegetation point of view, this does not exclude the presence of protected plant species along the route. Permits are required for the destruction of protected species. The following species were considered as protected species in this report due to being provincially protected as well as ToPS or CITES listed, although none have an IUCN red list status:

Aloe spp.	*Lessertia frutescens*
Anacampseros albidiflora	*Pachypodium succulentum*
Anacampseros cf. lanceolata	*Mesembryanthemum emarcidum*
Anacampseros ustulata	*Stapelia grandiflora*
Aristaloe aristata	*Stomatium difforme*
Euphorbia clavarioides	*Stomatium suaveolens*
Huernia barbata	*Stomatium villetii*
Gonialoe variegata	

Although there are some protected species on the overhead route, the construction of the overhead cable will not impact significantly on the flora and fauna of the area. Furthermore, it is recommended that the construction teams should avoid obvious rocky sheets (where *Anacampseros* spp. and *Stomatium* spp. may be found) and microsite the location of a post when conspicuous plants are present, e.g. *Aloe broomii*. If heavy machinery is used on steep slopes the impact on the vegetation will increase and appropriate mitigation measures should be implemented.

Some sites were identified where some micrositing of the underground trench should take place to avoid some of the protected species present. These sites are mostly where road cuttings occur through elevated areas and it is recommended that the trench is moved down to the foot of the cutting.

Screening tool verification

The screening tool rated the sensitivity of the Animal Species Theme as **High.** Animal species highlighted by the screening tool for the region included the riverine rabbit, mountain reedbuck and Karoo dwarf tortoise. The presence of two red listed bird species was singled out by the screening tool although our background study revealed the presence of 10 red listed species. **Our own findings concur with the screening tool on the animal theme, in particular as it relates to riverine rabbit habitat around Loxton**.

The screening tool rated the sensitivity of the Plant Species Theme as **Medium.** Plant species highlighted by the screening tool for the region included: *Cliffortia arborea* and sensitive species 704. Our background study corresponded with the screening tool on the possible presence of *Cliffortia arborea* along the route, however sensitive species 704 was not listed for the region on the NewPosa database. Neither of these species were encountered during the site visit. Based solely on the presence of red listed species which were not found along the route, **we would suggest to downgrade the rating of the Plant Species Theme to low**. However, many provincially protected/specially protected and CITES II listed species were recorded.

The screening tool rated the sensitivity of the Relative Terrestrial Biodiversity theme as **Very High.** Our background study disputes the findings of the screening tool on this theme, **and suggests a downgrade to Low.** Since the development will primarily take place in the road reserve it will have little impact on existing protected areas or the NPAES, and the classification of the road reserve as CBA is untenable (see part on Critical Biodiversity Areas above). Where the overhead cabling traverses the Karoo National Park, the physical impact footprint is very limited.

Environmental impacts

The key botanical issue is the fact that the study area is predominantly located in the fenced road reserve and therefore represents a habitat that is in essence transformed and continually disturbed. This habitat is seldom representative of the natural veld adjacent to the road reserve and furthermore, water run-off from the road surface contributes to an unnatural species assemblage in most areas. Rare plant species usually occur in specialised and localised habitats, which are mostly destroyed by road building.

The key faunal issue is the known occurrence of the Critically Endangered riverine habitat (*Bunolagus monticularis)*. The area south of Loxton is regarded as prime riverine rabbit habitat, in particular around the Sak and Brak Rivers.

Although the proposed fibre-optic cable may negatively impact the fauna and flora of the site in various ways, the extent of the impact is expected to be small. The potential impacts for the different phases of the project, identified during the current assessment, are listed below:

Direct and indirect Impacts identified during construction, operational and decommissioning phases:

- Potential impact 1: The clearing of natural vegetation and resultant loss of faunal habitat;
- Potential impact 2: The loss of threatened, protected and endemic plants/animals;
- Potential impact 3: Direct faunal mortalities due to trench digging, increased traffic and possible ingestion or ensnarement of animals due to waste material lying around during construction; bird collisions with the overhead cable during the operational phase could possibly occur;
- Potential impact 4: Increased noise levels due to heavy machinery;
- Potential impact 5: Increased dust deposition;
- Potential impact 6: Establishment of alien vegetation as a result of the clearing of the vegetation; and
- Potential impact 7: Increased water run-off and erosion.

Cumulative impacts identified included:

- Cumulative impact 1: Vegetation loss and habitat destruction and concommittant loss of SCC and protected species.
- Cumulative impact 2: Compromising integrity of CBAs, ESAs and NPAES.
- Cumulative impact 3: Increased water run-off and erosion.

Significance of environmental impact

The impacts of the proposed development on the terrestrial ecology were assessed based on the knowledge gained during the site visit and literature review. In summary:

- Cable installation will probably have a temporary impact on the composition and structure of vegetation. The vegetation in the road reserve contains a large proportion of pioneer plant species that will be able to recolonise the disturbed cable trench within a relatively short period of time. On the overhead sections the impact of the development on the vegetation is deemed to be even less than in the underground sections.
- Since the development footprint is small, the loss of habitat or species will be limited.
- The extent of clearing activities in the different vegetation types is small in relation to the remaining extent of the vegetation types and ecosystem threat status will not be affected.
- The impact on overall species and ecosystem diversity of the adjacent land will not be affected and even within the road reserve, the impact will be small.
- Due to the small area that will be disturbed along the route, the impact on populations of protected species will be negligible.
- Roads are permanent infrastructure and are fenced. The fibre-optic cable will mostly be installed in the road reserve, but will not contribute additional obstruction to animal movement.

The overall impact significance is provided in the table below:

Phase	Overall Impact Significance
Construction	Very low to Low
Operational	Very low
Decommissioning	Very low
Cumulative - Construction	Very low
Cumulative - Operational	Very low
Cumulative - Decommissioning	Very low

Legislative and permit requirements

The regulatory authorities for permit requirements are Department of Environment, Forestries and Fisheries (DEFF) Northern Cape Department of Environment and Nature Conservation (NCDENC) and CapeNature. The following legislation is relevant to the development and may require permits from the relevant authority:

- Protected tree species - National Forest Act (Act No. 84 of 1998): no protected tree species present;
- Threatened or Protected Species (ToPS) – National Environmental Management: Biodiversity Act (Act No. 10 of 2004): no ToPS protected plant species recorded for development; several ToPS protected animal species present, but none to be affected if mitigation measures are applied;
- Protected fauna and flora - Northern Cape Nature Conservation Act (Act No. 9 of 2009) (NCNCA) and Western Cape Nature and Environmental Conservation Ordinance (No. 19 of 1974) (WCNECO) as amended in the Western Cape Nature Conservation Laws Amendment Act (No. 3 of 2000). According to the legislation, no person may pick any flora on a public road or on the land on either side of such road within a distance of 90 m from the centre of such road in the Western Cape (or 100 m in the Northern Cape), without a permit. Furthermore, many of the species are protected/specially protected and separate permits may have to be issued for the destruction of individuals of these species.
- Several plant species are listed in Appendix II of CITES and procedures need to be followed as stipulated by CITES.
- The fibre optic cabling is proposed in the eastern section of the Karoo National Park so as to traverse the difficult terrain associated with the Molteno Pass. As such, Section 50(5) approval from the Karoo National Park in terms of the NEM:PAA is required (refer to Chapter 8.1).

Key environmental mitigation and management actions proposed

- Ensure that the placing of infrastructure takes the sensitivity mapping of the ecological assessment into account to avoid and reduce impacts on Habitats of Conservation Concern and protected species.
- Demarcate all infrastructure sites and delineate routing clearly to avoid unnecessary clearance of the vegetation.
- Avoid or minimise impacts that could potentially affect animal behaviour, in particular that of the riverine rabbit.
- Before trenches are dug, in those areas that have been indicated as prime habitat for the riverine rabbit, the route should be walked on foot to ensure that no burrows are present in the path of the trench.
- Construction of the trench in favoured riverine rabbit habitat should preferably not be conducted during the breeding season (August to May).
- Trenches should not be left open for long periods of time. Trenches should also be inspected for the presence of trapped animals immediately before they are filled.
- Construction crew, in particular the drivers, should undergo environmental training (induction) to increase their awareness of environmental concerns.
- Proper waste management procedures should be in place to avoid waste lying around and to remove all waste material from the site.

- Speed limits should be strictly adhered to.
- Dust control measures must be implemented.
- Permits have to be obtained for the removal of plants within the road reserve and/or NCNCA and WCNECO protected species.
- Implement a monitoring program for the early detection of alien invasive plant species and employ a control program to combat declared alien invasive plant species.

Statement regarding the acceptability or not

The very low impact significance and low sensitivity rating for many of the habitats means the project could go ahead without major constraints, provided the mitigation measures and management actions proposed to protect rare fauna and flora on the site are taken into consideration. We thus support the approval of the project.

LIST OF FIGURES

LIST OF TABLES

ACRONYMS

AIS	Alien Invasive species
BA	Basic Assessment
BAR	Basic Assessment Report
CBA	Critical Biodiversity Area
CBD	Convention on Biodiversity
CITES	Convention on the International Trade in Endangered Species of Wild Fauna and Flora
CSIR	Council for Scientific and Industrial Research
DEFF	Department of Environment, Forestry and Fisheries
DEA	Department of Environmental Affairs
DEA&DP	Department of Environmental Affairs and Development Planning
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EMPr	Environmental Management Plan Report
ESA	Ecological Support Area
IUCN	International Union for the Conservation of Nature
I&APs	Interested and Affected Parties
GIS	Geographical Information System
NC	Northern Cape province
NEMA	National Environmental Management Act
NEM:BA	National Environmental Management: Biodiversity Act
NCNCA	Northern Cape Nature Conservation Act
NPAES	National Protected Area Expansion Strategy
ONA	Other Natural Areas
PA	Protected Area
PWA	Protected Wild Animal
SEA	Strategic Environmental Assessment
SANBI	South African National Biodiversity Institute
SWSA	Strategic Water Source Area
ToPS	Threatened and Protected Species
ToR	Terms of Reference
WC	Western Cape province
WCNECO	Western Cape Nature and Environmental Conservation Ordinance

GLOSSARY

Alien invasive species	Any species whose establishment and spread outside of its natural distribution range (i) threatens ecosystems, habitats or other species or has a demonstrable potential to threaten ecosystems, habitats or other species; and (ii) may result in economic or environmental harm or harm to human health.
Alternative	A possible course of action, in place of another, that would meet the same purpose and need (of the proposal). Alternatives can refer to any of the following but are not limited to: alternative sites for development, alternative projects for a particular site, alternative site layouts, alternative designs, alternative processes and alternative materials.
Alluvium	Unconsolidated material deposited by flowing water
Biodiversity	The variability among living organisms from all sources including, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part and also includes diversity within species, between species, and of ecosystems.
Category 1a Listed Invasive Species	Species listed by notice in terms of section 70(1)(a) of the act, as a species that must be combatted or eradicated. Species are listed in Notice 3 of the AIS list (National List of Invasive Species). Landowners are obliged to take immediate steps to control Category 1a species.
Category 1b Listed Invasive Species	Species listed by notice in terms of section 70(1)(a) of the act, as species that must be controlled or ‘contained’. Species are listed in Notice 3 of the AIS list (National List of Invasive Species). Landowners are obliged to “control” the species in accordance with the requirements of Invasive Species Management Programme.
Category 2 Listed Invasive Species	Species which require a permit to carry out a restricted activity e.g. cultivation within an area specified in the Notice or an area specified in the permit, as the case may be. Category 2 includes plant species that have economic, recreational, aesthetic or other valued properties, notwithstanding their invasiveness. It is important to note that a Category 2 species that falls outside the demarcated area specified in the permit, becomes a Category 1b invasive species. Permit-holders must take all the necessary steps to prevent the escape and spread of the species.
Category 3 Listed Invasive Species	A species listed by notice in terms of section 70(1)(a) of the act, as species which are subject to exemptions in terms of section 71(3) and prohibitions in terms of section 71A of the act, as specified in the notice. Category 3 species are less-transforming invasive species which are regulated by activity. The principal focus with these species is to ensure that they are not introduced, sold or transported. However, Category 3 plant species are automatically Category 1b species within riparian and wetland areas.
Common indigenous animal	A species of indigenous wild animal listed in Schedule 3. (NCNCA 2009).
Common indigenous plant	A species of indigenous plant listed in Schedule 3. (NCNCA 2009).
Critical Biodiversity Areas	Areas required to meet biodiversity targets for ecosystems, species or ecological processes. CBAs are regarded as areas of high biodiversity and ecological value and need to be kept in a natural or near-natural state, with no further loss of habitat or species.
Damage-causing animal	An animal declared to be a damage-causing animal listed in Schedule 4. (NCNCA 2009).
Development	The building, erection, construction or establishment of a facility, structure or infrastructure, including associated earthworks or borrow pits, that is necessary for the undertaking of a listed or specified activity.
Development footprint	Any evidence of physical alteration as a result of the undertaking of any activity.
Ecological Support Areas	These are not essential for meeting biodiversity targets, but play an important role in supporting the functioning of Protected Areas or CBAs and are often vital for delivering ecosystem services. ESAs must be maintained in at least a functional and often natural state, but some limited habitat loss may be acceptable.
Endangered flora	Any species which is in danger of extinction and is specified in Schedule 3 or Appendix I of the CITES (WCNECO 1974).
Endangered wild animal’	A wild animal of any species which is in danger of extinction and is specified in Schedule I or Appendix I of the CITES (WCNECO 1974).
Exempted Alien Species	An alien species that is not regulated in terms of this statutory framework - as defined in Notice 2 of the AIS List.
Habitat	A place where a species or ecological community naturally occurs.
indigenous vegetation	Vegetation consisting of indigenous plant species occurring naturally in an area, regardless of the level of alien infestation and where the topsoil has not been lawfully disturbed during the preceding ten years.
Indigenous	A species that occurs, or has historically occurred, naturally in a free state in nature within the borders of the Republic, but excludes a species that has been introduced in the Republic as a result of human activity;.
Introduced	In relation to a species, means the introduction by humans, whether deliberately or accidentally, of a species to a place outside the natural range or natural dispersal potential of that species;
Linear activity	An activity that is arranged in or extending along one or more properties and which affects the environment or any aspect of the environment along the course of the activity, and includes railways, roads, canals, channels, funiculars, pipelines, conveyor belts, cableways, power lines, fences, runways, aircraft landing strips, firebreaks and telecommunication lines.
Mitigate	The implementation of practical measures to reduce adverse impacts or enhance beneficial impacts of an action.
"No-Go" option	The “no-go” development alternative option assumes the site remains in its current state, i.e. there is no development in the proposed project area.
Prohibited Alien Species	An alien species listed by notice by the Minister, in respect of which a permit may not be issued as contemplated in section 67(1) of the act. These species are contained in Notice 4 of the AIS List, which is referred to as the List of Prohibited Alien Species.
Protected animal	A species of wild animal listed as such in Schedule 2. (NCNCA 2009).

Protected plant	A species of plant listed as such in Schedule 2; NCNCA 2009.
Protected flora	Any species of flora specified in Schedule 4 or Appendix II of the CITES. (WCNECO 1974).
Protected wild animal	Any species of wild animal specified in Schedule 2 or Appendix II of the CITES. (WCNECO 1974).
Specially protected animal	Any animal listed as such in Schedule 1. (NCNCA 2009).
Specially protected plant	Any plant listed as such in Schedule 1. (NCNCA 2009).
Watercourse	Includes (a) a river or spring; (b) a natural channel in which water flows regularly or intermittently; (c) a wetland, pan, lake or dam into which, or from which, water flows; and a reference to a watercourse includes, where relevant, its bed and banks.
Wetland	Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.

REGULATIONS GOVERNING THIS REPORT

This report has been prepared in terms of the EIA Regulations under the National Environmental Management Act (Act No. 107 of 1998) (NEMA 2014, 2017, 2020).

Appointment of specialist

Ekotrust cc was commissioned by CSIR (EMS) Stellenbosch to provide an assessment on the terrestrial ecology and biodiversity of the SKA fibre-optic cable project between Beaufort West in the Western Cape and Carnarvon in the Northern Cape, a distance of 181 km.

Company profile:

Name of Company: Ekotrust cc
(Registration number: CK90/05465/23)
Sole Member: Dr Noel van Rooyen
Founding date: 1990

Ekotrust cc specialises in habitat evaluation, vegetation classification and mapping, floristic diversity assessments, rare species assessments, alien plant assessments and management, wildlife management, wildlife production and economic assessments, veld condition assessment, bush encroachment, fire management, carrying capacity, wildlife numbers and ratios.

Specialist declaration:

We, Noel van Rooyen and Gretel van Rooyen, as the appointed independent specialists, hereby declare that we:

- act as independent specialists in this application;
- 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 our specialist input/study, to be objective, true and correct within the framework of assumptions and limitations;
- do not have and will not have any business, financial, personal or other 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 amendments 2017, NEMA 2020 Procedures for the assessment and minimum requirements for reporting on identified environmental themes in terms of Sections 24(5) (a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for environmental authorisation, and any specific environmental management act;
- declare that there are no circumstances that may compromise our objectivity in performing such work;
- 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;
- will comply with the Act, Regulations and all other applicable legislation;
- have no, and will not engage in, conflicting interests in the undertaking of the activity;
- have no vested interest in the proposed activity proceeding;
- undertake to disclose to the applicant and the competent authority all material information in our 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; or the objectivity of any report, plan or document to be prepared by us for submission to the competent authority;
- all the particulars furnished by us in this form are true and correct; and

- realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Indemnity and conditions relating to this report:
The observations, findings, recommendations and conclusions provided in the current report are based on the compilers' best scientific and professional knowledge and other available information. If new information should become available Ekotrust cc reserves the right to modify aspects of the report. This report (hard copy and/or electronic) must not be amended or extended without the prior written consent of the author. Furthermore, any recommendations, statements or conclusions drawn from or based on this report must make reference to the report. If these recommendations, statements or conclusions form part of a main report relating to the current investigation, this report must be included in its entirety (as an Appendix).

Although Ekotrust cc has exercised due care in preparing this report, it accepts no liability, and by receiving this document, the client indemnifies Ekotrust cc against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, and by the use of the information contained in this document.

Signature of specialists:		
Name of specialist:	Dr N van Rooyen	Prof. MW van Rooyen
Date:	14 January 2021	14 January 2021

GENERAL INFORMATION

Study site: Road from Beaufort West over Loxton to Carnarvon (R63 and R381)

District Municipality:	Pixley ka Seme
Local Municipality (Carnarvon):	Kareeberg
Local Municipality (Loxton):	Ubuntu
District Municipality:	Central Karoo
Local Municipality (Beaufort West):	Beaufort West

Approximate length of road: 181 km

Environmental Assessment Practitioner (EAP):

CSIR
SMART places (Environmental Management Services)
PO Box 320
Stellenbosch 7599
Contact person: Luanita Snyman-Van der Walt
Tel. +27 (0) 21 888 2490
Mobile: 072 182 9718
e-mail: lvdwalt1@co.za

Botanical assessment by:

This specialist assessment has been undertaken by Noel van Rooyen and Gretel van Rooyen of Ekotrust cc. Noel van Rooyen is registered with the South African Council for Natural and Scientific Professions (SACNASP), with Registration Number 401430/83 in the field of Botanical Sciences. Gretel van Rooyen is registered with the South African Council for Natural and Scientific Professions (SACNASP), with Registration Number 400509/14 in the field of Ecological Sciences. The *curriculum vitae* of the specialists are included in Appendix F of this assessment.

Dr Noel van Rooyen Pr.Sci.Nat; Reg. no. 401430/83 - Botanical Sciences
Prof. Gretel van Rooyen Pr.Sci.Nat., Reg. no. 400509/14 – Ecological Sciences; LAkadSA, SAAB;

Address:
7 St George Street,
Lionviham,
Somerset West, 7130,

Mobile: 082 882 0886

e-mails:
noel@ekotrust.co.za
gretel@ekotrust.co.za

TERMS OF REFERENCE

The Scope of Work for the terrestrial ecology specialist study includes the following tasks:

- Compilation of a specialist study in adherence to:
  - the gazetted *Procedures for the assessment and minimum requirements for reporting on identified environmental themes in terms of Sections 24(5) (a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for environmental authorisation* (GG 43110 / 320, 20 March 2020);
  - any additional relevant legislation and guidelines that may be deemed necessary.
- The assessment should be based on existing information, national and provincial databases, South African National Biodiversity Institute (SANBI) mapping, professional experience and field work conducted.
- Undertake a site inspection to identify the site sensitivities, and verify them in terms of the National Web-Based Screening Tool (https://screening.environment.gov.za/).
- Liaise with SANBI to obtain information on sensitive species flagged in the National Web-Based Screening Tool (where species names are obscured / only numbered).
- Describe the terrestrial ecological features of the project area, with focus on features that are potentially impacted by the proposed project. The description should include the major habitat forms within the study site, giving due consideration to terrestrial ecology (flora and fauna), Species of Conservation Concern (SCC) or Protected Species.
- Specify development set-backs / buffers, and provide clear reasons for these recommendations.
- Map the sensitive ecological features within the proposed project area, showing any “no-go” areas (i.e. “very high” sensitivity).
- Provide input on the preferred infrastructure route following the sensitivity analysis.
- Provide sensitive features spatial data in a useable GIS format (kmz / shp).
- Assessment of direct, indirect and cumulative impacts associated with the proposed fibre-optic cable development, with and without mitigation.
- Address relevant concerns / comments raised by Interested and Affected Parties and Stakeholders, including the Competent Authority, during Public Participation Processes on the draft Basic Assessment Report (BAR).
- Identify relevant legislative requirements and permits that may be required.
- Recommend mitigation measures, best practice management actions, monitoring requirements, and rehabilitation guidelines for all identified impacts to be included in the Environmental Management Programme (EMPr).
- Update draft specialist study report after Environmental Assessment Practitioner (EAP) and client review (before public release) and after public review for submission to the Competent Authority for decision-making.
- Address any queries from the Competent Authority during the decision-making phase (as and when they arise).

LIMITATIONS, ASSUMPTIONS AND UNCERTAINTIES

The following assumptions, limitations or uncertainties are listed regarding the evaluation of the impacts of the proposed SKA Fibre-optic Cable project on the terrestrial ecology along the route.

- Surveys along the route were restricted to the area between the road and the fence. In some instances, the fences had been erected very close to the road shoulder and in these cases it is possible that the full statutory width of the road reserve could not be surveyed.
- The area has been poorly collected and the list of plant species that could potentially occur on site as obtained from the NewPosa database, was therefore taken from a far broader area than the study site.
- Rare and threatened plant and animal species are generally uncommon and/or localised and the once-off survey may fail to locate such species.
- Furthermore, rare plant species usually occur in specialised and localised habitats which are mostly destroyed by road building and sightings of rare plant species are therefore unlikely.
- The survey was conducted during dry conditions at the end of September/beginning of October 2020, which is not the ideal sampling season for botanical assessments in this summer rainfall area.
- No trapping (either camera trapping or by way of Sherman traps) was conducted for fauna, since these methods generally provide an underrepresentation of the full faunal diversity within the limited timeframe available.
- The drainage lines (watercourses: streams, rivers) along the route were not surveyed in detail, because the aquatic habitat will be part of the aquatic assessment (EnviroSci 2020).
- The study area predominantly covers the fenced road reserve and therefore represents a habitat that is in essence transformed and continually disturbed. This habitat is seldom representative of the natural veld adjacent to the road except where some sections were not transformed (e.g. in the mountain and where cuttings through the hills or ridges occur). Water run-off from the road surface contributes to an unnatural species assemblage in most areas.
- At the time that the study was conducted, the entire proposed fibre-optic cable route was designed to fall within the road reserve. It has since become apparent that small sections need to traverse the Karoo National Park. These sections were thus not inspected on foot during the site visit.

1. INTRODUCTION

The South African Radio Astronomy Observatory (SARAO) leads South Africa's activities in the Square Kilometre Array (SKA) Radio Telescope. SARAO is a National Facility, managed by the National Research Foundation (NRF), which incorporates all national radio astronomy telescopes and programmes. The SKA project is an international effort to build the world's largest radio telescope, with a square kilometer collecting area. The SKA project in South Africa will include the instruments and programmes such as the MeerKAT and KAT-7 telescopes in the Karoo, Northern Cape province.

Connectivity is required between the SKA core site in the Northern Cape and a data processing facility in Cape Town to transport the science data for the SKA project and its precursor, MeerKAT. Access to fibre-optics is required to transport this data due to the expected data throughputs for the SKA project. SARAO has built an overhead fibre-optic route between Carnarvon and the SKA core site to the north. Additionally, the South African National Research Network (SANReN) has procured access to fibre-optics between Beaufort West and Cape Town. A fibre-optic cable connection must, therefore, be built between Carnarvon and Beaufort West to connect SKA to Cape Town.

The details of the preferred and selected SKA fibre-optic route (Route A) are as follows:

- The fibre route starts from Beaufort West Transnet building, to a 3 m x 6 m signal repeater station at Loxton, and then on to the Carnarvon SKA Point of Presence (PoP) site (location where networking equipment may be accessed).
- The fibre duct and cable will be laid in a 1 m deep and 300 mm wide trench and be buried by backfilling and compacting the trench.
- The majority of the fibre route will be installed underground within the road reserves of roads R381 and R63, and 1 m from the fence of the adjacent private land (approximately 160 km).
- Approximately 21 km will be overhead due to it not being technically or financially feasible to trench on the Molteno Pass and some sections further north. In these sections, the proposed routing may deviate from the road reserve into adjacent land. The total pole length is 9 m, buried 1.5 m deep, with a resultant above-ground height of 7.5 m.
- There are watercourses to cross. Rivers will be crossed using directional drilling 2 m below the riverbed starting 32 m away from river banks.
- There is only one river with solid bedrock (the Brak River near Loxton) where directional drilling is not technically or financially feasible. Here the fibre cable will be attached to the existing road bridge.

SANReN (the Applicant for Environmental Authorisation (EA)) commissioned the Council for Scientific and Industrial Research (CSIR) Environmental Management Services (EMS) to conduct an Environmental Screening Study (ESS), which was completed in May 2020. The ESS reviewed geographic information and relevant environmental legislation to determine the EA and / or licenses that would apply to the proposed SKA fibre-optic cable. The results of the ESS indicated that, inter alia:

- A Basic Assessment (BA) procedure is required to obtain EA for the proposed fibre-optic route. This requirement is triggered by the following Listed Activities of the Environmental Impact Assessment Regulations (NEMA 2017):
- .
    - ***Listing Notice 1: Activity 19 - The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse.***
    - ***Listing Notice 2: Activity 12 – The clearance of an area of 300 m^2 or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan;***

  - *(a) NORTHERN CAPE (i) within any critically endangered ecosystem or endangered ecosystem listed in terms of section 52 of NEM:BA or prior within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004; (ii) within Critical Biodiversity Areas (CBAs) identified in bioregional plans; (iii) within the littoral active zone or 100 m inland from the high water mark of the sea or an estuary; (iv) on land where such land was zoned open space, conservation or had an equivalent zoning;*
  - *(b) WESTERN CAPE (i) within any critically endangered ecosystem or endangered ecosystem listed in terms of section 52 of NEM:BA or prior within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004; (ii) within Critical Biodiversity Areas (CBAs) identified in bioregional plans; (iii) within the littoral active zone or 100 m inland from the high water mark of the sea or an estuarine functional zone; (iv) on land where such land was zoned open space, conservation or had an equivalent zoning; (v) on land designated for protection or conservation purposes in an Environmental Management Framework or a Spatial Development Framework.*
- A terrestrial ecology (fauna and flora) specialist assessment is required as part of the BA.

The current report presents the specialist assessment of the terrestrial ecology component of the BA to obtain EA for the proposed fibre-optic route. The scope, purpose and objectives of the report have essentially been summarised in the Terms of Reference (ToR).

2. APPROACH AND METHODOLOGY

2.1 Approach

The study commenced as a desktop study, followed by field-based surveys from 27 September to 2 October 2020. The focus of the site visit was to conduct surveys (fauna and flora) along the route for the classification of the vegetation into habitats (or plant communities), identification of sensitive habitats, compiling of species lists and at the same time to search for Species of Conservation Concern (SCC).

Hard copy and digital information from spatial databases, such as daffarcgis.nda.agric.za, the geological survey maps (3022 Britstown; 3122 Victoria West; 3222 Beaufort West), land type maps (3022 Britstown; 3122 Victoria West; 3222 Beaufort West), topocadastral maps (nine 1:50 000 maps), vegetation types (Mucina & Rutherford 2006, 2018), NewPosa database of SANBI, and databases of the Animal Demography Unit, University of Cape Town, were sourced to provide information on topography, geology, land types, broad vegetation types, flora and fauna of the study area. Information on the long-term climate was sourced from the Weather Bureau (1988, 1998).

Satellite images (Google Earth) were used to identify broad habitat types along the fibre-optic cable route. The vegetation survey consisted of visiting the habitat types along the route and systematically recording plant species on site, and estimating their cover-abundance. A total of 157 sites were surveyed. Physical habitat features were also noted. During the site visit, digital photographs were taken, and representative photographs of the different habitats are included in the report. The site was also surveyed for rare, threatened and/or endemic plant species during the site visit.

The animal survey was limited to day-time visual assessments along the route. Animal species present along the route were mainly attained by means of direct or indirect sighting methods (animals, spoor, burrows, scats, sounds), whilst traversing the route by vehicle or on foot. Red listed species are generally uncommon and/or localised and the survey may have been insufficient to record their presence at or near the development.

2.2 Vegetation and flora

The plant species data were arranged per vegetation type, and within each vegetation type per habitat. These habitats and their dominant species are briefly described.

The checklist in Appendix A was compiled from various sources. All plant species (the term species is used here in a general sense to denote species, subspecies and varieties) recorded during the site visit are listed in the checklist. A plant species checklist of the route was also obtained from the NewPosa database of SANBI (newposa.sanbi.org) and is incorporated in Appendix A. The International Union for the Conservation of Nature (IUCN) status, conservation and protected status of all plant species provided in Appendix A were determined from available literature and Acts, e.g. NewPosa database (newposa.sanbi.org) and Red list database of SANBI (redlist.sanbi.org), National Environmental Management: Biodiversity Act (NEM:BA) (2007c) (ToPS list), NCNCA (2009), WCNECO (1974, as amended 2000) and CITES (2019).

2.3 Fauna

Species lists (the term species is used here in a general sense to denote species, subspecies and varieties) of the faunal component were sourced from the Animal Demography Unit, University of Cape Town website (adu.uct.ac.za) and consulting of available databases and/or relevant literature, e.g. Skinner and Chimimba (2005), Alexander and

Marais (2007), BirdlifeSA (birdlife.org.za), Bates *et al.* (2014), Leeming (2003) and Mecenero *et al.* (2013) to determine the diversity, conservation status and distribution of relevant faunal species.

2.4 Sensitivity assessment

Based on the environmental features and the species encountered in the on-site survey, a sensitivity assessment of each terrestrial habitat was done (Chapter 9). Sensitive features are presented spatially in GIS format (provided as a separate .kmz file).

2.5 Impact assessment

An assessment of the ecological impacts and their significance on the terrestrial system, is discussed and mitigation measures proposed. The impact assessment was based on the criteria and methodology outlined in the template received from the CSIR (SKA fibre TERRESTRIAL template Sept 2020).

2.6 Sources of information

Vegetation:

- Vegetation types occurring in the area were obtained from Mucina & Rutherford (2006, 2018);
- Conservation status of the vegetation types was obtained from Mucina & Rutherford (2006), National List of Threatened Ecosystems (NEMA 2011) and the most recent National Biodiversity Assessment (NBA) (SANBI 2018a);
- The route does not occur in any Centre of Endemism (Van Wyk & Smith 2001).
- Information on endemic or near-endemic species for the vegetation types was obtained from Mucina & Rutherford (2006);
- A plant species checklist of the route was obtained from the SANBI NewPosa database (Appendix A) (website accessed August 2020).
- The IUCN Red List Category for the plant species was extracted from the Threatened Species Programme (Red List of South African plants; website accessed October 2020) as well as the SANBI NewPosa database (website accessed August 2020).
- WCNECO (1974 as amended in 2000) and NCNCA (2009) were consulted to establish provincially specially protected and protected status of plant species.
- The National Protected tree list (NFA 2019) was consulted.

Fauna

- Lists of mammals, reptiles, birds, frogs, scorpions (Scorpiones), spiders (Arachnida), butterflies (Lepidoptera), lacewings (Neuroptera), dung beetles (Scarabinae) and dragonflies (Odonata) were extracted from the Animal Demography Unit, University of Cape Town website (http://vmus.adu.org.za; website accessed October 2020) and supplemented by information gathered in Bates *et al*. (2014) for reptiles; Skinner and Chimimba (2005) for mammals; Birdlife SA website for the birds; and Mecenero *et al.* (2013) for butterflies (Appendix B).
- The IUCN Red List Category for the animal species was extracted from Child *et al.* (2016), Bates *et al*. (2014) for reptiles; Skinner and Chimimba (2005) for mammals; BirdlifeSA website for the birds (birdlife.org.za); and Mecenero *et al.* (2013) for butterflies. No IUCN Categories are however available for lacewings, dung beetles, spiders and scorpions.
- WCNECO (1974) and NCNCA (2009) were consulted to establish provincially specially protected and protected status of animal species.

Other

- The website of the National Protected Areas Expansion Strategy (NPAES) was consulted for possible inclusion of the site into a protected area in future (accessed October 2020).
- The Northern and Western Cape Biodiversity Area Maps were consulted for inclusion of the route into a Critical Biodiversity Area or Ecological Support Area (biodiversityadvisor.sanbi.org; accessed October 2020).

3. REGULATORY FRAMEWORK

3.1 Introduction

The White Paper on the conservation and sustainable use of South Africa's biodiversity and the NEMA (Act No. 107 of 1998) specify that due care must be taken to conserve and avoid negative impacts on biodiversity and that the sustainable, equitable and efficient use of biological resources must be promoted. Various acts provide control over natural resources in terms of their conservation, the use of biological resources and avoidance of negative impacts on biodiversity. Some international conventions are also relevant to sustainable development.

3.2 Natural resources

Terrestrial and other ecosystems and their associated species are widely used for commercial, semi-commercial and subsistence purposes through both formal and informal markets. While some of this use is well managed and/or sustainable, much is thought to be unsustainable. "Use" in this case refers to direct use, such as collecting, harvesting, hunting and fishing for human consumption and production, as well as more indirect use such as ecotourism and wildlife ranching.

3.3 Convention on Biodiversity (CBD)

South Africa became a signatory to the United Nations Convention on Biological Diversity (CBD) in 1993, which was ratified in 1995. The CBD requires signatory states to implement objectives of the Convention, which are the conservation of biodiversity; the sustainable use of biological resources and the fair and equitable sharing of benefits arising from the use of genetic resources. According to Article 14 (a) of the CBD, each Contracting Party, as far as possible and as appropriate, must introduce appropriate procedures, such as environmental impact assessments of its proposed projects that are likely to have significant adverse effects on biological diversity, to avoid or minimise these effects and, where appropriate, to allow for public participation in such procedures.

3.4 National Environmental Management Act (Act No. 107 of 1998) (NEMA)

The NEMA is the framework environmental management legislation, enacted as part of the government's mandate to ensure every person's constitutional right to an environment that is not harmful to his or her health or well-being. It is administered by DEFF but several functions have been delegated to the provincial environment departments. One of the purposes of NEMA is to provide for co-operative environmental governance by establishing principles for decision-making on matters affecting the environment. The Act further aims to provide for institutions that will promote cooperative governance and procedures for coordinating environmental functions exercised by organs of state and to provide for the administration and enforcement of other environmental management laws.

The EIA Regulations Listing Notices of 2010 were repealed in 2014 and replaced by NEMA (2014) and amended regulations and listings were published in 2017 (NEMA 2017) under the National Environmental Management Act. Listing Notice 1 (GRN No. 327), Listing Notice 2 (GRN No 325) and Listing Notice 3 (GRN No 324) of the 2017 Regulations list activities that may require EA prior to commencement of an activity and identify competent authorities in terms of sections 24(2) and 24D of the Act.

Procedures for the assessment and minimum criteria for reporting on identified environmental themes in terms of Sections 24(5)(a) and (h) and 44 of the NEMA 1998, when applying for EA were published in the Government Gazette 43110, No 320, 20 March 2020.

3.5 National Environmental Management: Biodiversity Act (Act No. 10 of 2004) (NEM:BA)

As the principal national act regulating biodiversity protection, NEM:BA, which is administered by DEA, is concerned with the management and conservation of biological diversity, as well as the use of indigenous biological resources in a sustainable manner. The term biodiversity, according to the Convention on Biodiversity (CBD), refers to the variability among living organisms from all sources including, *inter alia* terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity in genes, species and ecosystems.

Threatened ecosystems

Section 53 of NEM:BA lists the threatened status of ecosystems, i.e. critically endangered ecosystems, endangered ecosystems, and vulnerable ecosystems. The list of threatened ecosystems was published in 2011 (NEM:BA 2011). Thirty-four percent of South Africa's 440 terrestrial ecosystems are considered threatened. Of these, 5% are critically endangered (mostly in fynbos and forest biomes), 13% are endangered (mostly in the grassland and savanna biomes), and 16% are vulnerable (mostly in the fynbos and grassland biomes). The recent 2018 NBA (SANBI 2018a) includes the updated extent and status of threatened ecosystems, although not yet formally adopted under the NEM:BA.

Threatened or Protected Species (ToPS) Regulations

Section 56 of NEM:BA makes provision for the declaration of species which are of such high conservation value, national importance or are considered threatened that they need protection, i.e. critically endangered species, endangered species and vulnerable species. Lists of species that are threatened or protected, and associated activities that are prohibited and/or exempted from restriction were published in 2007 (NEMBA 2007c). Any proposed development involving one or more threatened or protected species and/or prohibited/restricted activities will require a permit in term of these Threatened or Protected Species (ToPS) Regulations.

Alien and Invasive Species (AIS) Regulations

Chapter 5 of NEM:BA provides for the protection of biodiversity from alien and invasive species. The act defines alien species and provides lists of invasive species in regulations. The Alien and Invasive Species (AIS) Regulations, in terms of Section 97(1) of NEM:BA, was published in Government Notice R598 in Government Gazette 37885 in 2014 (NEM:BA 2014). The Alien and Invasive Species (AIS) lists were subsequently published in Government Notice R 864 of 29 July 2016 (NEM:BA 2016).

In terms of the aforementioned legislation, the following categories of declared alien and invasive plants are recognised in South Africa (see Glossary for explanations):

1. Exempted Alien Species
2. Prohibited Alien Species
3. Category 1a Listed Invasive Species
4. Category 1b Listed Invasive Species
5. Category 2 Listed Invasive Species
6. Category 3 Listed Invasive Species

3.6 The National Environmental Management: Protected Areas Act (Act No. 57 of 2003) (NEM:PAA)

The National Environmental Management: Protected Areas Act (NEM:PAA) provides for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes; for the establishment of a national register of all national, provincial and local protected areas; for the management of those areas in accordance with national norms and standards; for intergovernmental co-operation and public consultation in matters concerning protected areas; and for matters in connection therewith. Specifically, before any development, construction or farming may be permitted in a national park, nature reserve or world heritage site, prior written approval of the Park management authority is required in order to go ahead (Section 50(5)). The fibre optic cabling is proposed in the eastern section of the Karoo National Park so as to traverse the difficult terrain associated with the Molteno Pass. As such, Section 50(5) approval from the Karoo National Park in terms of the NEM:PAA is required (refer to Chapter 8.1).

3.7 National Forests Act (Act No. 84 of 1998) (NFA)

The National Forest Act (NFA) makes provision for the declaration of for example specially protected areas, forest nature reserves, forest wilderness areas and protected woodlands. The latest list of declared protected tree species in terms of the NFA was published in 2019 (NFA 2019). In terms of section 15(1) of this act, no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree or any product derived from a protected tree, except under a license or exemption granted by the Minister to an applicant and subject to such period and conditions as may be stipulated. The competent authority responsible for considering and issuing the license in terms of the NFA will be the National DEFF.

3.8 Conservation of Agricultural Resources Act (Act No. 43 of 1983) (CARA)

The objectives of the Conservation of Agricultural Resources Act (CARA) are to provide for the conservation of the natural agricultural resources by the maintenance of the production potential of the land, by combating and preventing erosion and weakening or destruction of the water resources, and by protecting natural vegetation and combating weeds and invader plants. In order to achieve the objectives, certain control measures are prescribed to which land users must comply. The activities mentioned relate to:

- the cultivation of virgin soil;
- the irrigation of land;
- the prevention or control of waterlogging or salinisation of land;
- the utilisation and protection of vleis, marshes and water courses;
- the regulation of the flow pattern of run-off water;
- the utilisation and protection of vegetation; and
- the restoration or reclamation of eroded land.

3.9 Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES)

The Convention on the International Trade in Endangered Species (CITES) is an international agreement to which countries adhere voluntarily. The aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. The species covered by CITES are listed in three appendices reflecting the degree of protection that the species needs. Appendix I includes species that are threatened with extinction and trade in these species is permitted only in exceptional circumstances. Appendix II lists species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled. Appendix III lists species that are protected in at least one country that has asked other CITES parties for assistance in controlling the trade (Website: www.cites.org, accessed October 2020).

4. STUDY AREA

4.1 Location

The project covers the route along the R381 between Beaufort Wes and Loxton and the R63 between Loxton and Carnarvon (Figures 1 & 2). The road covers both the Western Cape and the Northern Cape with the provincial boundary about 15 km south of Loxton. The area falls within the Central Karoo District Municipality in the Western Cape (Beaufort West Local Municipality) and the Pixley ka Seme District Municipality of the Northern Cape. The two local municipalities in the Northern Cape are the Ubuntu Local Municipality and the Kareeberg Local Municipality. The route starts at 32° 21' 03.0" S; 22° 34' 35.3" E in Beaufort West and ends at 30° 58' 12.3" S; 22° 08' 29.1" E in Carnarvon in the north.

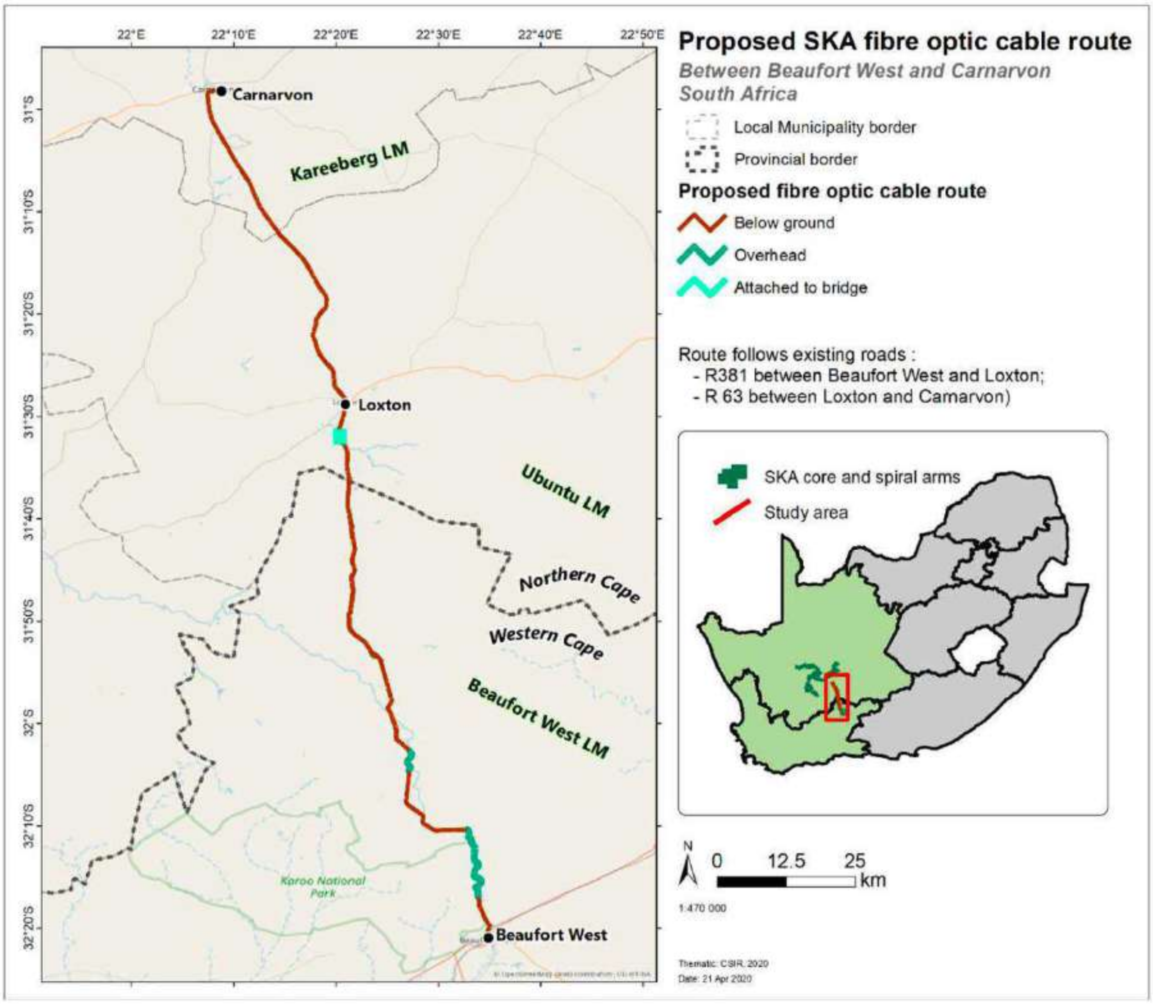


Figure 1:The proposed SKA fibre-optic cable route between Beaufort West and Carnarvon via the R381 and R63 roads (sourced from CSIR 2020).

The topocadastral quarter degree grid references and 1: 50 000 maps are:

3222 CC Beaufort West	3222 BA Kuilspoort
3222 AB Rosedene	3122 CD Dunedin
3122 CB Slangfontein	3122 AD Loxton
3122 AB Alarmkraal	3122 AA Flinkskop
3022 CC Carnarvon	

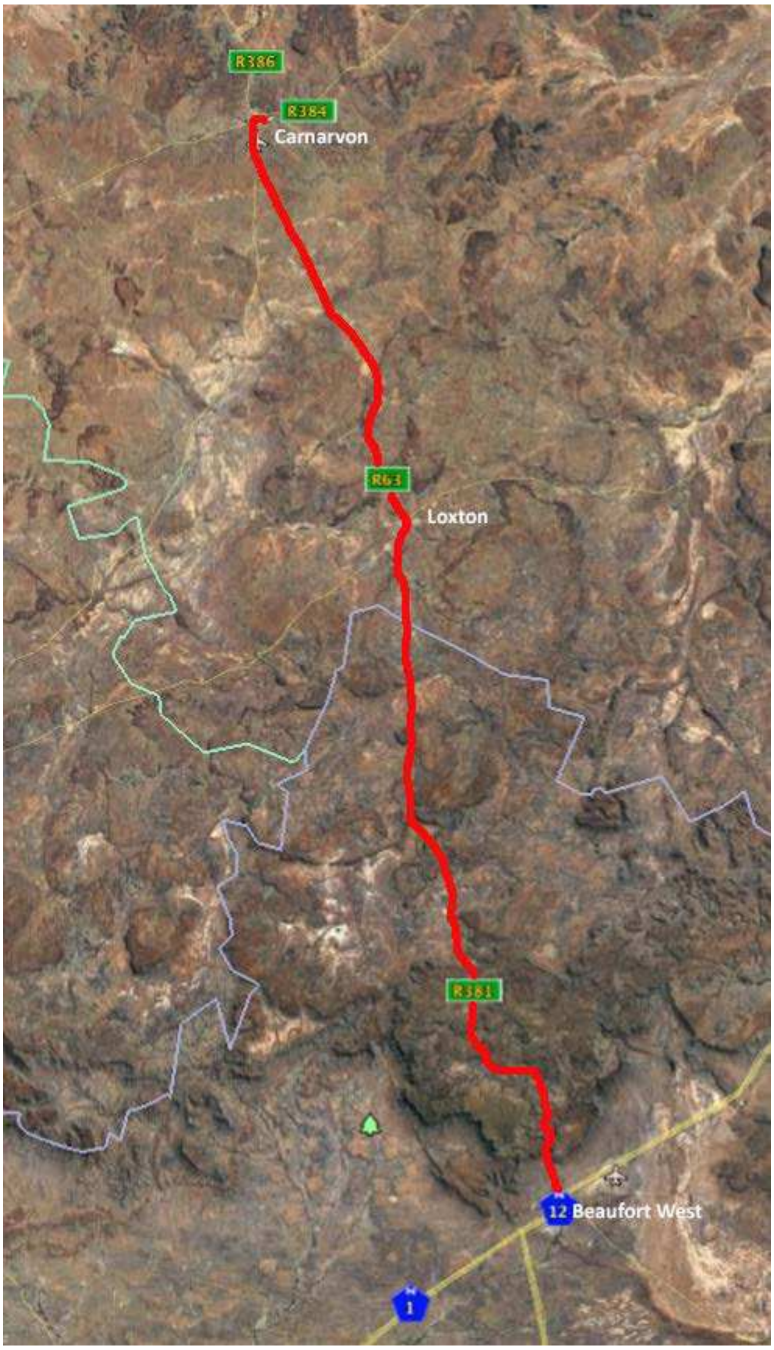


Figure 2: Google image of SKA fibre-optic cable route between Beaufort West and Carnarvon.

4.2 Terrain morphology

The route starts in the south at Beaufort West at an altitude of approximately 855 m. The altitude increases to about 1600 m north of the Karoo National Park and then decreases to reach Loxton at 1400 m altitude. From Loxton the altitude decreases further to approximately 1250 m at Carnarvon in the north. The terrain in the north is flat to gently sloping with isolated hills. Dolerite koppies, butts and mesas are characteristic south of Loxton with the Nuweveld Mountains of the Great Escarpment dominating the area towards Beaufort West.

4.3 Climate

4.3.1 Regional climate (Mucina & Rutherford 2006)

The Eastern Upper Karoo covers most of the plains to the north of the Great Escarpment. The mean annual precipitation in this vegetation type is 295 mm (range from 180 mm in the west to 430 mm in the east) with a peak in rainfall in March. The annual precipitation coefficient of variation is 35%. Mean annual potential evaporation is 2360 mm, while the mean annual soil moisture stress is 82%. Mean annual temperature is 14.7°C and frost is frequent in winter with a mean of 52 days per annum.

The Upper Karoo Hardeveld covers the Great Escarpment north of Beaufort West. The mean annual precipitation in this area is 254 mm (range from 150 mm in the northwest to 350 mm in the east) with a peak in March. The annual precipitation coefficient of variation is 36%; mean annual potential evaporation is 2440 mm, while the mean annual soil moisture stress is 82%. Mean annual temperature is 14.7°C and frost is frequent in winter with a mean of 46 days per annum.

The Gamka Karoo covers the plains south of the Great Escarpment (around Beaufort West) and is one of the most arid units of the Nama-Karoo Biome. The mean annual precipitation of this area is 165 mm (range from about 100 mm in some areas between the Dwyka and Gamka Rivers to about 240 mm against the Great Escarpment) with a peak in March. The annual precipitation coefficient of variation is 38%; mean annual potential evaporation is 2483 mm, while the mean annual soil moisture stress is 84%. The mean annual temperature is 16.3°C and frost is frequent in winter with a mean of 27 days per annum.

Thus, although there is a substantial difference in mean annual rainfall in the three vegetation types, the coefficient of variation in the annual rainfall; the mean annual potential evaporation and mean annual soil moisture stress are similar for all three vegetation types. The mean annual temperature in the Gamka Karoo is somewhat higher than that of the other two vegetation types.

4.3.2 Rainfall

The mean annual rainfall in the region ranges from 157 mm at Williston to 174 mm at Fraserburg, 236 mm at Beaufort West, 249 mm at Carnarvon and 253 mm at Victoria West (Table 1).

Table 1: Rainfall at some weather stations in the general environs of the fibre-optic cable's route (Weather Bureau 1998)

	Mean Annual Rainfall (mm)				
Month	**Beaufort West**	**Carnarvon**	**Williston**	**Victoria West**	**Fraserburg**
Jan	35	21	8	26	16
Feb	30	42	19	39	24
Mar	30	45	29	50	31
Apr	20	37	20	25	20
May	11	12	13	18	15
June	8	11	8	9	9
July	9	6	13	8	8
Aug	14	7	6	7	8
Sep	12	7	8	11	8
Oct	21	16	9	14	10
Nov	27	21	15	21	12
Dec	19	24	9	25	13
Year	236	249	157	253	174

The mean annual rainfall as measured at Carnarvon is 249 mm (Table 2, Figure 3). The total annual rainfall at Carnarvon during dry and wet years respectively may range from 102 mm to 493 mm, indicating a high variation in the annual rainfall and therefore a rainfall scenario that is highly unpredictable. The rainy season at Carnarvon is predominantly from November to April when about 76% of the annual rainfall occurs. February, March and April are the wettest months and the driest period is from July to September, when less than 10 mm of rain per month is recorded. Maximum rainfall measured over a 24-hour period at Carnarvon was 77 mm, recorded in April. The highest monthly rainfall recorded was 145 mm, measured in February.

Table 2: Maximum rainfall (mm) in 24 hours, highest maximum and lowest monthly minimum rainfall at Carnarvon: 30° 58' S; 22° 00' E; 1280 m (Weather Bureau 1998)

	Rainfall (mm)			
Month	**Mean (month)**	**24 h max**	**Max per month**	**Min per month**
Jan	21	38	104	0
Feb	42	68	145	1
Mar	45	63	112	2
Apr	37	77	115	1
May	12	23	29	0
June	11	28	34	1
July	6	18	29	0
Aug	7	15	38	0
Sep	7	32	38	0
Oct	16	32	65	0
Nov	21	58	69	0
Dec	24	47	125	0
Year	249	77	493	102

The mean annual rainfall as measured at Beaufort West to the southwest is 236 mm per annum (Table 3, Figure 4). The total annual rainfall at Beaufort West during dry and wet years respectively may range from 129 mm to 472 mm, indicating the unpredictable nature of the rainfall. October to April is the main rainy season at Beaufort West when about 77% of the annual rainfall occurs. January to March are the wettest months and the driest period is from June to July, when less than 10 mm of rain per month is recorded. The maximum rainfall measured over a 24-hour period at Beaufort West was 83 mm in March. The highest monthly rainfall recorded was 164 mm, measured in January.

Table 3: Maximum rainfall (mm) in 24 hours, highest maximum and lowest monthly minimum rainfall at Beaufort West: 32° 18' S; 22° 14' E; 893 m (Weather Bureau 1998)

Month	Mean (month)	24 h max	Max per month	Min per month
Jan	35	50	164	0
Feb	30	67	133	0
Mar	30	83	83	2
Apr	20	30	65	2
May	11	70	78	0
June	8	18	26	0
July	9	34	42	0
Aug	14	55	73	0
Sep	12	41	58	0
Oct	21	48	68	0
Nov	27	47	70	2
Dec	19	38	106	0
Year	236	83	472	129

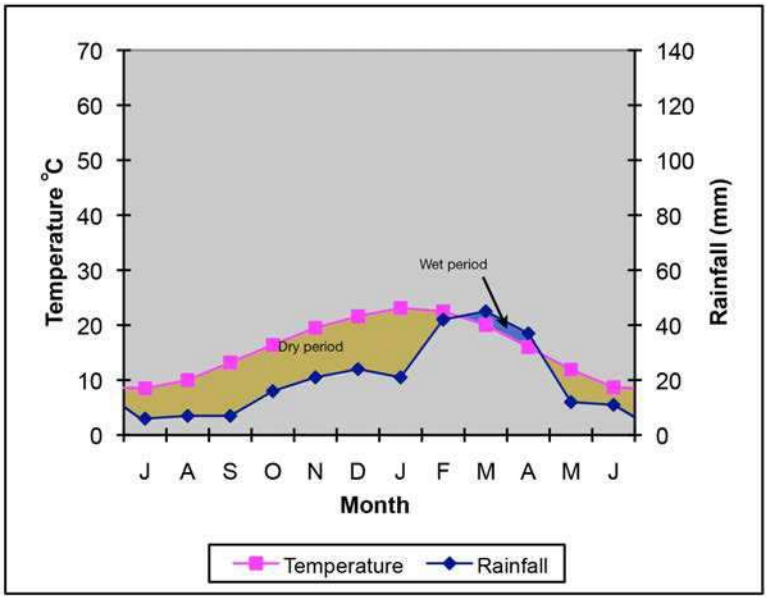


Figure 3: Climate diagram for Carnarvon. Months on X-axis are from July to June. When the rainfall curve is below the temperature curve it indicates a dry period.

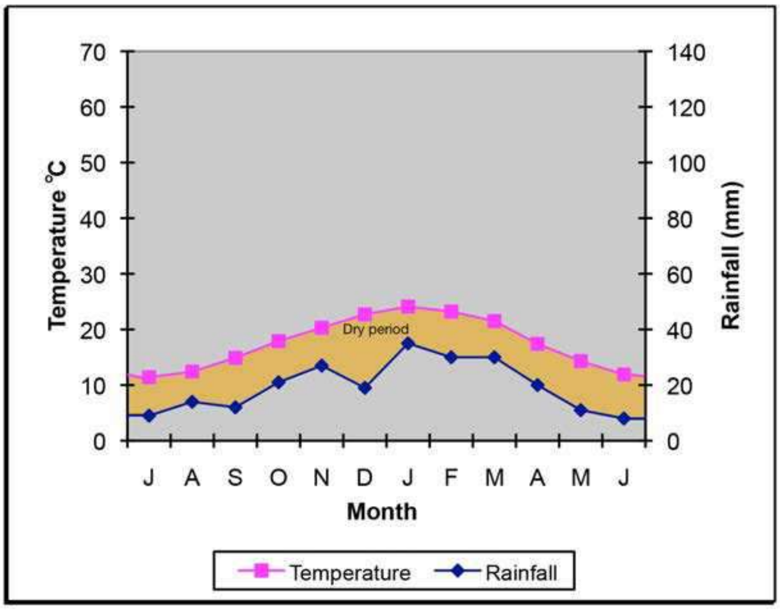


Figure 4: Climate diagram for Beaufort West. Months on X-axis are from July to June. When the rainfall curve is below the temperature curve it indicates a dry period.

4.3.3 Temperature

The mean annual temperature for Carnarvon is 16.0°C (Table 4) with the extreme maximum and minimum temperatures 39.0°C and -9.1°C respectively. The mean daily maximum for January is 31.4°C and for July it is 15.9°C, whereas the mean daily minimum for January is 14.8°C and for July it is 1.0°C. Frost may occur anytime from March to November.

The mean annual temperature for Beaufort West is 17.7°C (Table 5) with the extreme maximum and minimum temperatures 41.4°C and -5.6°C respectively. The mean daily maximum for January is 32.3°C and for July it is 18.4°C, whereas the mean daily minimum for January is 15.8°C and for July it is 4.3°C. Frost may occur from April to October.

Table 4: Temperature data (°C) for Carnarvon: 30° 58’ S; 22° 00’ E; 1280 m (Weather Bureau 1998)

	Temperature (°C)												
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Max	31.4	30.3	27.4	23.0	18.9	15.7	15.9	17.9	21.6	24.9	28.0	29.9	23.8
*Ext. Max	38.5	38.6	36.6	33.6	28.8	23.0	25.1	27.7	34.0	35.6	36.5	39.0	39.0
Min	14.8	14.8	12.6	9.0	4.8	1.8	1.0	2.1	4.8	8.0	11.0	13.3	8.2
*Ext. Min	6.5	4.6	-3.7	-1.0	-4.2	-7.5	-7.5	-9.1	-6.5	-2.5	-0.5	1.6	-9.1
Mean	23.1	22.5	20.0	16.0	11.9	8.7	8.5	10.0	13.2	16.4	19.5	21.6	16.0

Max = mean daily maximum temperature for the month
*Ext. Max = extreme maximum temperature recorded per month
Min = mean daily minimum temperature for the month
*Ext. Min = extreme minimum temperature recorded per month
Mean = mean monthly temperature for each month and for the year

Table 5: Temperature data (°C) for Beaufort West: 32° 18’ S; 22° 14’ E; 893 m (Weather Bureau 1998)

	Temperature (°C)												
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Max	32.3	31.2	28.9	24.4	21.1	18.5	18.4	19.8	22.8	25.7	28.4	31.0	25.2
*Ext. Max	41.4	40.7	38.8	36.0	32.2	28.8	28.5	33.8	36.2	38.8	40.5	40.3	41.4
Min	15.8	15.3	14.0	10.4	7.5	5.1	4.3	4.9	7.0	10.1	12.3	14.4	10.1
*Ext. Min	8.2	4.9	3.5	-0.3	-2.5	-4.9	-5.6	-5.4	-3.5	-0.5	3.0	4.3	-5.6
Mean	24.1	23.2	21.5	17.4	14.3	11.9	11.4	12.4	14.9	17.9	20.3	22.7	17.7

Max = mean daily maximum temperature for the month
*Ext. Max = extreme maximum temperature recorded per month
Min = mean daily minimum temperature for the month
*Ext. Min = extreme minimum temperature recorded per month
Mean = mean monthly temperature for each month and for the year

4.3.4 Cloudiness and relative air humidity

At Carnarvon, the cloud cover at 14:00 is the highest from February to April (2.8 - 3.0 eights) and in October (2.7 eights) and the lowest in June, July and August (1.8 - 2.1 eights) (Table 6). The highest mean relative air humidity (%) at 08:00 occurs during the autumn and winter months (April to July; 74 – 76%) and the lowest relative air humidity at 14:00 (25 - 26%) occurs in summer (November to January) (Weather Bureau 1988, 1998).

Table 6: Cloud cover at 14:00 and percentage relative air humidity at 08:00 and 14:00 at Carnarvon: 30° 58’ S; 22° 00’ E; 1280 m (Weather Bureau 1988, 1998)

	Cloud (0-8)	**Relative air humidity %**	
	14:00	**08:00**	**14:00**
Jan	2.4	56	25
Feb	3.0	64	32
Mar	2.9	71	36
Apr	2.8	75	39
May	2.4	76	38
June	2.1	76	39
July	1.8	74	35
Aug	2.0	69	32
Sept	2.5	64	29
Oct	2.7	56	27
Nov	2.5	53	25
Dec	2.4	55	26
Year	2.5	66	32

At Beaufort West, the cloud cover at 14:00 is the highest in April (3.3 eights) and from September to November (3.2 - 3.7 eights) and the lowest from December to March (2.4 - 2.8 eights) and May to August (2.7 - 2.9 eights) (Table 7). The highest mean relative air humidity (%) at 08:00 occurs during the autumn months (March and April; 70 – 74%)

and the lowest relative air humidity at 14:00 (26%) occurs in summer (December and January) (Weather Bureau 1988, 1998).

Table 7: Cloud cover at 14:00 and percentage relative air humidity at 08:00 and 14:00 at Beaufort West: 32° 18' S; 22° 14' E; 893 m (Weather Bureau 1988, 1998)

	Cloud (0-8)	Relative air humidity %	
	14:00	08:00	14:00
Jan	2.7	67	26
Feb	2.4	69	29
Mar	2.8	74	33
Apr	3.3	70	32
May	2.7	65	29
June	2.9	65	33
July	2.8	65	32
Aug	2.7	65	31
Sept	3.2	68	29
Oct	3.7	68	31
Nov	3.2	66	29
Dec	2.8	64	26
Year	2.9	68	30

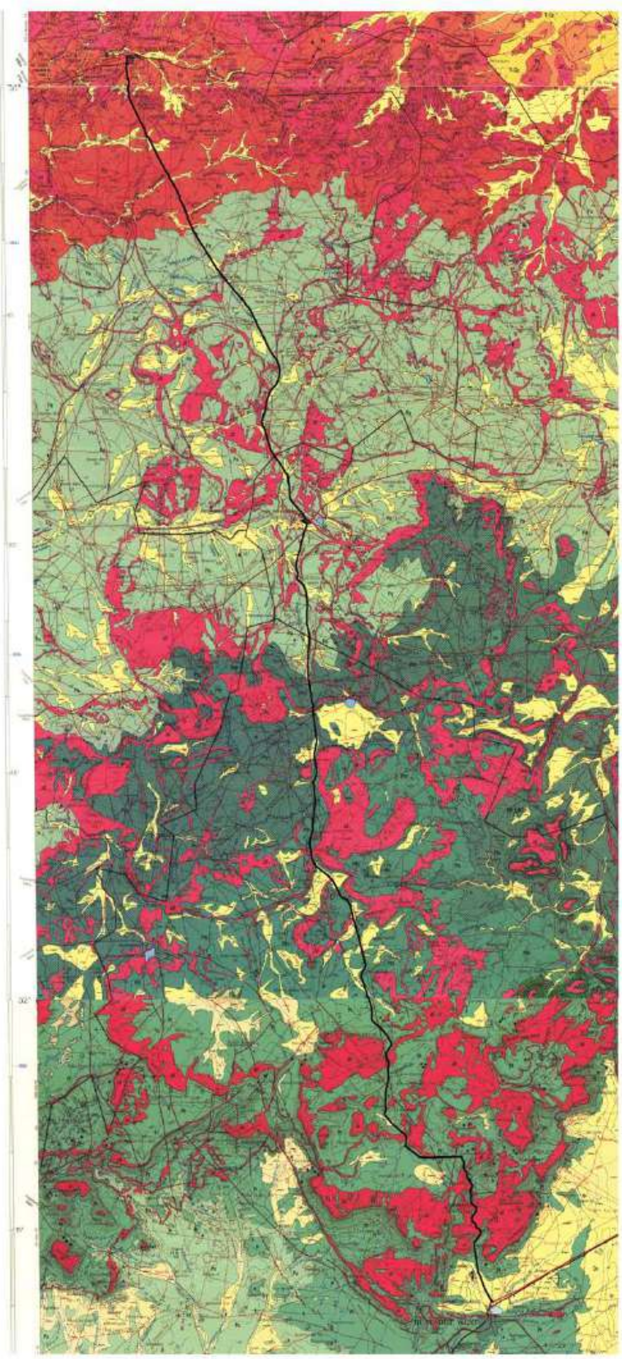
4.4 Geology

The geology of the route is depicted in the 1:250 000 geological maps 3022 Britstown, 3122 Victoria West and 3222 Beaufort West (Figure 5). The dominant geology consists of mudstone of the Ecca and Beaufort Groups, with dolerite intrusions forming koppies and high mountains, e.g. Nuweveld Mountains. Alluvium occurs along the drainage lines.

Around Beaufort West the geology consists of mudstone (red in places) with siltstone and sandstone and thin greenish cherty beds near the base and thin pink tuff beds in the northeast (Teekloof Formation, Beaufort Group). Further north the main substrates are purple, green and grey mudstone and sandstone and red and purple mudstone with subordinate sandstone, both of the Teekloof Formation, Beaufort Group. Towards Loxton, the geology consists of mudstone (red in places) and sandstone with thin greenish cherty beds of the Abrahamskraal Formation, Beaufort Group. The area around Carnarvon is underlain by grey to blue-grey mudstone (or shale), siltstone and sandstone of the Carnarvon Formation, Ecca Group.

4.5 Land types

Land types denote areas that display a marked degree of uniformity with respect to terrain form, soil pattern and climate. A terrain unit within a land type is any part of the land surface with homogeneous form and slope. The route covers about 22 land types consisting of the Ag, Da, Db, Fb, Fc and Ib Land Types (Figure 6). The Ag land types are characterised by red-yellow apedal freely drained soils with a high base status and less than 300 mm deep, derived from grey mudstone, shale, siltstone and sandstone. The soils of the Da and Db land types are typically with prismacutanic and/or pedocutanic diagnostic horisons dominant, mainly red horisons in the Da land type and not red in the Db land type. The soils are derived from purple-green to grey mudstone and sandstone. The Fb land types consist of Glenrosa and/or Mispah soil forms where lime is rare or absent in the upland soils but generally present in low-lying soils. The Fc land types are similar, but lime is generally present in the entire landscape. The soils are derived from mudstone, shale and sandstone while dolerite intrusions are common. The Ib land type covers the high mountains and is typically rocky with miscellaneous land classes and soils.



Legend

1	Alluvium, calcrete - Quaternary and Tertiary deposits (Qc and T-Qc)
2	Grey to greenish shale, mudstone, subordinate sandstone and siltstone, greenish chert and tuff (Pt)
3	Red and purple mudstone, subordinate sandstone (Pth)
4	Blue-grey to green mudstone, subordinate sandstone and siltstone (Pa)
5	Blue-grey to green mudstone, subordinate sandstone and siltstone, with shale, but richer in sandstone than Pa (Pc)
6	Dolerite (Jd)

Figure 5: Geology of the region along the fibre-optic route. (Note a slight mismatch between some of the geological sheets, e.g. Pt becoming Pth.)

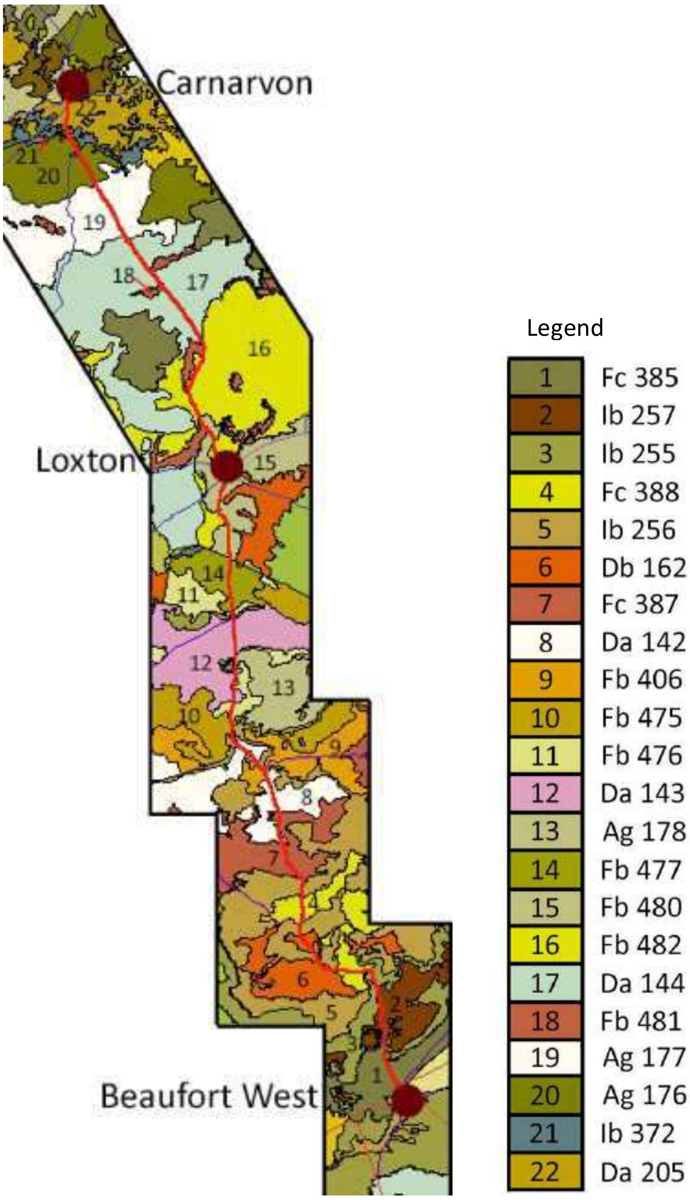


Figure 6: Land types of the region along the fibre-optic route.

5. VEGETATION

5.1 Overview

The route falls in the Nama-Karoo Biome and more specifically in the Upper Karoo Bioregion (NKu) from north of Beaufort West to Carnarvon. The plains around Beaufort West lie in the Lower Karoo Bioregion (NKl). The route does not fall within any Centre of Endemism according to Van Wyk & Smith (2001).

5.2 Broad-scale vegetation types

Six vegetation types (Mucina & Rutherford 2006; 2018) occur along the route (Figure 7).

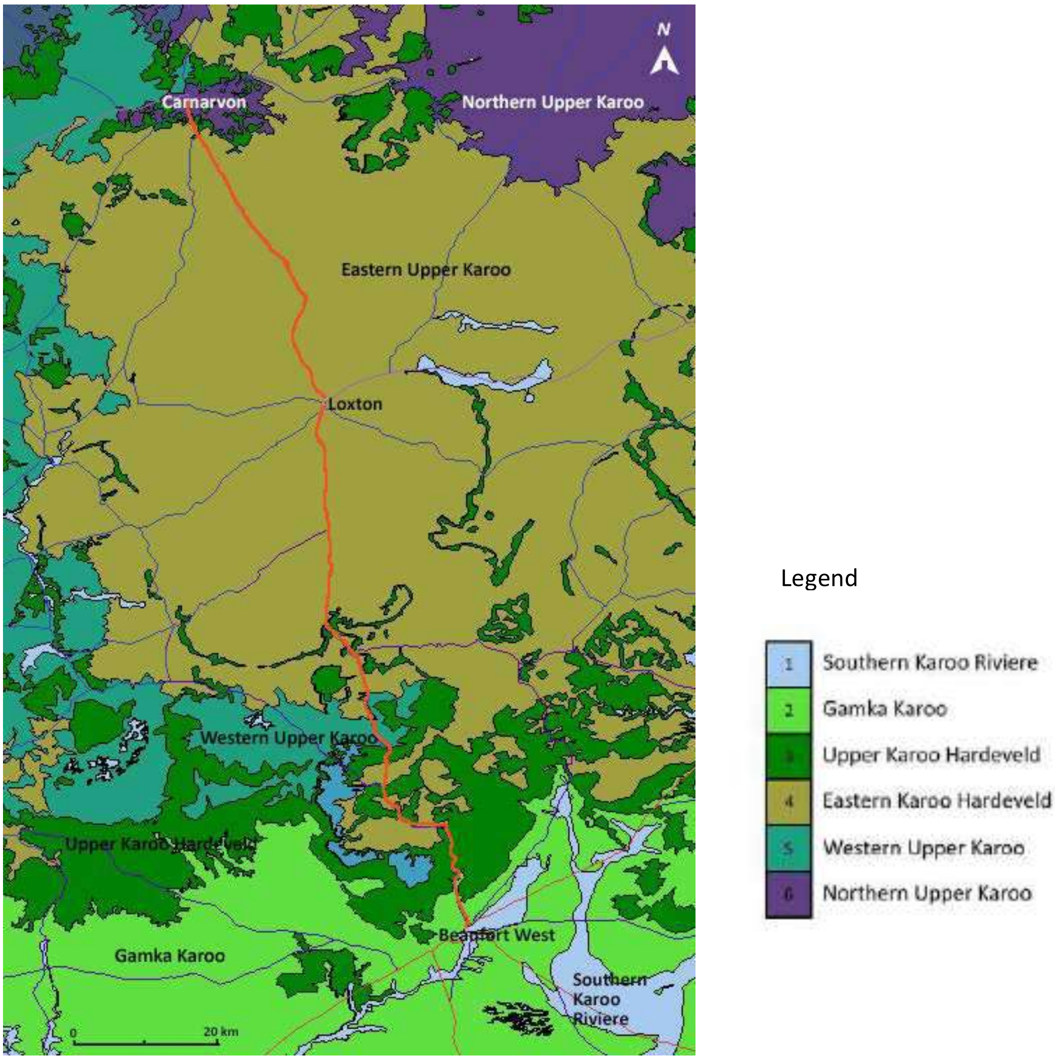


Figure 7. Vegetation types along the route from Carnarvon in the north to Beaufort West in the south.

5.2.1 Gamka Karoo (NKl 1)

This vegetation type occurs in the southern section of the route in the vicinity of Beaufort West. The vegetation type covers 20 325 km^2 in South Africa and occurs between the Great Escarpment (Nuweveld Mountains) in the north and Cape Fold Belt Mountains (Swartberg Mountains) in the south (Figure 7). It occurs on irregular to slightly undulating plains covered with dwarf spiny shrubland, dominated by Karoo dwarf shrubs (Figure 8). Mudrock and sandstones of the Beaufort Group with some Ecca Group shales cover the area. The dominant shrub and dwarf shrub species are *Lycium* spp., *Rhigozum obovatum, Vachellia karroo, Searsia burchellii, Chrysocoma ciliata, Eriocephalus* spp.*, Felicia muricata* and *Pentzia incana*. The most prominent grass species include *Aristida congesta, Aristida diffusa, Fingerhuthia africana, Stipagrostis ciliata, Stipagrostis obtusa* and *Eragrostis* spp.

Figure 8: Landscape of the Gamka Karoo (NKl 1) around Beaufort West.

The vegetation type is classified as 'least threatened' / 'least concern' with about 2.6% statutorily conserved in the Karoo National Park and some private nature reserves (Mucina & Rutherford 2006, NEMA 2011, SANBI 2018a). Only a small part has undergone transformation. Endemic plant species include *Chasmatophyllum stanleyi, Hereroa incurva, Hoodia dregei, Ruschia beaufortensis, Jamesbrittenia tenuifolia, Manulea karrooica* and *Piaranthus comptus*.

5.2.2 Western Upper Karoo (NKu 1)

This vegetation type covers 17 150 km^2 in South Africa and occurs on plains and much-dissected landscapes associated with the tributaries of the upper catchment of rivers such as the Sak River (Figures 7). Along the route of the fibre-optic cable this vegetation type covers a small section between the Upper Karoo Hardeveld and the Eastern Upper Karoo. A mixture of small-leaved shrubs and shrubby succulents with drought-resistant grasses is the determinant feature of the vegetation structure (Figure 9). The geological substrate includes Karoo sediments (mudstones, shales and arenite) of the Beaufort Group. The most prominent shrubs and dwarf shrubs include *Lycium cinereum, Rhigozum trichotomum, Chrysocoma ciliata, Eriocephalus ericoides, Pentzia globosa, Osteospermum spinescens* and *Tetragonia arbuscula*. The grass layer is dominated by *Aristida congesta, Enneapogon desvauxii, Stipagrostis ciliata* and *Stipagrostis obtusa.*

The vegetation type is classified as 'least threatened' / 'least concern', with none conserved in statutory conservation areas (Mucina & Rutherford 2006, NEMA 2011, SANBI 2018a). Very little of the area is transformed. Endemic plant species include *Stomatium villetii* and *Zaluzianskya bella*.

Figure 9: Landscape of the Western Upper Karoo (NKu1) between Beaufort West and Loxton.

5.2.3 Upper Karoo Hardeveld (NKu 2)

This vegetation type covers 11 734 km^2 in South Africa and is characterised by steep slopes of mesas, buttes and koppies supporting sparse, dwarf Karoo scrub (Figures 7 & 10). Dolerite dykes and sills with large boulders and stones often cover the landscape. Important shrubs and dwarf shrubs include *Lycium cinereum, Rhigozum obovatum, Cadaba aphylla, Ehretia rigida, Chrysocoma ciliata, Eriocephalus ericoides, Euryops lateriflorus, Pteronia glauca* and *Felicia muricata.* The prominent grasses include *Aristida* spp., *Cenchrus ciliaris, Enneapogon desvauxii, Eragrostis lehmanniana* and *Stipagrostis obtusa*.

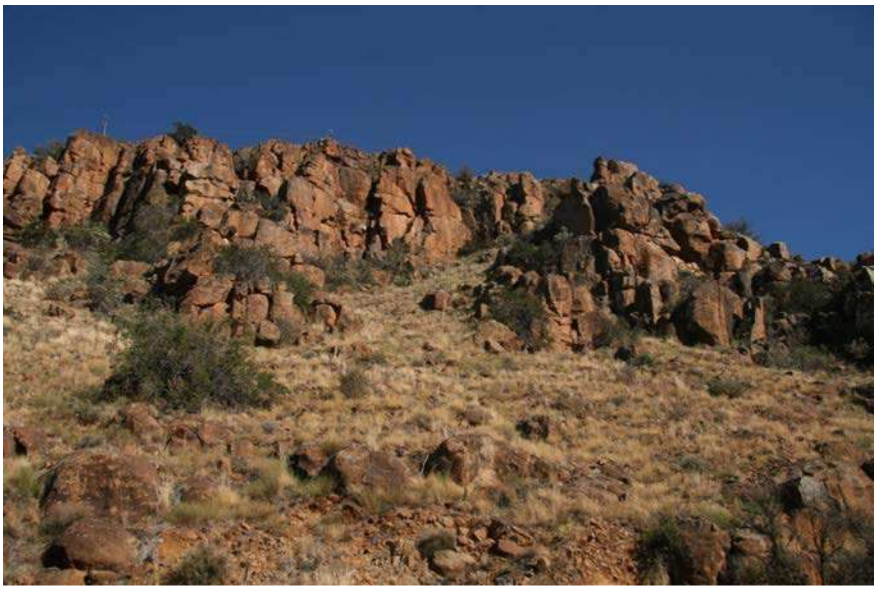


Figure 10: Landscape along the route through the Upper Karoo Hardeveld (NKu2) north of Beaufort West.

The vegetation type is classified as 'least threatened' / 'least concern', although only about 6% is statutorily conserved in the Karoo National Park and Karoo Nature Reserve (Mucina & Rutherford 2006, NEMA 2011, SANBI 1028a). Endemic plant species include:

Adromischus fallax
Adromischus humilis
Aloe chlorantha
Anisodontea malvastroides
Cineraria arctotidea
Cineraria polycephala

Crassula barbata subsp. *broomii*
Euryops petraeus
Lachenalia aurioliae
Ornithogalum paucifolium subsp. *karooparkense*
Selago magnakarooica
Vellereophyton niveum
Delosperma robustum
Gethyllis longistyla
Lotononis azureoides
Mesembryanthemum expansum
Stomatium suaveolens

5.2.4 Northern Upper Karoo (NKu 3)

This vegetation type covers 41 829 km^2 and is characterised by flat to gently sloping terrain with isolated hills and many interspersed pans (Figures 7 & 11). It covers a small portion of the route around Carnarvon. The shrubland is dominated by dwarf karoo shrubs, grasses and *Senegalia mellifera*. The geological substrate consists of shales of the Ecca Group and Dwyka Group diamictites. Karoo dolerite sills and sheets support this vegetation complex in places. Wide stretches of land are covered by superficial deposits including calcretes of the Kalahari Group. Dominant shrubs and dwarf shrubs include *Senegalia mellifera, Boscia albitrunca, Lycium* spp.*, Chrysocoma ciliata, Pentzia* spp. and *Oedera humilis.* The grass layer is characterised by *Aristida* spp., *Enneapogon desvauxii, Eragrostis* spp., *Stipagrostis* spp. and *Sporobolus fimbriatus*.

Figure 11: Landscape of the Northern Upper Karoo (NKu3) near Carnarvon.

The vegetation type is classified as 'least threatened' / 'least concern', with none conserved in statutorily conserved areas (Mucina & Rutherford 2006, NEMA 2011, SANBI 2018a). About 4% has been transformed by clearing for cultivation and building of dams. Endemic species include *Lithops hookeri, Stomatium pluridens, Atriplex spongiosa, Galenia exigua* and *Manulea deserticola.*

5.2.5 Eastern Upper Karoo (NKu 4)

This is the largest vegetation type in South Africa (covering 49 821 km^2) and also covers the largest portion of the fibre-optic cable route between Beaufort West and Carnarvon. The habitat consists of flat and gently sloping plains, interspersed with hills and rocky areas and is dominated by dwarf shrubs (Figures 7, 12 & 13). Mudrock and sandstone of the Beaufort Group are the dominant geological substrates. Prominent shrubs and dwarf shrubs include *Lycium* spp., *Chrysocoma ciliata, Eriocephalus ericoides, Pentzia incana, Pentzia globosa Phymaspermum parvifolium* and *Salsola calluna*. The grass layer is dominated by *Aristida* spp., *Cynodon incompletus, Eragrostis* spp., *Sporobolus fimbriatus* and *Stipagrostis ciliata*.

The vegetation type is classified as 'least threatened' / 'least concern', with about 2% of the unit transformed, and *ca*. 3% statutorily conserved in national parks and nature reserves (Mucina & Rutherford 2006, NEMA 2011, SANBI 2018a). Endemic plant species include:

Aspalathus acicularis subsp. *planifolia*	*Chasmatophyllum rouxii*
Hertia cluytiifolia	*Phymaspermum scoparium*
Rabiea albinota	*Salsola tetrandra*
Selago persimilis	*Selago walpersii*

Figure 12: Landscape of the Eastern Upper Karoo (NKu4) south of Loxton.

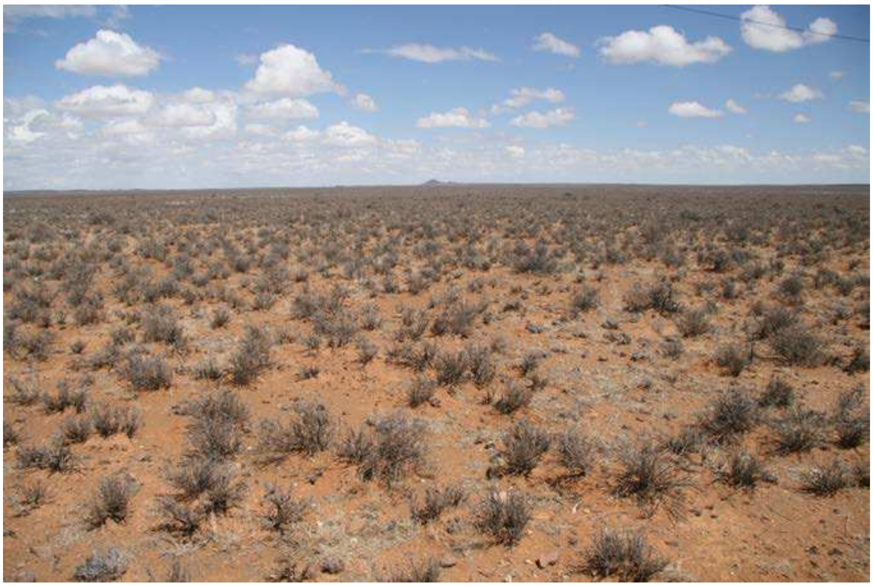


Figure 13: Landscape of the Eastern Upper Karoo (NKu4) between Loxton and Carnarvon.

5.2.6 Southern Karoo Riviere (AZi 6)

This vegetation type covers 5299 km^2 and includes the rivers and other drainage lines of the central Karoo, which support thickets and shrubland (Figures 14 & 15). Since this vegetation type is associated with rivers and drainage lines, the areas on site classified as this vegetation type should be considered as sensitive. It is classified as 'least threatened' / 'least concern' (Mucina & Rutherford 2006, NEMA 2011, SANBI 2018a), with about 5% statutorily conserved. Some 12% has been transformed for cultivation and building of dams (Mucina & Rutherford 2006). The most prominent tree and shrub species include *Vachellia karroo, Searsia lancea, Diospyros lycioides, Tamarix usneoides, Euclea undulata, Salsola* spp. and *Lycium* spp. The only endemic species is the graminoid *Isolepis expallescens.*

Figure 14: Drainage line and valley in the mountains (Upper Karoo Hardeveld).

Figure 15: One of the major rivers (Brak River) in the Eastern Upper Karoo, south of Loxton.

5.3 Description of the habitats and associated physical environment along the route from Beaufort West to Carnarvon

The study area primarily covers the fenced road reserve and therefore represents a habitat that is in essence highly transformed and disturbed as a result of the physical impact of road construction, maintenance activities for road safety reasons, adjacent land-use and the presence of alien vegetation. It is intended as a buffer between the road and the adjacent land, often hosting other services such as electric or telephone cables. There is usually a clearly defined boundary (fence line) where the road reserve abuts the adjacent land. The road reserve vegetation is seldom representative of the natural veld adjacent to the road except where some sections were not transformed in the mountains and where cuttings through the hills or ridges occur.

Water run-off from the road surface contributes to an unnatural species assemblage in most areas. Precipitation run-off from roads promotes the spread and establishment of alien species. These species often colonise road verges, and then rapidly spread along this corridor, thus degrading the condition of the natural vegetation of the road verge and compromising the conservation value not only of the reserves, but also of the adjacent land. Roads have a significant impact on the chemical environment and major additions of heavy metals, salt and nutrients may occur in the road reserves. Use of herbicides to control vegetation growth along roads contributes further to the transformed nature of road reserves. Overall, the impacts of disturbance and transformation in road reserves override the effects of the natural physical environment and cause homogenisation of the roadside vegetation.

Rare plant species usually occur in specialised and localised habitats, which are mostly destroyed by road building and the potential of road reserves to be of conservation value is therefore limited. Nevertheless, some rare species find refuge in road reserves and in certain circumstances accrue reproductive advantages over non-verge populations. The plants in road verges are also a potential source of seeds.

The six vegetation types of the region were used as the basis for describing the habitats along the route. The dominant geological substrate and land types of each vegetation type are summarised in Table 8.

Table 8: Main geological substrates and land types within the six vegetation types distinguished along the route

Vegetation type	**Dominant geological substrate (see Figure 5)**	**Land Type (see Figure 6)**
Gamka Karoo (NKl 1)	Alluvium and calcrete (Quaternary and Tertiary deposits) (Qc and T-Qc).	Fc385 and Ib257
Western Upper Karoo (NKu1)	Grey to greenish shale, mudstone, subordinate sandstone and siltstone, greenish chert and tuff (Pt). Red and purple mudstone with subordinate sandstone (Pth)	Da142 and Fc387
Upper Karoo Hardeveld (NKu2)	Alluvium and calcrete in the lowlands (Qc). Grey to greenish shale, mudstone, subordinate sandstone and siltstone, greenish chert and tuff (Pt). Dolerite (Jd)	Da 142, Fc387, Fc388, Ib255, Ib256, Ib257, Ib259 and Ib356
Northern Upper Karoo (NKu3)	Blue-grey to green mudstone, subordinate sandstone and siltstone, with shale (Pc).	Ib372
Eastern Upper Karoo (NKu4)	Basically all geological substrates in the region.	Ag177, Ag178, Da142, Da143, Da144, Db162, Fb476, Fb480, Fb482, Fc387, Fc388, Fc406, Fc480, Ib256 and Ib356
Southern Karoo Riviere (AZi6)	All geological substrates in the region, except the blue-grey to green mudstone, subordinate sandstone and siltstone, with shale (Pc).	Da142, Da144, Fb480, Fc385, Fc388, Fc406, Ib255, Ib256 and Ib257

Nine habitat types were distinguished along the route. The habitat types were based on the topography of the area and included features such as drainage lines, floodplains, valleys, plains, hills, footslopes and midslopes of koppies and mountains, scarps, crests and plateaux of the hilly and mountainous areas along the route. It should, however, be noted that all nine habitat types were not necessarily represented along the route within each of the vegetation types. The following habitat types were distinguished:

1. Drainage lines (watercourses: channels, streams, rivers) and their associated banks
2. Bottomlands on the plains (broad floodplains, leegtes, vloere) (B)
3. Plains (P)
4. Valleys in the mountains (bottomlands or valley floors) (V)
5. Low hills (H)

6. Footslopes (Fs) of koppies and mountains
7. Midslopes (Ms) of mountains, usually steep
8. Plateaux in the mountains (Pl)
9. Mountains (M) often comprising a mixture of upperslopes, scarps ad crests.

5.3.1 Southern Karoo Riviere (AZi 6)

Drainage lines (watercourses: channels, streams, rivers) and their associated banks

In principle, the drainage lines are classified under the Southern Karoo Riviere (AZi6). Most of the drainage lines are ephemeral in nature and they range from narrow dry channels to broad rivers with floodplains (leegtes, vloere) in the north. Examples of drainage lines along the route include the tributaries of the Gamka River north of Beaufort West, the Sak River and Brak River on the plains on the way to Loxton and the Brak River and Soutpoort River north of Loxton (Figures 16–19). Although these drainage lines form part of the Southern Karoo Riviere, they could not be mapped at the scale of the national vegetation map. The numerous "leegtes" on the way to Carnarvon are described as part of the bottomlands habitat type in this report.

The most widespread plant species found along the fibre-optic cable route in the drainage lines included:

Anchusa riparia
Chloris virgata
Deverra denudata
Eragrostis bicolor
Galenia namaensis
Lycium cinereum
Salsola kali
Stipagrostis namaquensis

The following species were locally conspicuous:

Afroscirpiodes dioeca
Buddleja salviifolia
Eragrostis bergiana
Helichrysum pentziodes
Phragmites australis
Pseudochoerus inanus
Salix mucronata
Vachellia karroo

Other common species included:

Argemone ochroleuca
Diospyros austro-africana
Drosanthemum hispidum
Drosanthemum karrooense
Lycium oxycarpum
Melianthus comosus
Osteospermum spinescens
Pteronia erythrochaeta
Sporobolus iocladus
Suaeda fruticosa

Figure 16: Dry drainage line on the plains of the Gamka Karoo vegetation type.


Figure 17: Stream in the mountains of the Upper Karoo Hardeveld.


Figure 18: Ephemeral river (Sak River) on the plains of the Eastern Upper Karoo.


Figure 19: Ephemeral, Soutpoort River on the plains of the Eastern Upper Karoo.

5.3.2 Gamka Karoo (NKI 1)

Three habitat types were distinguished within the Gamka Karoo, *viz*. plains, low hills and footslopes.

Plains

These are flats or gently sloping plains which are occasionally interrupted by low hills. Widespread or dominant (d) species found along the fibre-optic cable route included:

Arctotis leiocarpa	*Lycium* spp. (d)
Enneapogon desvauxii	*Mesembryanthemum coriarium*
Eragrostis lehmanniana	*Osteospermum scariosum*
Felicia muricata	*Pentzia* spp.
Fingerhuthia africana	*Rhigozum obovatum*
Gazania lichtensteinii	*Sporobolus fimbriatus* (d)
Heteropogon contortus	*Stipagrostis ciliata*
Lacomucinaea lineata (d)	*Stipagrostis obtusa* (d)

Several alien invasive species, *Argemone ochroleuca, Pennisetum setaceum* and *Prosopis glandulosa,* were noted.

Low hills

Low hills were considered as landforms that are elevated compared to the surrounding land, but with gentle slopes and generally without scarps and cliffs. Within the road reserve section of this vegetation type, the low hills covered a relatively small area. The most prominent species included:

Enneapogon desvauxii	*Osteospermum scariosum*
Enneapogon scaber	*Pentzia* spp. (d)
Drosanthemum hispidum (d)	*Rhigozum obovatum*
Felicia muricata	*Ruschia* spp.
Heteropogon contortus	*Sericocoma avolans*
Mesembryanthemum coriarium (d)	

The low hills were also the habitat for some of the more uncommon or protected species such as *Anacampseros* cf. *lanceolata* and *Astroloba foliolosa*.

Footslopes

The footslopes represent the transition to the more mountainous Upper Karoo Hardeveld. The most common species in this habitat along the fibre-optic route were:

Asparagus retrofractus	*Rhigozum obovatum* (d)
Enneapogon desvauxii	*Searsia burchellii*
Fingerhuthia africana	*Searsia lancea* (d)
Grewia robusta (d)	*Vachellia karroo* (d)
Pentzia incana	

The alien invasive grass, *Pennisetum setaceum* was common within the road reserve in this habitat type.

5.3.3 Western Upper Karoo (NKu 1)

This is a fairly small unit within the fibre-optic cable route and is represented by three habitat types, *viz.* plains, low hills and footslopes. The description of the habitats is similar to that provided for the Gamka Karoo.

Plains

The most prominent species on the plains or gently undulating terrain along the fibre-optic route were:

Cynodon incompletus	*Gazania krebsiana*
Dimorphotheca cuneata	*Gonialoe variegata*
Eragrostis obtusa	*Mesembryanthemum crystallinum*
Eriocephalus spp.	*Pteronia sordida* (d)
Galenia namaensis	*Oedera oppositifolia* (d)

Low hills

The following species characterised the low hills along the fibre-optic route within the Western Upper Karoo:

Chrysocoma ciliata	*Lessertia frutescens*
Drosanthemum karrooense	*Mesembryanthemum grossum*
Eriocephalus spp.	*Pteronia glauca*
Gazania krebsiana	*Pteronia sordida*

Footslopes

On the footslopes in the Western Upper Karoo the following species were prominent along the fibre-optic route:

Diospyros austro-africana	*Pentzia spinescens*
Eragrostis obtusa (d)	*Pteronia glauca*
Eriocephalus spp.	*Pteronia sordida* (d)
Galenia namaensis	*Oedera humilis*
Gazania krebsiana	*Oedera oppositifolia* (d)
Lessertia frutescens	

5.3.4 Upper Karoo Hardeveld

This vegetation unit is represented by the mountainous terrain along the fibre-optic cable route. Six habitat types were recognised within this vegetation type, *viz.* plains, valleys, footslopes, midslopes, mountains and plateaux (Figures 20-26).

Plains

These areas are relatively flat plains occurring between the hills and mountains. Prominent species in this habitat type noted along the fibre-optic route were:

Chrysocoma ciliata	*Lycium cinereum* (d)
Drosanthemum hispidum	*Mesembryanthemum coriarium*
Eragrostis obtusa	*Pentzia* spp.
Eriocephalus brevifolius	*Oedera oppositifolia* (d)
Hermannia coccocarpa	*Sporobolus fimbriatus* (d)
Hermannia desertorum	

Valleys

The mountains are interrupted by valleys (valley floors) with a stream or river running through it (Figure 20). The most common species in the valleys along the fibre-optic route included:

Asparagus retrofractus (d)	*Lacomucinaea lineata*
Buddleja glomerata	*Melianthus comosus* (d)
Diospyros lycioides	*Searsia lancea* (d)
Hermannia vestita	*Sporobolus fimbriatus*
Lycium oxycarpum	*Vachellia karroo* (d)

Figure 20: Valley between the mountains with a relatively high cover of shrubby species.

Footslopes

The footslopes of the mountain and low hills along the fibre-optic route (Figure 21) are characterised by the following species:

Aristida diffusa (d)
Drosanthemum spp.
Eriocephalus spp. (d)
Felicia muricata
Galenia namaensis
Lycium cinereum (d)
Pentzia incana
Pteronia sordida
Sporobolus fimbriatus (d)

Figure 21: Footslope of a mountain along the route in the Upper Karoo Hardeveld.

Midslopes

Midslopes refer to moderate to steep slopes below the scarp/crest of mountains and were only found along the fibre-optic cable route in the Upper Karoo Hardeveld (Figures 22 & 23). The most prominent plant species on the midslopes included:

Aloe broomii
Aristida adscensionis
Aristida diffusa (d)
Carissa haematocarpa (d)
Gymnosporia szyszylowiczii (d)
Hermannia vestita
Heteropogon contortus
Lacomucinaea lineata

Cotyledon orbiculata
Dicerothamnus rhinocerotis
Digitaria eriantha (d)
Diospyros austro-africana (d)
Drosanthemum hispidum
Euclea crispa
Felicia filifolia
Fingerhuthia africana (d)
Grewia robusta (d)
Limeum aethiopicum
Lycium cinereum (d)
Rhigozum obovatum (d)
Searsia burchellii
Sporobolus fimbriatus (d)
Tarchonanthus minor
Themeda triandra
Vachellia karroo

Figure 22: Steep midslopes in the mountainous area of the Upper Karoo Hardeveld.

Figure 23: Steep midslopes in the mountainous area of the Upper Karoo Hardeveld.

Mountain plateaux

These areas included relatively flat to sloping terrain at mid-elevations in the mountains of the Upper Karoo Hardeveld (Figures 24 & 25). Along the fibre-optic cable route this habitat was characterised by the following species:

Aristida diffusa
Asparagus capensis
Cotyledon orbiculata
Dicerothamnus rhinocerotis
Digitaria eriantha (d)
Diospyros austro-africana
Fingerhuthia africana
Gymnosporia szyszylowiczii (d)
Heteropogon contortus
Rhigozum obovatum
Sporobolus fimbriatus
Tenaxia disticha

Eragrostis obtusa
Felicia filifolia (d)
Vachellia karroo

Figure 24: Plateaux at mid-elevations in the mountains of the Upper Karoo Hardeveld.

Figure 25: Plateaux in the background on mid-elevations in the mountains of the Upper Karoo Hardeveld.

Mountains

The Upper Karoo Hardeveld mountain habitat includes the steep upper slopes, scarp and crests of mountains, usually with large boulders (Figure 26). The most prominent plant species found in this habitat were:

Aloe broomii
Aristida diffusa (d)
Asparagus capensis
Buddleja glomerata
Dicerothamnus rhinocerotis
Digitaria eriantha (d)
Diospyros austro-africana (d)
Eriocephalus ericoides (d)
Euryops lateriflorus
Felicia filifolia
Hermannia comosa
Hermannia vestita
Heteropogon contortus
Lycium cinereum (d)
Melianthus comosus (d)
Pentzia spp.
Searsia burchellii (d)
Sporobolus fimbriatus (d)
Tarchonanthus minor
Tenaxia disticha
Themeda triandra
Vachellia karroo

Figure 26: Mountainous area with scarps and boulders (Upper Karoo Hardeveld).

5.3.5 Northern Upper Karoo (NKu 3)

The Northern Upper Karoo covers a small section of the route immediately to the south of Carnarvon. The only habitat type encountered in this section was the plains. The most prominent species were:

Calobota spinescens
Eragrostis lehmanniana
Eriocephalus decussatus (d)
Eriocephalus spinescens (d)
Mesembryanthemum coriarium
Senecio niveus
Stipagrostis ciliata
Stipagrostis obtusa

5.3.6 Eastern Upper Karoo (NKu 4)

The Eastern Upper Karoo covers the largest portion of the fibre-optic cable's route between Beaufort West and Carnarvon.

Bottomlands on the plains (broad floodplains, vloere, leegtes)

These are flat, very even surfaces of broad bottoms of rivers (leegtes, vloere) filled with silty and clayey alluvial deposits (Figure 27). They are found from south of Loxton (from the farm Rosedene) northwards to Carnarvon. The most widespread and common species in this habitat along the route included:

Aptosimum indivisum
Aristida adscensionis
Asparagus suaveolens (d)
Chrysocoma ciliata
Drosanthemum hispidum
Enneapogon desvauxii
Eragrostis obtusa
Eriocephalus spp. (d)
Felicia muricata
Fingerhuthia africana
Galenia namaensis
Indigofera meyeriana
Lycium horridum
Lycium cinereum
Pentzia spp.
Pteronia sordida
Oedera humilis (d)
Salsola kali
Salvia verbenaca
Senecio niveus
Sporobolus fimbriatus
Stipagrostis ciliata
Stipagrostis obtusa

Figure 27: Broad bottomlands on the plains of the Eastern Upper Karoo.

Plains

This habitat refers to flats and gently sloping plains interspersed with hills and rocky areas (Figures 28 & 29). Prominent species along the fibre-optic route in the Eastern Upper Karoo included:

Aristida adscensionis
Asparagus suaveolens
Chrysocoma ciliata
Drosanthemum spp.
Enneapogon desvauxii
Eragrostis lehmanniana
Eragrostis obtusa
Eriocephalus spp.
Felicia muricata
Fingerhuthia africana
Galenia namaensis
Hermannia cuneifolia
Lessertia inflata
Lycium cinereum
Mesembryanthemum spp.
Osteospermum spinescens
Pentzia spp.
Pteronia sordida
Pteronia staehelinoides
Oedera spp.
Ruschia spp.
Senecio niveus
Sesamum capense
Sporobolus fimbriatus
Stipagrostis obtusa

The invasive species, *Argemone ochroleuca* and *Salsola kali* were common in the road reserve in this habitat type.

Figure 28: Open bossieveld on the plains of the Eastern Upper Karoo.

Figure 29: Plains of the Eastern Upper Karoo.

Low hills

Most of the road cuttings along the fibre-optic cable route on the northern plains are part of this habitat type (Figures 30 & 31). The most widespread plant species included:

Drosanthemum spp. (d)
Enneapogon desvauxii
Eragrostis lehmanniana (d)
Eragrostis obtusa
Eriocephalus ericoides (d)
Euphorbia caterviflora
Fingerhuthia africana
Helichrysum pumilio
Hermannia cuneifolia
Hermannia grandiflora
Lycium cinereum (d)
Moraea miniata
Osteospermum spinescens (d)
Pentzia spp. (d)
Pteronia spp. (d)
Oedera spp. (d)
Ruschia spp.

Figure 30: Road cutting through low hills in the Eastern Upper Karoo.

Figure 31: Road cutting through low hills in the Eastern Upper Karoo.

Footslopes

This habitat refers to lower reaches of koppies, hills, inselbergs or mountains with gentle slopes. The following species occurred widespread within this habitat along the fibre-optic cable route:

Aristida adscensionis
Asparagus suaveolens
Chrysocoma ciliata (d)
Enneapogon desvauxii (d)
Eriocephalus ericoides (d)
Felicia muricata
Fingerhuthia africana
Gazania krebsiana
Hermannia grandiflora
Lycium cinereum
Pentzia incana (d)
Pteronia staehelinoides (d)
Pteronia sordida (d)
Oedera oppositifolia
Stipagrostis obtusa

6. FLORA: CHECKLISTS AND RED LISTED AND/OR PROTECTED SPECIES

Large sections of the study area have been very poorly collected botanically. However, in the Karoo National Park plant collection has been more active and the species list for the Upper Karoo Hardeveld can be considered as fairly representative of that vegetation type (Rubin & Palmer 1996, Rubin *et al.* 2001). A list of species that could be found in the region of the route of the fibre-optic cable (quarter degree grids: 3020CC; 3122AA, 3122AB, 3122AC, 3122AD; 3122CB, 3122CD; 3322AB, 3322AD, 3322BA, 3322BC) was downloaded from SANBI's website (SANBI: newposa.sanbi.org – accessed August 2020) (Appendix A). These 11 quarter degree grids produced a list of 758 plant species (the term species is used here in a general sense to denote species, subspecies and varieties). During the field surveys along the fibre-optic route for the current investigation, 356 species were recorded (Appendix A). Combined, the NewPosa list and the list for the current study yielded 854 species which could potentially occur in the region of the fibre-optic route.

The South African Threatened Species Programme website (redlist.sanbi.org) of SANBI; the NFA (2019); the NEMBA (2007c) (ToPS list); CITES (2019) appendices; the lists of protected plant species of the WCNECO (1974, as amended 2000), and the lists of protected species of the NCNCA (2009) were consulted to classify the species in the study area into the relevant IUCN or protected categories (Appendix A).

6.1 IUCN Red listed species

For the IUCN Categories, the following definitions were applied (see Figure 32). **The colours in Figure 32 were applied to the checklist of plants and animals in this section as well as in Appendices A and B.**

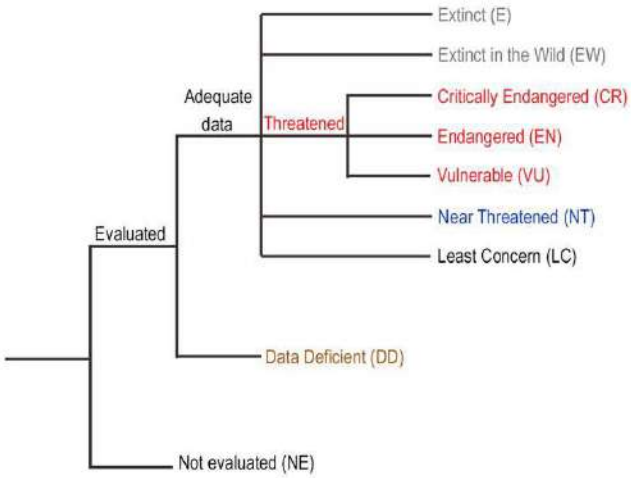


Figure 32: Schematic representation of the relationship between the various IUCN Red List Categories.

Threatened Species and Species of Conservation Concern (SCC)
Extinct Categories:

- **Extinct (E):** A species is Extinct when there is no reasonable doubt that the last individual has died. Species should be classified as Extinct only once exhaustive surveys throughout the species' known range have failed to record an individual.
- **Extinct in the Wild (EW):** A species is Extinct in the Wild when it is known to survive only in cultivation or as a naturalised population (or populations) well outside the past range.

Threatened Categories:

- **Critically Endangered (CR):** A species is Critically Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Critically Endangered, indicating that the species is facing an extremely high risk of extinction.

- **Endangered (EN):** A species is Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Endangered, indicating that it is facing a very high risk of extinction.
- **Vulnerable (VU):** A species is Vulnerable when the best available evidence indicates that it meets at least one of the five IUCN criteria for Vulnerable, indicating that it is facing a high risk of extinction.

Not Threatened Categories but of conservation concern:

- **Near Threatened (NT):** A species is Near Threatened when available evidence indicates that it nearly meets any of the IUCN criteria for Vulnerable, and is therefore likely to become at risk of extinction in the near future.
- **Data Deficient (DD):** A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A **DDD** taxon may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. The taxonomy of a **DDT** taxon is unresolved.

Not Threatened Categories:

- **Least Concern (LC):** A species is Least Concern when it has been evaluated against the IUCN criteria and does not qualify for any of the above categories. Species classified as Least Concern are considered at low risk of extinction. Widespread and abundant species are typically classified in this category.
- **Not Evaluated (NE):** A taxon is Not Evaluated when it is has not yet been evaluated against the five IUCN criteria. This category often applies to alien species.

Only three IUCN red listed species could potentially occur in the region according to the NewPosa list (Appendix A): *Annesorhiza filicaulis* (EN), *Cineraria vagans* (EN) and *Cliffortia arborea* (VU). Although both *Annesorhiza filicaulis* and *Cineraria vagans* are listed for the region, the current study area falls far beyond the known distribution of these species. Additionally, the screening tool highlighted the possibility of Sensitive species 704 (VU) occurring in the region. None of these IUCN red listed species were encountered during the site survey.

Data Deficient (DD) and Near Threatened (NT) species are not classified as threatened according to the IUCN classification. No Near Threatened species are listed for the region and only *Senecio erysimoides* and *Thesium sonderianum* are classified as DD. **Both species are further classified as DDT, implying that they are taxonomically unresolved and can therefore not be assessed. Neither of these species were encountered during the site survey.**

6.2 Protected species

6.2.1 Western Cape

One hundred and thirty three (133) plant species in Appendix A are listed as protected (Schedule 4) according to the WCNECO (as amended in 2000). Most of these Schedule 4 species are members of the Aizoaceae (64 species), Apocynaceae (25 species) or Iridaceae (20 species).

Fifty-eight (58) Schedule 4 protected species were recorded during the site survey in September/October 2020 (see Appendix A). Once again most of the protected species belonged to the Aizoaceae.

6.2.2 Northern Cape

The NCNCA contains an even more comprehensive list of protected species than the Western Cape. Appendix A contains 228 plant species that are listed as protected (Schedule 1 or 2) according to the NCNCA. The most prominent groups of protected species are members of the Aizoaceae (64 species), Crassulaceae (30 species), Apocynaceae (25 species) and Iridaceae (20 species).

Five specially protected species and 90 protected species were recorded during the site survey in September/October 2020 (see Appendix A). Most of the protected species encountered during the site visit belonged to the Aizoaceae or Crassulaceae.

6.3 ToPS list (NEM:BA 2007c)

No species, classified as protected within the NEMBA (2007c), is listed for the study area and none were found along the route.

6.4 CITES appendices

Appendix II of CITES lists species that are not necessarily now threatened with extinction, but that may become so unless trade is closely controlled. Twenty-one Appendix II species are listed for the region including mostly *Anacampseros* species, *Aloe* species and *Euphorbia* species. Thirteen species listed by CITES were recorded during the site survey (Appendix A).

6.5 National Forests Act (Act No. 84 of 1998) – Protected Tree Species

No nationally protected tree species is listed for the fibre-optic cable route (NFA 2019/2020) and none were recorded during the site visit.

6.6 Conservation of Agricultural Resources Act (Act No. 43 of 1983) (CARA) and the National Environmental Management: Biodiversity Act (Act No. 10 of 2004) (NEM:BA 2014, 2016)

In total 41 alien species are listed for the study area (Appendix A) of which 16 are categorised as invasive. Alien species with an invasive categorisation need to be controlled during the construction and operational stages of the project. Alien invasive species listed for the study area, in terms of sections 70(1), 71(3) and 71A include the following (species recorded during the site survey are marked with an asterisk):

Atriplex lindleyi subsp. *inflata**	1b
*Atriplex nummularia**	2
*Salsola kali**	1b
*Cirsium vulgare**	1b
Cylindropuntia fulgida	1b
Cylindropuntia imbricata	1b
*Opuntia ficus-indica**	1b
Opuntia microdasys	1b
Tephrocactus articulatus	1a
Cuscuta campestris	1b
*Prosopis glandulosa**	1b WC; 3 NC
Prosopis velutina	1b WC; 3 NC
*Argemone ochroleuca**	1b
Pinus sp.*	1b, 2 or 3
*Pennisetum setaceum**	1b
*Populus alba**	2

7. FAUNA: CHECKLISTS AND RED LISTED AND/OR PROTECTED SPECIES

Species lists (the term species is used here in a general sense to denote species, subspecies and varieties) of the faunal component were sourced for the study area from the Animal Demography Unit, University of Cape Town website (http://vmus.adu.org.za) and supplemented by relevant literature to determine the conservation status.

7.1 Mammals

The route falls within the distribution range of 82 terrestrial mammal species (Appendix B) comprising 22 rodents; 19 even-toed ungulates (Artiodactyla); 18 carnivores (Carnivora); 4 hares and rabbits (Lagomorpha); 4 bats (Chiroptera); 4 shrews (Eulipotyphla); 3 elephant shrews (Macroscelidae); 2 odd-toed ungulates (Perissodactyla); 2 primates; 1 golden mole (Afrosoricida); 1 aardvark (Tubulidentata); 1 hyrax (Hyracoidea) and 1 proboscidean (Proboscidea).

7.1.1 IUCN threatened mammal species

Three IUCN threatened mammal species could occur in the environs of the fibre-optic cable route:

Riverine rabbit	***Bunolagus monticularis***	**CR**
Mountain reedbuck	***Redunca fulvorufula fulvorufula***	**EN**
Black-footed cat	***Felis nigripes***	**VU**

The roan antelope, sable antelope and bontebok listed in Appendix B also have an IUCN threatened status, but have been introduced in the area. These species as well as the mountain reedbuck are likely to occur only in the Karoo National Park or private nature reserves and should not be impacted by the fibre-optic cable. Mitigation measures for the riverine rabbit are provided in Chapter 11.

Riverine rabbit (*Bunolagus monticularis*)

The riverine rabbit is one of the most endangered mammals in the world due to fragmentation of its habitat in the semi-arid central Karoo region of South Africa, to which it is endemic. The extremely low animal numbers (approximately 150 – 210 mature individuals) for the riverine rabbit and with no subpopulation having more than 50 mature individuals, have resulted in a species status of 'Critically Endangered' under IUCN Red List criteria C2a(i). Presence data for the riverine rabbit indicates that 70% of the known population occurs in the Nama Karoo Biome, 24% in the Succulent Karoo Biome and 6% in the Fynbos Biome. The majority of riverine rabbit occupancy lies in the Upper Karoo Bioregion (approximately 80%), with about 12% in the Rainshadow Valley Karoo Bioregion, 4% in the Trans-Escarpment Succulent Karoo Bioregion, 3% in the Western Fynbos-Renosterveld Bioregion and 1% in the Lower Karoo Bioregion. An important habitat requirement for the riverine rabbit is alluvial soil for constructing stable breeding burrows (Coetzee 1994), however this soil type is also the most fertile for cultivation. In the past, ploughing by Karoo farmers transformed large areas of the original habitat and remaining patches were intensively grazed by livestock.

The area south of Loxton is regarded as prime riverine rabbit habitat, in particular around the Sak and Brak Rivers. It is associated with the dense, discontinuous vegetation fringing the seasonal rivers of the central Karoo. Specifically, it occurs in riverine vegetation on alluvial soils adjacent to seasonal rivers. Although it is predominantly a browser, the riverine rabbit is known to occasionally feed on grasses during the early wet rainy season when short, green grasses become available. When browsing, they show a particular preference for *Pteronia erythrochaeta*, *Bassia salsoloides*, *Salsola glabrescens* and members of the Aizoaceae. They are unable to survive on heavily overgrazed or agriculturally transformed habitats, but have been found feeding on lucerne fields at night.

Subpopulations in the northern part of the distribution range (such as those around Loxton) are always associated with alluvial floodplains and narrow belts of riverine vegetation adjacent to seasonal rivers. However, in the southern Cape, they are not restricted to the alluvial floodplains and can also occur in abandoned cropland not associated with riverine vegetation.

This species is elusive and nocturnal, spending daylight hours in a scrape beneath riparian vegetation. They are solitary, and will only be found in breeding pairs for short periods, or in female-juvenile pairs for rearing purposes. Riverine rabbits have a single litter per year with 1–2 young per litter in a fur- and grass-lined subterranean chamber excavated in stable soils. Reproductive periodicity occurs from August through May. Home range has been estimated as 12 ha.

Comment: In general the habitat in the road reserve and at stream crossings is not suitable habitat for the riverine rabbit. Traffic would also deter the riverine rabbit from making burrows in the road reserve. Furthermore, the animals are nocturnal and thus not active while construction work will be in progress.

Southern Mountain reedbuck (*Redunca fulvorufula fulvorufula*)

The southern mountain reedbuck is listed as **Endangered A2b** (Taylor *et al*. 2016) due to large population declines in all protected areas for which long-term count data are available. Distribution maps of various authors show large disagreement on where the western boundary of their distribution lies (Friedman & Daly 2004; Skinner & Chimimba 2005; Skead 2011; Taylor *et al*. 2016). According to Du Plessis (1969) the past (historic) distribution of the mountain reedbuck in the Northern Cape was approximately east of a north-south line from Beaufort West northwards to Prieska past Postmasburg and Kuruman and then northeastwards to Gaberone, Botswana (Figure 33a). The fibre-optic route would thus more or less lie on the western boundary. The species has been extensively reintroduced into parts of its former range and according to the most recent distribution of the species in southern Africa (Taylor *et al.* 2016) the mountain reedbuck is indicated in the Karoo National Park where it seems to have been introduced (Figure 33b).

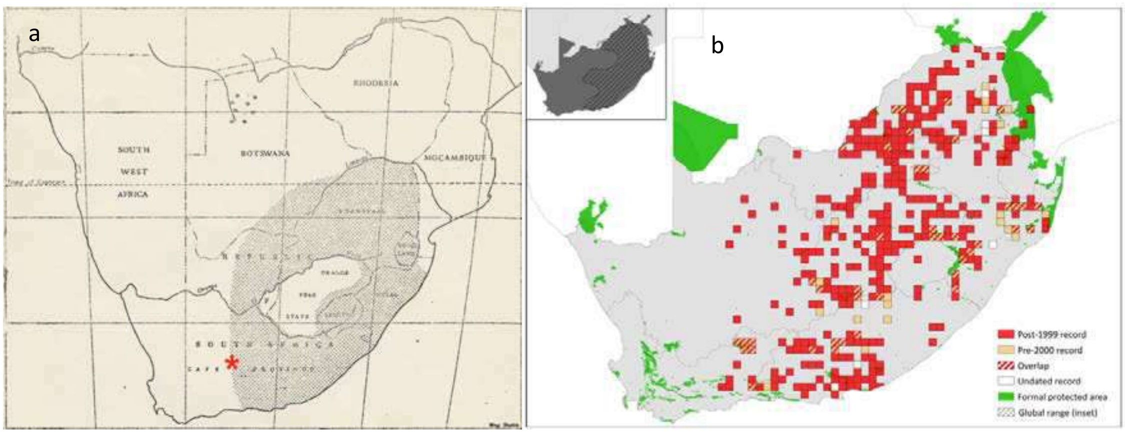


Figure 33. (a) Map of the past distribution of the southern mountain reedbuck (Du Plessis 1969); and (b) map showing past and present distribution of the species (Taylor *et al.* 2016).

It is important to note that because of their specialised habitat requirements, the distribution of the mountain reedbuck is patchy and discontinuous and that they are found only where there is suitable habitat. They favour grass-covered ridges and hillsides in broken rocky country or high-altitude grasslands. They are dependent on steep slopes, a well-developed grass layer and some scattered woody cover to evade predators. According to Rowe-Rowe

(1983) the mountain reedbuck favours slopes with a gradient of 20° or more. In regions where cover is locally more abundant in lower valleys than on upper slopes and ridges, it often prefers the lower slopes. They avoid the open conditions with no cover associated with the summits of mountainous areas as well as dense woody cover (Mason 1977; Oliver *et al.* 1978; Skinner & Chimimba 2005). They also occur in dry hilly areas (such as the Nama-Karoo), utilising steep slopes and the bases of hills for grazing. The extent of available slopes for predator evasion is regarded as an indicator of the quality of their territory (Dunbar & Roberts 1992).

Comment: The overhead infrastructure, proposed to traverse ridges and mountainous areas that are difficult to trench, will not interfere with the behaviour of the mountain reedbuck. No trenches are planned in areas possibly occupied by the mountain reedbuck. However, temporary dug trenches are also unlikely to pose a significant risk to the mountain reedbuck. Mitigation measures to reduce animal entrapment in open trenches are recommended (Chapter 11).

Black-footed cat (*Felis nigripes)*

The black-footed cat has a very wide distribution and habitat preference and it is likely that they can/do occur within the region. However, they are usually sparsely distributed. Furthermore, the black-footed cat is nocturnal, which would reduce interaction with human activity in the area.

7.1.2 Provincially protected mammal species

Thirty-two of the terrestrial mammal species in Appendix B are Schedule 2 protected wild animals (PWA) in the Western Cape, with the riverine rabbit and Cape Mountain zebra being the Schedule 1 endangered wild animals (EWA) (Appendix B). According to the Northern Cape Nature Conservation Act (NCNCA), 15 of the mammal species are Schedule 1 specially protected species (SPS), 61 Schedule 2 protected species (PS) and four Schedule 4 damage causing animals.

7.1.3 Nationally protected species: ToPS

According to ToPS legislation (NEMBA 2007c) seven species are protected, three are listed as Vulnerable, one as Endangered and one as Critically Endangered (see Chapter 12 and Appendix B).

7.2 Reptiles

Fifty-seven reptile species are listed for the fibre-optic cable route and these comprise eight tortoises and terrapins (Testudines); 15 snakes; and 34 lizards (Appendix B). Important habitats for reptiles include the drainage lines, cliffs and rocky outcrops. No trenches will be cut through the drainage lines and in the rocky areas the cable will be overhead, consequently the impact of the installation of the cable will be limited in these habitats.

One of the reptile species listed in Appendix B has an IUCN threatened status.

Chersobius boulengeri	**Karoo dwarf tortoise**	**EN**

The Karoo dwarf tortoise is an endemic species occurring in the region. Tortoises would be at risk of falling into open trenches during the construction phase of establishing the fibre-optic cable.

Comment: Some reptiles may inhabit the rocky areas where cuttings occur and it is recommended that trenches rather be dug along the road and not cross the cutting.

According to the WCNECO (1974, 2000) all lizards, all tortoises and turtles (except those listed in Schedule 1) and many snake genera are Schedule 2 protected species (Appendix B). Thus 44 of the 57 reptile species (77%) are protected. In the Northern Cape, 18 of the 57 species (32%) are protected. None of the reptiles are listed under ToPS legislation (NEMBA 2007c), however Appendix II of CITES lists nine reptile species in which trade needs to be strictly controlled. Mitigation measures for the Karoo dwarf tortoise are provided in Chapter 11.

7.3 Amphibians

Important areas for amphibians include the major drainage lines along the route. This habitat will be discussed in detail in the aquatic assessment (EnviroSci 2020).

Fourteen frog species are listed for the study area (Appendix B). Although none of the frog species listed in Appendix B has an IUCN threatened status, all frog species are Schedule 2 protected species according to the WCNECO (1974, 2000). In the Northern Cape all frog species are Schedule 2 protected species, with the exception of those listed under Schedule 1 as specially protected species.

7.4 Avifauna

In total 262 bird species are known to occur along the route of the fibre-optic cable. Of these species four are listed as Endangered and six as Vulnerable (IUCN status RSA) (Appendix B):

Circus maurus	**Black harrier**	**EN**
Mycteria ibis	**Yellow-billed stork**	**EN**
Neotis ludwigii	**Ludwig's bustard**	**EN**
Polemaetus bellicosus	**Martial eagle**	**EN**
Afrotis afra	**Southern black korhaan**	**VU**
Aquila verreauxii	**Verreaux's eagle**	**VU**
Ciconia nigra	**Black stork**	**VU**
Cursorius rufus	**Burchell's courser**	**VU**
Falco biarmicus	**Lanner falcon**	**VU**
Sagittarius serpentarius	**Secretarybird**	**VU**

In the Western Cape all bird species are listed as protected, except for the very common ones. In the Northern Cape, 38 bird species are considered as specially protected and 206 as protected. The remaining species are classified as common indigenous species (see Appendix B for lists of species).

Wherever the proposed cabling is to be buried, it will not pose a risk to birds. It is also unlikely that nesting sites would be found in the road reserve. On the overhead sections, birds may use the poles as perches, but there will be no risk of electrocution. Overhead cables are restricted to the mountainous sections of the route and collisions by mountain dwelling species may occur. Plains species such as the Ludwig’s bustard should therefore not be compromised. Nevertheless, it is recommended that bird collisions with the overhead cables are monitored for some time after the erection of the cable (see Chapter 11).

7.5 Scorpions

Sixteen scorpion species have been recorded for the region, with seven of them being protected in the Northern Cape, although none are listed as protected in the Western Cape (Appendix B). The red list status of South African scorpions is not available.

7.6 Spiders

Twenty-nine spider species have been recorded for the region, with two of them (baboon spiders) being specially protected in the Northern Cape, although none are listed as protected in the Western Cape (Appendix B). The red list status of South African spiders is not available.

8. CONSERVATION

8.1 National Environmental Management: Protected Areas Act (Act No. 10 of 2003)

In order to traverse the topographically and geologically difficult terrain of the Molteno Pass at the eastern side of the Karoo National Park, it is proposed that the fibre-optic cabling (overhead) be installed in the Park in a corridor where Eskom and Telkom infrastructure was historically established and currently still exists. To this end, Section 50(5) approval in terms of the NEM:PAA (see Chapter 3.6) is required in order to install the fibre-optic cabling in the Park.

8.2 National Protected Areas Expansion Strategy (NPAES)

The route of the fibre-optic cable does traverse areas earmarked by NPAES for future expansion of the Karoo National Park (Figure 34; NPAES, 2010). However, the proposed development will not interfere with the protected areas expansion strategy, since it is confined along existing roads that are unlikely to be closed in the future for the purposes of park expansion.

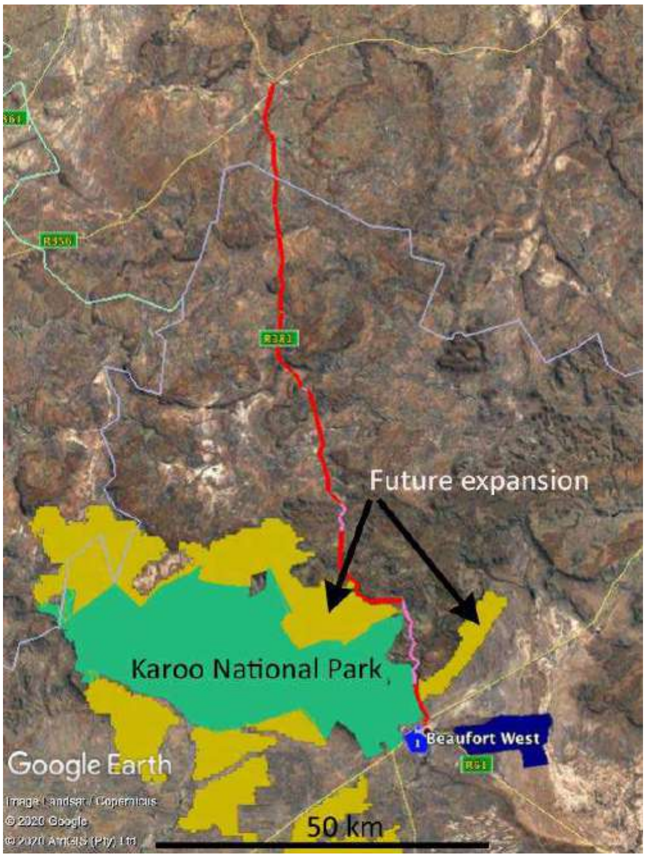


Figure 34: Map indicating the location of the Karoo National Park (South African Protected Areas database Q1, 2020) and areas for future expansion (National Protected Areas Expansion Strategy 2010).

8.3 National list of ecosystems that are threatened and in need of protection

All six vegetation types on site are listed as 'least threatened' / 'Least Concern' (Mucina & Rutherford 2006, NEMA 2011, SANBI 2018a).

8.4 Critical Biodiversity Areas (CBAs), Ecological Support Areas (ESAs) and Other Natural Areas (ONAs)

Critical Biodiversity Areas are areas required to meet biodiversity targets for ecosystems, species or ecological processes. An ESA is not essential for meeting biodiversity targets but plays an important role in supporting the ecological functioning in a CBA (Figure 35).

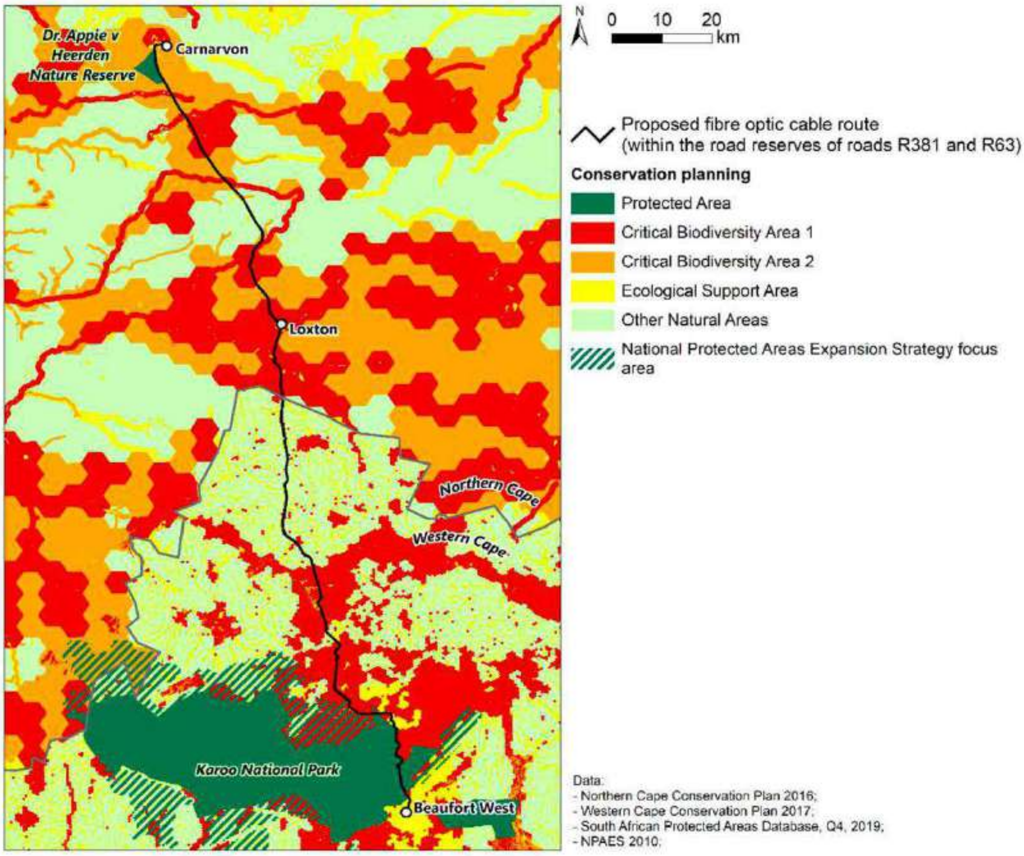


Figure 35: CBAs, ESAs and ONAs along the route of the fibre-optic cable in the Western Cape (biodiversityadvisor.sanbi.org) (source CSIR 2020).

8.4.1 Critical Biodiversity Areas (CBAs)

CBAs are regarded as areas of high biodiversity and ecological value and need to be kept in a natural or near-natural state, with no further loss of habitat or species.

Development within Critical Biodiversity Areas is not encouraged. According to the Western Cape Biodiversity Spatial Plan Handbook (Pool-Stanvliet *et al*. 2017) permissible land uses are those that are compatible with maintaining the natural vegetation cover of CBAs in a healthy ecological state, and that do not result in loss or degradation of natural habitat. Undesirable land uses in terrestrial CBAs are those that cause loss of natural habitat or ecosystem functionality, such as: (i) mining or prospecting; (ii) intensive agriculture (cultivation) or plantation forestry; (iii) residential, commercial or industrial developments; (iv) game-proof fences in CBA corridors; (v) linear infrastructure that disrupts the connectivity of CBA corridors; and (vi) extensive or intensive grazing that results in species diversity being lost through selective or over-grazing (Pool-Stanvliet *et al*. 2017). **The route of the fibre-optic cable does not constitute any of these CBA undesirable land uses.**

The main reasons provided for the mapping of the CBAs were: high sensitivity indicated in the shale gas SEA (without an indication of what caused the high sensitivity), water resource protection and Cape mountain zebra habitat. Although the area to the south of Loxton is prime riverine rabbit habitat it was not provided as reason for delineating CBAs in the Western Cape. Nevertheless, the watercourses picked up most of the riverine rabbit's favoured habitat.

It is important to take cognisance of the fact that the proposed construction of the fibre-optic cable will take place in the road reserve and that the road reserve is not representative of the adjacent land on which the CBA identification was based. Road reserves have been highly disturbed and degraded and often still contain piles of gravel used for road construction. Furthermore, sections of the road reserve are from time to time still being cleared of vegetation. Consequently, the classification of the road reserve as CBA1 cannot be upheld, even a CBA2 (degraded CBA) is difficult to reconcile with a road reserve. Where the routing deviates outside of the road reserve (overhead sections to traverse difficult terrain) the physical impact footprint will not result in significant loss of CBA-qualifying ecosystem features and function.

In summary:

- **The proposed SKA Fibre-optic Cable does not constitute any of the land uses considered to be undesirable in a CBA according to Pool-Stanvliet *et al*. (2017).**
- **Since most of the development will take place in the road reserve, the development will have no impact on the existing Dr Appie van Heerden Nature Reserve and will not affect the NPAES. Where the overhead fibre-optic cabling in the Molteno Pass section is proposed to transverse the Karoo National Park, relevant permissions to establish the infrastructure must be obtained (NEM:PAA Section 50(5)).**
- **Furthermore, the classification of the road reserve as CBA is questionable from a vegetation standpoint, although it might still be marginal riverine rabbit habitat.**
    - **The definition of a CBA1 is: "Areas that are irreplaceable for meeting biodiversity targets. There are no other options for conserving the ecosystems, species or ecological processes in these areas" (SANBI 2018b). The road reserve by no means complies with these conditions.**
    - **The definition of a CBA2 is: "Areas that are the best option for meeting biodiversity targets, in the smallest area, while avoiding conflict with other land uses". Road reserves are not the best option to meet biodiversity targets.**
    - **The question of whether or not the development is consistent with maintaining the CBA in a natural or near natural state or in achieving the goal of rehabilitation therefore becomes irrelevant.**
- **Cable installation will probably have a temporary impact on the composition and structure of vegetation. Since the vegetation in the road reserve contains a large proportion of pioneer plant species is will be able to colonise the disturbed cable trench within a relatively short period of time.**
- **Since the development footprint is small, the loss of habitat or species will be limited.**
- **The extent of clearing activities in the different vegetation types is small in relation to the remaining extent of the vegetation types and ecosystem threat status will not be affected.**
- **The impact on overall species and ecosystem diversity of the adjacent land will not be affected and even within the road reserve, the impact will be small.**
- **Due to the small area that will be disturbed along the route, the impact on populations of species of conservation concern in the CBA will be negligible.**
- **Roads are permanent infrastructure and are fenced. The fence will thus always be a barrier that impedes migration or movement of large faunal species. The fibre-optic cable, where installed underground in the road reserve or overhead, will not contribute additional obstruction to animal movement.**

8.4.2 Ecological Support Areas (ESAs)

ESAs need to be maintained in at least a functional and often natural state, but some limited habitat loss may be acceptable. **It is important that the project should not compromise the functional (natural) state of the ESAs as**

required by the conservation plan of the Western Cape (Pool-Stanvliet et al. 2017). The ESAs in both the Northern Cape and Western Cape follow the smaller watercourses.

- **Ecological processes that operate within or across the ESAs will not be altered by the trench or overhead structures.**
- **The extent of the development is small and will not have a negative impact on the functionality of the broader ESA.**
- **Cable installation will not sever ecological corridors or introduce barriers that impede migration and movement of flora and fauna. Thus, no loss of ecological connectivity in relation to the broader landscape is likely.**

8.4.3 Other Natural Areas (ONAs)

Other Natural Areas (ONAs) have not been identified as a priority, but retain most of their natural character and perform a range of biodiversity and ecological infrastructure functions. Land use guidelines for Terrestrial Other Natural Areas (ONAs) are not required to meet biodiversity targets.

ONAs represent the largest area in the region and form a matrix within which the CBAs and ESAs occur.

8.5 Ecological processes, functioning and drivers

Ecological processes include primary production, decomposition, nutrient cycling and fluxes of nutrients and energy. These processes will temporarily be altered by the clearing of the vegetation for the trenches and poles. The impact is expected to be fairly small in relation to the adjacent landscape where no change to the ecological processes is anticipated. The narrow width of the trench will not hinder pollination by airborne pollinators. Migration of ground-dwelling organisms will be hindered while the trench is open. It is therefore recommended that the trenches are not left open too long before the cabling is inserted and the trenched filled again. Once the trenches have been filled ecological connectivity will be restored and habitat fragmentation will not be an issue. Overall, it is unlikely that the fibre-optic cable will contribute to the disruption of broad-scale ecological processes such as dispersal, migration or the ability of fauna to respond to fluctuations in climate or other conditions. The installation of the cable will not cause any additional impediment to ecological corridors.

Road reserves often act as conduits for alien invasive species and the disturbance caused by the construction of the fibre-optic cable will inevitably create conditions favourable for invasion by alien species. However, the level of infestation along the route was fairly low and the most important invasive species were *Prosopis* spp. (not severe at this stage), *Argemone ochroleuca* (widespread but not severe), *Salsola kali* (widespread) and *Pennisetum setaceum* (local). Nevertheless, an alien invasive plant species monitoring and control programme needs to be initiated to control invasions.

Fire in this arid part of the Nama-Karoo is rare as a result of the high grazing pressure and variable rainfall and is thus not considered as an important driver of vegetation dynamics.

8.6 Key landscape features

A key landscape feature along the route of the fibre-optic cable is the riverine rabbit's habitat. This critically endangered species is associated with the dense vegetation on the alluvial soils fringing the seasonal rivers. It is particularly prominent around the Sak and Brak Rivers where plant species such as *Salsola* spp., *Pteronia erythrochaeta* and *Helichrysum pentzioides* occur.

In the mountainous Upper Karoo Hardeveld where the cliff habitat could be regarded as key landscape feature, this habitat can be avoided because cabling will be overhead in that section. Where rocky outcrops occur in the path of the fibre-optic cable in the Eastern Upper Karoo, these can also be avoided by diverting the trench to the shoulder of the road.

8.7 Indigenous forests

No indigenous forests occur along the route of the fibre-optic cable.

8.8 Freshwater Ecosystem priority and area subcatchments

The route of the fibre fibre-optic cable will cross several water catchments that are classified as Freshwater Ecosystem Priority Areas (FEPAs). These are priority areas for conserving freshwater ecosystems and supporting sustainable use of water resources and upstream management areas (Driver *et al*. 2011) (Figure 36). No Strategic Water Source Areas (SWSAs) (CSIR 2017) occur in the region where the fibre-optic cable is proposed. The potential impacts of the proposed fibre-optic cable development on aspects of terrestrial ecology, that may result in knock-on effects to the status and functioning of FEPAs and SWSAs (e.g. increased water runoff and erosion), are not expected to be significant. The impacts of the development on these freshwater / aquatic ecosystems are discussed in more detail in the aquatic assessment (EnviroSci 2020).

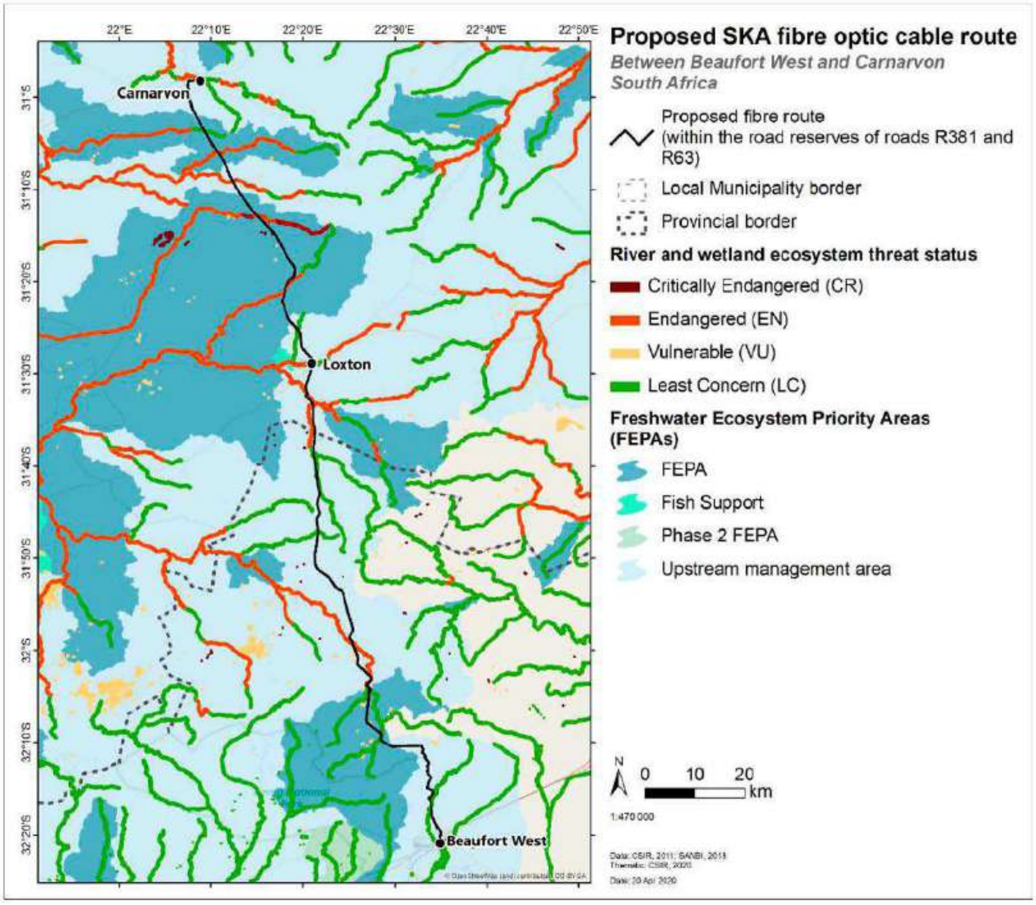


Figure 36: River ecosystem threat and freshwater priority areas in the project area proposed for the SKA fibre-optic cable route from Beaufort West to Carnarvon (source CSIR 2020).

9. ECOLOGICAL SENSITIVITY ANALYSIS

9.1 Introduction

Sensitivity is the vulnerability of a habitat to any impact, for example a dune, wetland or ridge system would be more vulnerable to development than would a sandy plain. Several features of a site can be identified and assessed to derive a sensitivity score, such as:

1. Threatened status of the regional vegetation type wherein the proposed site is situated:
   - all vegetation types are classified as Least Threatened.
2. Percentage of red listed plant species per habitat or site:
   - none of the red listed plant species, likely to occur in the region, were encountered.
3. Number of protected tree species per habitat or site:
   - no protected tree species occur in the region.
4. Percentage of provincially protected plant species per habitat:
   - The ranking from a high to low percentage of protected species was: Mountain plateaux > Midslopes > Valleys > Footslopes > Low hills = Mountain > Plains > Bottomlands > Drainage lines.
5. Presence of endemic plant species per habitat or site (endemic to vegetation type):
   - the only endemic species (Mucina & Rutherford 2006) encountered in the road reserve was *Stomatium suaveolens* in the Upper Karoo Hardeveld.
6. Conservation value of association (habitat) or site;
   - overall the watercourses, mountainous habitats, rocky sheets, as well as the floodplains (bottomlands) along the larger rivers were considered as having a higher conservation value.
7. Species richness per habitat or per sample plot (number of plant species):
   - Species richness was ranked as follows from high to low: Mountain plateaux > Midslopes > Valleys > Footslopes > Low hills > Mountain > Plains > Bottomlands > Drainage line.
8. Degree of connectivity and/or fragmentation of the habitat, i.e. high connectivity and low fragmentation infers a low rating:
   - the only naturally fragmented (micro)habitat was the rocky sheets which could occur within almost any of the broader habitat types.
9. Soil erosion potential:
   - in general the mountainous areas are more prone to soil erosion, however, the repeated disturbance within the road reserve in almost any broader habitat type could lead to soil erosion locally.
10. Resilience (this is a measure of the ability of a particular habitat to recover after an impact, i.e. high resilience infers low rating); in this instance recovering to its current state was considered not the recovery to an undisturbed vegetation state:
    - on the whole, the vegetation in the road reserve has already recovered from the impact of the road construction. It therefore differs from the adjacent undisturbed land. However, the vegetation is likely to recover to the same state after the construction of the fibre-optic cable. Where the fibre-optic cable deviates from the road reserve to traverse difficult terrain via overhead installation, the physical impact footprint of the installed wooden poles is limited.

9.2 Site survey to identify sensitive sites

To identify botanically sensitive areas along the 181 km route, Google satellite images were studied beforehand and the route stratified into relatively homogenous physiographic-physionomic units or habitats. The first level of stratification was thus the six vegetation types of the region and within each of them the different habitat types represented the second level of stratification (see Chapter 5 for full description). Sites were then selected along the route to represent these habitats. However, sites were also selected at localities identified by SANReN as possible problem areas for the placement of the underground fibre-optic cable. These problem areas are mostly at road cuttings where the road cuts through hills or rises and where soil and rock were removed (mostly in the low hill habitat).

During the field survey, 157 sites were surveyed along the route and the vegetation, flora and fauna noted in the road reserve where the cable route was indicated (Figure 37). This gave an average of one survey site every 1.2 km. All identifiable plant species were noted and specific attention was given to protected species or SCCs. Based on the presence of plant species of conservation concern at each of the sites surveyed, a number of sites were identified where it may be necessary to micro-site the location of the trench.

Figure 37: Map indicating the overhead sections (black dots) and the trench sections (red).

9.2.1 Sensitivity model

An **overall sensitivity model** (Table 9) was applied to the data for each habitat within the vegetation types on site. This was achieved by weighting each criterion and calculating the sum for the habitat, which reflects the sensitivity and sensitivity ranking. The brief description of the sensitivity rating of the parameters is provided below:

1. **Threatened status of the ecosystem** (depends on the percentage area intact, or degree of transformation) (Driver *et al*. 2005, Mucina & Rutherford 2006, NEM:BA 2011, SANBI 2018a). The ecosystems are classified into the following categories:
   - Low sensitivity: If "Least Threatened" (LT), the vegetation type has most of its habitat intact, i.e. more than 80%; or the vegetation type is adequately statutory or formally conserved in parks and reserves.
   - Moderate sensitivity: If "Vulnerable" (VU), the vegetation type has from 60% to 80% of the ecosystem intact; less than 40% has been transformed which could result in some ecosystem functioning being altered, and/or the ecosystem is statutory poorly conserved. For example, the vegetation type is rich in plant species but is not a pristine example of a vegetation type, therefore some transformation or disturbance occurred, such as human structures and degraded veld due to overgrazing and/or bush encroachment.
   - High sensitivity: If "Endangered" (EN), the vegetation type has from 40% to 60% of the ecosystem intact; or 40% to 60% transformed due to disturbance, cultivation or alien species; or the ecosystem is statutory poorly conserved e.g. less than about 3% conserved.
   - Very high sensitivity: If "Critically Endangered" (CR), the vegetation type has only 16% to 36% of the ecosystem intact. The richer the ecosystem is in terms of species, the higher the percentage threshold.

   Sensitivity category rating:

Low	(LT)	= 1
Moderate	(VU)	= 2
High	(EN)	= 3
Very high	(CR)	= 4

2. **Percentage of red list plant species** (listed higher than 'least concern', LC) (Threatened species Programme). The rating is determined by the presence of rare flora in a habitat (calculated as percentage of the total number of species per habitat).

   Sensitivity category rating:

None	(0%)	= 0
Low	(>0 – 2%)	= 1
Moderate	(>2 – 5%)	= 2
High	(>5%)	= 3

3. **Presence of protected tree species** (NFA 2019) refers to the presence of protected tree species in a habitat and is rated as follows:

   Sensitivity category rating:

None	(0 species)	= 0
Low	(1 - 2 species)	= 1
Moderate	(3 – 4 species)	= 2
High	(>4 species)	= 3

4. **Percentage of Northern Cape and/or Western Cape protected plant species** (NCNCA 2009; WCNECO, 1974 as amended). The rating depends on the percentage of protected species in relation to the total plant species per habitat.

   Sensitivity category rating:

None	(0%)	= 0
Low	(>0 - 10%)	= 1
Moderate	(>10 – 20%)	= 2
High	(>20%)	= 3

5. **Percentage of plant species endemic to the particular habitat** (Mucina & Rutherford 2006) refers to the number of species expressed as a percentage of the total number of species per habitat.

   Sensitivity category rating:

None	(0%)	= 0
Low	(>0 - 2%)	= 1
Moderate	(2–5%)	= 2
High	(>5%)	= 3

6. **Species richness per habitat** is expressed as mean number of species per plot.

   Sensitivity category rating:

Low	(<15)	= 1
Moderate	(15 – 30)	= 2

High	(>30)	= 3

7. **Conservation value of the habitat.** The assessment is made for the habitat in the broader region.

   Sensitivity category rating:

Low	= 1
Moderate	= 2
High	= 3

8. **Degree of connectivity and/or fragmentation of the ecosystem.** The degree of connectivity with surrounding or adjacent natural areas and/or fragmentation of habitats, thus high degree of connectivity and low degree of fragmentation infer a high rating.

   Sensitivity category rating (note reverse order)*:*

Low	= 3
Moderate	= 2
High	= 1

9. **Erosion potential of the soil.** The erosion potential of the soil is indicated as low, moderate or high, e.g. coarse sandy soils on plains have a low erosion potential.

   Sensitivity category rating:

Low	= 1
Moderate	= 2
High	= 3

10. **Resilience** is a measure of the ability of a particular road reserve habitat to recover to its current state after an impact, i.e. high resilience infers low rating.

    Sensitivity category rating (note reverse order):

Low	= 3
Moderate	= 2
High	= 1

Each criterium is weighted as follows in the model:

Threatened status of the vegetation type	x5
Percentage of red list plant species	x4
Presence of protected tree species	x3
Percentage of Northern Cape or Western Cape protected species	x4
Percentage of endemic species to vegetation type	x2
Species richness	x2
Conservation value (habitat)	x4
Degree of connectivity/fragmentation of habitat	x2
Erosion potential	x2
Resilience	x3

9.2.2 Sensitivity rating

The sum of all criteria is obtained per habitat and interpreted as follows:

≤ 39	= low	(L)	(rating scale = 1)
40 – 54	= moderate	(M)	(rating scale = 2)
55 – 69	= high	(H)	(rating scale = 3)
> 70	= very high	(VH)	(rating scale = 4)

In general, these sensitivity ratings are interpreted as follows:

- **Low** sensitivity means the sensitivity should not have an influence on the decision about the project. It is usually applicable to habitats that have been transformed, especially by human activities. However, any protected species must be avoided, or may not be removed/destroyed without a permit.

- **Moderate** means a sensitivity rating that is real and sufficiently important to require management, e.g. mitigation measures, management or protection of the rare/threatened fauna and flora, protection of a specific habitat on the property and/or rehabilitation.
- **High** means a sensitivity rating where the habitat should be excluded from any development.
- **Very high** means a sensitivity rating that should influence the decision whether or not to proceed with the project.

Table 9: Sensitivity of the habitats within vegetation types (see Figure 38)

Vegetation types	NKU 1	NKU 1	NKU 1	Nku 2	Nku 2	Nku 2	Nku 2	Nku 2	Nku 2	Nku 2	NKu 3	NKu 4	NKu 4	NKu 4	NKu 4	NKl 1	NKl 1	NKl 1	AZi6
Habitats	Fs	H	P	Fs	H	M	MS	Pl	P	V	P	B	Fs	H	P	Fs	H	P	Dl
Threatened status (x5)	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
% Red data species (x4)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of protected trees (x3)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% NCNCA/WCNECO species (x4)	12	12	12	8	8	8	8	8	12	8	8	8	12	12	12	4	12	4	8
% Endemic species (x2)	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Conservation value (x4)	4	8	4	4	8	12	12	12	4	12	4	8	4	8	4	4	8	4	12
Species richness (x2)	4	4	4	4	4	4	6	6	4	4	4	4	4	4	4	4	4	4	4
Connectivity (x2)	2	4	2	2	4	4	2	4	2	4	2	2	2	4	2	2	4	2	2
Erosion (x2)	2	2	2	2	2	4	4	2	2	4	2	2	2	2	2	2	2	2	4
Resilience (x3)	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Sum:	35	41	35	31	37	43	43	43	35	43	31	35	35	43	35	27	41	27	41
Sensitivity rating:	L	M	L	L	L	M	M	M	L	M	L	L	L	M	L	L	M	L	M

NKu1 = Western Upper Karoo; NKu2 = Upper Karoo Hardeveld; NKu3 = Northern Upper Karoo; NKu4 = Eastern Upper Karoo; NKl1 = Gamka Karoo
B = Bottomlands; FS = Footslopes; H = Low hills; MS = Midslope; M = Mountain; P = Plain; Pl = Plateau; V = Valley.

Overall, the mountainous parts, and drainage lines were more sensitive than the plains and footslopes. Thus, the mountains, midslopes, mountain plateaux, valleys in the mountains and low hills were assigned a moderate sensitivity, whereas the sensitivity of the bottomlands, plains and footslopes was low. No buffers are applicable to the development, except along the watercourses, which is dealt with in the aquatic specialist assessment (EnviroSci 2020). The sensitivity map (Figure 38) is additionally provided as a .kmz file.

Although none of the habitats were rated as highly sensitive from a vegetation point of view, construction activities in the specific locations of known riverine rabbit occupancy should proceed with the utmost care and consideration for these animals (locations identified on .kmz file) (see mitigation measures in Chapter 11).

Furthermore, although none of the habitats were rated as highly sensitive from a vegetation point of view and no red listed species were encountered, this does not exclude the presence of protected species along the route. In the NCNCA (2009) and to a lesser extent WCNECO (1974, 2000), a number of families and genera, for example the families Aizoaceae, (formerly Mesembryanthemaceae), Crassulaceae and Iridaceae and genera such as *Mesembryanthemum, Lessertia, Nemesia, Manulea* and *Oxalis* are listed as either Specially Protected Species/Flora or Protected Species/Flora. This blanket classification may be because of the presence of one or two species of vulnerable or higher conservation (IUCN) status in the genus. Unfortunately, this then includes many species that are either common, or even weedy, e.g. *Crassula muscosa, Drosanthemum hispidum*, *Euphorbia inaequilatera*, *Galenia namaensis, Lessertia inflata*, *Mesembryanthemum coriarium, Moraea miniata, Ruschia intricata* or *Oxalis obtusa* that do not need to be awarded special conservation status. To decide on which protected species to consider as being more conservation worthy a subjective judgement had to be made. The following provincially protected species were considered as conservation worthy in this report due to being provincially protected as well as CITES listed, although none have an IUCN red list status:

Aloe spp.	*Lessertia frutescens*
Anacampseros albidiflora	*Pachypodium succulentum*
Anacampseros cf. lanceolata	*Mesembryanthemum emarcidum*
Anacampseros ustulata	*Stapelia grandiflora*
Aristaloe aristata	*Stomatium difforme*
Euphorbia clavarioides	*Stomatium suaveolens*
Huernia barbata	*Stomatium villetii*
Gonialoe variegata	

9.3 Sites where caution should be applied when siting the trench or poles

Specific sites where precautionary measures should be taken are highlighted in the following section.

9.3.1 Overhead section

It is our judgement that although there are some conservation worthy protected present on the proposed overhead route sections (Figures 38 & 39), the construction of the overhead cable will not impact significantly on the flora and fauna of the area. The area that will be disturbed by the erection of posts for the overhead cable will be negligible and the impact on the vegetation will not be a concern. However, should heavy machinery be used against the steep slopes for the excavation of holes for the posts, then it is cautioned that the impact will increase and that mitigation measures need to be implemented, such as re-aligning the route to less sensitive areas. It is, however, understood that a hand-held drill and and manual labour will be employed to plant posts in areas inaccessible by truck-mounted drills and pole-planting equipment. Four sites were identified where posts should be placed with caution (see Figure 38 - kmz, GPS).

Furthermore, it is recommended that the construction teams should avoid obvious rocky sheets (where *Anacampseros* spp. and *Stomatium* spp. may be found) and microsite the location of a post when conspicuous plants are present, e.g. *Aloe broomii*.

It should be noted that the actual watercourses and river crossings were not assessed for sensitivity in the current study, but that the sensitivity found in the aquatic study should be used for reporting. The drainage lines referred to in the habitat analysis were generally slightly further from the actual watercourse.

GPS coordinates of the four cable overhead sensitive sites:

Site 1:	32° 16' 13.45" S; 22° 33' 48.14" E; 972 m
Site 2:	32° 15' 56.90" S; 22° 33' 46.57" E; 1014 m
Site 3:	32° 15' 30.70" S; 22° 34' 11.90" E; 1125 m
Site 4:	32° 04' 22.19" S; 22° 27' 15.58" E; 1558 m

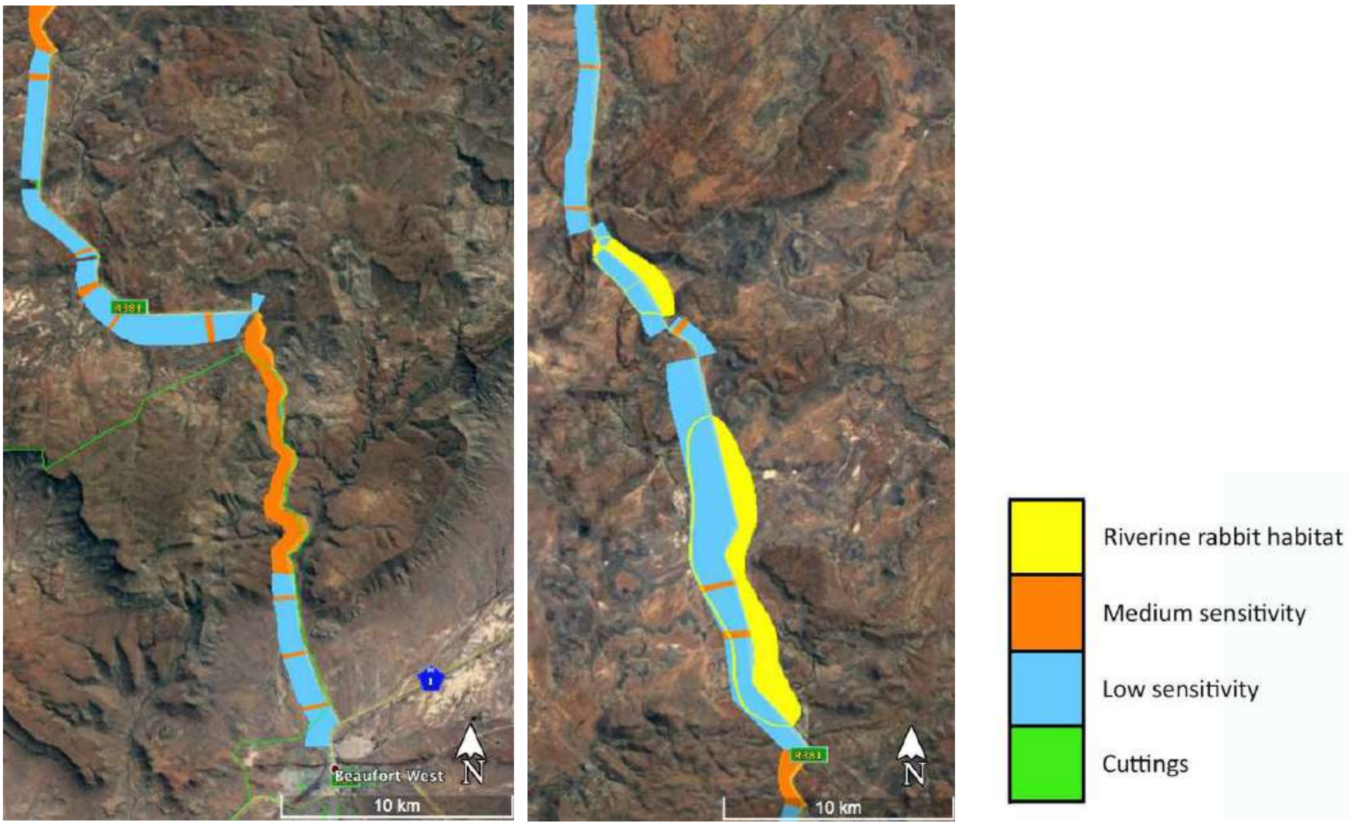
9.3.2 Underground section

Eight sites were identified where some micrositing should take place to avoid some of the conservation worthy protected present. These sites are mostly where road cuttings occur through elevated areas (Figures 38 & 40). It is recommended that the trench is moved down to the foot of the cutting, but as far as possible from the road itself. The reasons being:

- The rocky substrate and rocky sheets on top of the cuttings are the habitat for some of these species.
- The digging of the trench will most probably destroy these species on these localised sites.
- There is limited space between the existing fences over some of these cuttings and the steep slope down to the road.

GPS coordinates of the eight underground (trench) sensitive sites:

Site 5:	32° 18' 17.23" S; 22° 34' 11.94" E; 900 m
Site 6:	32° 10' 24.72" S; 22° 31' 27.16" E; 1595 m
Site 7:	32° 10' 12.84" S; 22° 29' 12.37" E; 1600 m
Site 8:	32° 04' 59.60" S; 22° 27' 07.60" E; 1600 m
Site 9:	32° 00' 15.84" S; 22° 25' 46.48" E; 1496 m
Site 10:	32° 28' 11.21" S; 22° 20' 48.92" E; 1368 m
Site 11:	31° 13' 33.95" S; 22° 15' 47.30" E; 1412 m
Site 12:	31° 12' 16.28" S; 22° 14' 32.58" E; 1390 m



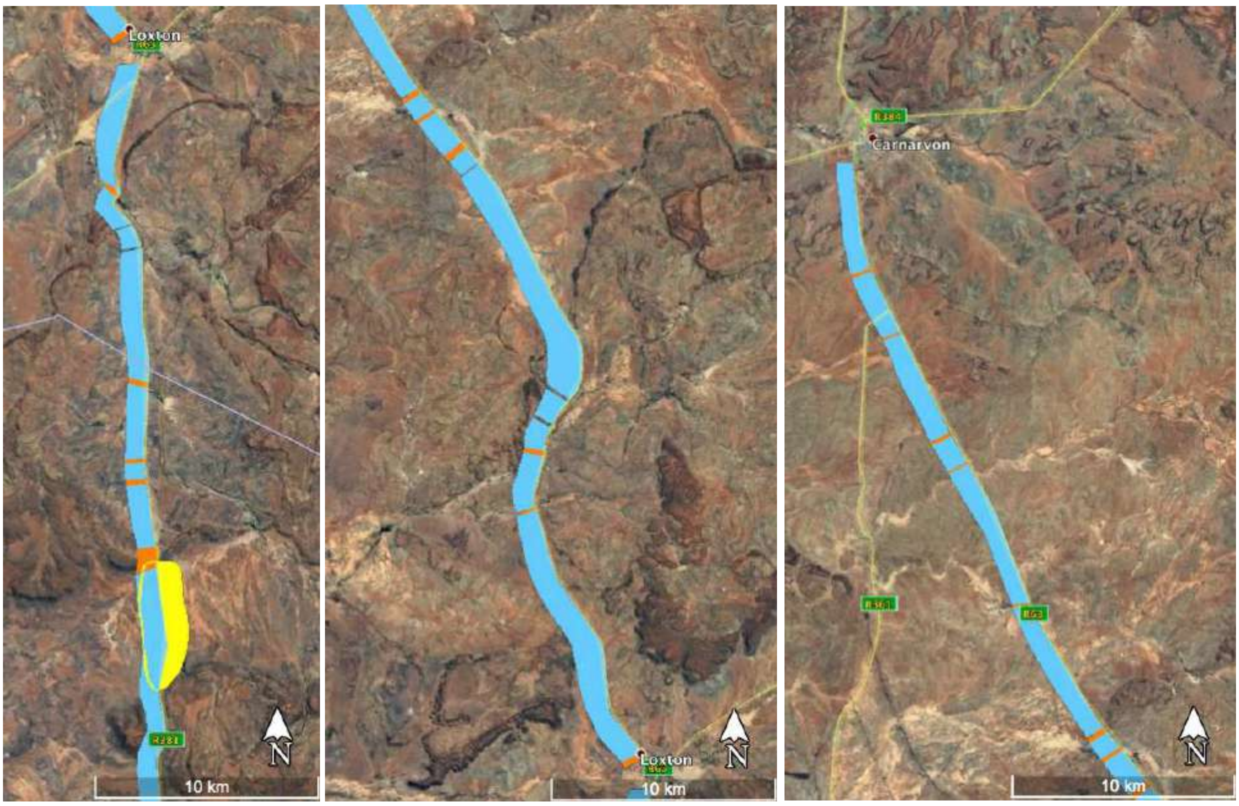


Figure 38: Sensitivity map of habitats along the route of the fibre-optic cable.

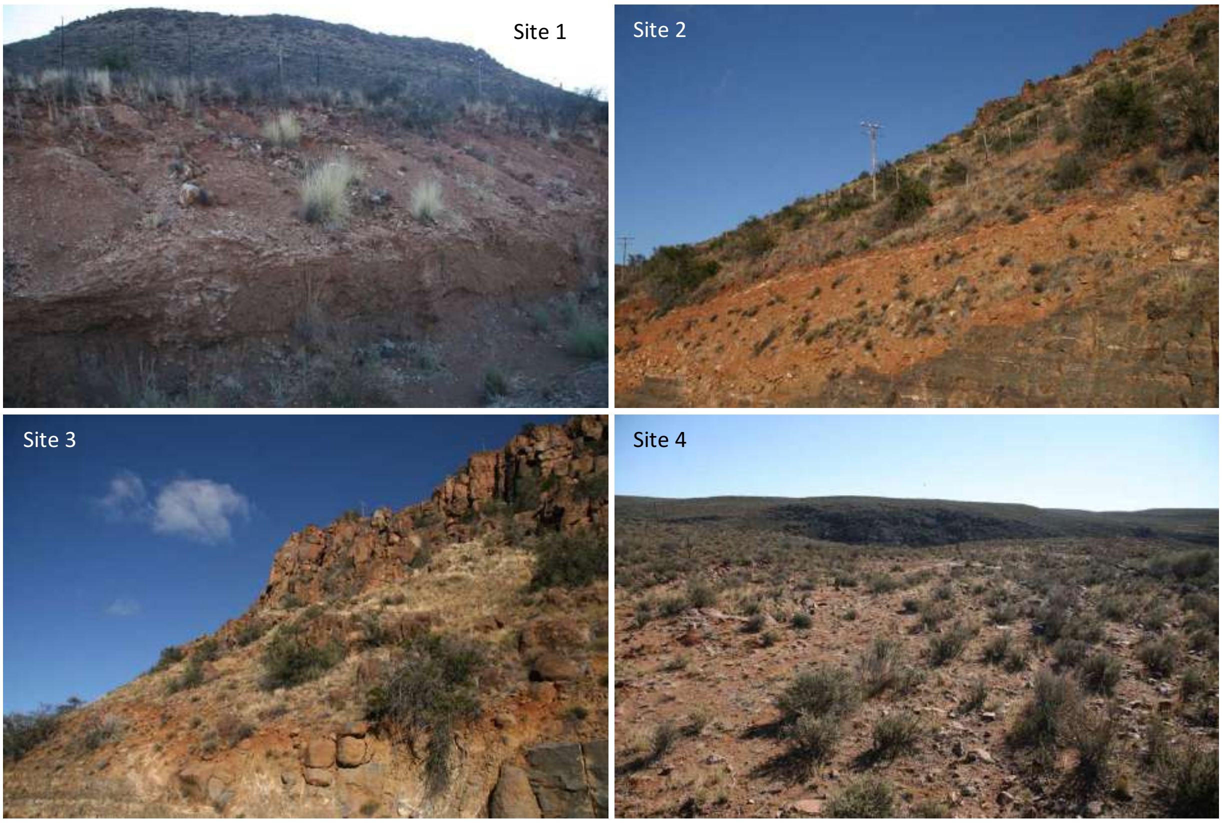


Figure 39: Instances on the overhead section of the cable where care should be taken when siting the exact location of posts. (a) Site 1; (b) Site 2; (c) Site 3; and (d) Site 4 (see text for GPS co-ordinates).

Figure 40: Instances on the underground section where trench location needs to be reconsidered. (a) Site 5; (b) Site 6; (c) Site 7; (d) Site 8 (e) Site 9; (f) Site 10; (g) Site 11; and (h) Site 12 (see text for GPS co-ordinates).

9.3.3 Some observed difficulties with trench placement

Most of the fibre-optic cable route is planned within the road reserve and 1 m from the fence of the private land. It was noticed that the fences along the road could be from 2 m up to > 100 m from the edge of the actual road. In some instances the fences going over the cutting was within 1 m of the edge of the cutting itself, leaving no space for the trench. The steep slopes and rockiness of the cuttings are also not suitable for trenching. From an ecological perspective it would be preferred that the trench follow the foot of the cutting next to the shoulder of the road to cause minimum damage to the habitat on top of the cutting. At some cuttings the fence was even placed directly on the edge to the steep edge.

At four specific areas conservation worthy protected species were noted on the top of the cuttings. GPS coordinates of the four road cuttings (where the trench should be directly next to the road) (Figure 41):

Site 13: 32° 09' 02.54" S; 22° 28' 28.68" E; 1583 m
Site 14: 32° 07' 25.51" S; 22° 26' 50.76" E; 1649 m
Site 15: 31° 20' 17.82" S; 22° 18' 13.62" E; 1391 m
Site 16: 31° 19' 41.41" S; 22° 18' 42.35" E; 1395 m

Locations of riverine rabbit habitat (Figure 38):

Between 32° 02' 27" S; 22° 27' 00" E & 31° 55' 14" S; 22° 24' 43" E
Between 31° 52' 53" S; 22° 23' 13" E & 31° 51' 07" S; 22° 21' 35" E
Between 31° 44' 00" S; 22° 21' 36" E & 31° 40' 53" S; 22° 21' 32" E

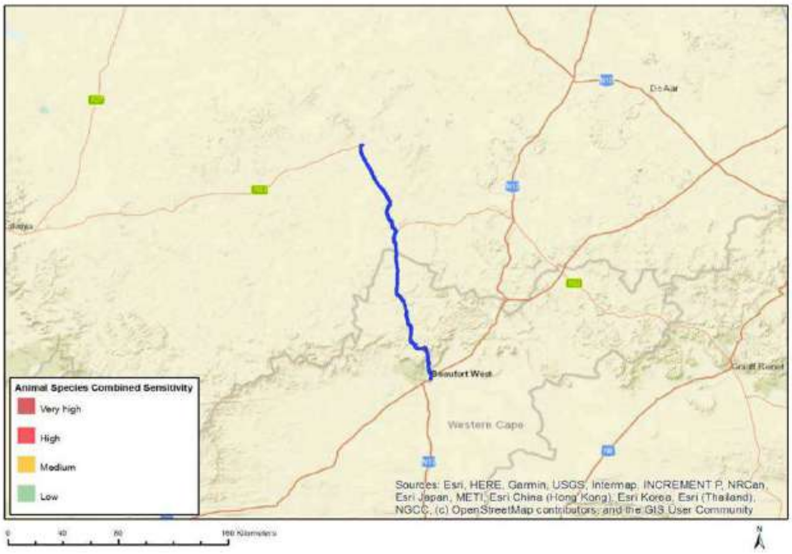
Figure 41: Instances on the underground section where trench where the trench cannot go over the cutting, but should be next to the road. (a) Site 13; (b) Site 14; (c) Site 15; and (d) Site 16 (see text for GPS co-ordinates).

9.4 Summary of screening tool results

The screening tool rated the sensitivity of the Animal Species Theme as **High** (Figure 42). The following animal species were highlighted:

Sensitivity	Feature(s)
High	Aves-*Aquila verreauxii*
High	Aves-*Circus maurus*
High	Mammalia-*Bunolagus monticularis*
High	Mammalia-*Redunca fulvorufula fulvorufula*
Medium	Mammalia-*Bunolagus monticularis*
Medium	Reptilia-*Chersobius boulengeri*

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



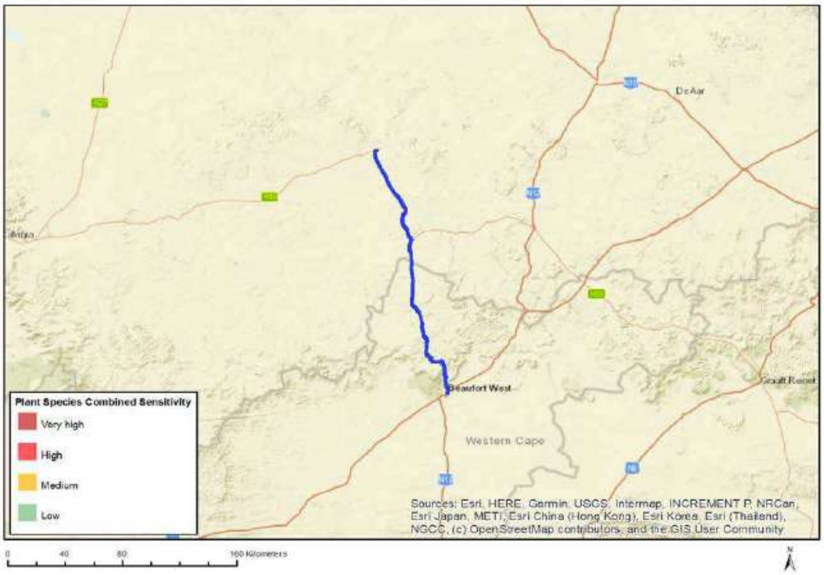
Very high sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	x		

Figure 42: Map and outcome of Animal Species Theme sensitivity generated by the screening tool. Unfortunately the mapping scale of the screening tool output does not allow colours of the categories to be visible.

The screening tool rated the sensitivity of the Plant Species Theme as **Medium** (Figure 43). The following plant species were highlighted:

Sensitivity	Feature(s)
Medium	*Cliffortia arborea*
Medium	Sensitive species 704

MAP OF RELATIVE PLANT SPECIES THEME SENSITIVITY

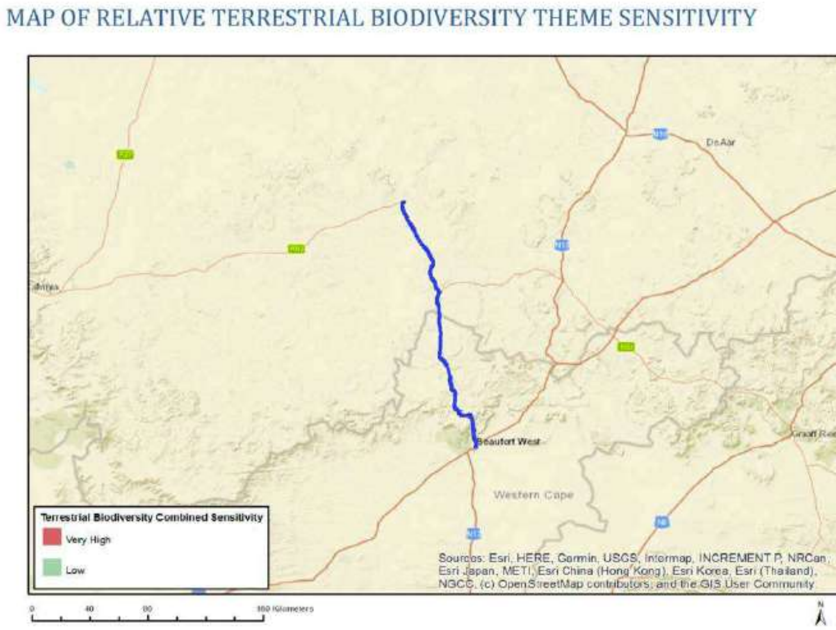


Very high sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		x	

Figure 43: Map and outcome of Plant Species Theme sensitivity generated by the screening tool. Unfortunately the mapping scale of the screening tool output does not allow colours of the categories to be visible.

The screening tool rated the sensitivity of the Relative Terrestrial Biodiversity theme as **Very High** (Figure 44). The following features were highlighted:

Sensitivity	Feature(s)
Very high	Ecological Support Area
Very high	Ecological Support Area 1
Very high	Ecological Support Area 2
Very high	Critical Biodiversity Area 1
Very high	Critical Biodiversity Area 2
Very high	Focus Areas for land-based protected areas expansion
Very high	Freshwater ecosystem priority area quinary catchments
Very high	Karoo National Park
Very high	Dr Appie van Heerden Nature Reserve



Very high sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
x			

Figure 44: Map and outcome of Relative Terrestrial Biodiversity sensitivity generated by the screening tool. Unfortunately the mapping scale of the screening tool output does not allow colours of the categories to be visible.

9.5 Screening tool in relation to background study and site verification

9.5.1 Animal theme

Mammals: Our background study concurred with the presence of the riverine rabbit (Collins *et al.* 2016) and the mountain reedbuck (Taylor *et al.* 2016) in the region. The presence of the riverine rabbit was furthermore confirmed by one of the landowners (Mr Johan Moolman) of the farm Dunedin and the notice board of the Endangered Wildlife Trust at Slangfontein. The background study also listed the presence of the black-footed cat in the region. A brief description of the habitat preference and of the impact of the development on the riverine rabbit is provided in Chapter 7. It is believed that the mountain reedbuck was introduced in the Karoo National Park and is unlikely to be encountered free-roaming in the road reserve. This will also be the case for the other red listed species introduced in the region (see Appendix B).

Reptiles: Our background study confirmed the presence of the Karoo dwarf tortoise. See Chapter 11 for possible impact and mitigation measures.

Birds: The presence of two red listed bird species was singled out by the screening tool although our background study revealed the presence of 10 red listed species. Additionally, Ludwig's bustard was sighted during the site survey. See Chapter 11 for possible impact and for mitigation measures.

9.5.2 Plant theme

Our background study corresponded with the screening tool on the possible presence of *Cliffortia arborea* along the route, however sensitive species 704 was not listed for the region on the NewPosa database. Neither of these species was encountered during the site visit. *Cliffortia arborea* is a conspicuous species in the high mountains and would have been spotted easily if it had been present. Sensitive species 704, on the other hand, is a small, cryptic species, preferring quartz patches. Along the fibre-optic cable route quartz patches were not noted and thus it can be assumed that the species is unlikely to occur along the route. Two other red listed species were listed on the NewPosa database for the region. However, these species seem to be beyond their known distribution range and could thus either be wrong identifications or specimens grown in collections. Based solely on the presence of red listed species which were not found along the route, we would suggest to downgrade the rating of the Plant Species Theme to low. However, many provincially protected/specially protected and CITES II listed species were recorded which could imply a medium rating.

9.5.3 Relative terrestrial biodiversity theme

This theme considers the presence of protected areas, NPAES, CBAs, ESAs and NFEPAs. Our background study concurred with the findings of the screening tool (see Chapter 8). Since the development will take place mostly in the road reserve it will have no impact on the Dr Appie van Heerden Nature Reserve or affect the NPAES. Installation of overhead fibre-optic cable proposed in the Karoo National Park must be done in consultation with SANParks and with correct approvals in terms of NEM:PA. The classification of the road reserve as CBA is questionable from a vegetation standpoint, although it might still be marginal riverine rabbit habitat. However, the presence of the riverine rabbit appeared not to be mentioned as a criterion in the CBA mapping of the Western Cape. Overall the impact of the route within the identified CBAs and ESAs is believed to be small. In the Western Cape NFEPA was considered in delineating CBAs, however in the Northern Cape a relatively long stretch between Loxton and Carnarvon was identified as a NFEPA that was not incorporated into the delineation of the CBAs.

See Appendix D for a complete discussion of the site verification.

10. IDENTIFICATION OF ENVIRONMENTAL IMPACTS

10.1 Introduction

In this section the issues, risks and impacts associated with the installation of the fibre-optic cable from a terrestrial ecology viewpoint is presented.

10.2 Key issues

The key botanical issue is the fact that the majority of the study area covers the fenced road reserve and therefore represents a habitat that is in essence transformed and continually disturbed. This habitat is seldom representative of the natural veld adjacent to the road reserve. Furthermore, water run-off from the road surface contributes to an unnatural species assemblage in most areas. Rare plant species usually occur in specialised and localised habitats, which are mostly destroyed by road building.

The key faunal issue is the known occurrence of the critically endangered riverine habitat (*Bunolagus monticularis)*. The area south of Loxton is regarded as prime riverine rabbit habitat, in particular around the Sak and Brak Rivers.

The proposed fibre-optic cable may negatively impact the fauna and flora of the site in various ways, albeit to a rather insignificant degree. The potential impacts for the different phases of the project, identified during the current assessment, are listed below. The significance of these impacts are assessed in Chapter 11.

10.3 Impacts during the construction phase

10.3.1 Direct impacts during the construction phase

- Potential impact 1: The clearing of natural vegetation and resultant loss of faunal habitat;
- Potential impact 2: The loss of threatened, protected and endemic plants/animals;
- Potential impact 3: Direct faunal mortalities due to construction, trench digging and increased traffic;
- Potential impact 4: Increased noise levels due to heavy machinery;
- Potential impact 5: Increased dust deposition.

10.3.2 Indirect impacts during the construction phase

- Potential impact 1: Establishment of alien vegetation as a result of the clearing of the vegetation;
- Potential impact 2: Increased water run-off and erosion.

10.4 Impacts during the operational phase

10.4.1 Direct impacts during the operational phase

- Potential impact 1: Direct faunal mortalities due to bird collisions with overhead cable and possibly increased traffic for cable maintenance.

10.4.2 Indirect impacts during the operational phase

- Potential impact 1: Establishment of alien vegetation will continue.

10.5 Impacts during the decommissioning phase

10.5.1 Direct impacts during the decommissioning phase

- Potential impact 1: Some clearing of natural vegetation due to removal of infrastructure.

10.5.2 Indirect impacts during the decommissioning phase

- Potential impact 1: Establishment of alien vegetation
- Potential impact 2: Possible ingestion or ensnarement of animals due to waste material lying around.

10.6 Cumulative impacts

- Cumulative impact 1: Vegetation loss and habitat destruction and concommittant loss of SCC and protected species
- Cumulative impact 2: Compromising integrity of CBA, ESA and NPAES
- Cumulative impact 3: Increased water run-off and erosion.

10.7 Summary of issues identified during the public participation process

These issues will be dealt with after the public participation process has been concluded, and presented in the final version of this Report.

Table 10: Comments Received from Stakeholders during the Public Consultation Phase

Comment	Commenter	Response

11. ASSESSMENT OF SIGNIFICANCE OF ENVIRONMENTAL IMPACTS

11.1 Introduction and approach

The Square Kilometre Array (SKA) is hosted by South Africa and Australia and will extend to eight African countries and is one of the largest multinational scientific collaboration projects. The project will collect a vast volume of data daily which requires immense data connectivity needs, amongst others the connection between the SKA core site and the data processing facility in Cape Town. Meeting the advanced technological and engineering needs of the project will result in local skills development, enable science and technology research and generate employment opportunities. The 'no-go' option (i.e. the proposed fibre-optic cable is not installed) would thus undermine the goals of the SKA project.

The impacts of the proposed development on the terrestrial ecology were assessed based on the knowledge gained during the site visit and literature review. The methodology follows the guidelines provided by the CSIR as set out below (DEAT Guideline 5: Assessment of Alternatives and Impacts (DEAT 2006), the following methodology is applied to the prediction and assessment of impacts and risks):

Potential impacts and risks have been rated in terms of the direct, indirect and cumulative impacts:

- **Direct impacts:** are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.
- **Indirect impacts:** are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken or which occur at a different place as a result of the activity.
- **Cumulative impacts:** are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.

The impact assessment methodology includes the following aspects:

- **Nature of impact/risk** - The type of effect that a proposed activity will have on the environment.

- **Status** - Whether the impact/risk on the overall environment will be:
    - Positive - environment overall will benefit from the impact/risk;
    - Negative - environment overall will be adversely affected by the impact/risk; or
    - Neutral - environment overall will not be affected.

- **Spatial extent** – The size of the area that will be affected by the impact/risk:
    - Site specific;
    - Local (<10 km from site);
    - Regional (<100 km of site);
    - National; or
    - International (e.g. Greenhouse Gas emissions or migrant birds).

- **Duration** – The timeframe during which the impact/risk will be experienced:
    - Very short term - instantaneous;
    - Short term - less than 1 year;
    - Medium term - 1 to 10 years;
    - Long term - the impact will cease after the operational life of the activity (i.e. the impact or risk will occur for the project duration); or
    - Permanent - mitigation will not occur in such a way or in such a time span that the impact can be considered transient (i.e. the impact will occur beyond the project decommissioning).

- **Consequence** – The anticipated consequence of the risk/impact:
    - Extreme - extreme alteration of natural systems, patterns or processes, i.e. where environmental functions and

processes are altered such that they permanently cease;
- Severe - severe alteration of natural systems, patterns or processes, i.e. where environmental functions and processes are altered such that they temporarily or permanently cease;
- Substantial - substantial alteration of natural systems, patterns or processes, i.e. where environmental functions and processes are altered such that they temporarily or permanently cease;
- Moderate - notable alteration of natural systems, patterns or processes, i.e. where the environment continues to function but in a modified manner; or
- Slight - negligible alteration of natural systems, patterns or processes, i.e. where no natural systems/environmental functions, patterns, or processes are affected.

- **Reversibility of the Impacts** - the extent to which the impacts/risks are reversible assuming that the project has reached the end of its life cycle (decommissioning phase):
    - High reversibility - impact is highly reversible at end of project life i.e. this is the most favourable assessment for the environment;
    - Moderate reversibility of impacts;
    - Low reversibility of impacts; or
    - Impacts are non-reversible - impact is permanent, i.e. this is the least favourable assessment for the environment.

- **Irreplaceability of Receiving Environment/Resource Loss caused by impacts/risks** – the degree to which the impact causes irreplaceable loss of resources assuming that the project has reached the end of its life cycle (decommissioning phase):
    - High irreplaceability of resources - project will destroy unique resources that cannot be replaced, i.e. this is the least favourable assessment for the environment;
    - Moderate irreplaceability of resources;
    - Low irreplaceability of resources; or
    - Resources are replaceable - the affected resource is easy to replace/rehabilitate, i.e. this is the most favourable assessment for the environment.

Using the criteria above, the impacts are further assessed in terms of the following:

- **Probability** – The probability of the impact/risk occurring:
    - Extremely unlikely (little to no chance of occurring);
    - Very unlikely (<30% chance of occurring);
    - Unlikely (30-50% chance of occurring)
    - Likely (51 – 90% chance of occurring); or
    - Very Likely (>90% chance of occurring regardless of prevention measures).

To determine the significance of the identified impact/risk, the consequence is multiplied by probability (qualitatively as shown in Figure 45).

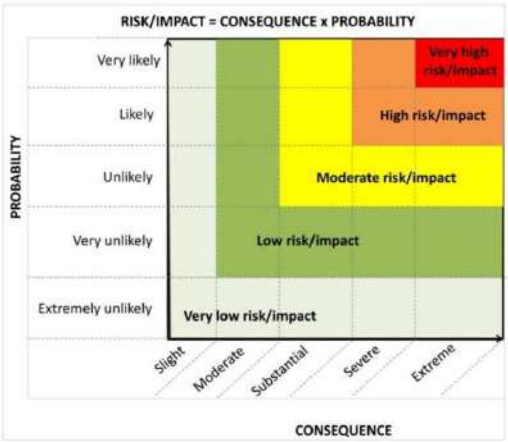


Figure 45: Guide to assessing risk/impact significance as a result of consequence and probability.

- **Significance** – Will the impact cause a notable alteration of the environment?
    - Very low - the risk/impact may result in very minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making;
    - Low - the risk/impact may result in minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making;
    - Moderate - the risk/impact will result in moderate alteration of the environment and can be reduced or avoided by implementing the appropriate mitigation measures, and will only have an influence on the decision-making if not mitigated;

- o High - the risk/impact will result in major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making; and
- o Very high - the risk/impact will result in very major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making (i.e. the project cannot be authorised unless major changes to the engineering design are carried out to reduce the significance rating).

With the implementation of mitigation measures, the residual impacts/risks are ranked as follows in terms of significance:

- o Very low = 5;
- o Low = 4;
- o Moderate = 3;
- o High = 2; and
- o Very high = 1.

Confidence – The degree of confidence in predictions based on available information and specialist knowledge:

- o Low;
- o Medium; or
- o High.

11.2 Impacts during the construction phase and their significance

11.2.1 Direct impacts during the construction phase

The clearing of vegetation

Nature: Natural vegetation will be cleared for the trench to bury the cable and for planting the overhead poles. The removal of indigenous vegetation may cause a loss of individuals of threatened, protected and endemic species and will also be accompanied by a loss of faunal habitat. Overall, this may lead to an impoverished biodiversity at those sites. Vegetation loss is generally also associated with increased water run-off and erosion (see indirect impacts).

Some destruction of the vegetation adjacent to the footprint will also inevitably occur due to the use of heavy machinery to dig the trench and holes for the overhead poles. Unnecessary clearing of vegetation beyond the footprint of the development can however, largely be avoided.

Proposed mitigation measures:

- Construction crew, in particular the drivers and operators of heavy machinery, should undergo environmental training (induction) to increase their awareness of environmental concerns.
- Vegetation clearance should be confined to the footprint of the development and unnecessary clearance should be avoided.
- The cliffs and rocky sheets should be avoided.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Site specific	Site specific
Duration	Short to medium term	Short to medium term
Consequence (Severity)	Moderate	Moderate
Probability	Very likely	Likely
Reversibility	Moderate	Moderate
Irreplaceability	Low	Low
Significance	**Low**	**Low**
Confidence level of assessment	High	High

The loss of threatened (Species of Conservation Concern – SCC), protected & endemic plants

Nature: The loss of the vegetation for trench digging and pole planting may cause a loss of individuals of SCC. The site visit did however not reveal the presence of any species with an **IUCN threatened status**. Many provincially protected plant species were present, most of them are quite common and some are even weedy. The rare protected species are often habitat specialists (e.g. found on rocky sheets) and in those cases the habitat should be avoided (see Chapter 9 for sites to avoid). Where protected species cannot be avoided, permits need to be obtained for the destruction of provincially protected or specially protected species. Only one species listed as endemic to a vegetation type was encountered.

Proposed mitigation measures:

- Construction crew, in particular the drivers and operators of heavy machinery, should undergo environmental training (induction) to make them aware of the importance of protected species.
- Placement of the trench or poles should be done in such a way as to minimise the impact on protected species (see sensitivity map). For example, micrositing of poles to avoid protected species; and at cuttings the trench should follow the bottom of the cutting and not over the top.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Site specific	Site specific
Duration	Long-term	Long-term
Consequence (Severity)	Moderate	Moderate
Probability	Likely	Likely
Reversibility	Low	Low
Irreplaceability	Moderate	Moderate
Significance	**Low**	**Low**
Confidence level of assessment	Medium	Medium

Direct faunal mortalities

Nature: Faunal mortalities may be caused by groundworks during construction activities, construction vehicles and waste material. In particular slow-moving species such as tortoises, might be prone to these mortalities. Animals could fall into the trench and be unable to get out unassisted. Fatalities might arise when animals ingest waste material or become ensnared in wires.

Proposed mitigation measures:

- Construction crew, in particular the drivers and operators of heavy machinery, should undergo environmental training (induction) to increase their awareness of environmental concerns. Although all road kills cannot be avoided, the increased awareness of drivers should be able to reduce the number of fatalities.
- Before trenches are dug in those areas that have been indicated as prime habitat for the riverine rabbit, the route should be walked on foot to ensure that no burrows are present in the path of the trench.
- Construction of the trench in favoured riverine rabbit habitat should preferably not be conducted during the breeding season (August to May).
- Trenches should not be left open for long periods of time. Trenches should also be inspected regularly for the presence of trapped animals and immediately before they are filled.
- Proper waste management procedures should be in place to avoid waste lying around and to remove all waste material from the site.
- Speed limits should be strictly adhered to.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Site specific	Site specific
Duration	Short-term	Short-term
Consequence (Severity)	Moderate	Moderate
Probability	Likely	Unlikely
Reversibility	Low	Low
Irreplaceability	Moderate	Moderate
Significance	**Low**	**Low**
Confidence level of assessment	Medium	Medium

Increased dust deposition

Nature: The cable follows long stretches of gravel road between Beaufort West and Loxton and dust caused by vehicles may remain in the air for a long time. Increased dust deposition can harm physiological processes of plants and results in reduced photosynthetic capacity. The dust layer on the vegetation may also deter herbivores. The increased dust levels will be temporary.

Proposed mitigation measures:

- Excessive dust can be reduced by spraying water onto the soil to control dust generation.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Site specific	Site specific
Duration	Short-term	Short-term
Consequence (Severity)	Slight	Slight
Probability	Likely	Likely
Reversibility	High	High
Irreplaceability	-	-
Significance	**Very low**	**Very low**
Confidence level of assessment	High	High

Increased human activity and noise levels

Nature: Construction activities will increase human presence and noise levels at the site. These activities may adversely affect animal behaviour.

Proposed mitigation measures:

- No construction should be done at night.
- Ensure all equipment is of good quality, good condition and maintained regularly;
- Ensure that all operators of construction equipment receive proper training in the use of the equipment and that the equipment is serviced regularly.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Site specific	Site specific
Duration	Very short-term	Very short-term
Consequence (Severity)	Slight	Slight
Probability	Likely	Likely
Reversibility	High	High
Irreplaceability	-	-
Significance	**Very low**	**Very low**
Confidence level of assessment	High	High

11.2.2 Indirect impacts during the construction phase

Establishment of alien vegetation

Nature: As a result of the clearance of indigenous vegetation and resulting degradation, alien species might invade the area. Alien invasive species are generally more common in road reserves than the adjacent undisturbed farm land. Nine declared invasive species were recorded en route. Increased vehicle traffic may further facilitate the introduction of seeds of alien species. Infestation by invasive alien species may cause changes to the structure and functioning of the ecosystem which often exacerbates the further loss of indigenous vegetation.

Proposed mitigation measures:

- Implement a monitoring program for the early detection of alien invasive plant species.
- Employ a control program to combat declared alien invasive plant species.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Local	Local
Duration	Long-term	Long-term
Consequence (Severity)	Moderate	Slight
Probability	Very likely	Likely
Reversibility	Moderate	Moderate
Irreplaceability	Low	Low
Significance	**Low**	**Very low**
Confidence level of assessment	Medium	Medium

Increased erosion and water run-off

Nature: Increased water run-off and erosion may be caused by the clearing of the vegetation, especially against slopes and going over cuttings. It is improbable that the increased run-off and erosion will affect hydrological processes in the area and change water and silt discharge into the streams.

Proposed mitigation measures:

- Clearing of vegetation should be restricted to the footprint of the proposed development.
- Avoid going over cuttings, but rather place trench next to the road shoulder.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Local	Local
Duration	Medium-term	Medium-term
Consequence (Severity)	Moderate	Slight
Probability	Likely	Likely
Reversibility	Low	Low
Irreplaceability	Moderate	Moderate
Significance	**Low**	**Very low**
Confidence level of assessment	Medium	Medium

11.3 Impacts during the operational phase and their significance

11.3.1 Direct impacts during the operational phase

It is anticipated that human activities during the operational phase will be for maintenance purposes and only arise when faulty cables need to be replaced. These activities are done through the manholes and no further disturbance of the soil or vegetation is expected.

Direct faunal mortalities

Nature: Faunal mortalities may be caused by maintenance vehicles or other maintenance activities and waste material. In particular slow-moving species such as tortoises, might be prone to road mortalities. Fatalities might also arise when animals ingest waste material or become ensnared in wires. Bird collisions might occur with the overhead cable.

Proposed mitigation measures:

- Maintenance crew should undergo environmental training to increase their awareness of environmental concerns.
- All excess cables and waste material should be removed from the site.
- A monitoring programme should be initiated to determine the extent of bird collisions with the overhead cable. Should the monitoring show unacceptable mortality levels an avifaunal study should be done to determine where there are areas of known flight paths. Flappers or other deterrent devices will then have to be attached onto the cable in these sections.
- Speed limits should be strictly adhered to.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Site specific	Site specific
Duration	Short-term (possibly long-term)	Short-term
Consequence (Severity)	Moderate	Slight
Probability	Unlikely	Unlikely
Reversibility	Moderate	Moderate
Irreplaceability	Low	Low
Significance	**Low**	**Very low**
Confidence level of assessment	Medium	Medium

11.3.2 Indirect impacts during the operational phase

Establishment of alien vegetation

Nature: As a result of the loss of indigenous vegetation and resulting degradation, alien species might invade the area. Alien invasive species are generally more common in road reserves than the adjacent undisturbed farm land. The invasion by alien species will continue unless controlled. Increased vehicle traffic may further facilitate the introduction of seeds of alien species. Infestation by invasive alien species may cause changes to the structure and functioning of the ecosystem which often exacerbates the further loss of indigenous vegetation.

Proposed mitigation measures:

- Implement a monitoring program for the early detection of alien invasive plant species.
- Employ a control program to combat declared alien invasive plant species.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Local	Local
Duration	Long-term	Long-term
Consequence (Severity)	Moderate	Slight
Probability	Likely	Likely
Reversibility	Moderate	Moderate
Irreplaceability	Low	Low
Significance	**Low**	**Very Low**
Confidence level of assessment	Medium	Medium

10.4 Impacts during the decommissioning phase and their significance

It has been assumed that the underground conduits will be left in place, but that the manholes, poles, overhead cables, and other aboveground structures will be removed during decommissioning. Consequently, few environmental impacts during this phase are anticipated.

11.4.1 Direct impacts during the decommissioning phase

The clearing of natural vegetation

Nature: Clearing of natural vegetation will be limited to the small sites where the infrastructure will be removed. Due to the small area that will be impacted it is unlikely that individuals of threatened, protected and endemic species will be lost or that any appreciable loss of faunal habitat will occur.

Proposed mitigation measures:

- Unnecessary clearance of natural vegetation should be avoided.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Site specific	Site specific
Duration	Short-term	Short-term
Consequence (Severity)	Slight	Slight
Probability	Very likely	Very likely
Reversibility	Moderate	Moderate
Irreplaceability	Low	Low
Significance	**Very low**	**Very low**
Confidence level of assessment	Medium	Medium

Direct faunal mortalities

Nature: Faunal mortalities may be caused by vehicles or other decommissioning activities and waste. In particular slow-moving species such as tortoises, might be prone to road mortalities. Fatalities might also arise when animals ingest waste material or become ensnared in it.

Proposed mitigation measures:

- Decommissioning crew should undergo environmental training to increase their awareness of environmental concerns.
- Speed limits should be adhered to.
- Proper waste management procedures should be in place and no material should be left on site in order to prevent instances of ensnarement or ingestion of foreign material.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Site specific	Site specific
Duration	Short-term	Short-term
Consequence (Severity)	Moderate	Slight
Probability	Likely	Unlikely
Reversibility	Moderate	Moderate
Irreplaceability	Low	Low
Significance	**Low**	**Very low**
Confidence level of assessment	Medium	Medium

11.4.2 Indirect impacts during the decommissioning phase

Establishment of alien vegetation

Nature: Invasion by alien invasive species is an ongoing process and will usually follow after any soil disturbance and loss of vegetation. Alien invasive species are generally more common in road reserves than the adjacent undisturbed farm land. Disturbance during the decommissioning phase is, however, believed to be minimal.

Proposed mitigation measures:

- Implement a monitoring program for the early detection of alien invasive plant species.
- Employ a control program to combat declared alien invasive plant species.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Local	Local
Duration	Long-term	Long-term
Consequence (Severity)	Slight	Slight
Probability	Likely	Likely
Reversibility	Moderate	Moderate
Irreplaceability	Low	Low
Significance	**Very low**	**Very low**
Confidence level of assessment	Medium	Medium

10.5 Cumulative impacts

The existing and proposed developments that were taken into consideration for cumulative impacts include:

- The existing road/s;
- Existing linear infrastructure adjacent to the road reserve on private land, such as powerlines and telephone lines (the latter no longer functional and will probably be removed);
- Existing powerline in Karoo National Park;
- Proposed renewable energy projects around Beaufort West
    - Beaufort West Photovoltaic Park;
    - Beaufort West Solar Power Plant sites 2 & 3;
    - Lombaardskraal Wind & Solar;
    - Beaufort West Wind Energy Project (Lapsed);
    - Steenrotsfontein Solar Energy Facility (Lapsed);
- Proposed housing development and expansion near Beaufort West;
- Loxton landfill;
- Uranium mining (southeast of Beaufort West);
- Proposed shale gas extraction (southwest of Loxton); and
- Prospecting for unspecified mineral (west of road between Carnarvon & Loxton).

The majority of these large developments (renewable energy, uranium mining) are close to Beaufort West, mainly to the south, southeast and northeast. These developments fall predominantly in the Gamka Karoo Vegetation Type with some sections in the Southern Karoo Riviere. Only about 4% of the route of the fibre-optic cable passes through the Gamka Karoo and this section is highly degraded due to its close proximity to Beaufort West.

Developments in the Eastern Upper Karoo include the proposed shale gas exploration, mining for an unspecific mineral and the powerline in the Karoo National Park. The powerline follows the R381 for part of its course and is thus in the same proximity as the proposed fibre-optic route. However, powerlines on the smaller roads generally do not occur in the road reserve. The project with the greatest negative impact would be the proposed shale gas extraction, since it coincides with the habitat of the riverine rabbit.

The impacts below refer only to the Gamka Karoo vegetation type where many solar farms and mining activities are planned which result in large scale clearing. In the other vegetation types cumulative impacts will be low. It is important to note that the contribution of the fibre-optic cable to these impacts in the Gamka Karoo is neglible.

Vegetation loss and habitat destruction due to developments in the Gamka Karoo

Nature: Vegetation loss and habitat destruction will occur. The habitat destruction will lead to changes in the physical features of the habitat, with concomitant changes in ecological processes. Secondary vegetation will develop at sites where the vegetation was cleared or the soil compacted. The species composition may change and alien species might invade. Vegetation loss will also constitute the loss of animal habitat. Considering all the developments in the region, the most severe impact will be on the Gamka Karoo's fauna and flora. However, the contribution of the fibre optic cable to further transformation an degradation of habitat is negligible.

Proposed mitigation measures:

- All projects should adhere to the site-specific recommendations of the ecologists to ensure that impacts are mitigated where possible.

Significance considering contribution of fibre optic cable to developments in the Gamka Karoo without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Regional	Regional
Duration	Long-term	Long-term
Consequence (Severity)	Moderate (in Gamka Karoo)	Slight
Probability	Likely	Likely
Reversibility	Moderate	Moderate
Irreplaceability	Low	Low
Significance	**Low**	**Very low**
Confidence level of assessment	Medium	Medium

Loss of Species of Conservation Concern (SCC)

Nature: The loss of vegetation in the Gamka Karoo might cause the loss of SCC. This would primarily be applicable to threatened and rare plant species that have a restricted distribution range. Although the fibre-optic cable will not contribute to the loss of SCC, the other projects might do so.

In the Eastern Upper Karoo the riverine rabbit populations could be affected.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Regional	Regional
Duration	Long-term	Long-term
Consequence (Severity)	Moderate (in Gamka Karoo)	Moderate (in Gamka Karoo)
Probability	Likely	Likely
Reversibility	Low to moderate	Moderate
Irreplaceability	Low	Low
Significance	**Low**	**Low**
Confidence level of assessment	Medium	Medium

Compromising integrity of CBA, ESA and NPAES due to developments in the Gamka Karoo

Nature: According to the mapping of CBAs in the Western and Northern Cape, several of the proposed developments are located/partially located within CBAs. Development within CBAs is not encouraged as such development may result in biodiversity loss and therefore compromise the integrity of the CBA. Development is only permitted in a CBA on condition approval is granted by the relevant competent authority. The loss of the area might also have an effect on the future suitability of the terrain as protected area, although only a small portion next to the Karoo National Park is earmarked for the National Protected Area Expansion. Considering the large number of developments in the Gamka Karoo, the CBAs in this vegetation type could be compromised and consequently the biodiversity target for the ecosystem could be affected. The contribution of the fibre optic cable to compromising the integrity of CBAs, ESAs and NPAES is however small.

Proposed mitigation measures:

- Avoid placing large infrastructure in CBAs.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Regional	Regional
Duration	Long-term	Long-term
Consequence (Severity)	Moderate (in Gamka Karoo)	Moderate (in Gamka Karoo)
Probability	Likely	Likely
Reversibility	Low to moderate	Moderate
Irreplaceability	Low	Low
Significance	**Low**	**Low**
Confidence level of assessment	Medium	Medium

Increased erosion and water run-off due to all developments in the Gamka Karoo

Nature: Increased water run-off and erosion will alter hydrological processes and might affect catchments and downstream habitats especially since increased erosion and water run-off will occur on all mountain slopes in the area. This is primarily relevant in the Upper Karoo Hardeveld Vegetation Type and might affect conditions in the Gamka Karoo.

Proposed mitigation measures:

- Structures to control erosion should be implemented.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Status	Negative	Negative
Spatial extent	Regional	Regional
Duration	Long-term	Long-term
Consequence (Severity)	Moderate	Moderate
Probability	Likely	Likely
Reversibility	Low to moderate	Moderate
Irreplaceability	Low	Low
Significance	**Low**	**Low**
Confidence level of assessment	Medium	Medium

10.6 Impact assessment summary

Tables 11 – 14 summarise the impact assessment across all phases of the development and the integrated assessment post-mitigation per phase is provided in Table 15.

Table 11: Summary assessment of (a) direct and (b) indirect impacts and their mitigation measures during the construction phase

(a)

Impact	***Impact Criteria***		***Significance and Ranking (Pre-Mitigation)***	***Potential mitigation measures***	***Significance and Ranking (Post-Mitigation)***	***Confidence Level***
CONSTRUCTION PHASE: DIRECT IMPACTS						
The clearing of vegetation	Status	Negative	Low	Vegetation clearance should be confined to the footprint of the development and unnecessary clearance should be avoided. The cliffs and rocky sheets should be avoided. Construction crew, in particular the drivers, should undergo environmental training to increase their awareness of environmental concerns.	Low - 4	High
	Spatial Extent	Site specific				
	Duration	Short to medium-term				
	Consequence	Moderate				
	Probability	Very likely				
	Reversibility	Moderate				
	Irreplaceability	Low				
The loss of threatened (SCC), protected & endemic plants	Status	Negative	Low	Construction crew, in particular the drivers, should undergo environmental training (induction) to make them aware of the importance of protected species. Placement of the trench or poles should be done in such a way as to minimise the impact on protected species (see sensitivity map). For example, micrositing of poles to avoid protected species; and at cuttings the trench should follow the bottom of the cutting and not over the top.	Low - 4	Medium
	Spatial Extent	Site specific				
	Duration	Long-term				
	Consequence	Moderate				
	Probability	Likely				
	Reversibility	Low				
	Irreplaceability	Moderate				
Direct faunal mortalities	Status	Negative	Low	Construction crew, in particular the drivers, should undergo environmental training to increase their awareness of environmental concerns. Before trenches are dug in those areas that have been indicated as prime habitat for the riverine rabbit, the route should be walked on foot to ensure that no burrows are present in the path of the trench. Construction of the trench in favoured riverine rabbit habitat should preferably not be conducted during the breeding season (August to May). Trenches should not be left open for long periods of time. Trenches should also be inspected for the presence of trapped animals before they are filled again. Proper waste management procedures should be in place to avoid waste lying around and to remove all waste material from the site. Speed limits should be strictly adhered to.	Low - 4	Medium
	Spatial Extent	Site specific				
	Duration	Short-term				
	Consequence	Moderate				
	Probability	Likely				
	Reversibility	Low				
	Irreplaceability	Moderate				
Increased dust deposition	Status	Negative	Very low	Excessive dust can be reduced by spraying water onto the soil to control dust generation.	Very low - 5	High
	Spatial Extent	Site specific				
	Duration	Short-term				
	Consequence	Slight				
	Probability	Likely				
	Reversibility	High				
	Irreplaceability	-				
Increased noise levels and human activity	Status	Negative	Very low	No construction should be done at night. Ensure all equipment is of good quality, good condition and maintained regularly. Ensure that all operators of construction equipment receive proper training in the use of the equipment and that the equipment is serviced regularly.	Very low - 5	High
	Spatial Extent	Site specific				
	Duration	Very short-term				
	Consequence	Slight				
	Probability	Likely				
	Reversibility	High				
	Irreplaceability	-				

(b)

Impact	***Impact Criteria***		***Significance and Ranking (Pre-Mitigation)***	***Potential mitigation measures***	***Significance and Ranking (Post-Mitigation)***	***Confidence Level***
CONSTRUCTION PHASE: INDIRECT IMPACTS						
Establishment of alien vegetation	Status	Negative	Low	Implement a monitoring program for the early detection of alien invasive plant species. Employ a control program to combat declared alien invasive plant species.	Very low - 5	Medium
	Spatial Extent	Local				
	Duration	Long-term				
	Consequence	Moderate				
	Probability	Very likely				
	Reversibility	Moderate				
	Irreplaceability	Low				
Increased erosion and water run-off	Status	Negative	Low	Clearing of vegetation should be restricted to the footprint of the proposed development. Avoid going over cuttings, but rather place trench next the road shoulder.	Very low - 4	Medium
	Spatial Extent	Local				
	Duration	Medium-term				
	Consequence	Moderate				
	Probability	Likely				
	Reversibility	Low				
	Irreplaceability	Moderate				

Table 12: Summary assessment of (a) direct and (b) indirect impacts and their mitigation measures during the operational phase

(a)

Impact	***Impact Criteria***		***Significance and Ranking (Pre-Mitigation)***	***Potential mitigation measures***	***Significance and Ranking (Post-Mitigation)***	***Confidence Level***
OPERATIONAL PHASE: DIRECT IMPACTS						
Direct faunal mortalities	Status	Negative	Low	Maintenance crew should undergo environmental training to increase their awareness of environmental concerns. All excess cables and waste material should be removed from the site. A monitoring programme should be initiated to determine the extent of bird collisions with the overhead cable. Speed limits should be strictly adhered to.	Very low - 5	Medium
	Spatial Extent	Site specific				
	Duration	Short-term (possibly long-term, monitoring to be done)				
	Consequence	Moderate				
	Probability	Unlikely				
	Reversibility	Moderate				
	Irreplaceability	Low				

(b)

Impact	***Impact Criteria***		***Significance and Ranking (Pre-Mitigation)***	***Potential mitigation measures***	***Significance and Ranking (Post-Mitigation)***	***Confidence Level***
OPERATIONAL PHASE: INDIRECT IMPACTS						
Establishment of alien vegetation	Status	Negative	Low	Implement a monitoring program for the early detection of alien invasive plant species. Employ a control program to combat declared alien invasive plant species.	Very low - 5	Medium
	Spatial Extent	Local				
	Duration	Long-term				
	Consequence	Moderate				
	Probability	Likely				
	Reversibility	Moderate				
	Irreplaceability	Low				

Table 13: Summary assessment of (a) direct and (b) indirect impacts and their mitigation measures during the decommissioning phase

(a)

Impact	***Impact Criteria***		***Significance and Ranking (Pre-Mitigation)***	***Potential mitigation measures***	***Significance and Ranking (Post-Mitigation)***	***Confidence Level***
DECOMMISSIONING PHASE: DIRECT IMPACTS						
Clearing of natural vegetation	Status	Negative	Very low	Unnecessary clearance of natural vegetation should be avoided.	Very low - 5	Medium
	Spatial Extent	Site specific				
	Duration	Short-term				
	Consequence	Slight				
	Probability	Very likely				
	Reversibility	Moderate				
	Irreplaceability	Low				

Direct faunal mortalities	Status	Negative	Low	Decommissioning crew should undergo environmental training to increase their awareness of environmental concerns. Speed limits should be adhered to. Proper waste management procedures should be in place and no material should be left on site in order to prevent instances of ensnarement or ingestion of foreign material.	Very low - 5	Medium
	Spatial Extent	Site specific				
	Duration	Short-term				
	Consequence	Moderate				
	Probability	Likely				
	Reversibility	Moderate				
	Irreplaceability	Low				

(b)

Impact	***Impact Criteria***		***Significance and Ranking (Pre-Mitigation)***	***Potential mitigation measures***	***Significance and Ranking (Post-Mitigation)***	***Confidence Level***
DECOMMISSIONING PHASE: INDIRECT IMPACTS						
Establishment of alien vegetation	Status	Negative	Very low	Implement a monitoring program for the early detection of alien invasive plant species. Employ a control program to combat declared alien invasive plant species.	Very low -5	Medium
	Spatial Extent	Local				
	Duration	Long-term				
	Consequence	Slight				
	Probability	Likely				
	Reversibility	Moderate				
	Irreplaceability	Low				

Table 14: Summary assessment of cumulative impacts

Impact	***Impact Criteria***		***Significance and Ranking (Pre-Mitigation)***	***Potential mitigation measures***	***Significance and Ranking (Post-Mitigation)***	***Confidence Level***
CONSTRUCTION PHASE:						
Loss of vegetation, habitat and SCC: compromising CBAs; soil erosion	Status	Negative	Very low	All projects should adhere to the site-specific recommendations of the ecologists to ensure that impacts are mitigated where possible. Avoid placing large infrastructure in CBAs. Erosion control measures should be implemented at all times.	Very low	Medium
	Spatial Extent	Local				
	Duration	Short-term				
	Consequence	Slight				
	Probability	Likely				
	Reversibility	Moderate				
	Irreplaceability	Low				
OPERATIONAL PHASE (the fibre-optic cable will make no contribution to the cumulative impacts during the operational phase)						
Loss of vegetation, habitat and SCC: compromising CBAs; soil erosion	Status			Project activities are likely to be minimal during this phase and only monitoring of alien invasive species and possible bird collisions should be continued.		
	Spatial Extent					
	Duration					
	Consequence					
	Probability					
	Reversibility					
	Irreplaceability					
DECOMMISSIONING PHASE (the fibre-optic cable will make no contribution to the cumulative impacts during the decommissioning phase)						
Loss of vegetation, habitat and SCC: compromising CBAs; soil erosion	Status			Avoid unnecessary clearance of vegetation.		
	Spatial Extent					
	Duration					
	Consequence					
	Probability					
	Reversibility					
	Irreplaceability					

Table 15: Overall Impact Significance (Post Mitigation)

Phase	Overall Impact Significance
Construction	Very low to Low
Operational	Very low
Decommissioning	Very low
Nature of Impact	**Overall Impact Significance**
Cumulative - Construction	Very low
Cumulative - Operational	Very low
Cumulative - Decommissioning	Very low

12. LEGISLATIVE AND PERMIT REQUIREMENTS

The following legislation is relevant to the development and may require permits from the relevant authority.

12.1 National Forest Act (Act No. 84 of 1998)(NFA 2019)

The National Forest Act provides for the protection of forests, as well as for specific tree species. In the case where a protected tree would have to be destroyed by the fibre-optic cable an application for a license granted by the Minister (or a delegated authority) would have to be made. **However, no protected trees, according to the protected tree list (NFA 2019), were observed and it is unlikely that any such species occur within the development footprint.**

12.2 National Environmental Management: Biodiversity Act (Act No. 10 of 2004)(NEMBA 2007c)

NEMBA also deals with endangered, threatened and otherwise controlled species, under the ToPS Regulations (Threatened or Protected Species Regulations). A ToPS permit is required for any activities involving any ToPS listed species.

No threatened or protected **plant species** (ToPS) were recorded during the site survey on the SKA fibre-optic study site. None of the mammals or carnivores are expected to be negatively affected by the development, but avifaunal collisions need to be monitored. The following protected **faunal species** (ToPS) are listed for the region:

Mammals:

Black wildebeest	*Connochaetes gnou*	Protected
Black-footed cat	*Felis nigripes*	Protected
Bontebok	*Damaliscus pygargus pygargus*	VU
Brown hyena	*Parahyaena brunnea*	Protected
Cape fox	*Vulpes chama*	Protected
Cape mountain zebra	*Equus zebra zebra*	EN
Elephant	*Loxodonta africana*	Protected
Honey badger	*Mellivora capensis*	Protected
Lion	*Panthera leo*	VU
Riverine rabbit	*Bunolagus monticularis*	CR
Roan antelope	*Hippotragus equinus*	VU
South African hedgehog	*Atelerix frontalis*	Protected

Amphibians

Giant bull frog	*Pyxicephalus adspersus*	Protected

Avifauna:

Black stork	*Ciconia nigra*	VU
Blue crane	*Grus paradiseus*	EN
Kori bustard	*Ardeotis kori*	VU
Lesser kestrel	*Falco naumanni*	VU
Ludwig's bustard	*Neotis ludwigii*	VU (possible collisions should be monitored)
Martial eagle	*Polemaetus bellicosus*	VU
Peregrine falcon	*Falco peregrinus*	VU

12.3 Conservation of Agricultural Resources Act (Act No. 43 of 1983)

The Conservation of Agricultural Resources Act provides for the regulation of control over the utilisation of the natural agricultural resources in order to promote the conservation of soil, water and vegetation and provides for combating weeds and invader plant species.

Currently alien abundance at the site is relatively low, however, disturbance associated with the construction phase would encourage alien invasion and woody species, in particular species such as *Prosopis glandulosa* would need to be cleared on a regular basis. No permitting would be required for such activities, but an alien invasive species control programme should be initiated.

Alien species recorded on site during the site survey include:

Argemone ochroleuca	1b
Atriplex lindleyi subsp. *inflata*	1b
Atriplex nummularia	2
Salsola kali	1b
Cirsium vulgare	1b
Opuntia ficus-indica	1b
Pennisetum setaceum	1b
Prosopis glandulosa	1b in Western Cape; 3 in Northern Cape
Pinus spp.	1b, 2 or 3
Populus alba	2

Additionally the following invasive alien species are listed for the region:

Cuscuta campestris	1b
Cylindropuntia fulgida	1b
Cylindropuntia imbricata	1b
Opuntia microdasys	1b
Tephrocactus articulatus	1a
Prosopis velutina	1b WC; 3 NC

12.4 Northern Cape Nature Conservation Act (Act No. 9 of 2009) (NCNCA 2009)

12.4.1 Flora (see Appendix A):

Under this Act, lists of provincially protected and endangered fauna and flora are provided. Some activities are restricted when dealing with protected species:

- According to Section 49. (1): No person may, without a permit - pick[1], import, export, transport, possess, cultivate or trade in a specimen of a specially protected plant.
- Section 50. (1): No person may, without a permit - pick, import, export, transport, cultivate or trade in a specimen of a protected plant.

Additionally:

- Section 51. (1): No person may, without a permit , pick an indigenous plant - **on a public road; on land next to a public road within a distance of 100 m; or within an area bordering a natural water course up to a distance of 100 m on either side of the natural water course.**

Five Schedule 1 Specially Protected Species and 90 Protected Species were observed on site - all with a Least Concern status.

[1] The definition of "pick" includes to collect, to cut, to chop off, to take, to gather, to pluck, to uproot, to break, to damage or to destroy

In the NCNCA (2009) (and to a lesser extent WCNECO (2000)), a number of families and genera, for example the family Aizoaceae, (formerly Mesembryanthemaceae), Crassulaceae, Iridaceae and Oxalidaceae and genera such as *Lessertia, Nemesia, Manulea* and *Oxalis* are listed as either Specially Protected Species or Protected Species. This blanket classification may be because of the presence of one or two species of vulnerable or higher status in the genus. Unfortunately, this then includes many species that are either common, or even weedy, e.g. *Galenia* spp., *Drosanthemum hispidum, Mesembryanthemum* spp., *Ruschia intricata, Euphorbia inaequilatera* or *Moraea miniata* that do not need to be awarded special conservation status.

Of particular relevance to the site are protected species within the following genera and families:

Schedule 1: Specially Protected Flora

• Family GERANIACEAE	all *Pelargonium* spp.
• Genus *Lessertia*	all species.

Schedule 2: Protected Flora

• Aizoaceae (Mesembryanthemaceae)	all species
• Amaryllidaceae	all species except those listed in Schedule 1
• Apiaceae	all species except those listed in Schedule 1
• Apocynaceae	all species except those listed in Schedule 1
• Asphodelaceae	all species except those listed in Schedule 1 & *Aloe ferox*
• Crassulaceae	all species except those listed in Schedule 1
• Euphorbiaceae	*Euphorbia* spp. - all species
• Iridaceae	all species except those listed in Schedule 1
• Anacampserotaceae (Portulacaceae)	*Anacampseros* spp.
• Scrophulariaceae	*Jamesbrittenia Manulea*, *Nemesia* - all species

In the case of the fibre-optic cable, permits may not be needed only for the protected species, since all plants, regardless of their protected status, that will be cleared for the fibre-optic cable fall within 100 m of the public road. This would imply that a permit would be needed for all plants or alternatively for the number of hectares to be cleared of vegetation.

12.4.2 Fauna permit requirements

The NCDENC is the regulatory authority in the Northern Cape for the issuing of permits for fauna, flora, hunting and CITES. Under the Act, the majority of mammals, reptiles and amphibians are listed as protected species (see Appendix B). No permits are required for animal species since none should be harmed by the development.

12.5. Western Cape Nature and Environmental Conservation Ordinance (No. 19 of 1974) as amended in the Western Cape Nature Conservation Laws Amendment Act (No. 3 of 2000)

12.5.1 Flora (see Appendix A):

Fifty-eight Schedule 4 Protected Species were observed on site - all with Least Concern status.

A permit is required if any of the following activities are involved:
Section 63. (1) No person shall:

a) uproot the plant in the process of picking the flower of any flora; _

b) without a permit—

i. pick any endangered or protected flora, or

ii. pick any flora on a public road or **on the land on either side of such road within a distance of ninety metres from the centre of such road**, or

c) pick any protected or indigenous unprotected flora on land of which he or she is not the owner, without the permission of the owner of such land or of any person authorised by such owner to grant such permission.

Schedule 3: Endangered flora

No Schedule 3 plant species were recorded on site.

Schedule 4: Protected flora

A number of plant genera and families are listed in their entirety as protected and of particular relevance to the site are species within the following genera and families:

• Amaryllidaceae	all species
• Apocynaceae	all species (except those specified in Schedule 3)
• Iridaceae	all species
• Asphodelaceae (Liliaceae)	all species of *Aloe* except those in Schedule 3 and *Aloe ferox*.
• Aizoaceae (Mesembryanthemaceae)	all species

Permit requirements for the Western Cape would basically be the same as for the Northern Cape (see Section 12.4 above), since in both cases no plants in the road reserve may not be destroyed.

12.5.2 Fauna permit requirements

CapeNature is the regulatory authority in the Western Cape for the issuing of permits for fauna, flora, hunting and CITES. Under the Act, the majority of mammals, reptiles and amphibians are listed as protected species (see Appendix B). However, no permits are required for animal species since none should be harmed by the development.

12.6 CITES (Convention on the International Trade in Endangered Species of Wild Fauna and Flora)

South Africa is a signatory to CITES and as such must comply with the import, export and re-export procedure as stipulated by CITES. CapeNature and NCDENC are the CITES Management and Scientific Authority for exports out of and imports into the respective provinces from or to other countries. The following species occurring in the study area are CITES listed. However, no permits are required for animal species since none should be harmed by the development. The following are CITES listed species:

Plant species:

Anacampseros	all species
Aloe	all species (thus would include current genera such as *Aristaloe* and *Gonialoe)*
Euphorbia	all succulent species

Animal species:

Bontebok	*Damaliscus pygargus pygargus*	CITES App II
Black-footed Cat	Felis nigripes	CITES App I
Lion	*Panthera leo*	CITES App II

13. ENVIRONMENTAL MANAGEMENT PROGRAMME INPUT

Impact	Mitigation / Management Objectives	Mitigation / Management actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
A. IMPACTS ON TERRESTRIAL ECOLOGY					
A. DESIGN PHASE					
Potential impact on terrestrial ecology as a result of the proposed fibre-optic cable.	Avoid or minimise impacts on terrestrial ecology on site regarding the placement of the infrastructure. Avoiding cliffs and rocky sheets will reduce the chances of protected species loss.	Ensure that the placing of infrastructure takes the sensitivity mapping of the ecological assessment into account to avoid and reduce impacts on Species and Habitats of Conservation Concern.	Ensure that this is taken into consideration during the planning and design phase.	During design cycle and before construction commences.	Project Developer and Appointed Ecological Specialist.
B. CONSTRUCTION PHASE					
Clearance of vegetation	Confine vegetation clearance to footprint and minimise disturbance of adjacent areas.	Demarcate all infrastructure sites and delineate routing clearly to avoid unnecessary clearance of the vegetation. Permits have to be obtained for the removal of plants within the road reserve and/or NCNCA and WCNECO protected species. Appoint a suitably qualified ecologist to advise on micro-siting of trenches and poles during construction.	Ensure that mitigation measures are enforced.	Daily, during active construction	The Environmental Control Officer (ECO) should monitor and report any incidents to the Holder of the EA. Ecologist to advise on micro-siting.
Impact on animal species	Avoid or minimise impacts that could potentially affect animal behaviour.	Construction crew, in particular the drivers, should undergo environmental training (induction) to increase their awareness of environmental concerns. Before trenches are dug in those areas that have been indicated as prime habitat for the riverine rabbit, the route should be walked on foot to ensure that no burrows are present in the path of the trench. Construction of the trench in favoured riverine rabbit habitat should preferably not be conducted during the breeding season (August to May). Trenches should not be left open for long periods of time. Trenches should also be inspected for the presence of trapped animals immediately before they are filled. Proper waste management procedures should be in place to	Ensure compliance with these mitigation measures.	Daily, during active construction	The ECO should monitor and report to the Holder of the EA. Ecologist to advise on micro-siting.

Impact	Mitigation / Management Objectives	Mitigation / Management actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
		avoid waste lying around and to remove all waste material from the site. Speed limits should be strictly adhered to. Appoint a suitably qualified ecologist to advise on micro-siting of trenches and poles during construction.			
Increased dust levels	Avoid or minimise increased dust levels.	Dust control measures should be implemented.	Ensure that dust control measures are in place.	Daily, as required	The ECO should monitor and report to the Holder of the EA.
Alien species invasion	Avoid invasion by alien species.	Implement a monitoring program for the early detection of alien invasive plant species. A control program to combat declared alien invasive plant species should be employed.	Ensure implementation of a control programme to combat alien invasive plants.	Every three months	The ECO should monitor and report to the Holder of the EA.
C. OPERATIONAL PHASE					
Impact on animal species	Avoid or minimise impacts that could potentially affect animal behaviour.	Implement a monitoring programme to determine the extent of bird collisions with the overhead cable. Proper waste management procedures should be put in place.	Ensure compliance with these mitigation measures.	Every six months	The ECO should monitor and report to the Holder of the EA.
Alien species invasion	Avoid invasion by alien species.	Implement a monitoring program for the early detection of alien invasive plant species and a control program to combat declared alien invasive plant species should be employed.	Ensure implementation of a control programme to combat alien invasive plants.	Every three months	The ECO should monitor and report to the Holder of the EA.
C. DECOMMISSIONING PHASE					
Clearance of vegetation	Minimise disturbance and clearance of vegetation.	Unnecessary clearance of natural vegetation should be avoided.	Ensure that mitigation measures are enforced.	Every three months	The ECO should monitor and report to the Holder of the EA.
Impact on animal behaviour	Avoid or minimise impacts that could potentially affect animal behaviour.	Proper waste management procedures should be put in place.	Ensure compliance with these mitigation measures.	Every three months	The ECO should monitor and report to the Holder of the EA.
Alien species invasion	Avoid invasion by alien species.	Implement a monitoring program for the early detection of alien invasive plant species and a control program to combat declared alien invasive plant species should be employed.	Ensure implementation of a control programme to combat alien invasive plants.	Every three months	The ECO should monitor and report to the Holder of the EA.

14. FINAL SPECIALIST STATEMENT AND AUTHORISATION RECOMMENDATION

The very low impact significance and low sensitivity rating for many of the habitats means the project could go ahead without major constraints, provided the mitigation measures and management actions proposed to protect rare fauna and flora on the site are taken into consideration. **We thus recommend EA may be granted for the proposed project, provided all mitigation measures are implemented.**

A brief summary of the most important considerations is provided below:

Vegetation and flora:

- **Road reserve vegetation:** The key botanical issue is the fact that the majority of the study area covers the fenced road reserve and therefore represents a habitat that is in essence transformed and continually disturbed. This habitat is seldom representative of the natural veld adjacent to the road reserve. Furthermore, water run-off from the road surface contributes to an unnatural species assemblage in most areas and often favours alien invasive species. Rare plant species usually occur in specialised and localised habitats, which are mostly destroyed by road building. The overhead cabling sections may be installed outside of the road reserve, in adjacent land, but here the physical impact footprint of the poles is small and can be micro-sited so as to avoid disturbance to or destruction of important and / or sensitive species.
- **Vegetation types:** All six vegetation types on site are listed as "least threatened".
- **Threatened plant species:** No red list threatened plant species were encountered during the field survey.
- **Habitats:** None of the habitats had a high sensitivity.
- **Overall sensitivity of plant theme:** Rated as low (on the basis of red list plants) to medium (based on the presence of provincially protected plants).

Fauna:

- **Threatened animal species:** The key faunal issue is the known occurrence of the Critically Endangered riverine habitat (*Bunolagus monticularis)*. The area south of Loxton is regarded as prime riverine rabbit habitat, in particular around the Sak and Brak Rivers. The mountain reedbuck and Karoo dwarf tortoise and additionally, a number of threatened bird species also occur in the region.
- **Overall sensitivity of animal theme:** This is rated as high. However, if the suggested mitigation measures are followed the threatened animal species should not be negatively affected.

Conservation:

- **Protected Areas:** In order to traverse the topographically and geologically difficult terrain of the Molteno Pass at the eastern side of the Karoo National Park, it is proposed the fibre-optic cabling (overhead) be installed in the Park in a corridor where Eskom and Telkom infrastructure has historically been established and currently still exists. To this end, Section 50(5) approval in terms of the NEM:PAA must be obtained.
- **National Protected Areas Expansion Strategy (NPAES):** The route of the fibre-optic cable does traverse areas earmarked by NPAES for future expansion of the Karoo National Park, but will not interfere with the protected areas expansion strategy, since it is confined along existing roads that will not be closed.
- **Critical Biodiversity Areas (CBAs):** The proposed construction of the fibre-optic cable will take place in the road reserve, a highly transformed habitat that is not representative of the adjacent land on which the CBA identification was based. Consequently, the classification of the road reserve as CBA1 is untenable.
- The proposed SKA fibre-optic cable does not constitute any of the land uses considered to be undesirable in a CBA according to Pool-Stanvliet *et al*. (2017).
- **Ecological Support Areas (ESAs):** Ecological processes that operate within or across ESAs will not be altered by the cable project. The extent of the development is small and will not have a negative impact on the

functionality of the broader ESA. Thus no additional loss of ecological connectivity in relation to the broader landscape is likely.

Ecological processes, function and drivers:

- Overall, it is unlikely that the fibre-optic cable will contribute to the disruption of broad-scale ecological processes such as dispersal, migration or the ability of fauna to respond to fluctuations in climate or other conditions.
- Road reserves often act as conduits for alien invasive species and the disturbance caused by the construction of the cable, especially where trenching will take place, will inevitably create conditions favourable for invasion by alien species.

Significance of environmental impacts:

Overall the significance of the environmental impacts was rated as low to very low. In summary:

- Cable installation will probably have a temporary impact on the composition and structure of vegetation. Since the vegetation in the road reserve contains a large proportion of pioneer plant species is will be able to recolonise the disturbed cable trench within a relatively short period of time.
- Since the development footprint is small, the loss of habitat or species will be limited.
- The extent of clearing activities in the different vegetation types is small in relation to the remaining extent of the vegetation types and ecosystem threat status will not be affected.
- None of the habitats identified were rated as sensitive, and the overall impact per habitat type will be small.
- The impact on overall species and ecosystem diversity of the adjacent land will not be affected and even within the road reserve, the impact will be small.
- Due to the small area that will be disturbed along the route, the impact on populations of protected species will be negligible.
- Roads are permanent infrastructure and are fenced. The fibre-optic cable will predominantly be installed in the road reserve, but will not contribute additional obstruction to animal movement.

Key environmental mitigation and management actions proposed

- Appoint a suitably qualified ecologist to advise on micro-siting trench routing and pole placement during construction.
- Ensure that the placing of infrastructure takes the sensitivity mapping of the ecological assessment into account to avoid and reduce impacts on species and habitats of conservation concern.
- Demarcate all infrastructure sites and delineate the routing clearly to avoid unnecessary clearance of the vegetation.
- Avoid or minimise impacts that could potentially affect animal behaviour, in particular that of the riverine rabbit.
- Before trenches are dug in those areas that have been indicated as prime habitat for the riverine rabbit, the route should be walked on foot to ensure that no burrows are present in the path of the trench.
- Construction of the trench in favoured riverine rabbit habitat should preferably not be conducted during the breeding season (August to May).
- Trenches should not be left open for long periods of time. Trenches should also be inspected for the presence of trapped animals immediately before they are filled.
- Construction crew, in particular the drivers, should undergo environmental training (induction) to increase their awareness of environmental concerns.
- Proper waste management procedures should be in place to avoid waste lying around and to remove all waste material from the site.
- Speed limits should be strictly adhered to.
- Dust control measures should be implemented.

- Permits have to be obtained for the removal of plants within the road reserve and/or NCNCA and WCNECO protected species.
- Implement a monitoring program for the early detection of alien invasive plant species. Employ a control program to combat declared alien invasive plant species.

REFERENCES AND BIBLIOGRAPHY

ALEXANDER, G. & MARAIS, J. 2007. *A guide to the reptiles of southern Africa*. Struik Nature, Cape Town.

AVENANT, N.L. 2013. *Redunca fulvorufula* Mountain Reedbuck. In: Kingdon, J.S, Hoffmann, M., (eds). *The Mammals of Africa*. Volume VI: Pigs, Hippopotamuses, Chevrotain, Giraffes, Deer, and Bovids. Bloomsbury Publishing, London, UK. Pp. 422-426.

BATES, M.F., BRANCH, W.R., BAUER, A.M., BURGER, M., MARAIS. J., ALEXANDER, G.L. & DE VILLIERS, M.S. (eds). 2014 Atlas and Red List of reptiles of South Africa, Lesotho and Swaziland. *Suricata* 1. South African National Biodiversity Institute, Pretoria.

BROWNLIE, S. & BOTHA, M. 2009. Biodiversity offsets: adding to the conservation estate, or 'no net loss'? *Impact Assess. Proj. Apprais*. 27: 227–231.

BROWNLIE, S., VON HASE, A., BOTHA, M., MANUAL, J., BALMFORTH, Z. & JENNER, N. 2017. Biodiversity offsets in South Africa – challenges and potential solutions. *Impact Assessment and Project Appraisal* 35: 248-256. DOI: 10.1080/14615517.2017.1322810

CADMAN, M. 2016. *Ecosystem Guidelines for Environmental Assessment in the Western Cape.* Edition 2. Fynbos Forum, Cape Town.

CAPENATURE. 2017. Western Cape Biodiversity Spatial Plan. Spatial data. Available at [https://bgis.sanbi.org/Projects/Detail/194].

CARA. 1983. *Conservation of Agricultural Resources Act* (No 43 of 1983), as amended 2001. Government Printer, Pretoria.

CEQ. 1997. *Considering cumulative effects under the National Environmental Policy Act*. Council on Environmental Quality. Executive Office of the President, Washington, D.C.

CHILD, M.F., ROXBURGH, L., DO LINH SAN, E., RAIMONDO, D., DAVIES-MOSTERT, H.T. (Eds). 2016. The 2016 Red List of Mammals of South Africa, Swaziland and Lesotho. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. Available at https://www.ewt.org.za.

CITES. 2019. APPENDICES I, II & III

COETZEE, B.W.T., DUNCAN, F.D., ERASMUS, B.F.N., SCHOLES, R.J., SHERIDAN, C. & WITKOWSKI, E.D.F. 2017. *Position paper and recommendations to the draft National Biodiversity Offset Policy*. Global Change Institute, University of the Witwatersrand, Johannesburg.

COLLINS, K., BRAGG, C., BIRRS, C., CHILD, M.F. 2016. A conservation assessment of *Bunolagus monticularis.* In CHILD, M.F., ROXBURGH, L., DO LINH SAN E, RAIMONDO, D. DAVIES-MOSTERT, H.T. (eds). *The Red List of Mammals of South Africa, Swaziland and Lesotho*. SANBI and EWT, South Africa.

COLLINS, K., BRAGG, C. & BIRSS, C. 2019. *Bunolagus monticularis*. The IUCN Red List of Threatened Species.

COLLINS, K. & DU TOIT, J.T. 2016. Population status and distribution modelling of the critically endangered riverine rabbit (*Bunolagus monticularis*). *African Journal of Ecology* 54: 196-206.

CSIR. 2017. *Strategic Water Source Areas*. Council for Scientific and Industrial Research. Available at http://bgis.sanbi.org/Projects/Detail/207

CSIR. 2020. *Environmental screening study for the proposed Square Kilometre Array (SKA) fibre optic cable from Beaufort West to Carnarvon*. CSIR, EMS. Stellenbosch.

DAFF. 2019. *Notice of the list of protected tree species under the National Forest Act 1998* (Act No. 84 of 1998). Government Gazette.

DE WITT, M. 2015. *A critical analysis of biodiversity offsets in South Africa*. M.Sc. dissertation. North-West University, Potchefstroom.

DEA. 2016. Distribution maps of mammals of South Africa. Website: www.environment.gov.za/distributionmapsmammals southafrica. Department of Environmental Affairs (DEA).

DEA. 2016. National Protected Areas Expansion Strategy for South Africa 2016. Department of Environmental Affairs, Pretoria, South Africa.

DEA&DP. 2007. *Provincial guideline on biodiversity offsets.* Republic of South Africa, Provincial Government of the Western Cape, Department of Environmental Affairs & Development Planning, Cape Town.

DEA&DP. 2011. *Information document on biodiversity offsets*. EIA Guideline and Information Document Series.

Western Cape: Department of Environmental Affairs and Development Planning.

DEAT. 2006. *Guideline 5: Assessment of alternatives and impacts in support of the Environmental Impact Assessment Regulations, 2006.* Integrated Environmental Management Guideline Series, Department of Environmental Affairs and Tourism (DEAT), Pretoria.

DEAT. 2007. *Strategic Environmental Assessment Guideline.* Integrated Environmental Guideline Series 4, Department of Environmental Affairs and Tourism (DEAT), Pretoria, South Africa.

DEAT. 2008. *The National Protected Area Expansion Strategy 2008-2012: A framework for implementation.* SANBI. Department of Environmental Affairs & Tourism.

DENC. 2016. *Northern Cape Critical Biodiversity Areas.* Spatial data. Available at https://bgis.sanbi.org.

DIPPENAAR-SCHOEMAN, A.S. & VAN DEN BERG, A.M. *Spiders of the Kalahari*. Plant Protection Research Institute Handbook No. 18. ARC, Pretoria.

DRIVER A., SINK, K.J., NEL, J.N., HOLNESS, S., VAN NIEKERK, L., DANIELS, F., JONAS, Z., MAJIEDT, P.A., HARRIS, L. & MAZE, K. 2012. *National Biodiversity Assessment 2011: An assessment of South Africa's biodiversity and ecosystems.* Synthesis Report. South African National Biodiversity Institute and Department of Environmental Affairs, Pretoria.

DU PLESSIS, S.F. 1969. *Past and present geographical distribution of the Perissodactyla and Artiodactyla in southern Africa*. M.Sc. dissertation, University of Pretoria, Pretoria.

DUNBAR, R.I.M. & ROBERTS, S.C. 1992. Territory quality in mountain reedbuck (*Redunca fulvorufula chanleri*): distance to safety. *Ethology* 90: 134-142.

ENVIROSCI. 2020. *Aquatic ecology, biodiversity and species specialist assessment: Basic Assessment for the proposed Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon*.

EWT. 2012. *The Red Data Book of Mammals of South Africa: a conservation assessment*. Endangered Wildlife Trust, South Africa.

FRIEDMANN, Y. & DALY, B. (eds). 2004. *Red Data Book of the Mammals of South Africa: A Conservation Assessment.* IUCN SSC Conservation Breeding Specialist Group, Endangered Wildlife Trust, South Africa.

GEOLOGICAL SURVEY. 1979. *Geological map 3222 Beaufort West.* 1: 250 000 scale. Government printer, Pretoria.

GEOLOGICAL SURVEY. 1989. *Geological map 3122 Victoria West.* 1: 250 000 scale. Government printer, Pretoria.

GEOLOGICAL SURVEY. 1991. *Geological map 3022 Britstown.* 1: 250 000 scale. Government printer, Pretoria.

HOFFMAN, L.C, VAN SCHALKWYK, S., & MULLER, N.M. 2008. Physical and chemical properties of male and female mountain reedbuck (*Redunca fulvorufula*) meat. *S. Afr. J. Wildl. Res.* 38:11–16.

HOFMEYER, J.M. 1962. Fieldwork section report on zoological survey of the southern portion of Loskop Dam Nature Reserve, Part 1 – mammals, the mountain reedbuck (*Redunca fulvorufula*). *Afr. Wildlife* 16:247-254.

IRBY, L.R. 1972. The ecology and natural history of the mountain reedbuck (*Redunca fulvorufula*). In: Annual report, *Ceasar Kleberg Res. Progr. Wildl. Ecol*.: 273-281. Texas A & M Univ., College Station.

IRBY, L.F. 1973. A preliminary report on the mountain reedbuck (*Redunca fulvorufula*) in the Loskop Dam Nature Reserve. *J. sth. Afr. Wildl. Mgmt. Ass*. 3: 53-58.

IRBY, L.F. 1975. Meat production potential of mountain reedbuck. *S. Afr. J. Anim. Sci.* 5: 67-76.

IRBY, L.F. 1976. A note on mountain reedbuck *Redunca fulvorufula fulvorufula* Afzelius in the Kruger National Park. *Koedoe* 19: 53-66.

IRBY, L.F. 1976. *The ecology of mountain reedbuck in southern and eastern Africa*. Ph.D. thesis. Texas A & M Univ., College Station.

IRBY L.R. 1977. Studies on mountain reedbuck populations with special reference to Loskop Dam Nature Reserve. *S. Afr. J. Wildl. Res*. 7: 73–86.

IRBY, L.F. 1979. Reproduction in mountain reedbuck (*Redunca fulvorufula*). *Mammalia* 43: 191-213.

IRBY, L.F. 1981. Mountain reedbuck activity patterns in the Loskop Dam Nature Reserve. *S. Afr. J. Wildl. Res*. 11: 115-120.

IRBY, L.F. 1984. Food selection by mountain reedbuck in the Loskop Dam Nature Reserve. *S. Afr. J. Wildl. Res*. 14: 29-32.

IUCN SSC Antelope Specialist Group. 2008. *Redunca fulvorufula*. The IUCN Red List of Threatened Species 2008: T19391A8874377.

KIRKWOOD, D., PENCE, G.Q. & VON HASE, A. 2010 *Western Cape Biodiversity Framework: Critical Biodiversity Areas and Ecological Support Areas of the Western Cape*. A C.A.P.E. Land-use planning project.

KRAAIJ, T. & MILTON, S.J. 2006. Vegetation changes (1995-2004) in semi-arid Karoo shrubland, South Africa: effects of rainfall, wild herbivores and change in land use. *Journal of Arid Environments* 64: 174-192.

LAND TYPE SURVEY STAFF. 2006. Land Type maps 3222 Beaufort West and 3322 Oudtshoorn. *Memoirs agric. nat. Resour. S. Afr*. No 16. ARC - Institute of Soil, Climate and Water, Pretoria.

LAND TYPE SURVEY STAFF. 2012. Land Type map 3024 Colesberg, 3122 Victoria West and 3124 Middelburg. *Memoirs agric. nat. Resour. S. Afr.* No 18. ARC - Institute of Soil, Climate and Water, Pretoria.

LEEMING, J. 2003. *Scorpions of southern Africa*. Struik, Cape Town.

LEROY, A, & LEROY, J. 2003. *Spiders of southern Africa.* Struik, Cape Town.

MARON, M., GORDON, A., MACKEY, B.G., POSSINGHAM, H.P. & WATSON, J.E.M. 2015. Conservation: stop the misuse of biodiversity offsets. *Nature* 523:401–403.

MASON, D.R. 1977. Notes on social , ecological and population characteristics of mountain reedbuck in the jack Scott Nature Reserve. *S. Afr. J. Wildl. Res*. 7: 31-36.

MECENERO, S., BALL, J.B., EDGE, D.A., HAMER, M.L., HENNING, G.A., KRÜGER, M, PRINGLE, E.L., TERBLANCHE, R.F. & WILLIAMS, M.C. 2013. *Conservation Assessment of Butterflies of South Africa, Lesotho and Swaziland: Red List and Atlas.* Animal Demography Unit, University of Cape Town, Cape Town.

MILLS, G. & HES, L. 1997. *The complete book of southern African mammals*. Struik, Cape Town.

MUCINA, L. & RUTHERFORD, M.C. (Eds). 2006. *Vegetation of South Africa, Swaziland and Lesotho*. *Strelitzia* 19. South African National Biodiversity Institute (SANBI), Pretoria.

NEM:BA. 2004. *National Environmental Management: Biodiversity Act (Act No. 10 of 2004).* Government Printer, Pretoria.

NEMBA. 2007a. National Environmental Management: Biodiversity Act (Act No. 10 of 2004). *Threatened or protected species regulations*. *Government Gazette* No. 29657, Notice R152, 23 February 2007.

NEMBA. 2007b. National Environmental Management: Biodiversity Act (Act No. 10 of 2004). *Lists of critically endangered, endangered, vulnerable and protected species. Government Gazette*. No. 29657, Notice R151, 23 February 2007.

NEMBA. 2007c. National Environmental Management: Biodiversity Act (Act No. 10 of 2004). *Amendment of critically endangered, endangered, vulnerable and protected species list*. *Government Gazette* No. 30568, Notice R.1187, 14 December 2007.NEM:BA. 2014a. National Environmental Management: Biodiversity Act (Act No. 10 of 2004). Alien and Invasive Species Regulations in terms of Section 97(1) of the Government Notice R598 in Government Gazette 37885 dated 1 August 2014. Department of Environmental Affairs, Pretoria.

NEM:BA. 2014b. National Environmental Management: Biodiversity Act (Act No. 10 of 2004). *Norms and Standards for Biodiversity Management Plans for Ecosystems.* Government Notice No. 83 in Government Gazette No 37302 of 7 February 2014.

NEM:BA. 2016. National Environmental Management: Biodiversity Act (Act No. 10 of 2004). *Alien and Invasive Species lists.* Government Gazette, No 40166, 29 July 2016. Department of Environmental Affairs, South Africa.

NEM:PAA. 2003. *The National Environmental Management: Protected Areas Act (Act No. 10 of 2003).* Department of Environmental Affairs, South Africa.

NEMA. 2011. *National list of threatened ecosystems*. National Environmental Management Act (Act No 107 of 1998). General Notice 1002, 9 December 2011 Government Gazette No 34809. Department of Environmental Affairs.

NEMA. 2017. *Draft National Biodiversity Offset Policy*. National Environmental Management Act (Act No. 107 of 1998). Government Gazette No 40733. Department of Environmental Affairs.

NEMA. 2017. *Amendments to the Environmental Impact Assessment Regulations, 2014. Listing Notices GRN 324, 325, 326 & 327*. Government Gazette No. 40772, 7 April 2017. Department of Environmental Affairs, Pretoria.

NEMA. 2020. Procedures for the assessment and minimum criteria for reporting on identified environmental themes in terms of Sections 24(5)(a) and (h) and 44 of the NEMA 1998, when applying for Environmental Authorisation. Goverment Gazette 43110, No 320, 20 March 2020.

NFA. 1998. *National Forests Act* (Act No. 84 of 1998). Department of Agriculture, Forestry and Fisheries. Government Printer, Pretoria.

NICHOLSON, G. 2010. *Road reserves as conservation assets: exploring the species of conservation concern and the* *ecological condition of the N7 road reserve.* MSc dissertation (Botany). University of Cape Town.

NPAES, 2016. *National Protected Area Expansion Strategy for South Africa 2008*. Priorities for expanding the protected area network for ecological sustainability and climate change adaptation. Government of South Africa Pretoria.

NWA. 1998. *National Water Act (Act No. 36 of 1998).* Department of Water Affairs. Government Printer,

OLIVER, M.D.N., SHORT, N.M.R. & HANKS, J. 1978. Population ecology of oribi, grey rhebuck and mountain reedbuck in Highmoor State Forest Land, Natal. *S. Afr. J. Wildl. Res.* 8: 95-105.

OLIVIER, W. 2016. *Draft National Biodiversity Offset Policy*. Government Gazette 40733 (Notice No. 276). DEA, Pretoria (power point presentation).

POOL-STANVLIET, R., DUFFEL-CANHAM, A., PENCE, G. & SWART, R. 2017. *Western Cape Biodiversity Spatial Plan Handbook.* CapeNature, Stellenbosch.

POWER, R.J. 2014. *The Distribution and Status of Mammals in the North West Province.* Department of Economic Development, Environment, Conservation & Tourism, North West Provincial Government, Mahikeng, South Africa.

ROWE-ROWE, D.T. 1973a. Horn development of mountain reedbuck. *Lammergeyer* 19: 36-38.

ROWE-ROWE, D.T. 1973b. Notes on the development of mountain reedbuck. *Lammergeyer* 19: 38-39.

ROWE-ROWE, D.T. 1982. Influence of fire on antelope distribution and abundance in the Natal Drakensberg. *S. Afr. J. Wildl. Res*. 12: 124-129.

ROWE-ROWE, D.T. 1983. Habitat preferences of five Drakensberg antelopes. *S. Afr. J. Wildl. Res*. 13: 1–8.

RUBIN, F. & PALMER, A.R. 1996. The physical environment and major plant communities of the Karoo National Park, South Africa. *Koedoe* 39 (2) 25-52.

RUBIN, F., PALMER, A.R. & TYSON, C. 2001. Patterns of endemism within the Karoo National Park, South Africa. *Bothalia* 31: 117-133.

SANBI. 2018a. *National Biodiversity Assessment. Spatial Data.* Available at [https://bgis.sanbi.org/Projects/Detail/221].

SANBI. 2018b. Using CBA Maps to support land-use planning and decision-making. SANBI Factsheet Series. South African National Biodiversity Institute, Pretoria.SKEAD, C.J. 2011. *Historical incidence of the Larger Land Mammals in the broader Western and Northern Cape*. Second edition, (eds: Boshoff, A.F., Kerley, G.I.H. & Lloyd, P.H. Port Elizabeth: Centre for African Conservation Ecology. Nelson Mandela Metropolitan University.

SKINNER, J.D. & CHIMIMBA C.T. 2005. *The mammals of the southern African subregion.* Third edition. Cambridge University Press, Cambridge, UK.

SKOWNO, A.L., HOLNESS, S.D. & DESMET, P. 2009. *Biodiversity assessment of the Central Karoo District.*

TAYLOR, W.A. 2004. *Factors influencing productivity in sympatric populations of mountain reedbuck and grey rhebok in the Sterkfontein Dam Nature Reserve, South Africa.* Ph.D. thesis, University of `Pretoria, Pretoria.

TAYLOR, A., AVENANT, N., SCHULZE, E., VILJOEN, P. & CHILD, M.F. 2016. A conservation assessment of *Redunca fulvorufula fulvorufula*. In: Child, M.F, Roxburgh, L, Do Linh San, E, Raimondo, D, Davies-Mostert, H.T. (eds). *The Red List of Mammals of South Africa, Swaziland and Lesotho.* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.

TAYLOR W.A, SKINNER J.D, KRECEK R.C. 2007. Home ranges of sympatric grey rhebok and mountain reedbuck in a South African Highveld grassland. *African Zoology* 42: 145-151.

TAYLOR, W.A. & SKINNER, J.D. 2010. A review of the social organization of mountain reedbuck, *Redunca fulvorufula*, and grey rhebok, *Pelea capreolus*, in relation to their ecology. *Trans. Royal Soc. S. Afr*. 61: 8-10.

TAYLOR, W.A., SKINNER, J.D. & KRECEK, R.C. 2005. Seasonal body condition indices of mountain reedbuck (*Redunca fulvorufula*) in two areas of South African Highveld: the grassland and Karoo biomes. *S. Afr. J. Animal Sci*. 35: 19 -29.

TAYLOR, W.A., SKINNER, J.D. & KRECEK, R.C. 2006. The activity budgets and activity patterns of sympatric grey rhebok and mountain reedbuck in a highveld grassland area of South Africa. *Afr. J. Ecol.* 44: 431–437.

TAYLOR, W.A., SKINNER, J.D., WILLIAMS, M.C. & KRECEK, R.C. 2006. Population dynamics of two sympatric antelope species, grey rhebok (*Pelea capreolus*) and mountain reedbuck (*Redunca fulvorufula*), in a highveld grassland region of South Africa. *Journal of Zoology* 268: 369-379.

WCNECO. 1974. *Western Cape Nature And Environmental Conservation Ordinance*. 1974 (No. 19 OF 1974) as amended by the Western Cape Nature Conservation Laws Amendment Act, No. 3 of 2000. Province of Western Cape.

APPENDIX A

PLANT SPECIES CHECKLISTS

[1]IUCN category
[2]Western Cape Nature and Environmental Conservation Ordinance (WCNECO)
[3]Northern Cape Nature Conservation Act (NCCA)
[4] Newposa list (SANBI)
[5] Plants observed during September/October 2020 site visit

Family	Species	IUCN[1]	WCNECO[2] SCH 4	NCNCA[3] SCH 1	NCNCA[3] SCH 2	CITES	ToPS	ENDEMIC	Invasive	Alien/ aturalised	NEWPOSA[4]	CURRENT[5]
Acanthaceae	*Barleria stimulans*	LC									x	
Acanthaceae	*Blepharis capensis*	LC									x	x
Acanthaceae	*Blepharis mitrata*	LC									x	x
Acanthaceae	*Justicia incana*	LC									x	x
Acanthaceae	*Justicia orchioides* subsp. *glabrata*	LC									x	
Acanthaceae	*Justicia spartioides*	LC									x	x
Acanthaceae	*Monechma* sp.	-										x
Achariaceae	*Guthriea capensis*	LC									x	
Achariaceae	*Kiggelaria africana*	LC									x	x
Aizoaceae	*Aizoon rigidum*	LC	x		x						x	x
Aizoaceae	*Aloinopsis rosulata*	LC	x		x						x	
Aizoaceae	*Antimima* sp.		x		x						x	
Aizoaceae	*Cephalophyllum* sp.		x		x							x
Aizoaceae	*Chasmatophyllum stanleyi*	LC	x		x						x	
Aizoaceae	*Delosperma aberdeenense*	LC	x		x						x	
Aizoaceae	*Delosperma lootsbergense*	LC	x		x						x	
Aizoaceae	*Delosperma* sp.		x		x							x
Aizoaceae	*Drosanthemum calycinum*	LC	x		x						x	
Aizoaceae	*Drosanthemum hispidum*	LC	x		x						x	x
Aizoaceae	*Drosanthemum karrooense*	LC	x		x							x
Aizoaceae	*Drosanthemum lique*	LC	x		x						x	x
Aizoaceae	*Drosanthemum parvifolium*	LC	x		x						x	
Aizoaceae	*Drosanthemum vespertinum*	LC	x		x						x	
Aizoaceae	*Galenia* cf. *papulosa*	-	x		x							x
Aizoaceae	*Galenia fruticosa*	LC	x		x						x	
Aizoaceae	*Galenia glandulifera*	LC	x		x						x	
Aizoaceae	*Galenia meziana*	LC	x		x							x
Aizoaceae	*Galenia namaensis*	LC	x		x						x	x
Aizoaceae	*Hereroa concava*	LC	x		x						x	cf.
Aizoaceae	*Malephora crocea*	LC	x		x						x	
Aizoaceae	*Malephora thunbergii*	LC	x		x						x	
Aizoaceae	*Mesembryanthemaceae* sp. 1		x		x							x
Aizoaceae	*Mesembryanthemum articulatum*	LC	x		x						x	x
Aizoaceae	*Mesembryanthemum coriarium*	LC	x		x						x	x
Aizoaceae	*Mesembryanthemum crystallinum*	LC	x		x						x	x
Aizoaceae	*Mesembryanthemum emarcidum*	LC	x		x						x	x
Aizoaceae	*Mesembryanthemum excavatum*	LC	x		x						x	
Aizoaceae	*Mesembryanthemum geniculiflorum*	LC	x		x						x	x
Aizoaceae	*Mesembryanthemum granulicaule*	LC	x		x						x	cf.

Aizoaceae	*Mesembryanthemum grossum*	LC	x	x					x	x
Aizoaceae	*Mesembryanthemum guerichianum*	LC	x	x					x	
Aizoaceae	*Mesembryanthemum inachabense*	LC	x	x					x	
Aizoaceae	*Mesembryanthemum noctiflorum* subsp. *noctiflorum*	LC	x	x					x	
Aizoaceae	*Mesembryanthemum noctiflorum* subsp. *stramineum*	LC	x	x					x	x
Aizoaceae	*Mesembryanthemum oubergense*	LC	x	x					x	
Aizoaceae	*Mesembryanthemum stenandrum*	LC	x	x					x	
Aizoaceae	*Mesembryanthemum tetragonum*	LC	x	x					x	x
Aizoaceae	*Plinthus karooicus*	LC	x	x					x	
Aizoaceae	*Ruschia altigena*	LC	x	x					x	
Aizoaceae	*Ruschia cradockensis subsp. triticiformis*	LC	x	x					x	x
Aizoaceae	*Ruschia hamata*	LC	x	x					x	
Aizoaceae	*Ruschia indurata*	LC	x	x					x	
Aizoaceae	*Ruschia intricata*	LC	x	x					x	x
Aizoaceae	*Ruschia pauciflora*	LC	x	x					x	
Aizoaceae	*Ruschia* sp. 1		x	x						x
Aizoaceae	*Ruschia* sp. 2		x	x						x
Aizoaceae	*Ruschia spinosa*	LC	x	x					x	x
Aizoaceae	*Schlechteranthus spinescens*	LC	x	x					x	cf.
Aizoaceae	*Stomatium difforme*	LC	x	x					x	x
Aizoaceae	*Stomatium suaveolens*	LC	x	x		x			x	x
Aizoaceae	*Stomatium villetii*	LC	x	x		x			x	x
Aizoaceae	*Tetragonia acanthocarpa*	LC	x	x						x
Aizoaceae	*Tetragonia arbuscula*	LC	x	x					x	
Aizoaceae	*Tetragonia robusta*	LC	x	x					x	
Aizoaceae	*Tetragonia spicata*	LC	x	x					x	x
Aizoaceae	*Tetragonia* sp. 1	-	x	x						x
Aizoaceae	*Tetragonia* sp. 2	-	x	x						x
Aizoaceae	*Trichodiadema attonsum*	LC	x	x					x	
Aizoaceae	*Trichodiadema barbatum*	LC	x	x					x	
Aizoaceae	*Trichodiadema densum*	LC	x	x					x	
Aizoaceae	*Trichodiadema intonsum*	LC	x	x					x	
Aizoaceae	*Trichodiadema pomeridianum*	LC	x	x					x	
Aizoaceae	*Trichodiadema setuliferum*	LC	x	x						x
Alliaceae	*Tulbaghia leucantha*	LC							x	
Amaranthaceae	*Amaranthus* sp.	-								x
Amaranthaceae	*Atriplex lindleyi subsp. inflata*	NE					1b	x	x	x
Amaranthaceae	*Atriplex nummularia sunsp. nummularia*	NE					2	x	x	x
Amaranthaceae	*Atriplex semibaccata*	LC						x	x	x
Amaranthaceae	*Atriplex vestita*	LC								x
Amaranthaceae	*Bassia salsoloides*	LC								x
Amaranthaceae	*Chenopodium schraderianum*	NE						x	x	
Amaranthaceae	*Salsola aphylla*	LC							x	
Amaranthaceae	*Salsola atrata*	LC							x	
Amaranthaceae	*Salsola dealata*	LC							x	
Amaranthaceae	*Salsola kali*	NE					1b	x	x	x
Amaranthaceae	*Salsola minutifolia*	LC							x	
Amaranthaceae	*Salsola rabieana*	LC							x	
Amaranthaceae	*Salsola seminuda*	LC							x	
Amaranthaceae	*Salsola spp.*	-								x
Amaranthaceae	*Salsola tuberculata*	LC							x	
Amaranthaceae	*Sericocoma avolans*	LC							x	x
Amaranthaceae	*Suaeda fruticosa*	LC								x
Amaryllidaceae	*Ammocharis coranica*	LC	x	x						x
Amaryllidaceae	*Boophone disticha*	LC	x	x						x
Amaryllidaceae	*Gethyllis longistyla*	LC	x	x					x	
Amaryllidaceae	*Gethyllis transkarooica*	LC	x	x					x	cf.
Amaryllidaceae	*Haemanthus humilis* subsp. *humilis*	LC	x	x					x	
Anacampserotaceae	*Anacampseros albidiflora*	LC	x	x	x					x
Anacampserotaceae	*Anacampseros filamentosa* subsp. *filamentosa*	LC	x	x	x				x	
Anacampserotaceae	*Anacampseros lanceolata* subsp. *lanceolata*	LC	x	x	x				x	cf
Anacampserotaceae	*Anacampseros ustulata*	LC	x	x	x				x	x

Anacardiaceae	*Searsia burchellii*	LC					x	x
Anacardiaceae	*Searsia lancea*	LC					x	x
Anacardiaceae	*Searsia pallens*	LC					x	
Anacardiaceae	*Searsia undulata*	LC					x	
Apiaceae	*Annesorhiza filicaulis*	EN					x	
Apiaceae	*Berula thunbergii*	LC		x			x	
Apiaceae	*Bupleurum mundii*	LC		x			x	
Apiaceae	*Chamarea longipedicellata*	LC		x			x	
Apiaceae	*Conium chaerophylloides*	LC		x			x	
Apiaceae	*Deverra denudata* subsp. *aphylla*	LC		x			x	x
Apiaceae	*Heteromorpha arborescens*	LC		x			x	x
Apiaceae	*Notobubon ferulaceum*	LC		x			x	
Apiaceae	*Notobubon laevigatum*	LC		x			x	
Apiaceae	*Torilis arvensis*	NE				x	x	
Apocynaceae	*Asclepias monticola*	LC	x	x			x	
Apocynaceae	*Brachystelma circinatum*	LC	x	x			x	
Apocynaceae	*Carissa bispinosa*	LC	x	x			x	x
Apocynaceae	*Carissa haematocarpa*	LC	x	x				x
Apocynaceae	*Ceropegia filiformis*	LC	x	x			x	
Apocynaceae	*Ceropegia stapeliiformis* subsp. *stapeliiformis*	LC	x	x			x	
Apocynaceae	*Duvalia angustiloba*	LC	x	x			x	
Apocynaceae	*Duvalia maculata*	LC	x	x			x	
Apocynaceae	*Gomphocarpus filiformis*	LC	x	x			x	
Apocynaceae	*Gomphocarpus fruticosus* subsp. *fruticosus*	LC	x	x			x	x
Apocynaceae	*Gomphocarpus tomentosus* subsp. *tomentosus*	LC	x	x			x	x
Apocynaceae	*Hoodia flava*	LC	x	x			x	
Apocynaceae	*Huernia barbata* subsp. *barbata*	LC	x	x			x	x
Apocynaceae	*Huernia humilis*	LC	x	x			x	
Apocynaceae	*Microloma armatum*	LC	x	x			x	
Apocynaceae	*Pachypodium succulentum*	LC	x	x	x		x	x
Apocynaceae	*Piaranthus comptus*	LC	x	x			x	
Apocynaceae	*Piaranthus geminatus* subsp. *geminatus*	LC	x	x			x	
Apocynaceae	*Schizoglossum aschersonianum* var. *longipes*	LC	x	x			x	
Apocynaceae	*Schizoglossum bidens* subsp. *atrorubens*	LC	x	x			x	
Apocynaceae	*Schizoglossum bidens* subsp. *bidens*	LC	x	x			x	
Apocynaceae	*Stapelia grandiflora*	LC	x	x			x	x
Apocynaceae	*Tridentea jucunda*	LC	x	x			x	
Apocynaceae	*Xysmalobium gomphocarpoides* var. *gomphocarpoides*	LC	x	x			x	
Apocynaceae	*Xysmalobium gomphocarpoides* var. *parvilobum*	LC	x	x			x	
Araliaceae	*Cussonia paniculata*	LC		x			x	x
Asparagaceae	*Asparagus aethiopicus*	LC					x	
Asparagaceae	*Asparagus asparagoides*	LC						x
Asparagaceae	*Asparagus burchellii*	LC					x	
Asparagaceae	*Asparagus capensis* var. *capensis*	LC					x	x
Asparagaceae	*Asparagus concinnus*	LC					x	
Asparagaceae	*Asparagus exuvialis*	LC						x
Asparagaceae	*Asparagus laricinus*	LC					x	x
Asparagaceae	*Asparagus mucronatus*	LC					x	
Asparagaceae	*Asparagus retrofractus*	LC					x	x
Asparagaceae	*Asparagus sp.*	-						x
Asparagaceae	*Asparagus striatus*	LC					x	x
Asparagaceae	*Asparagus suaveolens*	LC					x	x
Asphodelaceae	*Aloe affinis*	LC	x	x	x		x	
Asphodelaceae	*Aloe broomii*	LC	x	x	x			x
Asphodelaceae	*Aloe claviflora*	LC	x	x	x		x	x
Asphodelaceae	*Aristaloe aristata*	LC	x	x	x		x	x
Asphodelaceae	*Astroloba foliolosa*	LC		x			x	x
Asphodelaceae	*Bulbine abyssinica*	LC		x			x	x
Asphodelaceae	*Bulbine frutescens*	LC		x			x	
Asphodelaceae	*Bulbine narcissifolia*	LC		x			x	
Asphodelaceae	*Bulbine triebneri*	LC		x			x	

Asphodelaceae	*Gasteria disticha* var. *disticha*	LC		x				x	
Asphodelaceae	*Gonialoe variegata*	LC	x	x	x			x	x
Asphodelaceae	*Haworthia marumiana* var. *marumiana*	LC	x	x				x	
Asphodelaceae	*Haworthia semiviva*	LC	x	x				x	
Asphodelaceae	*Haworthiopsis nigra* var. *diversifolia*	-		x				x	
Asphodelaceae	*Haworthiopsis nigra* var. *nigra*	-		x				x	
Asphodelaceae	*Haworthiopsis tessellata* var. *tessellata*	LC		x				x	
Asphodelaceae	*Kniphofia uvaria*	LC	x	x				x	
Asphodelaceae	*Trachyandra acocksii*	LC		x				x	
Asphodelaceae	*Trachyandra jacquiniana*	LC						x	
Aspleniaceae	*Asplenium cordatum*	LC						x	
Aspleniaceae	*Asplenium trichomanes* subsp. *quadrivalens*	LC						x	
Asteraceae	*Amellus tridactylus* subsp. *olivaceus*	LC						x	x
Asteraceae	*Amphiglossa* sp.	-							x
Asteraceae	*Amphiglossa triflora*	LC							x
Asteraceae	*Arctotheca calendula*	LC							x
Asteraceae	*Arctotis arctotoides*	LC						x	
Asteraceae	*Arctotis dimorphocarpa*	LC						x	
Asteraceae	*Arctotis leiocarpa*	LC						x	x
Asteraceae	*Arctotis microcephala*	LC						x	
Asteraceae	*Arctotis perfoliata*	LC						x	
Asteraceae	*Arctotis subacaulis*	LC						x	
Asteraceae	*Artemisia afra*	LC							x
Asteraceae	*Athanasia linifolia*	LC						x	
Asteraceae	*Athanasia microcephala*	LC						x	
Asteraceae	*Berkheya carlinifolia*	LC						x	x
Asteraceae	*Berkheya glabrata*	LC						x	
Asteraceae	*Berkheya pinnatifida* subsp. *pinnatifida*	LC						x	
Asteraceae	*Berkheya spinosa*	LC						x	x
Asteraceae	*Caputia tomentosa*	LC						x	
Asteraceae	*Chrysocoma ciliata*	LC						x	x
Asteraceae	*Chrysocoma obtusata*	LC						x	
Asteraceae	*Chrysocoma sp.*	-							x
Asteraceae	*Cineraria aspera*	LC						x	
Asteraceae	*Cineraria mollis*	LC						x	
Asteraceae	*Cineraria vagans*	EN						x	
Asteraceae	*Cirsium vulgare*	NE				1b	x	x	
Asteraceae	*Conyza scabrida*	-						x	cf.
Asteraceae	*Cotula microglossa*	LC						x	cf.
Asteraceae	*Cotula sororia*	LC						x	
Asteraceae	*Cotula* sp. 1								x
Asteraceae	*Curio acaulis*	LC						x	
Asteraceae	*Curio articulatus*	LC						x	
Asteraceae	*Curio radicans*	LC						x	x
Asteraceae	*Cuspidia cernua subsp. annua*	LC						x	
Asteraceae	*Dicerothamnus rhinocerotis*	LC						x	x
Asteraceae	*Dicoma capensis*	LC							x
Asteraceae	*Dicoma picta*	LC						x	
Asteraceae	*Dimorphotheca cuneata*	LC						x	x
Asteraceae	*Dimorphotheca pinnata* var. *pinnata*	LC						x	
Asteraceae	*Dimorphotheca polyptera*	LC						x	
Asteraceae	*Eriocephalus africanus* var. *paniculatus*	LC						x	
Asteraceae	*Eriocephalus brevifolius*	LC						x	x
Asteraceae	*Eriocephalus decussata*	LC							x
Asteraceae	*Eriocephalus ericoides* subsp. *ericoides*	LC						x	x
Asteraceae	*Eriocephalus eximius*	LC						x	
Asteraceae	*Eriocephalus glandulosus*	LC						x	
Asteraceae	*Eriocephalus microcephalus*	LC						x	
Asteraceae	*Eriocephalus spinescens*	LC						x	x
Asteraceae	*Eriocephalus tenuifolius*	LC						x	
Asteraceae	*Eumorphia corymbosa*	LC						x	

Asteraceae	*Euryops abrotanifolius*	LC		x	x
Asteraceae	*Euryops anthemoides* subsp. *anthemoides*	LC		x	
Asteraceae	*Euryops cuneatus*	LC		x	
Asteraceae	*Euryops empetrifolius*	LC		x	
Asteraceae	*Euryops imbricatus*	LC		x	x
Asteraceae	*Euryops lateriflorus*	LC		x	x
Asteraceae	*Euryops oligoglossus* subsp. *oligoglossus*	LC		x	x
Asteraceae	*Euryops oligoglossus* subsp. *racemosus*	LC		x	
Asteraceae	*Euryops subcarnosus* subsp. *vulgaris*	LC		x	
Asteraceae	*Euryops trifidus*	LC		x	x
Asteraceae	*Euryops* sp.	-			x
Asteraceae	*Felicia fascicularis*	LC		x	
Asteraceae	*Felicia filifolia* subsp. *bodkinii*	LC		x	
Asteraceae	*Felicia filifolia* subsp. *filifolia*	LC		x	x
Asteraceae	*Felicia hirsuta*	LC		x	x
Asteraceae	*Felicia muricata* subsp. *muricata*	LC		x	x
Asteraceae	*Felicia namaquana*	LC		x	
Asteraceae	*Felicia ovata*	LC		x	
Asteraceae	*Garuleum bipinnatum*	LC		x	x
Asteraceae	*Gazania ciliaris*	LC		x	
Asteraceae	*Gazania heterochaeta*	LC		x	
Asteraceae	*Gazania krebsiana*	LC			x
Asteraceae	*Gazania krebsiana* subsp. *arctotoides*	LC		x	
Asteraceae	*Gazania krebsiana* subsp. *serrulata*	LC		x	
Asteraceae	*Gazania lichtensteinii*	LC		x	x
Asteraceae	*Gazania rigida*	LC		x	x
Asteraceae	*Gazania tenuifolia*	LC			x
Asteraceae	*Geigeria filifolia*	LC		x	x
Asteraceae	*Geigeria ornativa* subsp. *ornativa*	LC		x	x
Asteraceae	*Gerbera piloselloides*	LC		x	
Asteraceae	*Gnaphalium capense*	LC		x	
Asteraceae	*Gorteria alienata*	LC		x	
Asteraceae	*Helichrysum asperum* var. *appressifolium*	LC		x	cf
Asteraceae	*Helichrysum caespititium*	LC		x	
Asteraceae	*Helichrysum dregeanum*	LC		x	
Asteraceae	*Helichrysum hamulosum*	LC		x	
Asteraceae	*Helichrysum herniarioides*	LC		x	
Asteraceae	*Helichrysum lineare*	LC		x	
Asteraceae	*Helichrysum lucilioides*	LC		x	x
Asteraceae	*Helichrysum pentzioides*	LC			x
Asteraceae	*Helichrysum pumilio* subsp. *pumilio*	LC		x	x
Asteraceae	*Helichrysum rosum*	LC		x	
Asteraceae	*Helichrysum rosum* var. *arcuatum*	LC		x	
Asteraceae	*Helichrysum rugulosum*	LC		x	
Asteraceae	*Helichrysum scitulum*	LC		x	
Asteraceae	*Helichrysum* sp. 1	-			x
Asteraceae	*Helichrysum* sp. 2	-			x
Asteraceae	*Helichrysum trilineatum*	LC		x	
Asteraceae	*Helichrysum zeyheri*	LC		x	x
Asteraceae	*Ifloga* sp.	-			x
Asteraceae	*Hertia ciliata*	LC		x	
Asteraceae	*Hertia cluytiifolia*	LC		x	
Asteraceae	*Kleinia longiflora*	LC			x
Asteraceae	*Lactuca inermis*	LC		x	x
Asteraceae	*Lasiospermum poterioides*	LC		x	cf.
Asteraceae	*Leysera gnaphalodes*	LC		x	
Asteraceae	*Leysera tenella*	LC		x	x
Asteraceae	*Macledium spinosum*	LC		x	
Asteraceae	*Mantisalca salmantica*	NE	x	x	
Asteraceae	*Oedera glandulosa*	LC			x
Asteraceae	*Oedera humilis*	LC		x	x

Asteraceae	*Oedera oppositifolia*	LC	x	x
Asteraceae	*Oedera spinescens*	LC	x	x
Asteraceae	*Oncosiphon piluliferus*	LC	x	x
Asteraceae	*Osteospermum calendulaceum*	LC	x	
Asteraceae	*Osteospermum leptolobum*	LC	x	x
Asteraceae	*Osteospermum microphyllum*	LC	x	x
Asteraceae	*Osteospermum scariosum*	LC	x	x
Asteraceae	*Osteospermum sinuatum*	LC	x	x
Asteraceae	*Osteospermum* sp. 1	-		x
Asteraceae	*Osteospermum* sp. 2	-		x
Asteraceae	*Osteospermum spinescens*	LC	x	x
Asteraceae	*Othonna eriocarpa*	LC	x	
Asteraceae	*Othonna furcata*	LC	x	
Asteraceae	*Othonna pavonia*	LC	x	
Asteraceae	*Othonna* sp.	-		x
Asteraceae	*Pegolettia retrofracta*	LC	x	x
Asteraceae	*Pentzia calcarea*	LC	x	
Asteraceae	*Pentzia globosa*	LC	x	x
Asteraceae	*Pentzia incana*	LC	x	x
Asteraceae	*Pentzia lanata*	LC	x	x
Asteraceae	*Pentzia pinnatisecta*	LC	x	
Asteraceae	*Pentzia punctata*	LC	x	
Asteraceae	*Pentzia quinquefida*	LC	x	x
Asteraceae	*Pentzia spinescens*	LC		x
Asteraceae	*Phymaspermum aciculare*	LC	x	x
Asteraceae	*Phymaspermum parvifolium*		x	x
Asteraceae	*Phymaspermum thymelaeoides*	LC	x	
Asteraceae	*Pseudognaphalium luteoalbum*	LC	x	
Asteraceae	*Pseudognaphalium* sp.	-		x
Asteraceae	*Pseudognaphalium undulatum*	LC	x	
Asteraceae	*Pteronia acuminata*	LC	x	
Asteraceae	*Pteronia adenocarpa*	LC	x	
Asteraceae	*Pteronia aspalatha*	LC	x	
Asteraceae	*Pteronia bolusii*	LC	x	
Asteraceae	*Pteronia erythrochaeta*	LC	x	x
Asteraceae	*Pteronia glauca*	LC	x	x
Asteraceae	*Pteronia glaucescens*	LC	x	
Asteraceae	*Pteronia glomerata*	LC	x	x
Asteraceae	*Pteronia hutchinsoniana*	LC	x	
Asteraceae	*Pteronia membranacea*	LC	x	x
Asteraceae	*Pteronia sordida*	LC	x	x
Asteraceae	*Pteronia* sp.	-		x
Asteraceae	*Pteronia staehelinoides*	LC	x	x
Asteraceae	*Pteronia viscosa*	LC	x	x
Asteraceae	*Rhynchopsidium sessiliflorum*	LC	x	
Asteraceae	*Senecio achilleifolius*	LC	x	
Asteraceae	*Senecio angustifolius*	LC	x	
Asteraceae	*Senecio asperulus*	LC	x	x
Asteraceae	*Senecio burchellii*	LC	x	
Asteraceae	*Senecio cordifolius*	LC	x	
Asteraceae	*Senecio cotyledonis*	LC	x	
Asteraceae	*Senecio erysimoides*	DD	x	
Asteraceae	*Senecio hastatus*	LC	x	
Asteraceae	*Senecio inaequidens*	LC	x	x
Asteraceae	*Senecio incomptus*	LC	x	
Asteraceae	*Senecio madagascariensis*	LC	x	
Asteraceae	*Senecio niveus*	LC		x
Asteraceae	*Senecio pinnulatus*	LC	x	
Asteraceae	*Senecio sisymbriifolius*	LC	x	
Asteraceae	*Senecio* sp.	-		x
Asteraceae	*Senecio striatifolius*	LC	x	

Asteraceae	*Sonchus dregeanus*	LC				x	
Asteraceae	*Tarchonanthus minor*	LC				x	x
Asteraceae	*Tragopogon dubius*	NE			x	x	
Asteraceae	*Troglophyton capillaceum* subsp. *capillaceum*	LC				x	
Asteraceae	*Ursinia nana* subsp. *nana*	LC				x	x
Asteraceae	*Vellereophyton niveum*	LC				x	
Bignoniaceae	*Rhigozum obovatum*	LC				x	x
Bignoniaceae	*Rhigozum trichotomum*	LC				x	
Boraginaceae	*Anchusa capensis*	LC					x
Boraginaceae	*Anchusa riparia*	LC				x	
Boraginaceae	*Cynoglossum obtusicalyx*	LC				x	
Boraginaceae	*Ehretia rigida*	LC				x	x
Boraginaceae	*Heliotropium ciliatum*	LC				x	
Boraginaceae	*Lithospermum scabrum*	LC				x	
Boraginaceae	*Lobostemon stachydeus*	LC				x	x
Boraginaceae	*Myosotis arvensis*	NE			x	x	
Boraginaceae	*Trichodesma africanum*	LC				x	x
Brassicaceae	*Heliophila carnosa*	LC				x	
Brassicaceae	*Heliophila cornuta* var. *squamata*	LC				x	
Brassicaceae	*Heliophila crithmifolia*	LC				x	x
Brassicaceae	*Heliophila minima*	LC				x	
Brassicaceae	*Heliophila suavissima*	LC				x	
Brassicaceae	*Lepidium desertorum*	LC				x	x
Brassicaceae	*Sisymbrium burchellii* var. *burchellii*	LC				x	
Brassicaceae	*Sisymbrium capense*	LC				x	
Brassicaceae	*Sisymbrium orientale*	NE			x	x	
Cactaceae	*Cylindropuntia fulgida*	-		1b	x	x	
Cactaceae	*Cylindropuntia imbricata*	-		1b	x	x	
Cactaceae	*Opuntia ficus-indica*	-		1b	x	x	x
Cactaceae	*Opuntia microdasys*	-		1b	x	x	
Cactaceae	*Tephrocactus articulatus*	-		1a	x	x	
Campanulaceae	*Wahlenbergia androsacea*	LC				x	
Campanulaceae	*Wahlenbergia capillacea* subsp. *capillacea*	LC				x	
Campanulaceae	*Wahlenbergia cernua*	LC				x	
Campanulaceae	*Wahlenbergia nodosa*	LC				x	x
Campanulaceae	*Wahlenbergia tenella* var. *tenella*	LC				x	
Campanulaceae	*Wahlenbergia undulata*	LC				x	
Capparaceae	*Cadaba aphylla*	LC				x	x
Caryophyllaceae	*Cerastium capense*	LC				x	
Caryophyllaceae	*Dianthus micropetalus*	LC	x			x	x
Caryophyllaceae	*Pollichia campestris*	LC				x	
Caryophyllaceae	*Silene burchellii* subsp. *pilosellifolia*	LC				x	
Caryophyllaceae	*Silene burchellii* subsp. *modesta*	LC				x	
Caryophyllaceae	*Silene undulata* subsp. *undulata*	LC				x	
Celastraceae	*Gymnosporia szyszylowiczii*	-	x			x	x
Colchicaceae	*Colchicum albomarginatum*	LC				x	
Colchicaceae	*Colchicum melanthioides*	LC				x	
Colchicaceae	*Colchicum striatum*	LC	x			x	
Colchicaceae	*Colchicum volutare*	LC				x	
Colchicaceae	*Ornithoglossum vulgare*	LC				x	
Commelinaceae	*Commelina africana var. lancispatha*	LC				x	
Convolvulaceae	*Convolvulus dregeanus*	LC				x	
Convolvulaceae	*Convolvulus sagittatus*	LC				x	x
Convolvulaceae	*Cuscuta campestris*	NE		1b	x	x	
Crassulaceae	*Adromischus filicaulis subsp. marlothii*	LC	x			x	
Crassulaceae	*Adromischus humilis*	LC	x			x	
Crassulaceae	*Adromischus liebenbergii*	LC	x			x	
Crassulaceae	*Adromischus* sp.	-	x				x
Crassulaceae	*Cotyledon cuneata*	LC	x			x	
Crassulaceae	*Cotyledon orbiculata*	LC	x			x	x
Crassulaceae	*Cotyledon orbiculata var. oblonga*	LC	x			x	

Crassulaceae	*Cotyledon* sp.	-	x				x
Crassulaceae	*Cotyledon papillaris*	LC	x			x	
Crassulaceae	*Crassula barbata* subsp. *barbata*	LC	x			x	
Crassulaceae	*Crassula capitella* subsp. *thyrsiflora*	LC	x			x	
Crassulaceae	*Crassula corallina* subsp. *corallina*	LC	x			x	x
Crassulaceae	*Crassula corallina* subsp. *macrorrhiza*	LC	x			x	
Crassulaceae	*Crassula cotyledonis*	LC	x			x	cf.
Crassulaceae	*Crassula dependens*	LC	x			x	
Crassulaceae	*Crassula deltoidea*	LC	x				x
Crassulaceae	*Crassula ericoides*	LC	x				x
Crassulaceae	*Crassula exilis* subsp. *exilis*	LC	x			x	
Crassulaceae	*Crassula expansa* subsp. *expansa*	LC	x			x	
Crassulaceae	*Crassula montana* subsp. *quadrangularis*	LC	x			x	
Crassulaceae	*Crassula muscosa* var. *muscosa*	LC	x			x	x
Crassulaceae	*Crassula natans*	LC	x			x	
Crassulaceae	*Crassula pubescens* subsp. *pubescens*	LC	x			x	
Crassulaceae	*Crassula rogersii*	LC	x			x	
Crassulaceae	*Crassula rupestris*	LC	x			x	x
Crassulaceae	*Crassula socialis*	LC	x			x	
Crassulaceae	*Crassula subaphylla*	LC	x				cf.
Crassulaceae	*Crassula tetragona* subsp. *tetragona*	LC	x			x	x
Crassulaceae	*Crassula tomentosa* var. *tomentosa*	LC	x			x	
Crassulaceae	*Crassula vaillantii*	LC	x		x	x	x
Crassulaceae	*Tylecodon reticulatus* subsp. *reticulatus*	LC				x	
Crassulaceae	*Tylecodon wallichii* subsp. *wallichii*	LC				x	
Cucurbitaceae	*Cucumis africanus*	LC				x	
Cucurbitaceae	*Cucumis myriocarpus* subsp. *leptodermis*	LC				x	
Cucurbitaceae	*Kedrostis africana*	LC				x	
Cyperaceae	*Afroscirpoides dioeca*	LC				x	x
Cyperaceae	*Bulbostylis humilis*	LC				x	
Cyperaceae	*Carex burkei*	LC				x	
Cyperaceae	*Cyperus bellus*	LC				x	
Cyperaceae	*Cyperus indecorus* var. *namaquensis*	LC				x	
Cyperaceae	*Cyperus longus* var. *tenuiflorus*	LC				x	
Cyperaceae	*Cyperus marginatus*	LC				x	
Cyperaceae	*Cyperus squarrosus*	LC				x	
Cyperaceae	*Cyperus usitatus*	LC				x	
Cyperaceae	*Ficinia ramosissima*	LC				x	
Cyperaceae	*Kyllinga pulchella*	LC				x	
Cyperaceae	*Pseudoschoenus inanis*	LC				x	x
Cyperaceae	*Schoenoxiphium* sp.	-				x	
Dipsacaceae	*Scabiosa columbaria*	LC				x	
Ebenaceae	*Diospyros austro-africana* var. *austro-africana*	LC				x	x
Ebenaceae	*Diospyros austroafricana* var. *microphylla*	LC				x	
Ebenaceae	*Diospyros lycioides* subsp. *lycioides*	LC				x	x
Ebenaceae	*Euclea crispa* subsp. *ovata*	LC				x	x
Euphorbiaceae	*Euphorbia* cf. *caterviflora*	-	x	x			x
Euphorbiaceae	*Euphorbia* cf. *decepta*	-	x	x		x	x
Euphorbiaceae	*Euphorbia clavarioides*	LC	x	x		x	x
Euphorbiaceae	*Euphorbia hypogaea*	LC	x	x		x	
Euphorbiaceae	*Euphorbia inaequilatera*	LC	x			x	x
Euphorbiaceae	*Euphorbia mauritanica*	LC	x	x		x	x
Euphorbiaceae	*Euphorbia patula* subsp. *patula*		x	x		x	
Euphorbiaceae	*Euphorbia pillansii*	LC	x	x		x	
Euphorbiaceae	*Euphorbia rhombifolia*	LC	x	x		x	
Euphorbiaceae	*Euphorbia spartaria*	LC	x	x		x	
Euphorbiaceae	*Euphorbia stellispina*	LC	x	x		x	
Euphorbiaceae	*Euphorbia stolonifera*	LC	x	x		x	
Fabaceae	*Argyrolobium argenteum*	LC				x	
Fabaceae	*Aspalathus acicularis* subsp. *acicularis*	LC	x			x	
Fabaceae	*Aspalathus divaricata* subsp. *divaricata*	LC	x			x	

Fabaceae	*Calobota spinescens*	LC					x
Fabaceae	*Indigastrum argyraea*	LC					x
Fabaceae	*Indigofera alternans* var. *alternans*	LC				x	
Fabaceae	*Indigofera exigua*	LC				x	
Fabaceae	*Indigofera hantamensis*	LC				x	
Fabaceae	*Indigofera heterophylla*	LC				x	
Fabaceae	*Indigofera meyeriana*	LC				x	x
Fabaceae	*Indigofera sessilifolia*	LC				x	
Fabaceae	*Lessertia annularis*	LC	x			x	
Fabaceae	*Lessertia frutescens* subsp. *frutescens*	LC	x			x	x
Fabaceae	*Lessertia frutescens* subsp. *microphylla*	LC	x			x	
Fabaceae	*Lessertia inflata*	LC	x			x	x
Fabaceae	*Lessertia sneeuwbergensis*	LC	x			x	
Fabaceae	*Lotononis azureoides*	LC				x	
Fabaceae	*Lotononis caerulescens*	LC				x	
Fabaceae	*Lotononis carnosa* subsp. *carnosa*	LC				x	
Fabaceae	*Lotononis fruticoides*	LC				x	
Fabaceae	*Lotononis laxa*	LC				x	
Fabaceae	*Lotononis lenticula*	LC				x	
Fabaceae	*Lotononis pungens*	LC				x	
Fabaceae	*Lotononis* sp.	-					x
Fabaceae	*Medicago laciniata* var. *laciniata*	NE			x	x	
Fabaceae	*Medicago polymorpha*	NE			x	x	
Fabaceae	*Melolobium candicans*	LC				x	x
Fabaceae	*Melolobium canescens*	LC					x
Fabaceae	*Melolobium microphyllum*	LC				x	x
Fabaceae	*Prosopis chilensis*	NE			x	x	
Fabaceae	*Prosopis glandulosa* var. *torreyana*	NE		1b/3	x	x	
Fabaceae	*Prosopis glandulosa* var. *glandulosa*	NE		1b/3	x	x	x
Fabaceae	*Prosopis velutina*	NE		1b/3	x	x	
Fabaceae	*Trifolium africanum* var. *africanum*	LC				x	
Fabaceae	*Trifolium* sp.	-					x
Fabaceae	*Vachellia karroo*	LC				x	x
Frankeniaceae	*Frankenia pulverulenta*	LC				x	
Fumariaceae	*Cysticapnos pruinosa*	LC				x	
Gentianaceae	*Chironia palustris* subsp. *palustris*	LC				x	
Gentianaceae	*Sebaea pentandra* var. *pentandra*	LC				x	
Geraniaceae	*Erodium cicutarium*	NE			x	x	x
Geraniaceae	*Geranium dregei*	LC				x	
Geraniaceae	*Geranium harveyi*	LC				x	
Geraniaceae	*Monsonia camdeboensis*	LC				x	
Geraniaceae	*Monsonia crassicaulis*	LC				x	
Geraniaceae	*Monsonia salmoniflorum*	LC				x	x
Geraniaceae	*Pelargonium abrotanifolium*	LC	x			x	cf.
Geraniaceae	*Pelargonium althaeoides*	LC	x			x	
Geraniaceae	*Pelargonium aridum*	LC	x			x	x
Geraniaceae	*Pelargonium brevirostre*	LC	x			x	
Geraniaceae	*Pelargonium capituliforme*	LC	x			x	
Geraniaceae	*Pelargonium denticulatum*	LC	x			x	
Geraniaceae	*Pelargonium glutinosum*	LC	x			x	
Geraniaceae	*Pelargonium griseum*	LC	x			x	
Geraniaceae	*Pelargonium grossularioides*	LC	x			x	
Geraniaceae	*Pelargonium laxum* subsp. *laxum*	LC	x			x	
Geraniaceae	*Pelargonium malacoides*	-	x			x	
Geraniaceae	*Pelargonium minimum*	LC	x				x
Geraniaceae	*Pelargonium multicaule* subsp. *multicaule*	LC	x			x	
Geraniaceae	*Pelargonium myrrhifolium* var. *myrrhifolium*	LC	x			x	
Geraniaceae	*Pelargonium ramosissimum*	LC	x			x	
Geraniaceae	*Pelargonium ribifolium*	LC	x			x	
Geraniaceae	*Pelargonium sessiliflorum*	-	x			x	
Geraniaceae	*Pelargonium tetragonum*	LC	x			x	

Geraniaceae	*Pelargonium tragacanthoides*	LC		x			x	
Gisekiaceae	*Gisekia pharnaceoides* var. *pharnaceoides*	LC					x	
Grubbiaceae	*Grubbia rosmarinifolia* subsp. *rosmarinifolia* var. *rosmarinifolia*	LC	x				x	
Hyacinthaceae	*Albuca exuviata*	LC					x	
Hyacinthaceae	*Albuca namaquensis*	LC					x	
Hyacinthaceae	*Albuca setosa*	LC					x	cf.
Hyacinthaceae	*Albuca* sp.	-						x
Hyacinthaceae	*Albuca suaveolens*	LC					x	
Hyacinthaceae	*Albuca virens* subsp. *arida*	LC					x	
Hyacinthaceae	*Dipcadi ciliare*	LC					x	x
Hyacinthaceae	*Dipcadi viride*	LC					x	
Hyacinthaceae	*Drimia anomala*	LC					x	
Hyacinthaceae	*Drimia intricata*	LC					x	
Hyacinthaceae	*Drimia physodes*	LC					x	
Hyacinthaceae	*Drimia platyphylla*	LC					x	
Hyacinthaceae	*Drimia* sp.	-						x
Hyacinthaceae	*Lachenalia aurioliae*	LC	x		x		x	
Hyacinthaceae	*Lachenalia campanulata*	LC	x		x		x	cf
Hyacinthaceae	*Ledebouria ensifolia*	LC					x	
Hyacinthaceae	*Massonia dentata*	LC					x	
Hyacinthaceae	*Massonia depressa*	LC					x	
Hyacinthaceae	*Massonia echinata*	LC					x	
Hyacinthaceae	*Ornithogalum comptonii*	LC			x		x	
Hyacinthaceae	*Ornithogalum flexuosum*	LC			x		x	
Hyacinthaceae	*Ornithogalum juncifolium* var. *juncifolium*	LC			x		x	
Hyacinthaceae	*Ornithogalum paludosum*	LC			x		x	
Hyacinthaceae	*Ornithogalum* sp.	-			x			x
Hyacinthaceae	*Veltheimia capensis*	LC	x		x		x	
Hypoxidaceae	*Empodium elongatum*	LC					x	
Hypoxidaceae	*Empodium flexile*	LC					x	
Hypoxidaceae	*Empodium gloriosum*	LC					x	
Iridaceae	*Babiana hypogaea*	LC	x		x			x
Iridaceae	*Babiana* sp.	-	x		x			x
Iridaceae	*Gladiolus permeabilis*	LC	x		x		x	x
Iridaceae	*Gladiolus* sp.	-	x		x			x
Iridaceae	*Hesperantha bachmannii*	LC	x		x		x	
Iridaceae	*Hesperantha cucullata*	LC	x		x			cf.
Iridaceae	*Ixia marginifolia*	LC	x		x		x	
Iridaceae	*Lapeirousia plicata* subsp. *foliosa*		x		x		x	
Iridaceae	*Moraea ciliata*	LC	x		x		x	
Iridaceae	*Moraea cookii*	LC	x		x		x	
Iridaceae	*Moraea crispa*	LC	x		x		x	
Iridaceae	*Moraea elliotii*	LC	x		x		x	
Iridaceae	*Moraea miniata*	LC	x		x		x	x
Iridaceae	*Moraea polystachya*	LC	x		x		x	
Iridaceae	*Moraea* sp.	-	x		x			x
Iridaceae	*Moraea speciosa*	LC	x		x		x	
Iridaceae	*Moraea unguiculata*	LC	x		x		x	
Iridaceae	*Romulea atrandra* var. *esterhuyseniae*	LC	x		x		x	
Iridaceae	*Syringodea concolor*	LC	x		x		x	
Juncaceae	*Juncus oxycarpus*	LC	x		x		x	
Juncaceae	*Juncus rigidus*	LC					x	
Kewaceae	*Kewa salsoloides*	LC					x	
Lamiaceae	*Ballota africana*	LC					x	x
Lamiaceae	*Salvia disermas*	LC					x	x
Lamiaceae	*Salvia stenophylla*	-					x	
Lamiaceae	*Salvia verbenaca*	LC				x	x	x
Lamiaceae	*Stachys cuneata*	LC					x	x
Lamiaceae	*Stachys dregeana*	LC					x	
Lamiaceae	*Stachys linearis*	LC					x	x
Lamiaceae	*Stachys rugosa*	LC					x	

Lamiaceae	*Teucrium trifidum*	LC					x	
Lentibulariaceae	*Utricularia bisquamata*	LC					x	
Limeaceae	*Limeum aethiopicum* var. *aethiopicum*	LC					x	x
Linaceae	*Linum adustum*	LC					x	
Linaceae	*Linum thunbergii*	LC					x	
Lobeliaceae	*Lobelia dregeana*	LC					x	
Lobeliaceae	*Lobelia thermalis*	LC					x	
Loranthaceae	*Moquiniella rubra*	LC					x	
Loranthaceae	*Septulina glauca*	LC					x	x
Lycopodiaceae	*Lycopodium clavatum*	LC					x	
Malvaceae	*Abutilon sonneratianum*	LC					x	
Malvaceae	*Anisodontea capensis*	LC					x	
Malvaceae	*Anisodontea malvastroides*	LC					x	
Malvaceae	*Anisodontea triloba*	LC					x	
Malvaceae	*Grewia robusta*	LC					x	x
Malvaceae	*Hermannia alnifolia*	LC					x	x
Malvaceae	*Hermannia althaeifolia*	LC					x	
Malvaceae	*Hermannia burkei*	LC					x	
Malvaceae	*Hermannia cernua*	LC					x	
Malvaceae	*Hermannia coccocarpa*	LC					x	x
Malvaceae	*Hermannia comosa*	LC					x	x
Malvaceae	*Hermannia cuneifolia* var. *cuneifolia*	LC					x	x
Malvaceae	*Hermannia cuneifolia* var. *glabrescens*	LC					x	
Malvaceae	*Hermannia desertorum*	LC					x	x
Malvaceae	*Hermannia filifolia* var. *filifolia*	LC					x	x
Malvaceae	*Hermannia filifolia* var. *grandicalyx*	LC					x	
Malvaceae	*Hermannia grandiflora*	LC					x	x
Malvaceae	*Hermannia linearifolia*	LC					x	
Malvaceae	*Hermannia paucifolia*	LC					x	
Malvaceae	*Hermannia pulchella*	LC					x	x
Malvaceae	*Hermannia* sp.	-						x
Malvaceae	*Hermannia spinosa*	LC					x	x
Malvaceae	*Hermannia stipulacea*	LC					x	
Malvaceae	*Hermannia stricta*	LC					x	
Malvaceae	*Hermannia vestita*	LC					x	x
Malvaceae	*Hibiscus pusillus*	LC					x	x
Malvaceae	*Malva pusilla*	NE				x	x	x
Malvaceae	*Radyera urens*	LC					x	x
Marsileaceae	*Marsilea burchellii*	LC					x	
Melianthaceae	*Melianthus comosus*	LC					x	x
Menispermaceae	*Cissampelos capensis*	LC						x
Neuradaceae	*Grielum sinuatum*	LC					x	
Nyctaginaceae	*Boerhavia cordobensis*	NE				x	x	
Myrtaceae	*Eucalyptus* sp.	-						x
Oleaceae	*Menodora juncea*	LC					x	x
Ophioglossaceae	*Ophioglossum polyphyllum* var. *polyphyllum*	LC					x	x
Orchidaceae	*Eulophia hians* var. *hians*	LC					x	
Orchidaceae	*Holothrix villosa* var. *villosa*	LC					x	
Orobanchaceae	*Harveya* sp.	LC	x	x			x	
Oxalidaceae	*Oxalis ambigua*	LC		x			x	
Oxalidaceae	*Oxalis lanata* var. *lanata*	LC		x			x	
Oxalidaceae	*Oxalis obtusa*	LC		x			x	
Oxalidaceae	*Oxalis psilopoda*	LC		x			x	
Papaveraceae	*Argemone ochroleuca*	NE			1b	x	x	x
Papaveraceae	*Papaver aculeatum*	LC					x	
Pedaliaceae	*Sesamum capense*	LC						x
Peraceae	*Clutia marginata*	LC					x	x
Peraceae	*Clutia thunbergii*	LC					x	
Plantaginaceae	*Veronica anagallis-aquatica*	LC					x	
Pinaceae	*Pinus* sp.	-			1b/2/3	x		x
Plantaginaceae	*Plantago lanceolata*	LC						x

Poaceae	*Agrostis lachnantha* var. *lachnantha*	LC			x	
Poaceae	*Aristida adscensionis*	LC			x	x
Poaceae	*Aristida congesta*	LC			x	x
Poaceae	*Aristida diffusa* subsp. *burkei*	LC			x	
Poaceae	*Aristida diffusa* subsp. *diffusa*	LC			x	x
Poaceae	*Brachypodium bolusii*	LC			x	
Poaceae	*Bromus catharticus*	NE		x	x	x
Poaceae	*Bromus pectinatus*	LC			x	
Poaceae	*Capeochloa arundinacea*	LC			x	
Poaceae	*Cenchrus ciliaris*	LC			x	x
Poaceae	*Chaetobromus involucratus* subsp. *dregeanus*	LC			x	
Poaceae	*Chloris virgata*	LC			x	x
Poaceae	*Cymbopogon dieterlenii*	LC			x	
Poaceae	*Cymbopogon nardus*	LC			x	
Poaceae	*Cymbopogon prolixus*	LC			x	x
Poaceae	*Cynodon dactylon*	LC			x	
Poaceae	*Cynodon incompletus*	LC			x	x
Poaceae	*Digitaria argyrograpta*	LC			x	x
Poaceae	*Digitaria eriantha*	LC			x	x
Poaceae	*Ehrharta calycina*	LC			x	x
Poaceae	*Ehrharta dura*	LC			x	
Poaceae	*Ehrharta erecta*	LC			x	
Poaceae	*Ehrharta longigluma*	LC			x	
Poaceae	*Ehrharta pusilla*	LC			x	
Poaceae	*Enneapogon desvauxii*	LC			x	x
Poaceae	*Enneapogon scaber*	LC			x	x
Poaceae	*Enneapogon scoparius*	LC			x	x
Poaceae	*Eragrostis annulata*	LC				x
Poaceae	*Eragrostis bergiana*	LC			x	x
Poaceae	*Eragrostis bicolor*	LC			x	x
Poaceae	*Eragrostis brizantha*	LC			x	
Poaceae	*Eragrostis chloromelas*	LC			x	x
Poaceae	*Eragrostis cilianensis*	LC			x	
Poaceae	*Eragrostis curvula*	LC			x	x
Poaceae	*Eragrostis cylindriflora*	LC			x	
Poaceae	*Eragrostis echinochloidea*	LC				x
Poaceae	*Eragrostis homomalla*	LC			x	
Poaceae	*Eragrostis lehmanniana*	LC			x	x
Poaceae	*Eragrostis obtusa*	LC			x	x
Poaceae	*Eragrostis procumbens*	LC			x	
Poaceae	*Eragrostis rotifer*	LC			x	x
Poaceae	*Festuca scabra*	LC			x	
Poaceae	*Fingerhuthia africana*	LC			x	x
Poaceae	*Fingerhuthia sesleriiformis*	LC			x	
Poaceae	*Helictotrichon hirtulum*	LC			x	
Poaceae	*Heteropogon contortus*	LC			x	x
Poaceae	*Hordeum capense*	LC			x	
Poaceae	*Hordeum murinum* subsp. *glaucum*	NE		x	x	
Poaceae	*Hordeum murinum* subsp. *leporinum*	NE		x	x	
Poaceae	*Hyparrhenia hirta*	LC			x	x
Poaceae	*Koeleria capensis*	LC			x	
Poaceae	*Leptochloa fusca*	LC			x	
Poaceae	*Lolium multiflorum*	NE		x	x	
Poaceae	*Melica decumbens*	LC			x	
Poaceae	*Melica racemosa*	LC			x	
Poaceae	*Oropetium capense*	LC				x
Poaceae	*Panicum coloratum*	LC			x	
Poaceae	*Panicum lanipes*	LC			x	
Poaceae	*Panicum maximum*	LC			x	
Poaceae	*Pennisetum setaceum*	NE	1b	x	x	x
Poaceae	*Pennisetum sphacelatum*	LC			x	

Poaceae	*Pentameris airoides* subsp. *airoides*	LC			x	x
Poaceae	*Pentameris airoides* subsp. *jugorum*	LC			x	
Poaceae	*Pentameris setifolia*	LC			x	x
Poaceae	*Phragmites australis*	LC			x	x
Poaceae	*Polypogon monspeliensis*	NE		x	x	
Poaceae	*Schismus barbatus*	LC				x
Poaceae	*Schmidtia kalahariense*	LC			x	x
Poaceae	*Setaria sphacelata* var. *torta*	LC			x	
Poaceae	*Setaria verticillata*	LC			x	x
Poaceae	*Sporobolus coromandelianus*	LC			x	
Poaceae	*Sporobolus fimbriatus*	LC			x	x
Poaceae	*Sporobolus ioclados*	LC			x	x
Poaceae	*Sporobolus tenellus*	LC			x	
Poaceae	*Stipagrostis ciliata*	LC			x	x
Poaceae	*Stipagrostis namaquensis*	LC				x
Poaceae	*Stipagrostis obtusa*	LC			x	x
Poaceae	*Stipagrostis uniplumis*	LC			x	x
Poaceae	*Tenaxia disticha*	LC			x	x
Poaceae	*Tenaxia dura*	LC			x	
Poaceae	*Tetrachne dregei*	LC			x	
Poaceae	*Themeda triandra*	LC			x	x
Poaceae	*Tragus berteronianus*	LC			x	x
Poaceae	*Tragus koelerioides*	LC			x	x
Poaceae	*Tragus racemosus*	LC			x	x
Poaceae	*Tribolium purpureum*	LC			x	
Poaceae	*Tricholaena capensis* subsp. *capensis*	LC			x	
Poaceae	*Urochloa* cf. *panicoides*	-				x
Poaceae	*Vulpia myuros*	NE		x	x	
Polygalaceae	*Muraltia macrocarpa*	LC			x	
Polygalaceae	*Polygala asbestina*	LC			x	
Polygalaceae	*Polygala ephedroides*	LC			x	x
Polygalaceae	*Polygala leptophylla* var. *leptophylla*	LC			x	x
Polygonaceae	*Rumex crispus*	NE		x	x	
Polygonaceae	*Rumex lanceolatus*	LC			x	
Polypodiaceae	*Polypodium vulgare*	LC			x	
Pteridaceae	*Cheilanthes contracta*	LC			x	
Pteridaceae	*Cheilanthes eckloniana*	LC			x	x
Pteridaceae	*Cheilanthes hirta var. hirta*	LC			x	
Pteridaceae	*Cheilanthes induta*	LC			x	
Pteridaceae	*Cheilanthus* sp.	-				x
Pteridaceae	*Pellaea calomelanos* var. *calomelanos*	LC			x	x
Pteridaceae	*Pellaea leucomelas*	LC			x	
Pteridaceae	*Pellaea rufa*	LC			x	
Ranunculaceae	*Clematis brachiata*	LC			x	x
Ranunculaceae	*Ranunculus multifidus*	LC			x	x
Ranunculaceae	*Ranunculus trichophyllus*	LC			x	
Rhamnaceae	*Phylica purpurea*	LC			x	
Rhamnaceae	*Rhamnus prinoides*	LC				x
Rosaceae	*Cliffortia arborea*	VU			x	
Rosaceae	*Rubus ludwigii* subsp. *ludwigii*	LC			x	x
Rubiaceae	*Anthospermum dregei* subsp. *dregei*	LC			x	
Rubiaceae	*Anthospermum rigidum* subsp. *pumilum*	LC			x	
Rubiaceae	*Anthospermum spathulatum* subsp. *spathulatum*	LC			x	
Rubiaceae	*Anthospermum* sp.	-				x
Rubiaceae	*Galium capense* subsp. *garipense*	LC			x	
Rubiaceae	*Galium capense* subsp. *capense*	LC			x	
Rubiaceae	*Kohautia cynanchica*	LC			x	
Rubiaceae	*Nenax microphylla*	LC			x	x
Ruscaceae	*Eriospermum* sp.	-				x
Salicaceae	*Populus alba*	NE	2	x		x
Salicaceae	*Populus nigra* var. *italica*	NE		x	x	

Salicaceae	*Salix mucronata*	LC				x
Santalaceae	*Lacomucinaea lineata*	LC			x	x
Santalaceae	*Thesium gnidiaceum* var. *gnidiaceum*	LC			x	
Santalaceae	*Thesium hystricoides*	LC			x	
Santalaceae	*Thesium hystrix*	LC			x	
Santalaceae	*Thesium junceum* var. *junceum*	LC			x	
Santalaceae	*Thesium* sp.	-				x
Santalaceae	*Thesium sonderianum*	DD			x	
Santalaceae	*Viscum continuum*	LC			x	
Santalaceae	*Viscum rotundifolium*	LC			x	x
Scrophulariaceae	*Aptosimum indivisum*	LC			x	x
Scrophulariaceae	*Aptosimum procumbens*	LC			x	x
Scrophulariaceae	*Aptosimum spinescens*	LC			x	x
Scrophulariaceae	*Buddleja glomerata*	LC			x	x
Scrophulariaceae	*Buddleja salviifolia*	LC			x	x
Scrophulariaceae	*Chaenostoma halimifolium*	LC			x	
Scrophulariaceae	*Chaenostoma macrosiphon*	LC			x	
Scrophulariaceae	*Chaenostoma pauciflorum*	LC			x	
Scrophulariaceae	*Cromidon confusum*	LC			x	
Scrophulariaceae	*Cromidon decumbens*	LC			x	
Scrophulariaceae	*Diascia alonsooides*	LC	x	x	x	
Scrophulariaceae	*Diascia capsularis*	LC	x	x	x	
Scrophulariaceae	*Gomphostigma incomptum*	LC			x	
Scrophulariaceae	*Hebenstretia parviflora*	LC			x	
Scrophulariaceae	*Hebenstretia robusta*	LC			x	
Scrophulariaceae	*Jamesbrittenia atropurpurea*	LC		x	x	
Scrophulariaceae	*Jamesbrittenia filicaulis*	LC		x	x	
Scrophulariaceae	*Jamesbrittenia tysonii*	LC		x	x	x
Scrophulariaceae	*Limosella grandiflora*	LC			x	
Scrophulariaceae	*Manulea chrysantha*	LC			x	
Scrophulariaceae	*Manulea fragrans*	LC			x	
Scrophulariaceae	*Nemesia cynanchifolia*	LC		x	x	cf.
Scrophulariaceae	*Nemesia floribunda*	LC		x	x	
Scrophulariaceae	*Nemesia fruticans*	LC		x	x	
Scrophulariaceae	*Nemesia linearis*	LC		x	x	
Scrophulariaceae	*Peliostomum leucorrhizum*	LC			x	x
Scrophulariaceae	*Peliostomum virgatum*	LC				x
Scrophulariaceae	*Selago acocksii*	LC			x	
Scrophulariaceae	*Selago albida*	LC			x	
Scrophulariaceae	*Selago centralis*	LC			x	
Scrophulariaceae	*Selago divaricata*	LC			x	
Scrophulariaceae	*Selago geniculata*	LC			x	
Scrophulariaceae	*Selago gracilis*	LC			x	
Scrophulariaceae	*Selago magnakarooica*	LC			x	
Scrophulariaceae	*Selago rigida*	LC			x	
Scrophulariaceae	*Selago saxatilis*	LC			x	x
Scrophulariaceae	*Selago* sp. 1	-				x
Scrophulariaceae	*Selago* sp. 2	-				x
Scrophulariaceae	*Trieenea glutinosa*	LC			x	
Scrophulariaceae	*Zaluzianskya karrooica*	LC			x	
Scrophulariaceae	*Zaluzianskya peduncularis*	LC			x	x
Scrophulariaceae	*Zaluzianskya venusta*	LC			x	x
Solanaceae	*Lycium bosciifolium*	LC			x	
Solanaceae	*Lycium cinereum*	LC			x	x
Solanaceae	*Lycium hirsutum*	LC			x	
Solanaceae	*Lycium horridum*	LC			x	x
Solanaceae	*Lycium oxycarpum*	LC			x	x
Solanaceae	*Lycium pumilum*	LC			x	
Solanaceae	*Lycium schizocalyx*	LC			x	x
Solanaceae	*Solanum burchellii*	LC				x
Solanaceae	*Solanum retroflexum*	LC			x	

Solanaceae	*Solanum tomentosum*			x	
Solanaceae	*Withania somnifera*	LC		x	
Thymelaeaceae	*Gnidia meyeri*	LC		x	
Thymelaeaceae	*Lasiosiphon deserticola*	LC		x	
Thymelaeaceae	*Lasiosiphon microphyllus*	LC		x	x
Thymelaeaceae	*Lasiosiphon polycephalus*	LC		x	x
Thymelaeaceae	*Passerina corymbosa*	LC		x	
Thymelaeaceae	*Passerina obtusifolia*	LC		x	
Urticaceae	*Forsskaolea candida*	LC		x	x
Urticaceae	*Urtica dioica*	NE	x	x	
Verbenaceae	*Chascanum garipense*	LC			x
Verbenaceae	*Chascanum pinnatifidum* var. *pinnatifidum*	LC		x	x
Verbenaceae	*Chascanum pumilum*	LC		x	x
Verbenaceae	*Lantana rugosa*	LC		x	
Zygophyllaceae	*Roepera incrustata*	LC		x	
Zygophyllaceae	*Roepera lichtensteiniana*	LC		x	x
Zygophyllaceae	*Tetraena microcarpa*	LC		x	x
Zygophyllaceae	*Tetraena simplex*	LC		x	
Zygophyllaceae	*Roepera microphyllum*	LC		x	
Zygophyllaceae	*Tetraena chrysopteron*	LC		x	x
Zygophyllaceae	*Tribulus terrestris*	LC		x	x

APPENDIX B

ANIMAL SPECIES CHECKLISTS (ADU DATABASE)

1. Mammals

[1]IUCN category
[2]Western Cape Nature and Environmental Conservation Ordinance (WCNECO)
[3]Northern Cape Nature Conservation Act (NCCA)
[4]Animals observed during September/October 2020 site visit
Prot = Protected

Family	Scientific name	Common name	IUCN RSA[1]	IUCN Global[1]	WCNECO[2] Sch 1 EWA	WCNECO[2] Sch 2 PWA	NCNCA[3] Sch 1 SPS	NCCA[3] Sch 2 PS	NCNCA[3] Sch 4	ToPS	CITES	CURRENT[4]
ORDER: Rodentia (Rodents)												
Bathyergidae	*Cryptomys hottentotus*	Southern African mole-rat	LC					x				
Gliridae	*Graphiurus ocularis*	Spectacled African dormouse	NT					x				
Hystricidae	*Hystrix africaeaustralis*	Cape porcupine	LC					x				x
Muridae	*Acomys subspinosus*	Cape spiny mouse	LC					x				
Muridae	*Aethomys granti*	Grant's rock mouse	LC					x				
Muridae	*Aethomys namaquensis*	Namaqua rock mouse	LC					x				
Muridae	*Desmodillus auricularis*	Cape short-tailed gerbil	LC					x				
Muridae	*Gerbilliscus paeba*	Paeba hairy-footed gerbil	LC					x				
Muridae	*Mastomys coucha*	Southern African mastomys	LC					x				
Muridae	*Mastomys natalensis*	Natal multimammate mouse	LC					x				
Muridae	*Mus (Nannomys) minutoides*	Southern African pygmy mouse	LC					x				
Muridae	*Myomyscus verreauxi*	Verreaux's mouse	LC					x				
Muridae	*Otomys irroratus*	Southern African vlei rat (Fynbos type)	LC					x				
Muridae	*Otomys unisulcatus*	Karoo bush rat	LC					x				
Muridae	*Parotomys brantsii*	Brants's whistling rat	LC					x				
Muridae	*Rhabdomys pumilio*	Xeric four-striped grass rat	LC					x				
Nesomyidae	*Malacothrix typica*	Large-eared African desert mouse	LC					x				
Nesomyidae	*Petromyscus collinus*	Pygmy rock mouse	LC					x				
Nesomyidae	*Saccostomus campestris*	Southern African pouched mouse	LC					x				
Nesomyidae	*Steatomys krebsii*	Kreb's African fat mouse	LC					x				
Pedetidae	*Pedetes capensis*	South African spring hare	LC					x				
Sciuridae	*Xerus inauris*	South African ground squirrel	LC					x				
ORDER: Artiodactyla												
Bovidae	*Aepyceros melampus*	Impala	LC			x		x				
Bovidae	*Alcelaphus buselaphus caama*	Red hartebeest	LC			x		x				
Bovidae	*Antidorcas marsupialis*	Springbok	LC			x		x				x
Bovidae	*Connochaetes gnou*	Black wildebeest	LC			x		x		Prot		
Bovidae	*Damaliscus pygargus phillipsi*	Blesbok	LC			x		x				
Bovidae	*Damaliscus pygargus pygargus*	Bontebok	VU			x		x		VU	App II	
Bovidae	*Hippotragus equinus*	Roan antelope	EN	LC				x		VU		
Bovidae	*Hippotragus niger niger*	Sable antelope	VU	LC				x				
Bovidae	*Oreotragus oreotragus*	Klipspringer	LC			x		x				
Bovidae	*Oryx gazella*	Gemsbok	LC			x		x				
Bovidae	*Pelea capreolus*	Grey rhebok	NT			x		x				x
Bovidae	*Raphicerus campestris*	Steenbok	LC			x		x				x
Bovidae	*Redunca arundinum*	Southern reedbuck	LC			x		x				
Bovidae	*Redunca fulvorufula*	Mountain reedbuck	EN	EN		x		x				
Bovidae	*Sylvicapra grimmia*	Bush duiker	LC			x		x				

Bovidae	*Syncerus caffer*	African buffalo	LC			x		x				
Bovidae	*Tragelaphus oryx*	Common eland	LC			x		x				
Bovidae	*Tragelaphus sylvaticus*	Southern bushbuck	LC			x		x				
Bovidae	*Tragelaphus strepsiceros*	Greater kudu	LC			x		x				
ORDER: Carnivora (Carnivores)												
Canidae	*Canis mesomelas*	Black-backed jackal	LC						x			
Canidae	*Otocyon megalotis*	Bat-eared fox	LC			x	x					
Canidae	*Vulpes chama*	Cape fox	LC			x	x			Prot		
Felidae	*Caracal caracal*	Caracal	LC						x		App II	
Felidae	*Felis nigripes*	Black-footed cat	VU	VU		x	x			Prot	App I	
Felidae	*Felis silvestris*	African wildcat	LC				x				App II	
Felidae	*Panthera leo*	Lion	LC			x	x			VU	App II	
Herpestidae	*Atilax paludinosus*	Water mongoose	LC					x				
Herpestidae	*Cynictis penicillata*	Yellow mongoose	LC					x				
Herpestidae	*Herpestes pulverulentus*	Cape Gray mongoose	LC									
Herpestidae	*Suricata suricatta*	Suricate meerkat	LC					x				
Hyaenidae	*Parahyaena brunnea*	Brown hyena	NT			x	x			Prot		
Hyaenidae	*Proteles cristata*	Aardwolf	LC			x	x					
Mustelidae	*Ictonyx striatus*	Striped polecat	LC				x					
Mustelidae	*Mellivora capensis*	Honey badger	LC			x	x			Prot		
Mustelidae	*Poecilogale albinucha*	African striped weasel	NT			x	x					
Viverridae	*Genetta genetta*	Small-spotted genet	LC					x				
Viverridae	*Genetta tigrina*	Cape genet	LC					x				
ORDER: Primates												
Cercopithecidae	*Chlorocebus pygerythrus*	Vervet monkey	LC						x			x
Cercopithecidae	*Papio ursinus*	Chacma baboon	LC						x			x
ORDER: Afrosoricida (Golden moles)												
Chrysochloridae	*Chlorotalpa sclateri*	Sclater's golden gole	LC					x				
ORDER: Perissodactyla												
Equidae	*Equus quagga*	Plains zebra	LC					x				
Equidae	*Equus zebra zebra*	Cape Mountain zebra	LC		x		x			EN	App II	
ORDER: Lagomorpha (Hares and rabbits)												
Leporidae	*Bunolagus monticularis*	Riverine rabbit	CR		x		x			CR		
Leporidae	*Lepus capensis*	Cape hare	LC					x				
Leporidae	*Lepus saxatilis*	Scrub hare	LC					x				x
Leporidae	*Pronolagus rupestris*	Smith's red rock rabbit	LC					x				
ORDER: Macroscelidea (Elephant shrews)												
Macroscelididae	*Elephantulus edwardii*	Cape rock sengi	LC					x				
Macroscelididae	*Elephantulus rupestris*	Western rock sengi	LC					x				
Macroscelididae	*Macroscelides proboscideus*	Karoo round-eared sengi	LC					x				
ORDER: Tubulidentata												
Orycteropodidae	*Orycteropus afer*	Aardvark	LC			x	x					x
ORDER: Hyracoidea (Hyraxes)												
Procaviidae	Procavia capensis	Rock hyrax	LC					x				x
ORDER: Eulipotyphla (Shrews)												
Soricidae	*Crocidura cyanea*	Reddish-grey musk shrew	LC					x				
Soricidae	*Crocidura flavescens*	Greater red musk shrew	LC					x				
Soricidae	*Myosorex varius*	Forest shrew	LC					x				
Erinaceidae	*Atelerix frontalis*	Southern African hedgehog	NT			x	x			Prot		
ORDER: Chiroptera												
Molossidae	*Tadarida aegyptiaca*	Egyptian free-tailed bat	LC			x		x				
Rhinolophidae	*Rhinolophus clivosus*	Geoffroy's horseshoe bat	LC			x		x				
Vespertilionidae	*Miniopterus natalensis*	Natal long-fingered bat	LC			x						
Vespertilionidae	*Neoromicia capensis*	Cape serotine	LC			x		x				
ORDER: Proboscidea												
Elephantidae	*Loxodonta africana*	African savanna Eeephant	LC			x	x			Prot	App II	

2. Reptiles

[1]IUCN category
[2]Western Cape Nature and Environmental Conservation Ordinance (WCNECO)
[3]Northern Cape Nature Conservation Act (NCCA)
[4]Animals observed during September/October 2020 site visit

Family	Scientific name	Common name	IUCN[1]	WCNECO[2] Sch 2 PWA	NCNCA[3] Sch 2 PS	ToPS	CITES	CURRENT[4]
ORDER: SQUAMATA								
SUB-ORDER: LACERTILIA (LIZARDS)								
Agamidae	*Agama aculeata aculeata*	Western ground agama	LC	x				
Agamidae	*Agama anchietae*	Anchieta's agama	LC	x				
Agamidae	*Agama atra*	Southern rock agama	LC	x				X
Chamaeleonidae	*Bradypodion ventrale*	Eastern Cape dwarf chameleon	LC	x			App II	
Cordylidae	*Cordylus cordylus*	Cape girdled lizard	LC	x			App II	
Cordylidae	*Karusasaurus polyzonus*	Southern karusa lizard	LC	x				
Cordylidae	*Pseudocordylus microlepidotus namaquensis*	Nuweveldberg crag lizard	LC	x				
Gekkonidae	*Chondrodactylus angulifer angulifer*	Common giant ground gecko	LC	x				
Gekkonidae	*Chondrodactylus bibronii*	Bibron's gecko	LC	x				
Gekkonidae	*Goggia braacki*	Braack's pygmy gecko	NT	x				
Gekkonidae	*Pachydactylus capensis*	Cape gecko	LC	x				
Gekkonidae	*Pachydactylus kladaroderma*	Thin-skinned Gecko	LC	x				
Gekkonidae	*Pachydactylus latirostris*	Quartz gecko	LC	x				
Gekkonidae	*Pachydactylus maculatus*	Spotted gecko	LC	x				
Gekkonidae	*Pachydactylus mariquensis*	Common banded gecko	LC	x				
Gekkonidae	*Pachydactylus oculatus*	Golden spotted gecko	LC	x				
Gekkonidae	*Pachydactylus purcelli*	Purcell's gecko	LC	x				
Gekkonidae	*Pachydactylus rugosus*	Common rough gecko	LC	x				
Gekkonidae	*Ptenopus garrulus maculatus*	Spotted barking gecko	LC	x				
Gerrhosauridae	*Cordylosaurus subtessellatus*	Dwarf plated lizard	LC	x				
Gerrhosauridae	*Tetradactylus tetradactylus*	Cape Long-tailed Seps	LC	x				
Lacertidae	*Meroles suborbitalis*	Spotted desert lizard	LC	x	x			
Lacertidae	*Nucras livida*	Karoo sandveld lizard	LC	x	x			
Lacertidae	*Pedioplanis burchelli*	Burchell's sand lizard	LC	x	x			
Lacertidae	*Pedioplanis laticeps*	Karoo sand lizard	LC	x	x			
Lacertidae	*Pedioplanis lineoocellata pulchella*	Common sand lizard	LC	x	x			
Lacertidae	*Pedioplanis namaquensis*	Namaqua sand lizard	LC	x	x			
Scincidae	*Acontias meleagris*	Cape legless skink	LC	x				
Scincidae	*Trachylepis capensis*	Cape skink	LC	x				
Scincidae	*Trachylepis homalocephala*	Red-sided Skink	LC	x				
Scincidae	*Trachylepis occidentalis*	Western three-striped skink	LC	x				
Scincidae	*Trachylepis sulcata sulcata*	Western rock skink	LC	x				X
Scincidae	*Trachylepis variegata*	Variegated skink	LC	x				
Varanidae	*Varanus albigularis albigularis*	Southern rock monitor	LC		x		App II	
SUB-ORDER: SERPENTES (SNAKES)								
Typhlopidae	*Rhinotyphlops lalandei*	Delalande's beaked blind snake	LC					
Typhlopidae	*Rhinotyphlops schinzi*	Schinz's beaked blind snake	LC					
Colubridae	*Crotaphopeltis hotamboeia*	Red-lipped snake	LC					
Colubridae	*Dasypeltis scabra*	Rhombic egg-eater	LC	x	x			
Colubridae	*Dipsina multimaculata*	Dwarf beaked snake	LC					
Lamprophiidae	*Boaedon capensis*	Common house snake	LC					
Lamprophiidae	*Homoroselaps lacteus*	Spotted harlequin snake	LC					
Lamprophiidae	*Lamprophis guttatus*	Spotted rock snake	LC	x	x			
Lamprophiidae	*Prosymna sundevallii*	Sundevall's shovel-snout	LC	x	x			
Lamprophiidae	*Psammophis notostictus*	Karoo sand snake	LC					
Lamprophiidae	*Psammophylax rhombeatus*	Spotted grass snake	LC					
Elapidae	*Aspidelaps lubricus lubricus*	Coral shield cobra	LC					
Elapidae	*Hemachatus haemachatus*	Rinkhals	LC					
Elapidae	*Naja nivea*	Cape cobra	LC					
Viperidae	*Bitis arietans arietans*	Puff adder	LC					
ORDER: TESTUDINATA (CHELONIANS)								
Testudinidae	*Chersina angulata*	Angulate tortoise	LC	x	x		App II	
Testudinidae	*Homopus femoralis*	Greater padloper	LC	x	x		App II	
Testudinidae	*Psammobates tentorius*	Tent tortoise	LC	x	x		App II	
Testudinidae	*Psammobates tentorius tentorius*	Karoo tent tortoise	-	x	x		App II	
Testudinidae	*Psammobates tentorius verroxii*	Verrox's tent tortoise	-	x	x		App II	
Testudinidae	*Stigmochelys pardalis*	Leopard tortoise	LC	x	x		App II	X
Testudinidae	*Chersobius boulengeri*	Karoo dwarf tortoise	EN					
Pelomedusidae	*Pelomedusa galeata*	South African helmeted terrapin	Not	x				

3. Frogs

[1]IUCN category
[2]Western Cape Nature and Environmental Conservation Ordinance (WCNECO)
[3]Northern Cape Nature Conservation Act (NCCA)

Family	Scientific name	Common name	IUCN category[1]	WCNECO[2] Sch 2 PWA	NCNCA[3] Sch 2 PS	ToPs
Bufonidae	Poyntonophrynus vertebralis	Southern pygmy toad	LC	x	x	
Bufonidae	Sclerophrys capensis	Raucous toad	LC	x	x	
Bufonidae	Vandijkophrynus gariepensis gariepensis	Karoo toad (subsp. gariepensis)	LC	x	x	
Hyperoliidae	Kassina senegalensis	Bubbling kassina	LC	x	x	
Pipidae	Xenopus laevis	Common platanna	LC	x	x	
Pyxicephalidae	Amietia fuscigula	Cape river frog	LC	x	x	
Pyxicephalidae	Amietia poyntoni	Poynton's river frog	LC	x	x	
Pyxicephalidae	Cacosternum boettgeri	Common caco	LC	x	x	
Pyxicephalidae	Cacosternum karooicum	Karoo caco	LC	x	x	
Pyxicephalidae	Pyxicephalus adspersus	Giant bull frog	NT	x	Sch 2 SPS	Prot
Pyxicephalidae	Strongylopus grayii	Clicking stream frog	LC	x	x	
Pyxicephalidae	Tomopterna cryptotis	Tremelo sand frog	LC	x	x	
Pyxicephalidae	Tomopterna delalandii	Cape sand frog	LC	x	x	
Pyxicephalidae	Tomopterna tandyi	Tandy's sand frog	LC	x	x	

4. Avifauna

[1]IUCN category
[2]Western Cape Nature and Environmental Conservation Ordinance (WCNECO)
[3]Northern Cape Nature Conservation Act (NCCA)
[4]Animals observed during September/October 2020 site visit

Family	Species	Common name	IUCN[1] (RSA, global)	WCNECO[2]	NCNCA[3] SCH 1 SPS	NCNCA[3] SCH 2 PS	ToPS	CITES	CURRENT[4]
Accipitridae	*Milvus aegyptius*	Yellow-billed Kite		x					
Accipitridae	*Polemaetus bellicosus*	Martial eagle	EN, VU	x	x		VU		
Accipitridae	*Polyboroides typus*	African harrier-hawk		x	x				
Acrocephalidae	*Acrocephalus baeticatus*	African reed-warbler		x		x			
Acrocephalidae	*Acrocephalus gracilirostris*	Lesser swamp-warbler		x		x			
Acrocephalidae	*Acrocephalus palustris*	Marsh warbler		x		x			
Alaudidae	*Calandrella cinerea*	Red-capped lark		x		x			
Alaudidae	*Certhilauda curvirostris*	Cape long-billed lark		x		x			
Alaudidae	*Certhilauda semitorquata*	Eastern long-billed lark		x		x			
Alaudidae	*Certhilauda subcoronata*	Karoo long-billed lark		x		x			
Alaudidae	*Chersomanes albofasciata*	Spike-heeled lark		x		x			
Alaudidae	*Eremopterix australis*	Black-eared sparrowlark		x		x			
Alaudidae	*Eremopterix verticalis*	Grey-backed sparrowlark		x		x			
Alaudidae	*Galerida magnirostris*	Large-billed lark		x		x			
Alaudidae	*Mirafra fasciolata*	Eastern clapper lark		x		x			
Alaudidae	*Spizocorys conirostris*	Pink-billed lark		x		x			
Alaudidae	*Spizocorys sclateri*	Sclater's lark	NT, NT	x	x				
Alcedinidae	*Alcedo cristata*	Malachite kingfisher		x		x			
Alcedinidae	*Ceryle rudis*	Pied kingfisher		x		x			
Alcedinidae	*Halcyon albiventris*	Brown-hooded Kingfisher		x		x			
Alcedinidae	*Megaceryle maximus*	Giant kingfisher		x		x			
Anatidae	*Alopochen aegyptiacus*	Egyptian goose		x		x			
Anatidae	*Anas capensis*	Cape teal		x		x			
Anatidae	*Anas erythrorhyncha*	Red-billed teal		x		x			
Anatidae	*Anas smithii*	Cape shoveler		x		x			
Anatidae	*Anas sparsa*	African black duck		x		x			
Anatidae	*Anas undulata*	Yellow-billed duck		x		x			
Anatidae	*Dendrocygna viduata*	White-faced duck		x		x			
Anatidae	*Netta erythrophthalma*	Southern pochard		x		x			
Anatidae	*Oxyura maccoa*	Maccoa duck	NT, VU	x		x			
Anatidae	*Plectropterus gambensis*	Spur-winged goose		x		x			
Anatidae	*Tadorna cana*	South African shelduck		x		x			
Anhingidae	*Anhinga rufa*	African darter		x		x			
Apodidae	*Apus affinis*	Little swift		x		x			
Apodidae	*Apus apus*	Common swift		x		x			
Apodidae	*Apus barbatus*	African black swift		x		x			
Apodidae	*Apus caffer*	White-rumped Swift		x		x			
Apodidae	*Cypsiurus parvus*	African palm-swift		x		x			
Apodidae	*Tachymarptis melba*	Alpine swift		x		x			
Ardeidae	*Ardea cinerea*	Grey heron		x		x			
Ardeidae	*Ardea melanocephala*	Black-headed heron		x		x			
Ardeidae	*Ardeola ralloides*	Squacco heron		x		x			
Ardeidae	*Bubulcus ibis*	Cattle egret		x		x			
Ardeidae	*Egretta garzetta*	Little egret		x		x			
Ardeidae	*Ixobrychus minutus*	Common little bittern		x		x			
Ardeidae	*Nycticorax nycticorax*	Black-crowned night-heron		x		x			
Bucerotidae	*Tockus leucomelas*	Southern yellow-billed hornbill		x		x			
Burhinidae	*Burhinus capensis*	Spotted thick-knee		x		x			
Burhinidae	*Burhinus vermiculatus*	Water thick-knee		x		x			
Alaudidae	*Calendulauda albescens*	Karoo lark		x		x			
Alaudidae	*Calendulauda sabota*	Sabota lark		x		x			
Charadriidae	*Charadrius hiaticula*	Common ringed plover		x		x			
Charadriidae	*Charadrius pecuarius*	Kittlitz's plover		x		x			
Charadriidae	*Charadrius tricollaris*	Three-banded plover		x		x			
Charadriidae	*Vanellus armatus*	Blacksmith lapwing		x		x			
Charadriidae	*Vanellus coronatus*	Crowned lapwing		x		x			
Charadriiformes	*Glareola nordmanni*	Black-winged pratincole	NT, NT	x	x				

Ciconiidae	*Ciconia ciconia*	White stork		x		x			
Ciconiidae	*Ciconia nigra*	Black stork	VU, LC	x	x		VU	App II	
Ciconiidae	*Leptoptilos crumeniferus*	Marabou stork	NT, LC	x	x				
Ciconiidae	*Mycteria ibis*	Yellow-billed stork	EN, LC	x	x				
Ciconiidae	*Phoenicopterus minor*	Lesser flamingo		x	x			App II	
Ciconiidae	*Phoenicopterus roseus*	Greater flamingo	NT, LC	x	x			App II	
Cisticolidae	*Apalis thoracica*	Bar-throated apalis		x		x			
Cisticolidae	*Cisticola aridulus*	Desert cisticola		x		x			
Cisticolidae	*Cisticola fulvicapilla*	Neddicky neddicky		x		x			
Cisticolidae	*Cisticola juncidis*	Zitting cisticola		x		x			
Cisticolidae	*Cisticola subruficapilla*	Grey-backed cisticola		x		x			
Cisticolidae	*Cisticola tinniens*	Levaillant's cisticola		x		x			
Cisticolidae	*Eremomela gregalis*	Karoo eremomela		x		x			
Cisticolidae	*Eremomela icteropygialis*	Yellow-bellied eremomela		x		x			
Cisticolidae	*Euryptila subcinnamomea*	Cinnamon-breasted warbler		x		x			
Cisticolidae	*Malcorus pectoralis*	Rufous-eared warbler		x		x			
Cisticolidae	*Phragmacia substriata*	Namaqua warbler		x		x			
Cisticolidae	*Prinia flavicans*	Black-chested prinia		x		x			
Cisticolidae	*Prinia maculosa*	Karoo prinia		x		x			
Coliidae	*Colius colius*	White-backed mousebird							
Coliidae	*Colius striatus*	Speckled mousebird							
Coliidae	*Urocolius indicus*	Red-faced mousebird							
Columbidae	*Columba guinea*	Speckled pigeon		x		x			x
Columbidae	*Columba livia*	Rock dove		x		x			
Columbidae	*Oena capensis*	Namaqua dove		x		x			
Columbidae	*Streptopelia capicola*	Cape turtle-dove		x		x			
Columbidae	*Streptopelia semitorquata*	Red-eyed dove		x		x			
Columbidae	*Streptopelia senegalensis*	Laughing dove		x		x			
Corvidae	*Corvus albicollis*	White-necked daven		x		x			
Corvidae	*Corvus albus*	Pied crow							X
Corvidae	*Corvus capensis*	Cape crow							
Cuculidae	*Chrysococcyx caprius*	Diderick cuckoo		x		x			
Cuculidae	*Clamator glandarius*	Great spotted cuckoo		x		x			
Dicruridae	*Dicrurus adsimilis*	Fork-tailed drongo		x		x			
Emberizidae	*Emberiza capensis*	Cape bunting		x		x			
Emberizidae	*Emberiza flaviventris*	Golden-breasted bunting		x		x			
Emberizidae	*Emberiza impetuani*	Lark-like bunting		x		x			
Emberizidae	*Emberiza tahapisi*	Cinnamon-breasted bunting		x		x			
Estrildidae	*Amadina erythrocephala*	Red-headed finch		x		x			
Estrildidae	*Estrilda astrild*	Common waxbill		x		x			
Estrildidae	*Lagonosticta rubricata*	African firefinch		x		x			
Estrildidae	*Lagonosticta senegala*	Red-billed firefinch		x		x			
Estrildidae	*Ortygospiza atricollis*	African quailfinch		x		x			
Falconiformis	*Accipiter melanoleucus*	Black sparrowhawk		x	x			App II	
Falconiformis	*Accipiter rufiventris*	Rufous-chested sparrowhawk		x	x			App II	
Falconiformis	*Aquila pennatus*	Booted eagle		x	x			App II	
Falconiformis	*Aquila verreauxii*	Verreaux's eagle	VU, LC	x	x			App II	
Falconiformis	*Buteo rufofuscus*	Jackal buzzard		x	x			App II	
Falconiformis	*Buteo vulpinus*	Steppe buzzard		x	x			App II	
Falconiformis	*Circaetus cinereus*	Brown snake-eagle		x	x			App II	
Falconiformis	*Circaetus pectoralis*	Black-chested snake-eagle		x	x			App II	
Falconiformis	*Circus maurus*	Black harrier	EN, EN	x	x			App II	
Falconiformis	*Elanus caeruleus*	Black-shouldered kite		x	x			App II	
Falconiformis	*Falco amurensis*	Amur falcon		x	x			App II	
Falconiformis	*Falco biarmicus*	Lanner falcon	VU, LC	x	x			App II	
Falconiformis	*Falco naumanni*	Lesser kestrel		x	x		VU	App II	X
Falconiformis	*Falco peregrinus*	Peregrine falcon		x	x		VU	App I	
Falconiformis	*Falco rupicoloides*	Greater kestrel		x	x			App II	
Falconiformis	*Falco rupicolus*	Rock kestrel		x	x			App II	
Falconiformis	*Falco subbuteo*	Eurasian hobby		x	x			App II	
Falconiformis	*Haliaeetus vocifer*	African fish-eagle		x	x			App II	
Falconiformis	*Melierax canorus*	Southern pale chanting goshawk		x	x			App II	X
Falconiformis	*Melierax gabar*	Gabar goshawk		x	x			App II	
Fringillidae	*Crithagra albogularis*	White-throated canary		x		x			
Fringillidae	*Crithagra atrogularis*	Black-throated canary		x		x			
Fringillidae	*Crithagra flaviventris*	Yellow canary		x		x			
Fringillidae	*Crithagra gularis*	Streaky-headed seedeater		x		x			
Fringillidae	*Serinus alario*	Black-headed canary		x		x			
Fringillidae	*Serinus canicollis*	Cape canary		x		x			
Glareolidae	*Cursorius rufus*	Burchell's courser	VU, LC	x		x			
Glareolidae	*Cursorius temminckii*	Temminck's courser		x		x			

Glareolidae	*Rhinoptilus africanus*	Double-banded courser		x		x			
Gruidae	*Grus paradisea*	Blue crane	NT, VU	x			EN	App II	
Hirundinidae	*Delichon urbicum*	Common house-martin		x		x			
Hirundinidae	*Hirundo albigularis*	White-throated swallow		x		x			
Hirundinidae	*Hirundo cucullata*	Greater striped swallow		x		x			
Hirundinidae	*Hirundo dimidiata*	Pearl-breasted swallow		x		x			
Hirundinidae	*Hirundo fuligula*	Rock martin		x		x			
Hirundinidae	*Hirundo rustica*	Barn swallow		x		x			
Hirundinidae	*Hirundo spilodera*	South African cliff-swallow		x		x			
Hirundinidae	*Riparia cincta*	Banded martin		x		x			
Hirundinidae	*Riparia paludicola*	Brown-throated martin		x		x			
Indicatoridae	*Indicator indicator*	Greater honeyguide		x		x			
Indicatoridae	*Indicator minor*	Lesser honeyguide		x		x			
Laniidae	*Lanius collaris*	Common fiscal		x		x			
Laniidae	*Lanius collurio*	Red-backed shrike		x		x			
Laridae	*Chlidonias hybrida*	Whiskered tern		x		x			
Laridae	*Chlidonias leucopterus*	White-winged tern		x		x			
Laridae	*Larus cirrocephalus*	Grey-headed gull		x		x			
Locustellidae	*Bradypterus baboecala*	Little rush-warbler		x		x			
Lybiidae	*Tricholaema leucomelas*	Acacia pied barbet		x		x			
Macrosphenidae	*Sylvietta rufescens*	Long-billed crombec		x		x			
Malaconotidae	*Laniarius ferrugineus*	Southern boubou		x		x			
Malaconotidae	*Tchagra tchagra*	Southern tchagra		x		x			
Malaconotidae	*Telophorus zeylonus*	Bokmakierie		x		x			
Meropidae	*Merops apiaster*	European bee-eater		x		x			
Meropidae	*Merops bullockoides*	White-fronted bee-eater		x		x			
Monarchidae	*Terpsiphone viridis*	African paradise-flycatcher		x		x			
Motacillidae	*Anthus cinnamomeus*	African pipit		x		x			
Motacillidae	*Anthus crenatus*	African rock pipit	NT, LC	x		x			
Motacillidae	*Anthus leucophrys*	Plain-backed pipit		x		x			
Motacillidae	*Anthus similis*	Nicholson's pipit		x		x			
Motacillidae	*Anthus similis*	Long-billed pipit		x		x			
Motacillidae	*Anthus vaalensis*	Buffy pipit		x		x			
Motacillidae	*Motacilla capensis*	Cape wagtail		x		x			
Muscicapidae	*Bradornis infuscatus*	Chat flycatcher		x		x			
Muscicapidae	*Cercotrichas coryphoeus*	Karoo scrub-robin		x		x			
Muscicapidae	*Cossypha caffra*	Cape robin-chat		x		x			
Muscicapidae	*Monticola brevipes*	Short-toed rock-thrush		x		x			
Muscicapidae	*Monticola rupestris*	Cape rock-thrush		x		x			
Muscicapidae	*Muscicapa striata*	Spotted flycatcher		x		x			
Muscicapidae	*Myrmecocichla formicivora*	Southern anteating chat		x		x			
Muscicapidae	*Oenanthe monticola*	Mountain wheatear		x		x			
Muscicapidae	*Oenanthe pileata*	Capped wheatear		x		x			
Muscicapidae	*Saxicola torquatus*	African stonechat		x		x			
Muscicapidae	*Sigelus silens*	Fiscal flycatcher		x		x			
Muscicapidae.	*Cercomela familiaris*	Familiar chat		x		x			
Muscicapidae.	*Cercomela schlegelii*	Karoo chat		x		x			
Muscicapidae.	*Cercomela sinuata*	Sickle-winged chat		x		x			
Muscicapidae.	*Cercomela tractrac*	Tractrac chat		x		x			
Nectariniidae	*Anthobaphes violacea*	Orange-breasted sunbird		x		x			
Nectariniidae	*Cinnyris chalybeus*	Southern double-collared sunbird		x		x			
Nectariniidae	*Cinnyris fuscus*	Dusky sunbird		x		x			
Nectariniidae	*Cinnyris talatala*	White-bellied sunbird		x		x			
Nectariniidae	*Nectarinia famosa*	Malachite sunbird		x		x			
Numididae	*Numida meleagris*	Helmeted guineafowl		x		x			
Oriolidae	*Oriolus oriolus*	Eurasian golden oriole		x		x			
Otididae	*Afrotis afra*	Southern black korhaan	VU, VU	x		x			
Otididae	*Afrotis afraoides*	Northern black korhaan		x		x			
Otididae	*Ardeotis kori*	Kori bustard	NT, NT	x			VU	App II	
Otididae	*Eupodotis vigorsii*	Karoo korhaan	NT, LC	x		x			
Otididae	*Neotis ludwigii*	Ludwig's bustard	EN, EN	x	x		VU		X
Paridae	*Melaniparus afer*	Grey tit		x		x			
Passeridae	*Passer diffusus*	Southern grey-headed sparrow		x		x			
Passeridae	*Passer domesticus*	House sparrow							
Passeridae	*Passer melanurus*	Cape sparrow							
Phalacrocoracidae	*Phalacrocorax africanus*	Reed cormorant		x		x			
Phalacrocoracidae	*Phalacrocorax carbo*	White-breasted cormorant		x		x			
Phasianidae	*Coturnix coturnix*	Common quail		x		x			
Phasianidae	*Pavo cristatus*	Indian peafowl		x		x			
Phasianidae	*Pternistis capensis*	Cape spurfowl		x		x			
Phasianidae	*Scleroptila africanus*	Grey-winged francolin		x		x			

Phoeniculidae	*Phoeniculus purpureus*	Green wood-hoopoe		x		x		
Phylloscopidae	*Phylloscopus trochilus*	Willow warbler		x		x		
Picidae	*Dendropicos fuscescens*	Cardinal woodpecker		x		x		
Picidae	*Geocolaptes olivaceus*	Ground woodpecker	LC, NT	x		x		
Platysteiridae	*Batis pririt*	Pririt batis		x		x		
Ploceidae	*Euplectes afer*	Yellow-crowned bishop		x		x		
Ploceidae	*Euplectes orix*	Southern red bishop				x		
Ploceidae	*Philetairus socius*	Sociable weaver		x		x		
Ploceidae	*Ploceus capensis*	Cape weaver						
Ploceidae	*Ploceus velatus*	Southern masked-weaver						
Ploceidae	*Quelea quelea*	Red-billed quelea						
Ploceidae	*Sporopipes squamifrons*	Scaly-feathered finch		x		x		
Podicipedidae	*Podiceps cristatus*	Great crested grebe		x		x		
Podicipedidae	*Podiceps nigricollis*	Black-necked grebe		x		x		
Podicipedidae	*Tachybaptus ruficollis*	Little grebe		x		x		
Pteroclidae	*Pterocles namaqua*	Namaqua sandgrouse		x		x		X
Pycnonotidae	*Pycnonotus nigricans*	African red-eyed bulbul						
Rallidae	*Crecopsis egregia*	African crake		x		x		
Rallidae	*Fulica cristata*	Red-knobbed coot		x		x		
Rallidae	*Gallinula chloropus*	Common moorhen		x		x		
Recurvirostridae	*Himantopus himantopus*	Black-winged stilt		x		x		
Recurvirostridae	*Recurvirostra avosetta*	Pied avocet		x		x		
Remizidae	*Anthoscopus minutus*	Cape penduline-tit		x		x		
Sagittariidae	*Sagittarius serpentarius*	Secretarybird	VU, VU	x	x			
Scolopacidae	*Actitis hypoleucos*	Common sandpiper		x		x		
Scolopacidae	*Arenaria interpres*	Ruddy turnstone		x		x		
Scolopacidae	*Calidris ferruginea*	Curlew sandpiper	LC, NT	x		x		
Scolopacidae	*Calidris minuta*	Little stint		x		x		
Scolopacidae	*Gallinago nigripennis*	African snipe		x		x		
Scolopacidae	*Philomachus pugnax*	Ruff ruff		x		x		
Scolopacidae	*Tringa glareola*	Wood sandpiper		x		x		
Scolopacidae	*Tringa nebularia*	Common greenshank		x		x		
Scolopacidae	*Tringa stagnatilis*	Marsh sandpiper		x		x		
Scopidae	*Scopus umbretta*	Hamerkop		x		x		X
Stenostiridae	*Stenostira scita*	Fairy flycatcher		x		x		
Strigiformes	*Caprimulgus pectoralis*	Fiery-necked ightjar		x	x		App II	
Strigiformes	*Caprimulgus rufigena*	Rufous-cheeked nightjar		x	x		App II	
Strigiformes	*Caprimulgus tristigma*	Freckled nightjar		x	x		App II	
Strigiformes	*Tyto alba*	Barn owl		x	x		App II	
Strigiformis	*Bubo africanus*	Spotted eagle-owl		x	x		App II	
Strigiformis	*Bubo capensis*	Cape eagle-owl		x	x		App II	
Strigiformis	*Glaucidium perlatum*	Pearl-spotted owlet		x	x		App II	
Struthionidae	*Struthio camelus*	Common ostrich		x		x		
Sturnidae	*Creatophora cinerea*	Wattled starling		x		x		
Sturnidae	*Lamprotornis nitens*	Cape starling		x		x		
Sturnidae	*Onychognathus morio*	Red-winged starling						
Sturnidae	*Onychognathus nabouroup*	Pale-winged starling		x		x		
Sturnidae	*Spreo bicolor*	Pied starling		x		x		
Sturnidae	*Sturnus vulgaris*	Common starling						
Sylviidae	*Parisoma layardi*	Layard's tit-babbler		x		x		
Sylviidae	*Parisoma subcaeruleum*	Chestnut-vented tit-babbler		x		x		
Sylviidae	*Sylvia borin*	Garden warbler		x		x		
Threskiornithidae	*Bostrychia hagedash*	Hadeda ibis		x		x		
Threskiornithidae	*Platalea alba*	African spoonbill		x		x		
Threskiornithidae	*Plegadis falcinellus*	Glossy ibis		x		x		
Threskiornithidae	*Threskiornis aethiopicus*	African sacred ibis		x		x		
Turdidae	*Turdus smithi*	Karoo thrush		x		x		
Upupidae	*Upupa africana*	African hoopoe		x		x		
Viduidae	*Vidua chalybeata*	Village indigobird		x		x		
Viduidae	*Vidua macroura*	Pin-tailed whydah		x		x		
Viduidae	*Vidua paradisaea*	Long-tailed paradise-whydah		x		x		
Zosteropidae	*Zosterops pallidus*	Orange river white-eye		x		x		
Zosteropidae	*Zosterops virens*	Cape white-eye		x		x		

5. Scorpions

Family	Scientific name	NCNCA
BUTHIDAE	*Parabuthus capensis*	
BUTHIDAE	*Parabuthus granulatus*	
BUTHIDAE	*Parabuthus laevifrons*	
BUTHIDAE	*Parabuthus nanus*	
BUTHIDAE	*Parabuthus schlechteri*	
BUTHIDAE	*Uroplectes sp.*	
BUTHIDAE	*Uroplectes carinatus*	
BUTHIDAE	*Uroplectes gracilior*	
BUTHIDAE	*Uroplectes schlechteri*	
HORMURIDAE	*Hadogenes* sp.	Sch 2 PS
SCORPIONIDAE	*Opistophthalmus austerus*	Sch 2 PS
SCORPIONIDAE	*Opistophthalmus carinatus*	Sch 2 PS
SCORPIONIDAE	*Opistophthalmus crassimanus*	Sch 2 PS
SCORPIONIDAE	*Opistophthalmus karrooensis*	Sch 2 PS
SCORPIONIDAE	*Opistophthalmus lornae*	Sch 2 PS
SCORPIONIDAE	*Opistophthalmus pictus*	Sch 2 PS

6. Spiders

Family	Scientific name	Common name	NCNCA
Araneidae	*Argiope sp.*	Garden orb-web spiders	Sch 3
Araneidae	*Argiope australis*	Common garden orb-web spiders	Sch 3
Araneidae	*Nemoscolus sp.*	Stone nest spiders	Sch 3
Araneidae	*Neoscona sp.*	Neoscona hairy field spiders	Sch 3
Caponiidae	*Caponia sp.*	Eight-eyed orange lungless spiders	Sch 3
Eresidae	*Seothyra sp.*	Buckspoor or bokspoor spiders	Sch 3
Eresidae	*Stegodyphus sp.*	Community nest spiders	Sch 3
Eresidae	*Stegodyphus mimosarum*	Bush-legged stegodyphus	Sch 3
Eresidae	*Stegodyphus tentoriicola*	Pale stegodyphus	Sch 3
Eutichuridae	*Cheiracanthium sp.*	Sac spiders	Sch 3
Gnaphosidae	*Drassodes sp.*	Dark-face ground spiders	Sch 3
Lycosidae	*Hogna sp.*	Burrowing wolf spiders	Sch 3
Nemesiidae	*Hermacha sp.*		Sch 3
Oecobiidae	*Oecobius sp.*	Dwarf round headed spiders	Sch 3
Oecobiidae	*Oecobius navus*	House ant-eating spiders	Sch 3
Palpimanidae	*Palpimanus namaquensis*	Namaqua palp-footed spiders	Sch 3
Philodromidae	*Thanatus sp.*	running spiders	Sch 3
Pisauridae	*Rothus sp.*	Crowned pisaurids	Sch 3
Salticidae	*Mexcala elegans*	Elegant mexcala ant-like jumping spiders	Sch 3
Salticidae	*Mexcala rufa*	Scaly mexcala ant-like jumping spiders	Sch 3
Sparassidae	*Olios sp.*	huntsman spiders	Sch 3
Sparassidae	*Palystes sp.*	Rain spiders	Sch 3
Theraphosidae	*Harpactira baviana*	Baboon spiders	Sch 1 SPS
Theraphosidae	*Harpactira namaquensis*	Baboon spiders	Sch 1 SPS
Theraphosidae	*Harpactirella sp.*	Baboon spiders	Sch 3
Theridiidae	*Latrodectus geometricus*	Common brown button spiders	Sch 3
Thomisidae	*Xysticus sp.*	crab spiders	Sch 3
Zodariidae	*Cicynethus sp.*	burrowing zodariids & ant-eating spiders	Sch 3
Zodariidae	*Psammorygma sp.*	Tunnelling zodariids	Sch 3

7. Dung beetles

Family	Scientific name
Scarabaeidae	Digitonthophagus sp.
Scarabaeidae	Gymnopleurus humanus
Scarabaeidae	Metacatharsius marani
Scarabaeidae	Onthophagus fritschi
Scarabaeidae	Scarabaeus basuto
Scarabaeidae	Scarabaeus bohemani
Scarabaeidae	Scarabaeus fritschi
Scarabaeidae	Scarabaeus megaparvulus
Scarabaeidae	Scarabaeus parvulus
Scarabaeidae	Scarabaeus satyrus
Scarabaeidae	Scarabaeus viator

8. Lacewings (Neuroptera)

Family	Scientific name
Ascalaphidae	Melambrotus papio
Ascalaphidae	Melambrotus simia
Ascalaphidae	Proctolyra brincki
Chrysopidae	Chrysemosa jeanneli
Chrysopidae	Chrysoperla sp.
Chrysopidae	Dichochrysa karooensis
Chrysopidae	Dichochrysa rubicunda
Chrysopidae	Dichochrysa tacta
Chrysopidae	Italochrysa neurodes
Coniopterygidae	Aleuropteryx ohmi
Myrmeleontidae	Centroclisis maligna
Myrmeleontidae	Centroclisis mendax
Myrmeleontidae	Crambomorphus sinuatus
Myrmeleontidae	Creoleon sp.
Myrmeleontidae	Creoleon africanus
Myrmeleontidae	Creoleon mortifer
Myrmeleontidae	Cueta infima
Myrmeleontidae	Cueta trivirgata
Myrmeleontidae	Cymothales illustris
Myrmeleontidae	Furgella damarinus
Myrmeleontidae	Golafrus oneili
Myrmeleontidae	Myrmeleon alcestris
Myrmeleontidae	Myrmeleon doralice
Myrmeleontidae	Myrmeleon obscurus
Myrmeleontidae	Nannoleon michaelseni
Myrmeleontidae	Nemoleon delicatus
Myrmeleontidae	Nesoleon boschimanus
Myrmeleontidae	Nesoleon braunsi
Myrmeleontidae	Neuroleon chloranthe
Myrmeleontidae	Obus capensis
Myrmeleontidae	Obus elizabethae
Myrmeleontidae	Palparellus dubiosus
Myrmeleontidae	Palparellus pulchellus
Myrmeleontidae	Palpares elegantulus
Myrmeleontidae	Palpares immensus
Myrmeleontidae	Palpares karrooanus
Myrmeleontidae	Palpares speciosus
Myrmeleontidae	Palparidius capicola
Myrmeleontidae	Pamexis karoo
Nemopteridae	Laurhervasia setacea
Nemopteridae	Nemia karrooa
Nemopteridae	Nemopterella sp.
Nemopteridae	Nemopterella peringueyi
Psychopsidae	Silveira jordani

9. Butterflies (Lepidoptera)

Family	Scientific name	IUCN category	NCNCA
CRAMBIDAE	Bocchoris inspersalis	Not listed	
CRAMBIDAE	Loxostege frustalis	Not listed	
ELACHISTIDAE	Ethmia sp.		
EREBIDAE	Achaea catella	Not listed	
EREBIDAE	Amata alicia		
EREBIDAE	Bracharoa quadripunctata	Not listed	
EREBIDAE	Cerocala vermiculosa	Not listed	
EREBIDAE	Cyligramma latona	Not listed	
EREBIDAE	Eilema sanguicosta	Not listed	
EREBIDAE	Eublemma seminivea	Not listed	
EREBIDAE	Grammodes stolida	Not listed	
EREBIDAE	Leucaloa eugraphica	Not listed	
EREBIDAE	Ophiusa mejanesi	Not listed	
EREBIDAE	Ophiusa tirhaca		
EREBIDAE	Sozusa scutellata	Not listed	
EREBIDAE	Sphingomorpha chlorea	Not listed	
EREBIDAE	Tytroca metaxantha	Not listed	
EREBIDAE	Utetheisa pulchella	Not listed	
GEOMETRIDAE	Acanthovalva focularia	NT	
GEOMETRIDAE	Anthemoctena textilis	NT	
GEOMETRIDAE	Chiasmia subcurvaria	Not listed	
GEOMETRIDAE	Drepanogynis sp.		
GEOMETRIDAE	Drepanogynis bifasciata	NT	
GEOMETRIDAE	Drepanogynis tripartita	NT	
GEOMETRIDAE	Eulycia sp.		
GEOMETRIDAE	Eulycia grisea grisea	NT	
GEOMETRIDAE	Eupithecia sp.		
GEOMETRIDAE	Isturgia catalaunaria		
GEOMETRIDAE	Isturgia deerraria	NT	
GEOMETRIDAE	Prasinocyma sp.		
GEOMETRIDAE	Rhodometra participata	NT	
GEOMETRIDAE	Rhodometra sacraria	NT	
GEOMETRIDAE	Scopula sp.		
HESPERIIDAE	Alenia sandaster	LC	Sch 2 PS
HESPERIIDAE	Borbo fatuellus fatuellus	LC	Sch 2 PS
HESPERIIDAE	Coeliades pisistratus	LC	Sch 2 PS
HESPERIIDAE	Gomalia elma elma	LC	Sch 2 PS
HESPERIIDAE	Sarangesa phidyle	LC	Sch 2 PS
HESPERIIDAE	Spialia agylla agylla	LC	Sch 2 PS
HESPERIIDAE	Spialia ferax	LC	Sch 2 PS
HESPERIIDAE	Spialia nanus	LC	Sch 2 PS
HESPERIIDAE	Spialia sataspes	LC	Sch 2 PS
HESPERIIDAE	Spialia spio	LC	Sch 2 PS
HESPERIIDAE	Tagiades flesus	LC	Sch 2 PS
LASIOCAMPIDAE	Streblote sp.		
LYCAENIDAE	Aloeides caledoni	LC	Sch 2 PS
LYCAENIDAE	Aloeides damarensis damarensis	LC	Sch 2 PS
LYCAENIDAE	Aloeides depicta	LC	Sch 2 PS
LYCAENIDAE	Aloeides kaplani	LC	Sch 2 PS
LYCAENIDAE	Aloeides macmasteri	LC	Sch 2 PS
LYCAENIDAE	Aloeides pallida pallida	LC	Sch 2 PS
LYCAENIDAE	Aloeides pierus	LC	Sch 2 PS
LYCAENIDAE	Aloeides vansoni	LC	Sch 2 PS
LYCAENIDAE	Anthene amarah amarah	LC	Sch 2 PS
LYCAENIDAE	Argyraspodes argyraspis	LC	Sch 2 PS
LYCAENIDAE	Azanus jesous	LC	Sch 2 PS
LYCAENIDAE	Azanus moriqua	LC	Sch 2 PS
LYCAENIDAE	Azanus ubaldus	LC	Sch 2 PS
LYCAENIDAE	Brephidium metophis	LC	Sch 2 PS
LYCAENIDAE	Cacyreus fracta fracta	LC	Sch 2 PS
LYCAENIDAE	Cacyreus marshalli	LC	Sch 2 PS

LYCAENIDAE	Chilades trochylus	LC	Sch 2 PS
LYCAENIDAE	Chrysoritis beaufortia beaufortia	LC	Sch 2 PS
LYCAENIDAE	Chrysoritis chrysantas	LC	Sch 2 PS
LYCAENIDAE	Chrysoritis chrysaor	LC	Sch 2 PS
LYCAENIDAE	Chrysoritis midas	LC	Sch 2 PS
LYCAENIDAE	Chrysoritis pan lysander	LC	Sch 2 PS
LYCAENIDAE	Crudaria leroma	LC	Sch 2 PS
LYCAENIDAE	Cupidopsis jobates jobates	LC	Sch 2 PS
LYCAENIDAE	Deudorix antalus	LC	Sch 2 PS
LYCAENIDAE	Eicochrysops messapus messapus	LC	Sch 2 PS
LYCAENIDAE	Harpendyreus notoba	LC	Sch 2 PS
LYCAENIDAE	Hypolycaena philippus philippus	LC	Sch 2 PS
LYCAENIDAE	Lampides boeticus	LC	Sch 2 PS
LYCAENIDAE	Leptomyrina lara	LC	Sch 2 PS
LYCAENIDAE	Leptotes pirithous pirithous	LC	Sch 2 PS
LYCAENIDAE	Lycaena clarki	LC	Sch 2 PS
LYCAENIDAE	Oraidium barberae	LC	Sch 2 PS
LYCAENIDAE	Stugeta bowkeri bowkeri	LC	Sch 2 PS
LYCAENIDAE	Thestor protumnus aridus	LC	Sch 2 PS
LYCAENIDAE	Trimenia macmasteri macmasteri	LC	Sch 2 PS
LYCAENIDAE	Trimenia wykehami	LC	Sch 2 PS
LYCAENIDAE	Tuxentius melaena melaena	LC	Sch 2 PS
LYCAENIDAE	Tylopaedia sardonyx sardonyx	LC	Sch 2 PS
LYCAENIDAE	Zizeeria knysna knysna	LC	Sch 2 PS
LYCAENIDAE	Zizula hylax	LC	Sch 2 PS
NOCTUIDAE	Helicoverpa armigera armigera	Not listed	
NOCTUIDAE	Heliothis scutuligera	Not listed	
NOCTUIDAE	Ozarba hemiochra hemiochra	Not listed	
NOCTUIDAE	Proschaliphora albida	Not listed	
NOCTUIDAE	Proschaliphora butti	Not listed	
NOCTUIDAE	Pseudozarba opella	Not listed	
NYMPHALIDAE	Acraea horta	LC	Sch 2 PS
NYMPHALIDAE	Acraea natalica	LC	Sch 2 PS
NYMPHALIDAE	Acraea neobule neobule	LC	Sch 2 PS
NYMPHALIDAE	Acraea trimeni	LC	Sch 2 PS
NYMPHALIDAE	Bicyclus anynana anynana	LC	Sch 2 PS
NYMPHALIDAE	Byblia ilithyia	LC	Sch 2 PS
NYMPHALIDAE	Cassionympha detecta	LC	Sch 2 PS
NYMPHALIDAE	Charaxes zoolina	LC	Sch 2 PS
NYMPHALIDAE	Coenyropsis bera		Sch 2 PS
NYMPHALIDAE	Danaus chrysippus orientis	LC	Sch 2 PS
NYMPHALIDAE	Hypolimnas anthedon wahlbergi	LC	Sch 2 PS
NYMPHALIDAE	Hypolimnas misippus	LC	Sch 2 PS
NYMPHALIDAE	Junonia hierta cebrene	LC	Sch 2 PS
NYMPHALIDAE	Junonia oenone oenone	LC	Sch 2 PS
NYMPHALIDAE	Melampias huebneri huebneri	LC	Sch 2 PS
NYMPHALIDAE	Melanitis leda	LC	Sch 2 PS
NYMPHALIDAE	Protogoniomorpha parhassus	LC	Sch 2 PS
NYMPHALIDAE	Pseudonympha southeyi wykehami	LC	Sch 2 PS
NYMPHALIDAE	Pseudonympha trimenii nieuwveldensis	LC	Sch 2 PS
NYMPHALIDAE	Sevenia boisduvali boisduvali	LC	Sch 2 PS
NYMPHALIDAE	Sevenia natalensis	LC	Sch 2 PS
NYMPHALIDAE	Stygionympha irrorata	LC	Sch 2 PS
NYMPHALIDAE	Stygionympha robertsoni	LC	Sch 2 PS
NYMPHALIDAE	Tarsocera fulvina	LC	Sch 2 PS
NYMPHALIDAE	Telchinia serena	LC	Sch 2 PS
NYMPHALIDAE	Torynesis magna	LC	Sch 2 PS
NYMPHALIDAE	Vanessa cardui	LC	Sch 2 PS
NYMPHALIDAE	Ypthima asterope hereroica	LC	Sch 2 PS
PAPILIONIDAE	Papilio dardanus cenea	LC	
PAPILIONIDAE	Papilio demodocus demodocus	LC	
PIERIDAE	Belenois aurota	LC	
PIERIDAE	Belenois creona severina	LC	
PIERIDAE	Catopsilia florella	LC	
PIERIDAE	Colias electo electo	LC	
PIERIDAE	Colotis antevippe gavisa	LC	
PIERIDAE	Colotis auxo auxo	LC	
PIERIDAE	Colotis euippe omphale	LC	
PIERIDAE	Colotis evenina evenina	LC	
PIERIDAE	Eurema brigitta brigitta	LC	
PIERIDAE	Pinacopteryx eriphia eriphia	LC	

PIERIDAE	Pontia helice helice	LC	
PIERIDAE	Teracolus subfasciatus	LC	
PYRALIDAE	Hypotia bolinalis	Not listed	
SATURNIIDAE	Heniocha apollonia	Not listed	Sch 2 PS
SPHINGIDAE	Agrius convolvuli		
SPHINGIDAE	Hyles livornica	Not listed	
SPHINGIDAE	Nephele comma	Not listed	

10. Odonata

Family	Scientific name	Common name	Red list
Aeshnidae	*Anax ephippiger*	Vagrant Emperor	LC
Aeshnidae	*Anax imperator*	Blue Emperor	LC
Aeshnidae	*Zosteraeschna minuscula*	Friendly Hawker	LC
Coenagrionidae	*Africallagma glaucum*	Swamp Bluet	LC
Coenagrionidae	*Ischnura senegalensis*	Tropical Bluetail	LC
Coenagrionidae	*Pseudagrion citricola*	Yellow-faced Sprite	LC
Libellulidae	*Crocothemis erythraea*	Broad Scarlet	LC
Libellulidae	*Orthetrum caffrum*	Two-striped Skimmer	LC
Libellulidae	*Orthetrum chrysostigma*	Epaulet Skimmer	LC
Libellulidae	*Orthetrum trinacria*	Long Skimmer	LC
Libellulidae	*Pantala flavescens*	Wandering Glider	LC
Libellulidae	*Rhyothemis semihyalina*	Phantom Flutterer	LC
Libellulidae	*Sympetrum fonscolombii*	Red-veined Darter or Nomad	LC
Libellulidae	*Tholymis tillarga*	Twister	LC
Libellulidae	*Tramea limbata*	Ferruginous Glider	LC
Libellulidae	*Trithemis arteriosa*	Red-veined Dropwing	LC
Libellulidae	*Trithemis dorsalis*	Highland Dropwing	LC
Libellulidae	*Trithemis kirbyi*	Orange-winged Dropwing	LC
Libellulidae	*Urothemis assignata*	Red Basker	LC
Libellulidae	*Zygonyx torridus*	Ringed Cascader	LC
Macromiidae	*Phyllomacromia picta*	Darting Cruiser	LC
Synlestidae	*Chlorolestes fasciatus*	Mountain Malachite	LC

APPENDIX C
Table of species encountered per habitat

NKu1 = Western Upper Karoo; NKu2 = Upper Karoo Hardeveld; NKu3 = Northern Upper Karoo; NKu4 = Eastern Upper Karoo; NKl1 = Gamka Karoo
B = Bottomlands; FS = footslopes; H = low hills; MS = midslope; M = mountain; P = plain; Pl = plateau; V = valley
c = species common; d = species dominant; x = species present

Species	NKu 1	NKu 1	NKu 1	NKu 3	NKu 4	NKu 4	NKu 4	NKu 4	NKu 2	NKu 2	NKu 2	NKu 2	NKu 2	NKu 2	NKu 2	NKl 1	NKl 1	NKl 1
	Fs	**H**	**P**	**P**	**B**	**Fs**	**H**	**P**	**Fs**	**H**	**M**	**MS**	**Pl**	**P**	**V**	**Fs**	**H**	**P**
Asparagus tuberosus	x																	
Cotula sp. 1			x															
Galenia meziana			x															
Sporobolus ioclados			x															
Gonialoe variegata	x		x					c										
Calobota spinescens				c														
Trifolium sp.					x													
Aloe claviflora						x												
Eragrostis annularis						x												
Tetraena lichtensteiniana						x												
Anacampseros ustulata							x											
Asparagus sp.							x											
Atriplex semibaccata							x											
Chascanum pinnatifidum							x											
Clutia thunbergii							x											
Eriospermum sp.							x											
Ifloga sp.							x											
Oropetium capense							x											
Osteospermum sinuatum							x											
Polygala leptophylla							x											
Schlechteranthus spinescens							x											
Stapelia grandiflora							x											
Tetragonia sp.							x											
Zaluzianskya venusta							x											
Afroscirpoides dioeca								x										
Anchusa riparia								x										
Mesembryanthemum noctiflorum								x										
Aristaloe aristata								x										
Asparagus exuvialis								x										
Cephalophyllum sp.								x										
Chrysocoma sp.								x										
Cotula sp. 2								x										
Crassula subaphylla								x										
Crassula vaillantii								x										
Eragrostis rotifer								x										
Eucalyptus sp.								x										
Euphorbia clavarioides								x										
Gazania rigida								x										
Gazania tenuifolia								x										
Hereroa sp.								x										
Helichrysum cf. *asperum*								x										
Helichrysum pentzioides								x										
Helichrysum sp. 1								x										
Hermannia spinosa								x										
Hesperantha cf. *cucullata*								x										
Indigastrum argyraea								x										
Lasiosiphon microcephalus								x										
Malva pusilla								x										
Pelargonium aridum								x										
Plantago lanceolata								x										
Pteronia sp.								x										
Selago saxatilis								x										
Senecio asperulus								x										
Tetraena chrysopteron								x										
Atriplex vestita					x			c										
Berkheya carlinifolia					x			c										
Eragrostis bergiana					x			c										
Heliophila crithmifolia							x	x										
Crassula corallina							x	x										
Crassula deltoidea							x	x										
Dianthus micropetalus							c	c										
Felicia hirsuta							x	x										
Ornithogalum sp.							x	x										
Pelargonium minimum							x	x										
Radyera urens							x	x										
Oedera glandulosa							x	x										
Oedera spinescens						x		x										
Lasiopogon muscoides						x	x											

Ruschia cradockensis					x		c	c										
Mesembryanthemum articulatum					x			c										
Pteronia erythrochaeta					x			x										
Schmidtia kalahariense					x			x										
Amphiglossa triflora							x	x										x
Jamesbrittenia tysonii							x	c		x								
Dicoma capensis							x	x										x
Boophone disticha							x	c			x							
Opuntia ficus-indica							x	x			x							
Peliostomum virgatum							x	x									x	
Bromus pectinatus					x			c						x				
Wahlenbergia nodosa							x	x				x						
Crassula muscosa							c	c	x									x
Osteospermum spinescens			x				d	d										
Osteospermum leptolobum			x				x	x										
Eragrostis bicolor			x		x			c										x
Euryops oligoglossus		x					x	c						x				
Helichrysum pumilio							c	x						x			x	
Indigofera meyeriana	x		x		c			c										
Ruschia intricata		x	x				d	d										
Sarcocaulon cf. *salmoniflorum*							c	c									x	x
Senecio niveus				x	c		c	c										
Euphorbia mauritanica						x	x	x	x									
Oedera humilis			c		d		c	c										
Trichodiadema sp.					x	x	x	c										
Stipagrostis ciliata				c	c		x	c									x	c
Stipagrostis obtusa				c	c	c	c	d										d
Stomatium sp.		x					x	x						x				
Tragus koelerioides			x			x	x	c										
Pteronia staehelinoides	x					c	d	d										
Albuca sp. 1			x				x	x										
Mesembryanthemum crystallinum	x		x		x	x	c	c						x				
Mesembryanthemum geniculiflorum	x		x			x	x	c	c					x				
Mesembryanthemum grossum		x	x			x	x	c										
Lessertia inflata			x	x	x	x	x	c										
Pentzia spinescens			d		x	x	c	d						c				
Ruschia spinosa			x			x	c	c	x								d	
Stachys cuneata					x	x	x	c	x		x							
Salsola spp.					x	x	c	c										x
Selago sp.				x	x		x	x				x						
Salvia verbenaca			x	x	c	x	c	c			x							
Babiana hypogaea									x									
Drimia sp.									x									
Pteronia membranacea									x									
Amphiglossa sp.											x							
Ballota africana											x							
Carissa bispinosa											x							
Clematis brachiata											x							
Cussonia paniculata											x							
Cymbopogon prolixus											x							
Eragrostis curvula											x							
Hermannia filifolia											x							
Heteromorpha arborea											x							
Pelargonium cf. *abrotanifolium*											x							
Pseudoschoenus inanus											x							
Salix capense											x							
Adromischus sp.												x						
Aizoon rigidum												x						
Asparagus laricinus												x						
Babiana sp.												x						
Chascanum garipense												x						
Crassula rupestris												x						
Delosperma sp.												x						
Enneapogon scoparius												x						
Euclea crispa												x						
Gladiolus permeabilis							x					x						
Helichrysum zeyheri								x				x						
Hermannia pulchella												x						
Kiggelaria africana												x						
Lasiopogon micropoides												x						
Lobostemon stachydeus												x						
Nenax microphylla												x						
Pachypodium succulentum												x						
Pellaea calomelanos												x						
Pentameris setifolia												x						
Senecio inaequidens												x						
Tetraena cf. microcarpa												x						
Crassula sp. 1													x					
Hermannia sp.													x					
Osteospermum sp.													x					
Dipcadi cf. *ciliare*														x				
Euphorbia inaequilatera														x				
Huernia barbata														x				
Crassothonna sp.														x				
Tetragonia spicata															x			
Ehretia rigida											x	x						
Hibiscus pusillus											x	x						
Menodora juncea											x	x						

Carissa haematocarpa											x	d						
Cheilanthus eckloniana											x	x						
Lotononis sp.											x	x						
Cissampelos capensis											x	x						
Buddleja salviifolia											x	x						
Crassula ericoides												x	x					
Mesembryanthemum cf. *granulicaule*											x		x					
Tarchonanthus minor											c	c						
Artemisia afra											x	x	x					
Gymnosporia szyszylowiczii											x	d	d					
Themeda triandra											x	c	x					
Ophioglossum sp.												x		x				
Euryops imbricatus									x			x						
Buddleja glomerata											c				x			
Asparagus retrofractus									x		c			x	d	c		
Searsia burchellii									x		d	x	c		x	c		
Vachellia karroo									x		c	c	c		d	d		x
Forsskaolea candida											x	x					x	
Grewia robusta											x	d	x			d		
Euryops abrotanifolius												x			x			x
Nemesia cf. cynanchifolia								x			x	x						
Berkheya spinosa								x			x	x						
Asparagus capensis							x				c	x	c					
Cotyledon orbiculata								c			x	c	c					
Crassula tetragona								x				x	x					
Helichrysum lucilioides								x				c	x					
Moraea sp.								x			x		x					
Dimorphotheca cuneata	x						x				x		x					
Pentameris airoides								c					x	x				
Lycium oxycarpum							x		x						c			
Arctotheca calendula								x				x	x		x			
Hermannia comosa								x		x	c				x			
Drosanthemum lique								x			x	x		x				
Eriocephalus brevifolius								d				x	x	c				
Merxmuellera disticha								c			c	x	c					
Pegolettia retrofracta							x				x	x	x					
Pentzia quinquefida							x				c	c			x			
Stachys linearis							x				c	c	x					
Phymaspermum parvifolium								x			x	x	x					
Aloe broomii							x		x		x	x	x					
Polygala ephedroides								x			x			x				
Digitaria eriantha						x			x	x	d	d	d	x				
Cadaba aphylla								x			x	x	x	x				
Crassula sp. 2								x			x	x	x	x				
Euryops sp.							x	c			x	x	x					
Melianthus comosus							x		x		d	x			d			
Hermannia coccocarpa							x	c		x		x		c				
Lepidium sp.						x	x	x			x					x		
Leysera tenella							x	c				x		x				x
Aristida diffusa						x	d	d	d		d	d	c	x				
Euryops lateriflorus							x	d	x		c		x	x				
Dicerothamnus rhinocerotis							x	d	x		c	c	c	x				
Hermannia vestita						x	x	x			c	c	x		x			
Cynodon incompletus	x				x			x	x				x					
Erodium cicutarium			x		c			c					x	x				
Melolobium canescens			x					x	x		x			x				
Moraea miniata			x				c	c	x	x	x			x				
Pteronia glomerata			x					c	x	x				x				
Septulina glauca	x		x				x	c						x				
Galenia namaensis	c		c	x	c	x	c	c	c					c				
Gazania krebsiana	x	x	c		x	c	c	c	x	x								
Oedera oppositifolia	d		d		x		d	d	v	x	x			d				
Pteronia sordida	d	x	d		c	x	d	d	c			x		x				
Asparagus suaveolens			x		d	d	d	d	x	x	x	x	x	x	x			
Chrysocoma ciliata	x	x	x		c	d	c	d	x	x	x	x	x	c				
Melolobium microphyllum	x		x		x	x	x	x	x		x	x	c	x				
Eragrostis obtusa	c	x	d		c		d	c	x			x	c	c				
Diospyros austro-africana			c				x	c	x		d	d	c	x				
Eriocephalus decussata	c		c	d	c	x		d	c					x				
Eriocephalus spinescens		c	c	d	d		c	d	c					x				
Lessertia frutescens	x	x	c			x		c			x	c			x			
Pteronia glauca		c	c	x		x	c	c	x									
Drosanthemum karrooense		c	x		x	x	c	c	c									
Tragus berteronianus			x		x		c	c				x						
Ursinia nana		x	x				x	c				x						
Felicia filifolia		x	x				x	x			c	c	d					
Ehrharta calycina		x	x				x	c					x	x				
Hermannia cuneifolia			x				c	d			x	x		x				
Melolobium candicans			x				x	x	x			x		x				
Aptosimum procumbens			x				x	x	x			x	x		x			
Stipagrostis namaquensis		x		x	x	x		c			x			x				
Conyza sp.																x		
Panicum sp.																x		
Solanum burchellii																x		
Anacampseros cf. *lanceolata*																	x	
Astroloba foliolosa																	x	
Digitaria argyrograpta																	x	
Euryops multifidus																	x	

Hermannia alnifolia																	x	
Blepharis sp. 1																		x
Chascanum pumilum																		x
Crassula cf. *subaphylla*																		x
Eragrostis echinochloidea																		x
Euphorbia cf. *decepta*																		x
Gazania lichtensteinii																		c
Kleinia longiflora																		x
Monechma sp.																		x
Prosopis glandulosa																		x
Stipagrostis uniplumis																		x
Urochloa cf. panicoides																		x
Blepharis mitrata																	x	x
Sericocoma avolans																	c	c
Trichodesma africanum																	x	x
Monechma incanum											x						x	x
Pennisetum setaceum												x				c		x
Arctotis leiocarpa				x				c								x	x	c
Cenchrus ciliaris												x			x	x	x	x
Rhigozum obovatum									x			d	c			d	c	c
Heteropogon contortus											c	c	c				c	c
Hyparrrhenia hirta											x	x					x	x
Lacomucinaea lineata							x			x	x	c	x	x	x		x	d
Aristida congesta					x		x	c				x	x				x	x
Hermannia desertorum						c	x	d			x	x		c			x	
Limeum aethiopicum							c	c			x	c	x				x	x
Searsia lancea								d	x		x	x	x		d	d		
Trichodiadema setuliferum						x	x	x				x		x			x	x
Osteospermum scariosum							x	c	x		x	x	x	x		x	c	c
Hermannia grandiflora						c	d	c	x			x						x
Salsola kali					c		c	c	x		x	x		x		x		x
Aristida adscensionis	x		x		x	x	x	x	x	x		x		x		x	x	x
Eriocephalus ericoides	d	d	d		d	c	d	d	d	x	c	x	x	d			x	
Felicia muricata	x		c		c	c	c	d	c		x	c	x	x	x		c	c
Pentzia incana	d	x	x		d	c	d	d	c	x	x	c	c	c		c		
Sporobolus fimbriatus	d	d	d		c		x	d	d	x	d	d	d	d	x			d
Lycium cinereum	d	d	d	x	d	c	d	d	d	x	d	d	x	d	x			d
Euphorbia cf. *caterviflora*			x				c	c			x	x	x	x	x	x		c
Aptosimum indivisum	x				x	x	x	x	x	x		x		x			x	x
Enneapogon desvauxii		x	x		d	d	d	d					x	x		c	c	c
Mesembryanthemum coriarium			c	c	c	x	c	c	x				x	c			d	c
Fingerhuthia africana	x			x	d	c	d	d				d	c		x	c	x	c
Drosanthemum hispidum		c	d		c	x	c	d				c		c			d	
Eragrostis lehmanniana	c		c	c	c		d	d			x	x			x			c
Argemone ochroleuca			x	x	x			c								x		c
Chloris virgata			c		x			c					x			x		x
Enneapogon scaber		c				x	c	x									c	x
Galenia cf. *papulosa*			x				x	c			x				x		x	
Lycium horridum			x		c	x		c						x				c
Mesembryanthemum tetragonum		x	x		c		x	c										x
Pentzia globosa			x		d		x	c				x					d	c
Albuca sp. 2			x							x								
Anacampseros albidiflora												x					x	
Anthospermum sp.		x									x							
Bulbine abyssinica							x						x					
Convolvulus sagitatus								x								x		
Curio radicans								c									x	
Deverra denudata								x	x									
Diospyros lycioides															c	x		
Lycium schizocalyx			x					c										
Geigeria filifolia								x										x
Gethyllis sp.			x				x											
Gomphocarpus fruticosus								x				x						
Lachenalia sp.	x						x											
Lasiosiphon polycephala				x			x											
Monechma spartioides												x				x		
Pentzia lanata								x									x	
Crassula sp. 3								x	x									
Ruschia sp.						x		x				x						
Mesembryanthemum emarcidum							x					c						
Schismus barbatus			x					x										
Suaeda fruticosa								x						x				
Tetragonia acanthocarpa						x					x							
Tetragonia sarcophylla								x						x				
Tragus racemosus														x		x		
Viscum rotundifolium												x				x		
Zaluzianskya pedunculata								x						x				
Amaranthus sp.					x										x	x		
Thesium sp.			x			x								x				
Asparagus striatus							x					x						x
Aptosimum spinescens								x				x						x

APPENDIX D
SITE SENSITIVITY VERIFICATION

Prior to commencing with the Terrestrial Biodiversity Specialist Assessment in accordance with the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Biodiversity (Government Notice 320, dated 20 March 2020), a site sensitivity verification was undertaken in order to confirm the current land use and environmental sensitivity of the proposed project area as identified by the National Web-Based Environmental Screening Tool (Screening Tool).

The details of the site sensitivity verification are noted below:

Date of site visit	29 September 2020 to 2 October 2020
Specialist name	N. van Rooyen; M.W van Rooyen
Professional registration number	401430/83 Botanical Science (NvR); 400509/14 Ecological Science (MvR)
Specialist affiliation / company	Ekotrust cc

The site sensitivity verification was undertaken using the following means:

- desk top analysis using satellite imagery;
- consulting geological, land type, vegetation type maps of the region;
- consulting provincial datasets on the latest versions of the mapping of CBAs, ESAs, ONAs, NPAES and PAs;
- liasing with SANBI on the identify of the plant species referred to by number;
- checking distribution ranges of IUCN red listed species and species highlighted by the screening tool;
- compiling plant and animal species checklist for the region; and
- preliminary on-site inspection.

To verify the site sensitivity of the screening tool along the 181 km route, Google satellite images were studied beforehand and the route stratified into relatively homogenous physiographic-physionomic units or habitats. The first level of stratification was the six vegetation types of the region and within each of them the different habitat types represented the second level of stratification. Sites were then selected along the route to represent these habitats. During the field survey, 157 sites were surveyed along the route. This gave an average of one survey site every 1.2 km.

Animal Theme

Screening tool: The screening tool rated the sensitivity of the Animal Species Theme as **High.**
Site verification:

Mammals:

- Our background study concurred with the presence of the riverine rabbit (Collins *et al*. 2016) and the mountain reedbuck (Taylor *et al.* 2016) in the region. The presence of the riverine rabbit was furthermore confirmed by one of the landowners (Mr Johan Moolman) of the farm Dunedin and the notice board of the Endangered Wildlife Trust at Slangfontein. Although it is unlikely that the elusive riverine rabbit will be encountered by the construction teams, special mitigation measures need to be applied to ensure minimum impact on the riverine rabbit population.
- The background study also listed the presence of the black-footed cat in the region.
- The screening tool listed the mountain reedbuck for the area. It is however, believed that the mountain reedbuck was introduced in the Karoo National Park and is unlikely to be encountered free-roaming in the

road reserve. This will also be the case for the other red listed species introduced in the region (see Appendix B).

Reptiles:

- Our background study confirmed the presence of the Karoo dwarf tortoise.

Birds:

- The presence of two red listed bird species was singled out by the screening tool although our background study revealed the presence of 10 red listed species.
- Additionally, Ludwig's bustard was sighted during the site survey.

Plant Theme

Screening tool: The screening tool rated the sensitivity of the Plant Species Theme as **Medium.**
Site verification:

- Our background study corresponded with the screening tool on the possible presence of *Cliffortia arborea* along the route, however sensitive species 704 was not listed for the region on the NewPosa database. Neither of these species were encountered during the site visit. *Cliffortia arborea* is a conspicuous species in the high mountains and would have been spotted easily if it had been present. Sensitive species 704, on the other hand, is a small, cryptic species, preferring quartz patches. Along the fibre-optic cable route quartz patches were not noted and thus it can be assumed that the species would not occur along the route.
- Two other red listed species were listed on the NewPosa database for the region. However, these species seem to be beyond their known distribution range and could thus either be wrong identifications or specimens grown in collections.
- Based solely on the presence of red listed species which were not found along the route, we would suggest to downgrade the rating of the Plant Species Theme to Low. However, many provincially protected/specially protected and CITES II listed species were recorded which could imply a Medium rating.

Relative Terrestrial Biodiversity Theme

Screening tool: The screening tool rated the sensitivity of the Relative Terrestrial Biodiversity theme as **Very High**.
Site verification:

- This theme considers the presence of protected areas, National Protected Area Expansion Strategy (NPAES), CBA, ESA and National Freshwater Ecosystem Priority Area (NFEPA). Our background study concurred with the findings of the screening tool on the presence of these features.
- However, since the development will take place in the road reserve it will have no impact on existing protected areas (Karoo National Park and Dr Appie van Heerden Nature Reserve) and it will also not affect the NPAES. These features are thus irrelevant when considering the construction of the fibre-optic cable between Beaufort West and Carnarvon.
- Furthermore, the classification of the road reserve as CBA is questionable from a vegetation standpoint, although it might still be marginal riverine rabbit habitat (however, this species did not appear listed under the reasons for the CBA in the Western Cape).
    - The definition of a CBA1 is: 'Areas that are irreplaceable for meeting biodiversity targets. There are no other options for conserving the ecosystems, species or ecological processes in these areas' (SANBI 2018b). **The road reserve by no means complies with these conditions.**
    - The definition of a CBA2 is: 'Areas that are the best option for meeting biodiversity targets, in the smallest area, while avoiding conflict with other land uses'. **Road reserves are not the best option to meet biodiversity targets.**

- In the Western Cape NFEPA was considered in delineating CBAs, however in the Northern Cape a relative long stretch between Loxton and Carnarvon was identified as a NFEPA that was not incorporated into the delineation of the CBAs.

Outcome of the site sensitivity verification:

- We confirm the Animal Theme's site sensitivity as being High.
- Based solely on the presence of red listed species (highlighted by the screening tool), which were not found along the route, we would suggest to downgrade the rating of the Plant Species Theme to Low. However, many provincially protected/specially protected and CITES II listed species were recorded which could imply a Medium rating.
- We dispute the site sensitivity of the Relative Terrestrial Biodiversity **in the road reserve** as being Very high and suggest a downscaling to Low.

Figure Appendix D: (a) A road cutting along the optic-fibre route indicating the remnants of road building activities; (b) Water run-off may increase plant cover and change the vegetation composition in the road reserve; (c) & (d) changed species composition in the road reserve as a result of road building and road maintenance activities.

APPENDIX E COMPLIANCE WITH THE TERRESTRIAL BIODIVERSITY PROTOCOL (GN 320, 20 MARCH 2020)

Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Biodiversity	*Section where this has been addressed in the Specialist Report*
The assessment must provide a baseline description of the site which includes, as a minimum, the following aspects: *2.3.1. a description of the ecological drivers or processes of the system and how the proposed development will impact these;*	*Chapter 4 (pp. 8-16);* *Section 8.5, p. 65*
2.3.2. ecological functioning and ecological processes (e.g. fire, migration, pollination, etc.) that operate within the preferred site;	*Section 8.5, p. 65*
2.3.3. the ecological corridors that the proposed development would impede including migration and movement of flora and fauna;	*Section 8.5, p. 65*
2.3.4. the description of any significant terrestrial landscape features (including rare or important flora- faunal associations, presence of strategic water source areas (SWSAs) or freshwater ecosystem priority area (FEPA) sub catchments;	*Sections 8.5 to 8.8 (pp. 45 – 46)*
2.3.5. a description of terrestrial biodiversity and ecosystems on the preferred site, including: *a) main vegetation types;* *b) threatened ecosystems, including listed ecosystems as well as locally important habitat types identified;* *c) ecological connectivity, habitat fragmentation, ecological processes and fine-scale habitats; and* *d) species, distribution, important habitats (e.g. feeding grounds, nesting sites, etc.) and movement patterns identified;*	*(a) Chapter 4 (pp. 17 – 22)* *(b) Chapter 4 (pp. 17 – 22; 22 – 34)* *(c) Chapter 4 (pp. 22 – 34; 65)* *(d) Chapter 7 (pp. 38 – 41); Appendix A & B*
2.3.6. the assessment must identify any alternative development footprints within the preferred site which would be of a "low" sensitivity as identified by the screening tool and verified through the site sensitivity verification; and	*Alternative assessed by CSIR (2020) and found to have a higher impact than current choice.*
2.3.7. the assessment must be based on the results of a site inspection undertaken on the preferred site and must identify: *2.3.7.1. terrestrial critical biodiversity areas (CBAs), including:* *a) the reasons why an area has been identified as a CBA;* *b) an indication of whether or not the proposed development is consistent with maintaining the CBA in a natural or near natural state or in achieving the goal of rehabilitation;* *c) the impact on species composition and structure of vegetation with an indication of the extent of clearing activities in proportion to the remaining extent of the ecosystem type(s);* *d) the impact on ecosystem threat status;* *e) the impact on explicit subtypes in the vegetation;* *f) the impact on overall species and ecosystem diversity of the site; and* *g) the impact on any changes to threat status of populations of species of conservation concern in the CBA;*	*(a) Chapter 8 (pp. 43 – 45)* *(b) Chapter 8 (pp. 43 – 45)* *(c) Chapter 8 (pp. 43 – 45)* *(d) Chapter 14 (p. 85)* *(e) Chapter 4 (pp. 22 – 34)* *(f) Chapter 14 (p. 85)* *(g) Chapter 14 (p. 85)*
2.3.7.2. terrestrial ecological support areas (ESAs), including: *a) the impact on the ecological processes that operate within or across the site;* *b) the extent the proposed development will impact on the functionality of the ESA; and* *c) loss of ecological connectivity (on site, and in relation to the broader landscape) due to the degradation and severing of ecological corridors or introducing barriers that impede migration and movement of flora and fauna;*	*(a) Chapter 8 (pp. 44 – 45)* *(b) Chapter 8 (p. 45)* *(c) Chapter 8 (p. 45)*
2.3.7.3. protected areas as defined by the National Environmental Management: Protected Areas Act, 2004 including- *a) an opinion on whether the proposed development aligns with the objectives or purpose of the protected area and the zoning as per the protected area management plan;*	*Chapter 8 (p. 43)*
2.3.7.4. priority areas for protected area expansion, including- *a) the way in which in which the proposed development will compromise or contribute to the expansion of the protected area network;*	*Chapter 8 (p. 43)*

Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Biodiversity	***Section where this has been addressed in the Specialist Report***
2.3.7.5. SWSAs including: a) the impact(s) on the terrestrial habitat of a SWSA; and b) the impacts of the proposed development on the SWSA water quality and quantity (e.g. describing potential increased runoff leading to increased sediment load in water courses);	*n.a. – no SWSAs present*
2.3.7.6. FEPA subcatchments, including- a) the impacts of the proposed development on habitat condition and species in the FEPA sub catchment;	*Chapter 5 (pp. 22 – 34); Chapter 8 (p. 46)*
2.3.7.7. indigenous forests, including: a) impact on the ecological integrity of the forest; and b) percentage of natural or near natural indigenous forest area lost and a statement on the implications in relation to the remaining areas.	*n.a. – no indigenous forest present*
3.1. The Terrestrial Biodiversity Specialist Assessment Report must contain, as a minimum, the following information:	
3.1.1. contact details of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae;	*p. xvi; Appendix F*
3.1.2. a signed statement of independence by the specialist;	*p. xv*
3.1.3. a statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	*p. xviii*
3.1.4. a description of the methodology used to undertake the site verification and impact assessment and site inspection, including equipment and modelling used, where relevant;	*Chapter 2 (pp. 3 – 4)*
3.1.5. a description of the assumptions made and any uncertainties or gaps in knowledge or data as well as a statement of the timing and intensity of site inspection observations;	*p. xviii*
3.1.6. a location of the areas not suitable for development, which are to be avoided during construction and operation (where relevant);	*Depicted in Section 9.3; Sensitivity.kmz file*
3.1.7. additional environmental impacts expected from the proposed development;	*n.a.*
3.1.8. any direct, indirect and cumulative impacts of the proposed development;	*Chapter 10 & 11 (pp. 60 – 77)*
3.1.9. the degree to which impacts and risks can be mitigated;	*Chapter 11 (pp. 62 – 77)*
3.1.10. the degree to which the impacts and risks can be reversed;	*Chapter 11 (pp. 62 – 77)*
3.1.11. the degree to which the impacts and risks can cause loss of irreplaceable resources;	*Chapter 11 (pp. 62 – 77)*
3.1.12. proposed impact management actions and impact management outcomes proposed by the specialist for inclusion in the Environmental Management Programme (EMPr);	*Chapter 13 (pp. 82 – 83)*
3.1.13. a motivation must be provided if there were development footprints identified as per paragraph 2.3.6 above that were identified as having a "low" terrestrial biodiversity sensitivity and that were not considered appropriate;	*n.a.*
3.1.14. a substantiated statement, based on the findings of the specialist assessment, regarding the acceptability, or not, of the proposed development, if it should receive approval or not; and	*Chapter 14; (pp. 84 – 85)*
3.1.15. any conditions to which this statement is subjected.	*Chapter 14; (pp. 84 – 85)*
3.2. The findings of the Terrestrial Biodiversity Specialist Assessment must be incorporated into the Basic Assessment Report or the Environmental Impact Assessment Report including the mitigation and monitoring measures as identified, which must be incorporated into the EMPr, where relevant.	*For EAP to incorporate*
3.2.1. A signed copy of the assessment must be appended to the Basic Assessment Report or Environmental Impact Assessment Report.	*For EAP to append*

APPENDIX F

Curriculum vitae: DR NOEL VAN ROOYEN

1. Biographical information

Surname	**Van Rooyen**
First names	**Noel**
ID number	**501225 5034 084**
Citizenship	**South African**
Business address	**Ekotrust CC** **7 St George Street** **Lionviham 7130** **Somerset West** **South Africa**
Mobile	**082 882 0886**
e-mail	**noel@ekotrust.co.za**
Current position	**Member of Ekotrust cc**
Professional registration	**Botanical Scientist : Pr.Sci.Nat; Reg no. 401430/83**

Academic qualifications include BSc (Agric), BSc (Honours), MSc (1978) and DSc degrees (1984) in Plant Ecology at the University of Pretoria, South Africa. Until 1999 I was Professor in Plant Ecology at the University of Pretoria and at present I am a member of Ekotrust cc.

2. Publications

I am the author/co-author of 128 peer reviewed research publications in national and international scientific journals and was supervisor or co-supervisor of 9 PhD and 33 MSc students. More than 350 projects were undertaken by Ekotrust cc as consultant over a period of more than 40 years.

Books

VAN ROOYEN, N. 2001. ***Flowering plants of the Kalahari dunes***. Ekotrust CC, Pretoria. (In collaboration with H. Bezuidenhout & E. de Kock).

VAN ROOYEN, N. & VAN ROOYEN, M.W. 2019. ***Flowering plants of the southern Kalahari***. Somerset West.

Author / co-author of various chapters on the Savanna and Grassland Biomes in:

LOW, B. & REBELO, A.R. 1996. ***Vegetation types of South Africa, Lesotho and Swaziland*****,** Department of Environmental Affairs and Tourism, Pretoria.

KNOBEL, J. (Ed.) 1999, 2006. ***The Magnificent Natural Heritage of South Africa*****.** (Chapters on the Kalahari and Lowveld).

VAN DER WALT, P.T. 2010. **Bushveld.** Briza, Pretoria. (Chapter on Sour Bushveld).

Contributed to chapters on vegetation, habitat evaluation and veld management in the book:

BOTHMA, J. du P. & DU TOIT, J.G. (Eds). 2016**. *Game Ranch Management*.** 5th edition**.** Van Schaik, Pretoria.

Co-editor of the book:

BOTHMA, J. du P. & VAN ROOYEN, N**.** (eds). 2005**. *Intensive wildlife production in southern Africa.*** Van Schaik, Pretoria.

3. Ekotrust CC: Core Services

Ekotrust CC specializes in vegetation surveys, classification and mapping, wildlife management, wildlife production and economic assessments, vegetation ecology, veld condition assessment, carrying capacity, biodiversity assessments, rare species assessments, carbon pool assessments and alien plant management.

4. Examples of projects previously undertaken

Numerous vegetation surveys and vegetation impact assessments for Baseline, Scoping and Environmental Impact Assessments (BAs & EIA's) were made both locally and internationally.

Numerous projects have been undertaken in game ranches and conservation areas covering aspects such as vegetation surveys, range condition assessments and wildlife management. Of note is the Kgalagadi Transfrontier Park; iSimangaliso Wetland Park, Ithala Game Reserve, Phinda Private Game Reserve, Mabula Game Reserve, Tswalu Kalahari Desert Reserve, Maremani Nature Reserve and Associate Private Nature Reserve (previously Timbavati, Klaserie & Umbabat Private Game Reserve).

Involvement in various research programmes: vegetation of the northern Kruger National Park, Savanna Ecosystem Project at Nylsvley, Limpopo; Kuiseb River Project (Namibia); Grassland Biome Project; Namaqualand and Kruger Park Rivers Ecosystem research programme.

5. Selected references of other projects done by Ekotrust CC

VAN ROOYEN, N., THERON, G.K., BREDENKAMP, G.J., VAN ROOYEN, M.W., DEUTSCHLäNDER, M. & STEYN, H.M. 1996. *Phytosociology, vegetation dynamics and conservation of the southern Kalahari*. Final report: Department of Environmental Affairs & Tourism, Pretoria.

VAN ROOYEN, N. 1999 & 2017. The vegetation types, veld condition and game of Tswalu Kalahari Desert Reserve.

VAN ROOYEN, N. 2000. Vegetation survey and mapping of the Kgalagadi Transfrontier Park. Peace Parks Foundation, Stellenbosch.

VAN ROOYEN, N, VAN ROOYEN, M.W. & GROBLER, A. 2004. Habitat evaluation and stocking rates for wildlife and livestock - PAN TRUST Ranch, Ghanzi, Botswana.

VAN ROOYEN, N. 2004. Vegetation and wildlife of the Greater St Lucia Wetland Park, KZN.

VAN ROOYEN, N. & VAN ROOYEN, M.W. 2008. Vegetation classification, habitat evaluation and wildlife management of the proposed Royal Big Six Nsubane-Pongola Transfrontier Park, Swaziland. Ekotrust cc.

VAN ROOYEN, N., VAN DER MERWE, H. & Van Rooyen, M.W. 2011. The vegetation of the NECSA Vaalputs site. Report to NECSA.

VAN ROOYEN, N. & VAN ROOYEN, M.W. 2014. Ecological evaluation and wildlife management on Ndzalama Nature Reserve and adjacent farms, Gravelotte, Limpopo province.

VAN ROOYEN, N. & VAN ROOYEN, M.W. 2016. Ecological evaluation of the farm Springbokoog in the Van Wyksvlei region of Northern Cape, including a habitat assessment for the introduction of black rhinoceros. Ekotrust

cc.
VAN ROOYEN, M.W. & VAN ROOYEN, N. & VAN DEN BERG, H. 2016. Kathu Bushveld study: Research offset for first development phase of Adams Solor Energy Facility. Project conducted for Department of Environment and Nature Conservation Northern Cape (DENC) and the Department of Agriculture, Forestry and Fisheries (DAFF).
VAN ROOYEN, N. & VAN ROOYEN, M.W. 2018. Environmental screening study for the proposed essential oils and Moringa oil enterprise on Ferndale farm, Bathurst, Eastern Cape. Ekotrust cc, Somerset West.
VAN ROOYEN, M.W., GAUGRIS, J.Y. & VAN ROOYEN, N. 2018. Dish Mountain gold project, Republic of Ethiopia: Natural resource use evaluation - baseline report. FFMES, Report to SRK Consulting.
VAN ROOYEN, N. & VAN ROOYEN, M.W. 2018. Report on the terrestrial ecology (flora & fauna). Basic assessment report for the proposed development of the 325 MW Kudusberg Wind Energy Facility in the Northern and Western Cape. Ekotrust cc, Somerset West.
VAN ROOYEN, N. & VAN ROOYEN, M.W. 2019. Proposed amendments to the Ishwati Emoyeni Wind Energy Facility (WEF) of Special Energy Project (PTY) LTD, a subsidiary of Windlab Systems (PTY) LTD. Ekotrust cc, Somerset West.

6. Selected peer-reviewed research publications

VAN ROOYEN, N. 1978. A supplementary list of plant species for the Kruger National Park from the Pafuri area. *Koedoe* 21: 37 - 46.
VAN ROOYEN, N., THERON, G.K. & GROBBELAAR, N. 1981. A floristic description and structural analysis of the plant communities of the Punda Milia - Pafuri - Wambiya area in the Kruger National Park, Republic of South Africa. 2. The sandveld communities. *Jl S. Afr. Bot.* 47: 405 - 449.
VAN ROOYEN, N., THERON, G.K. & GROBBELAAR, N. 1986. The vegetation of the Roodeplaat Dam Nature Reserve. 4. Phenology and climate. *S. Afr. J. Bot*. 52: 159 - 166.
VAN ROOYEN, N. 1989. Phenology and water relations of two savanna tree species. *S. Afr. J. Sci*. 85: 736 - 740.
VAN ROOYEN, N., BREDENKAMP, G.J. & THERON, G.K. 1991. Kalahari vegetation: Veld condition trends and ecological status of species. *Koedoe* 34: 61 - 72.
VAN ROOYEN, M.W., GROBBELAAR, N., THERON, G.K. & VAN ROOYEN, N. 1992. The ephemerals of Namaqualand: effect of germination date on development of three species. *J. Arid. Environ*. 22: 51 - 66.
VAN ROOYEN, N. BREDENKAMP, G.J., THERON, G.K., BOTHMA, J. DU P. & LE RICHE, E.A.N. 1994. Vegetational gradients around artificial watering points in the Kalahari Gemsbok National Park. *J. Arid Environ*. 26: 349-361.
STEYN, H.M., VAN ROOYEN, N., VAN ROOYEN, M.W. & THERON, G.K. 1996. The phenology of Namaqualand ephemeral species: the effect of sowing date. *J. Arid Environ*. 32: 407 - 420.
JELTSCH, F., MILTON, S.J., DEAN, W.R.J. & VAN ROOYEN, N. 1997. Analyzing shrub encroachment in the southern Kalahari: a grid-based modelling approach. *Journal of Applied Ecology* 34 (6): 1497 - 1509.
VAN ROOYEN, N. & VAN ROOYEN, M.W. 1998. Vegetation of the south-western arid Kalahari: an overview. *Trans. Roy. Soc. S. Afr*. 53: 113 -140.
DE VILLIERS, A.J., VAN ROOYEN, M.W., THERON, G.K. & VAN ROOYEN, N. 1999. Vegetation diversity of the Brand-se-Baai coastal dune area, West Coast, South Africa: a pre-mining benchmark survey for rehabilitation. *Land Degradation & Development* 10: 207 - 224.
VAN ESSEN, L.D., BOTHMA, J. DU P., VAN ROOYEN, N. & TROLLOPE, W.S.W. 2002. Assessment of the woody vegetation of Ol Choro Oiroua, Masai Mara, Kenya. *Afr. J. Ecol.* 40: 76 - 83.
MATTHEWS, W.S., VAN WYK, A.E., VAN ROOYEN, N. & BOTHA, G.A. 2003. Vegetation of the Tembe Elephant Park, Maputaland, South Africa. *South African Journal of Botany* 67: 573-594.
BOTHMA, J. DU P., VAN ROOYEN, N. & VAN ROOYEN, M.W. 2004. Using diet and plant resources to set wildlife stocking densities in African savannas. *Wildlife Society Bulletin* 32 (3): 840-851.
VAN ROOYEN, M.W., THERON, G.K., VAN ROOYEN, N., JANKOWITZ, W.J. & MATTHEWS, W.S. 2004. Mysterious circles

in the Namib Desert: review of hypotheses on their origin. *Journal of Arid Environments* 57: 467-48.

STEENKAMP, J.C. VOGEL, A., VAN ROOYEN, N., & VAN ROOYEN, M.W. 2008. Age determination of *Acacia erioloba* trees in the Kalahari. *Journal of Arid Environments* 72: 302 - 313.

VAN DER MERWE, H., VAN ROOYEN, M.W. & VAN ROOYEN, N. 2008. Vegetation of the Hantam-Tanqua-Roggeveld subregion, South Africa Part 2. Succulent Karoo Biome-related vegetation. *Koedoe* 50: 160-183.

VAN ROOYEN, M.W., VAN ROOYEN, N. & BOTHMA, J. DU P. 2008. Landscapes in the Kalahari Gemsbok National Park, South Africa. *Koedoe:* 50: 32-41.

VAN ROOYEN, M.W., HENSTOCK, R., VAN ROOYEN. N. & VAN DER MERWE, H. 2010. Plant diversity and flowering displays on old fields in the arid Namaqua National Park, South Africa. *Koedoe* 52: Art. #1004, 7 pages. DOI: 10.4102/koedoe.v52i1.1004.

VAN ROOYEN, M.W., LE ROUX, A., GELDENHUYS, C., VAN ROOYEN, N., BROODRYK, N. & VAN DER MERWE, H. 2015. Long-term vegetation dynamics (40 yr) in the Succulent Karoo South Africa: effects of rainfall and grazing. *Applied Vegetation Science* 18: 311-322.

VAN ROOYEN, M.W., VAN ROOYEN, N., ORBAN, B., GAUGRIS, B., MOUTSAMBOTÉ, J.M., NSONGOLA' G. & MIABANGANA, E.S. 2016. Floristic composition, diversity and stand structure of the forest communities in the Kouilou Département, Republic of Congo. *Tropical Ecology*: 54: 805-824.

VAN ROOYEN, M.W., VAN ROOYEN, N., MIABANGANA, E.S., NSONGOLA, G., GAUGRIS, V. & GAUGRIS, J.Y. 2019. Floristic composition, diversity and structure of the rainforest in the Mayoko District, Republic of Congo. *Open Journal of Forestry* 9: 16-69. https://doi.org/10.4236/ojf.2019.91002.

VAN DER MERWE, H., VAN ROOYEN, N., BEZUIDENHOUT, H., BOTHMA, J. DU P. VAN ROOYEN, M.W. 2019. *Vachellia erioloba* dynamics over 38 years in the Kalahari Gemsbok National Park, South Africa. *Koedoe* a1534. https://doi.org/ 10.4102/koedoe.v61i1.1534

VAN DER MERWE, H., VAN ROOYEN, N., BEZUIDENHOUT, H., BOTHMA, J. DU P. & VAN ROOYEN, M.W. 2020. Woody vegetation change over more than 30 years in the interior duneveld of the Kalahari Gemsbok National Park. *Bothalia* 50 (1), a2 http://dx.doi.org/10.38201/btha.abc.v50.i1.2

Curriculum vitae: PROF GRETEL VAN ROOYEN

1. Biographical information

Surname	**Van Rooyen**	Maiden name	**Rösch**
First names	**Margaretha Wilhelmine**		
ID number	**5004130033084**	Citizenship	**South African**
Home address	**272 Thatcher's Field Lynnwood Pretoria 0081 South Africa**	Work address	**Department of Botany University of Pretoria Pretoria 0002 South Africa**
Tel (H)	**+27 (0)12 348-9043**	Tel (W)	**+27 (0)12 420-2009**
Fax (H)	**+27 (0)12 348-9043**	Fax (W)	**+27 (0)12 362-5099**
e-mail	**gretel.vanrooyen@up.ac.za**		
Current position	**Honorary Professor in Plant Ecology Scientific advisor - Ekotrust**		
Academic qualifications	**BSc; BSc (Hons), HNOD, MSc (Botany), PhD (Plant ecology)**		

2. Publications

I am author / co-author of more than 100 peer reviewed research publications and have presented / co-presented more than 100 posters or papers at international and national conferences. Five PhD-students and 29 Masters students have completed their studies under my supervision / co-supervision. I have co-authored a book as part of a series on the Adaptations of Desert Organisms by Springer Verlag (Van Rheede van Oudtshoorn, K. & Van Rooyen, M.W. 1999. ***Dispersal biology of desert plants.*** Springer Verlag, Berlin) and two wildflower guides (Van Rooyen, G., Steyn, H. & De Villiers, R. 1999. ***Cederberg, Clanwilliam and Biedouw Valley.*** Wild Flower Guide of South Africa no 10. Botanical Society of South Africa, Kirstenbosch, and Van der Merwe, H. & Van Rooyen, G. **Wild flowers of the Roggeveld and Tanqua**). I have also contributed to six chapters in the following books: (i) Dean, W.R.J. & Milton, S.J. (Eds) *The Karoo: Ecological patterns and processes*. Cambridge University Press, Cambridge. pp. 107-122; (ii) Knobel, J. (ed.) *The magnificent heritage of South Africa.* Sunbird Publishing, Llandudno. pp. 94-107; (iii)Hoffman, M.T., Schmiedel, U., Jürgens, N. [Eds]: *Biodiversity in southern Africa. Vol. 3: Implications for landuse and management*: pp. 109–150, Klaus Hess Publishers, Göttingen & Windhoek; (iv) Schmiedel, U., Jürgens, N. [Eds]: *Biodiversity in southern Africa. Vol. 2: Patterns and processes at regional scale: pp.* 222-232, Klaus Hess Publishers, Göttingen & Windhoek; (v) Stoffberg, H., Hindes, C. & Muller, L. South African Landscape Architecture: A Compendium and A Reader. Chapter 10, pp. 129 – 140; and (vi) Stoffberg, H., Hindes, C. & Muller, L. South African Landscape Architecture: A Compendium and A Reader. Chapter 11, pp. 141 – 146.

3. Research interests

My primary research interests lie in population biology and vegetation dynamics. The main aim of the research is to gain an understanding of ecosystem dynamics and to use this understanding to develop strategies to conserve, manage, use sustainably or restore ecosystems. Geographically the focus of the studies has been primarily in Namaqualand (Northern Cape Province, South Africa; classified as Succulent Karoo) and the Kalahari although several studies were conducted in Maputaland (Northern KwaZulu-Natal) and Namibia.

4. Selected project references

UYS, N. & VAN ROOYEN, M.W. 2008. The status of *Aloe dichotoma* subsp. *dichotoma* (quiver tree) populations in Goegap Nature Reserve. Report to Northern Cape Nature Conservation.

VAN ROOYEN, M.W, VAN ROOYEN, N., BOTHMA, J. DU P. & VAN DEN BERG, H.M. 2007. Landscapes in the Kalahari Gemsbok National Park, South Africa. Report to SANParks.

VAN ROOYEN, M.W. 2000. Effect of disturbance on the annual vegetation in Namaqualand. Final Report for South African National Parks on Skilpad Disturbance Plots.

VAN ROOYEN, M.W., THERON, G.K. & VAN ROOYEN, N. 1997. Studies on the ephemerals of Namaqualand. Report

on a project executed on behalf of the Department of Environmental Affairs and Tourism 1994 – 1996.

VAN ROOYEN, N., THERON, G.K., BREDENKAMP, G.J., VAN ROOYEN, M.W., DEUTSCHLÄNDER, M. & STEYN, H.M. 1996. *Phytosociology, vegetation dynamics and conservation of the southern Kalahari*. Final report on a project executed on behalf of the Department of Environmental Affairs & Tourism, Pretoria.

VAN ROOYEN, N. & VAN ROOYEN, M.W. 2000. Environmental audit of Namakwa Sands Mine at Brand-se-Baai, Western Cape. Report for Namaqua Sands to Department of Mineral Affairs and Energy.

VAN ROOYEN, N. & VAN ROOYEN, M.W. 2004. Vegetation of the Langer Heinrich area, Swakopmund, Namibia. Report to SoftChem.

VAN ROOYEN, N. & VAN ROOYEN, M.W. 2004. Vegetation of the Power Line Route from Walvisbaai to Langer Heinrich. Namibia. Ekotrust cc, Pretoria.

VAN ROOYEN, N, VAN ROOYEN, M.W. & GROBLER, A. 2004. Habitat evaluation and stocking rates for livestock and wildlife - PAN TRUST RANCH, Ghanzi, Botswana. Report to People and Nature TRUST, Botswana.

VAN ROOYEN, N. & VAN ROOYEN, M.W. 2010. Vegetation of the Inca, Tubas and Shiyela sites of Reptile Uranium Namibia, Swakopmund, Namibia. Ekotrust cc, Pretoria.

VAN ROOYEN, N. & VAN ROOYEN, M.W. 2011. Ecological evaluation of Kalahari Game Lodge, Namibia. Ekotrust cc, Pretoria.

VAN ROOYEN, N. VAN DER MERWE, M.W. & VAN ROOYEN, M.W. 2011. The vegetation, veld condition and wildlife of Vaalputs. Report to NECSA.

VAN ROOYEN, N., VAN ROOYEN, M.W. & VAN DER MERWE, H. 2012. The vegetation of Ratelkraal, Northern Cape. Report to Northern Cape Nature Conservation.

VAN ROOYEN, N., & VAN ROOYEN, M.W. 2013. Vegetation of the Ongolo and Tumas sites of Reptile Uranium Namibia (RUN), Swakopmund, Namibia. Ekotrust cc, Pretoria.

VAN ROOYEN, N. & VAN ROOYEN, M.W. 2013. Vegetation Monitoring Report: 2013 Veld condition Vaalputs. Report to NECSA.

VELDSMAN, S. & VAN ROOYEN, M.W. 2003. An analysis of the vegetation of the Witsand Nature Reserve. Report to Northern Cape Nature Conservation.

5. Selected research publications

BENEKE, K., VAN ROOYEN, M.W., THERON, G.K. & VAN DE VENTER, H.A. 1993. Fruit polymorphism in ephemeral species of Namaqualand: III. Germination differences between polymorphic diaspores. *Journal of Arid Environments* 24: 333-344.

BENEKE, K., VON TEICHMAN, I., VAN ROOYEN, M.W. & THERON, G.K. 1992. Fruit polymorphism in ephemeral species of Namaqualand: I. Anatomical differences between polymorphic diaspores of two *Dimorphotheca* species. *South African Journal of Botany* 58: 448 - 455.

DE VILLIERS, A.J. VAN ROOYEN, M.W. THERON, G.K. & VAN DE VENTER, H.A. 1994. Germination of three Namaqualand pioneer species, as influenced by salinity, temperature and light. *Seed Science & Technology* 22: 427-433.

DE VILLIERS, A.J., VAN ROOYEN, M.W. & THERON, G.K. 1994. Comparison of two methods for estimating the size of the viable seed bank of two plant communities in the Strandveld of the West Coast, South Africa. *South African Journal of Botany* 60: 81-84.

DE VILLIERS, A.J., VAN ROOYEN, M.W., THERON, G.K. & VAN ROOYEN, N. 1999. Vegetation diversity of the Brand-se-Baai coastal dune area, West Coast, South Africa: a pre-mining benchmark survey for rehabilitation. *Land Degradation and Development* 10: 207-224.

DE VILLIERS, A.J., VAN ROOYEN, M.W. & THERON, G.K. 2001. The role of facilitation in seedling recruitment and survival patterns in the Strandveld Succulent Karoo, South Africa. *Journal of Arid Environments* 49: 809-821.

DE VILLIERS, A.J., VAN ROOYEN, M.W. & THERON, G.K. 2002a. Germination strategies of Strandveld Succulent Karoo plant species for revegetation purposes: I. Temperature and light requirements. *Seed Science & Technology* 30: 17-33.

DE VILLIERS, A.J., VAN ROOYEN, M.W. & THERON, G.K. 2002b. Germination strategies of Strandveld Succulent Karoo plant species for revegetation purposes. II. Dormancy-breaking treatments. *Seed Science & Technology* 30: 35-49.

DE VILLIERS, A.J., VAN ROOYEN, M.W. & THERON, G.K. 2002c. Seed bank classification of the Strandveld Succulent Karoo, South Africa. *Seed Science Research* 12: 57-67.

DE VILLIERS, A.J., VAN ROOYEN, M.W. & THERON, G.K. 2003. Similarity between the soil seed bank and the standing vegetation in the Strandveld Succulent Karoo, South Africa. *Land Degradation & Development* 14: 527-540.

DE VILLIERS, A.J., VAN ROOYEN, M.W. & THERON, G.K. 2004. The restoration of Strandveld Succulent Karoo degraded by mining: an enumeration of topsoil seed banks. *South African Journal of Botany* 70: 1-9.

DREBER, N., OLDELAND, J. & VAN ROOYEN, M.W. 2011. Impact of severe grazing on soil seed bank composition and its implications for rangeland regeneration in arid Namibia. *Agriculture, Ecosystems and Environment* 141: 399-409.

GAUGRIS, J.Y. & VAN ROOYEN, M.W. 2010. Evaluating the adequacy of reserves in the Tembe-Tshanini complex: a case study in Maputaland, South Africa. *Oryx* 44: 399-410.

JANKOWITZ, W.J., VAN ROOYEN, M.W., SHAW, D., KAUMBA, J.S. & VAN ROOYEN, N. 2008. Mysterious Circles in the Namib Desert. *South African Journal of Botany* 74:332-334.

LAUCHLAN H.F., PITHER, J., JENTSCH, A., STERNBERG, M., ZOBEL, M., ASKARIZADEH, D., BARTHA, S., BEIERKUHNLEIN, C., BENNETT, J., BITTEL, A., BOLDGIV, B., BOLDRINI, I.I., BORK, E., BROWN, L., CABIDO, M., CAHILL, J., CARLYLE, C.N., CAMPETELLA, G., CHELLI, S., COHEN, O., CSERGO, A., DÍAZ, S., ENRICO, L., ENSING, D., FIDELIS, A., FOSTER, B., GARRIS, H., GOHEEN, J.R., HENRY, H.A.L., HOHN, M., JOURI, M.H., KLIRONOMOS, J., KOOREM, K., LKHAGVA, A., LODGE, R.L., LONG, R., PETE MANNING, P., RANDALL MITCHELL, R., MOORA, M., MÜLLER, S.C., NABINGER, C., NASERI, K., OVERBECK, G.E., PALMER, T.M., PARSONS, S., PESEK, M., PILLAR, V.D., PRINGLE, R.M., ROCCAFORTE, K., SCHMIDT, A., SHANG, Z., STAHLMANN, R., STOTZ, G., SUGIYAMA, S., SZENTES, S., THOMPSON, D., TUNGALAG, R., UNDRAKHBOLD, S., VAN ROOYEN, M., WELLSTEIN, C., WILSON, J.B., ZUPO, T. 2015. Worldwide Evidence of the Unimodal Relationship Between Productivity and Plant Species Richness. *Science* 349: 302 – 305.

NAUDE, Y., VAN ROOYEN, M.W. & ROHWER, E.R. 2011. Evidence for a geochemical origin of the mysterious circles in the Pro-Namib desert. *Journal of Arid Environments* 75: 446-456.

OOSTHUIZEN, M.A., VAN ROOYEN, M.W. & THERON, G.K. 1996. A replacement series evaluation of competition between three Namaqualand ephemeral plant species. *South African Journal of Botany* 62: 342-345.

RÖSCH, H., VAN ROOYEN, M.W. & THERON, G.K. 1997a. Competitive effect and response of ten Namaqualand pioneer plant species at two nutrient levels. *South African Journal of Botany* 63: 210-215.

RÖSCH, H., VAN ROOYEN, M.W. & THERON, G.K. 1997b. Predicting competitive interactions between pioneer plant species on the basis of plant traits. *Journal of Vegetation Science* 8: 489-494.

SCHMIEDEL, U., LINKE, T., CHRISTIAAN, R.A., FALK, T., GRÖNGRÖFT, A., HAARMEYER, D.H., HANKE, W., HENSTOCK, R., HOFFMAN, M.T., KUNZ, N., LABITZKY, T., LUTHER-MOSEBACH, J., LUTSCH, N., MEYER, S., PETERSEN, A., RÖWER, I.U., VAN DER MERWE, H., VAN ROOYEN, M.W., VOLLAN, B., WEBER, B. 2010. Environmental and socio-economic patterns and processes in the Succulent Karoo frame conditions for the management of this biodiversity hotspot. In: Hoffman, M. T., Schmiedel, U., Jürgens, N. [Eds.]: *Biodiversity in southern Africa. Volume 3: Implications for landuse and management*: 109–150, Klaus Hess Publishers, Göttingen & Windhoek.

STAPELBERG, F.H., VAN ROOYEN, M.W. & BOTHMA, J. DU P. 2008. Seasonal nutrient fluctuation in selected plant species in the Kalahari. *African Journal of Range & Forage Science* 25(3):

STEENKAMP, C.J., VOGEL, J.C., FULS, A., VAN ROOYEN, N., & VAN ROOYEN, M.W. 2008. Age determination of *Acacia erioloba* trees in the Kalahari. *Journal of Arid Environments* 72: 302 - 313.

STEYN, H.M., VAN ROOYEN, N., VAN ROOYEN, M.W. & THERON, G.K. 1996a. The phenology of Namaqualand ephemeral species. The effect of water stress. *Journal of Arid Environments* 33: 49-62.

STEYN, H.M., VAN ROOYEN, N., VAN ROOYEN, M.W. & THERON, G.K. 1996b. The prediction of phenological stages in four Namaqualand ephemeral species using thermal unit indices. *Israel Journal of Plant Sciences* 44: 147-160.

STOFFBERG, G.H., VAN ROOYEN, M.W., VAN DER LINDE, M.L. & GROENEVELD, H.T. 2010. Carbon sequestration estimates of indigenous street trees in the City of Tswane, South Africa. *Urban Forestry and Urban Greening.*

THERON, G.K., VAN ROOYEN, N. & VAN ROOYEN, M.W. 1980. The vegetation of the Lower Kuiseb River. *Madoqua* 11: 327-345.

UECKERMANN, C. & VAN ROOYEN, M.W. 2000. Insect pollination and seed set in four Namaqualand plant species. *South African Journal of Botany* 66: 28-30.

VAN DER MERWE, H., VAN ROOYEN, M.W. & VAN ROOYEN, N. 2008a. The vegetation of the Hantam-Tanqua-Roggeveld subregion, South Africa. Part 1: Fynbos Biome related vegetation. *Koedoe* 50: 61-81.

VAN DER MERWE, H., VAN ROOYEN, M.W. & VAN ROOYEN, N. 2008b. The vegetation of the Hantam-Tanqua-Roggeveld subregion, South Africa. Part 2: Succulent Karoo Biome related vegetation. *Koedoe* 50: 160-183.

VAN DER MERWE, H. & VAN ROOYEN, M.W. 2011a. Guiding conservation efforts in the Hantam-Tanqua- Roggeveld (South Africa) using diversity parameters. *Koedoe* 53: doi:10.4102/ koedoe.v53i1.1018.

VAN DER MERWE, H. & VAN ROOYEN, M.W. 2011b. Life form spectra in the Hantam-Tanqua-Roggeveld, South Africa. *South African Journal of Botany* 77: 371-380.

VAN DER MERWE, H. & VAN ROOYEN, M.W. 2011c. Life-form and species diversity on abandoned croplands, Roggeveld, South Africa. *African Journal of Range and Forage Science* 28: 99-110.

VAN DER MERWE, H. & VAN ROOYEN, M.W. 2011d. Species–area relationships in the Hantam-Tanqua-Roggeveld, Succulent Karoo, South Africa. *Biodiversity and Conservation* 20: 1183-1201.

VAN DER MERWE, H. & VAN ROOYEN, M.W. 2011e. Vegetation trends following fire in the Roggeveld, Mountain Renosterveld, South Africa. *South African Journal of Botany* 77: 127-136.

VAN DER MERWE, H., VAN ROOYEN, N., BEZUIDENHOUT, H., BOTHMA, J. DU P. VAN ROOYEN, M.W. 2019. *Vachellia erioloba* dynamics over 38 years in the Kalahari Gemsbok National Park, South Africa. K*oedoe*, 61, https://doi.org/ 10.4102/koedoe.v61i1.

VAN ROOYEN, M.W. 2002. Management of the old field vegetation in the Namaqua National Park, South Africa: conflicting demands of conservation and tourism. *Geographical Journal* 168: 211-223.

VAN ROOYEN, M.W., GROBBELAAR, N. & THERON, G.K. 1979. Phenology of the vegetation in the Hester Malan Nature Reserve in the Namaqualand Broken Veld: 2. The therophyte population. *Journal of South African Botany* 45: 433 - 452.

VAN ROOYEN, M.W., GROBBELAAR, N., THERON, G.K. & VAN ROOYEN, N. 1991. The ephemerals of Namaqualand: Effects of photoperiod, temperature and moisture stress on development and flowering of three species. *Journal of Arid Environments* 20: 15 - 29.

VAN ROOYEN, M.W., GROBBELAAR, N., THERON, G.K. & VAN ROOYEN, N. 1992a. The ephemerals of Namaqualand. Effect of germination date on development of three species. *Journal of Arid Environments* 22: 51 - 66.

VAN ROOYEN, M.W., GROBBELAAR, N., THERON, G.K. & VAN ROOYEN, N. 1992b. The ephemerals of Namaqualand. Effect of germination date on parameters of growth analysis of three species. *Journal of Arid Environments* 22: 117 - 136.

VAN ROOYEN, M.W., HENSTOCK, R., VAN ROOYEN. N. & VAN DER MERWE, H. 2010. Plant diversity and flowering displays on old fields in the arid Namaqua National Park, South Africa. *Koedoe* 52: Art. #1004, 7 pages. DOI: 10.4102/koedoe.v52i1.1004.

VAN ROOYEN, M.W., THERON, G.K. & GROBBELAAR, N. 1979. Phenology of the vegetation in the Hester Malan Nature Reserve in the Namaqualand Broken Veld: 1. General observations. *Journal of South African Botany* 45: 279 - 293.

VAN ROOYEN, M.W., THERON, G.K. & GROBBELAAR, N. 1990. Life forms and dispersal spectra of the Namaqualand flora. *Journal of Arid Environments* 19: 133-145.

VAN ROOYEN, M.W., THERON, G.K. & VAN ROOYEN, N. 1992. The ephemerals of Namaqualand: effect of density on yield and biomass allocation. *Journal of Arid Environments* 23: 249 - 262.

VAN ROOYEN, M.W., THERON, G.K., VAN ROOYEN, N., JANKOWITZ, W.J. & MATTHEWS, W.S. 2004. Mysterious circles in the Namib Desert: Review of hypotheses on their origin. *Journal of Arid Environments* 57: 467-485.

VAN ROOYEN, M.W., VAN ROOYEN, N. & BOTHMA, J. DU P. 2008. Landscapes in the Kalahari Gemsbok National Park, South Africa. *Koedoe* 50: 32-41.

VAN ROOYEN, M.W., VAN ROOYEN, N. & STOFFBERG, G.H. 2013. Carbon sequestration potential of post-mining reforestation activities on the KwaZulu-Natal coast, South Africa. Forestry 86:211-233.

VAN ROOYEN, M.W., LE ROUX, A., GELDENHUYS, C., VAN ROOYEN, N., BROODRYK, N. & VAN DER MERWE, H. 2015. Long-term vegetation dynamics (40 yr) in the Succulent Karoo South Africa: effects of rainfall and grazing. *Applied Vegetation Science 18: 311-322.*

VAN ROOYEN, M.W., LE ROUX, A., VAN DER MERWE, H., VAN ROOYEN, N. & GELDENHUYS, C. 2018. Long-term vegetation change (>20 years) in the plains habitat on the Goegap Nature Reserve, Succulent Karoo, South Africa. *African Journal of Range & Forage Science* 35: 289 – 302.

VAN ROOYEN, N. & VAN ROOYEN, M.W. 1998. Vegetation of the south-western arid Kalahari: an overview. *Transactions of the Royal Society of South Africa.* 53: 113-140.

WESULS, D., STROHBACH, M., HORN, A., KOS, M., ZIMMERMANN, J., HOFFMANN, J., GELDENHUYS, C., DREBER, N., KELLERMANN, L., VAN ROOYEN, M.W., POSCHLOD, P. 2010. Plant functional traits and types as a tool to analyse landuse impacts on vegetation. In: Schmiedel, U., Jürgens, N. [Eds.]: *Biodiversity in southern Africa. Volume 2: Patterns and processes at regional scale:* 222-232, Klaus Hess Publishers, Göttingen & Windhoek.

Appendix 3 Specialist assessment: Aquatic Ecology, Biodiversity and Species

AQUATIC ECOLOGY, BIODIVERSITY AND SPECIES

SPECIALIST ASSESSMENT

BASIC ASSESSMENT FOR THE PROPOSED SQUARE KILOMETRE ARRAY (SKA) FIBRE OPTIC CABLE BETWEEN BEAUFORT WEST AND CARNARVON

Report prepared for: CSIR – Environmental Management Services P O Box 320 Stellenbosch 7599 South Africa	*Report prepared by:* EnviroSci (Pty) Ltd Dr Brian Colloty 1 Rossini Rd Pari Park Port Elizabeth 6070

Version: Draft for comment

Date: 29 January 2021

Executive Summary

The CSIR appointed EnviroSci (Pty) Ltd to conduct an aquatic biodiversity assessment for the proposed installation of a fibre optic cable between Beaufort West and Carnarvon to complete the data connection between the Square Kilometre Array (SKA) radiotelescope and its data processing centre in Cape Town. This includes both underground and above ground (overhead) sections as required. It has been assumed that any temporary works areas (construction camps and laydowns) will be placed within previously disturbed areas along the route, and outside of any demarcated riverine / wetland areas as shown is this study.

The proposed alignment extends from Beaufort West in the south, and traverses the Nuweveld Mountains in a northerly direction, predominantly within the road reserves of the R381 / R63 roads. The area is characterised by rolling hills and valleys, with occasional cliffs and is covered rocky surface with low vegetation cover.

The findings of this report were supported by baseline data collected during a 3-day project-specific survey in August & October 2020, while adhering to the assessment criteria contained in the DWAF 2005 / 2008 delineation manuals and the Wetland / Riverine Classification System. The information collected for other projects between 2018 / 2019 (a total of 25 days) over various seasons while spanning the region between Beaufort West and Carnarvon, was also used in this assessment, where the R381 is used as an access road for those projects. This also includes a low-level aerial survey along the R381 / R63, to assess catchment wide connections between the aquatic systems.

Several important national and provincial scale conservation plans were also considered, with the results of those studies where relevant being included in this report. Most conservation plans are produced at a high level, so it is important to verify or groundtruth the actual status of the study area. Groundtruthing of aquatic resources in the project area was also important as the information was critical for the identification and mapping of important habitat where protected or endangered species are known to occur within the region.

The study area is dominated by various aquatic features associated with catchments and rivers, and are characterised as follows:

- Riverine: Alluvial Floodplain and tree riparian dominated systems, characterised by *Vachellia karroo* and / or *Sersia* species;
- Riverine: Incised channels with limited riparian vegetation or part of an alluvial valley. These are mostly associated with the central and northern portions of the cable alignment from Rosedene (just north of the Molteno Pass), northwards onto Carnarvon;
- Wetland: Valley bottom wetlands (mostly channelled);
- Pan (wetland): Endorheic Pan/Depressions; and
- Artificial: Dams, reservoirs and shallow borrowpits that were filled with surface water runoff.

Notably, most of the aquatic features within the study area are located within the riverine valleys and alluvial floodplains, linked to the rivers and their respective catchments. Wetlands can appear within riverine floodplains, while downstream riparian features are more dominant:

The catchments in the study area fall within the Great Karoo & Nama Karoo Ecoregions located in the Breede Gourits Catchment Management Agency and Orange Water Management Areas, with the majority of the project falling within the latter WMA, and include:

- Kuils / Gamka (J21A);
- Sak (D55A);
- Slangfontein se Leegte / Brak (D55C);
- Brak / Soutpoort (D55D);
- Gansvlei (D55G);
- Alarmleegte (D55F); and
- Carnarvonleegte (D54B).

During the site-specific assessment, all the mainstem systems were visited and groundtruthed in relation to the available aerial imagery to assess the difference between valley bottom wetland, riparian or alluvial areas. Previous visits in the region in 2019, allowed for the inspection of additional areas and the endorheic pans within the greater region but won’t be impacted upon by this development (i.e. > 500 m from the proposed alignment).

Several major bridge crossing occur along the alignment, such as that located on the Brak River, while several artificial systems such as water inundated borrowpits and dams are also prevalent in the area.

Based on the information collected during the field investigations, the DWS (2014) PES/EIS ratings are verified and upheld for the riverine / alluvial systems. The natural wetlands were however rated independently and achieved Present Ecological State (PES) scores of B & B/C, while the Ecological Importance and Sensitivity (EIS) was rated as HIGH. This high rating was due to the fact that these systems retained water during the dry periods, with small pools still evident in areas downstream of these wetlands area even after very little rainfall in 2019/2020. These pools also create refugia for important fish and amphibians known to occur within the region, as well as provide drinking water to small mammals and livestock within the area.

The Moderate and High EIS rating for both natural watercourses and wetlands, is further substantiated by the fact that the affected catchments are included in both the National Freshwater Ecosystem Priority Area (NFEPAs) and the Western Cape and Northern Cape Provincial Biodiversity Spatial Plans Critical Biodiversity Area (CBA) spatial layers. These areas are highlighted as support areas for downstream rivers (Upstream FEPAs) and important corridors along the various river systems.

Overall, these catchment areas and subsequent rivers / watercourses are largely in a natural state with localised impacts in some areas, which include the following:

- Erosion and sedimentation associated with road crossings;
- Impeded water flow due to several in-channel farm dams; and
- Sedimentation and scour of channels due to undersized culverts within present day road crossings

The potential impacts identified during this assessment are:

Construction Phase
- Potential impact 1: Clearing of vegetation within wetland crossings.
- Potential impact 2: Clearing of vegetation within riverine (with riparian and or alluvial systems) crossings.
- Potential impact 3: Loss of species of special concern.
- Potential impact 4: Spills and leaks from construction vehicles / machinery when working in or near the delineated systems, impacting localised surface water quality.
- Potential impact 5: Erosion and Sedimentation.

Operational Phase
- Potential impact 1: Creation of hard surfaces, resulting in runoff, erosion and sedimentation.

Decommissioning Phase
- Potential impact 1: Clearing of vegetation within wetland crossings.
- Potential impact 2: Clearing of vegetation within riverine (with riparian and or alluvial systems) crossings.
- Potential impact 3: Loss of species of special concern.
- Potential impact 4: Spills and leaks from construction vehicles / machinery when working in or near the delineated systems.
- Potential impact 5: Erosion and Sedimentation.

Cumulative Impacts
- Cumulative impact 1: All activities within delineated areas, when combined with present day activities.

Considering the impacts assessed with mitigation the significance of these are summarised as follows:

Phase	**Overall Impact Significance**
Construction	Very Low
Operational	Very Low
Decommissioning	Very Low
Nature of Impact	**Overall Impact Significance**
Cumulative - Construction	Very Low
Cumulative - Operational	Very Low
Cumulative - Decommissioning	Very Low

This is based on the following are key recommendations, which are also critical to the proposed mitigations:

- Where wetland areas aren't spanned with the overhead line cable installation (OHL), then the cables should be tied into the existing bridges. Should this not be an option, and the crossing distance suitable, then Horizontal Directional Drilling (HDD) is recommended. Failing these options, then it is suggested that hand dug trenching occur in these areas (i.e. no mechanical trenching is allowed to access these areas).
- Any of the activities, should also be monitored by an appointed aquatic specialist, to advise on micrositing, especially if unforeseen technical difficulties required routing changes, while the appointed Environmental Officer (EO) / Environmental Control Officer (ECO) should monitor on a daily basis, especially during periods of river flow.
- Any points of erosion should be stabilised immediately (sand bags in the short term) using gabions and reno mattresses as required.
- Activities should be limited to the demarcated servitude / road reserve as far as possible, to prevent additional cumulative impacts on these systems.
- Search and Rescue should be initiated prior to construction.
- The Construction Environmental Management Plan (EMP), must include a Specific Monitoring and Rehabilitation Plan related to the water course and wetland crossings.
- Monitoring should occur on a monthly basis for 6 months post construction and where any unstable soils occur, these must be protected with temporary stabilisation dependent on the scale of the impact i.e. sand bags - hay bales) until areas become revegetated. If any areas require permanent erosion protection (e.g. gabions or stone pitching) then this must be included into the General Authorisation (GA) application.

On these grounds the current overall impact on the aquatic environment is Very Low (with mitigation) and in summary the findings of this study, the specialist finds no reason to withhold an Environmental Authorisation (EA) or GA of any of the proposed activities, assuming that key mitigations measures are implemented with the final recommendations as follows:

- A key recommendation is that that during the construction mobilisation process, any required temporary construction camps, stockpiles and laydown areas are located outside of any delineated aquatic systems and within any existing disturbed areas.
- A final walkdown by an aquatic specialist must be conducted to ensure that the routing is installed within disturbed areas, within the road reserve servitude, and avoiding sensitive areas as far as possible.

Contents

List of Figures

List of Plates

List of Tables

List of Abbreviations

CARA	Conservation of Agricultural Resources Act
CBA	Critical Biodiversity Area
CSIR	Council for Scientific and Industrial Research
DEFF	Department of Environmental Fisheries and Forestry
DHSWS	Department of Human Settlements, Water and Sanitation (formerly Department of Water and Sanitation)
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation (formerly the Department of Water Affairs)
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
ESA	Ecological Support Area
GA	General Authorisation (Water Use Authorisation type)
GIS	Geographic Information System
HDD	Horizontal Directional Drilling
HGM	Hydrogeomorphic
IHI	Habitat Integrity
NAEHMP	National Aquatic Ecosystem Health Monitoring Programme
NEMA	National Environmental Management Act
NFEPA	National Freshwater Ecosystem Priority Atlas (Nel, *et al*. 2011).
NWA	National Water Act (No. 36 of 1998)
NWCS	National Wetland Classification System
OHL	Overhead Line – (fibre optic cable that is not buried, but mounted on wooden poles)
PES	Present Ecological State
RHP	River Health Programme
SACNASP	South African Council for Natural and Scientific Professions
SAIIAE	South African Inventory of Inland Aquatic Ecosystems
SANBI	South African National Biodiversity Institute
SAPAD	South African National Protected Areas Database
SCC	Species of Conservation Concern
SQ	Subquaternary catchment = Quinary Catchment as used by DEFF
WCBSP	Western Cape Biodiversity Spatial Plan
Wet-Health	Wet-Ecoservices
WETLAND-IHI	Wetland Index of Habitat Integrity
WUA	Water Use Authorisation
WUL	Water Use License
WULA	Water Use License Application
WMA	Water Management Area

This report serves as the Aquatic Biodiversity and Species Specialist Assessment that was prepared as part of the Basic Assessment (BA) for the proposed installation of a fibre optic cable between Beaufort West and Carnarvon to complete a connection between the Square Kilometre Array (SKA) radio telescope to a data processing facility in Cape Town.

1. Introduction

The Council for Scientific and Industrial Research (CSIR) appointed EnviroSci (Pty) Ltd to conduct an aquatic biodiversity and ecology assessment for the proposed installation of a fibre optic cable along the route as shown Figure 1 and 2. The proposed cabling includes both underground and above ground (overhead) sections as required. It has been assumed that any temporary works areas (construction camps and laydowns) will be placed within previously disturbed areas along the route, and outside of any demarcated riverine / wetland areas as identified is this study.

The proposed alignment extends form Beaufort West in the south, and traverses the Nuweveld Mountains in a northerly direction, predominantly within the road reserves of the R381 / R63. The area is characterised by rolling hills and valleys, with occasional cliffs and is covered rocky surface with low vegetative cover, coupled to an arid climate, drives a mostly ephemeral aquatic environment.

The findings of this report were supported by baseline data collected during a 3 day project-specific survey in August & October 2020, while adhering to the assessment criteria contained in the DWAF 2005 / 2008 delineation manuals and the Wetland / Riverine Classification System. Information collected by EnviroSci for other projects (mainly large-scale electricity transmission line projects) between 2018 / 2019 (a total of 25 days), over various seasons between Beaufort West and Carnarvon, was also used in this assessment, where the R381 / R 63 is used as an access road for those projects. This also includes a low-level flight along the R381 to Droërivier, to assess catchment wide connections between the systems.

Several important national and provincial scale conservation plans were also considered, with the results of those studies, where relevant, being included in this report. Most conservation plans are produced at a high level, so it is important to verify or ground truth the actual status of the study area. Groundtruthing of aquatic resources in the project area was also important as the information was critical for the identification and mapping of important habitat where protected or endangered species are known to occur within the region.

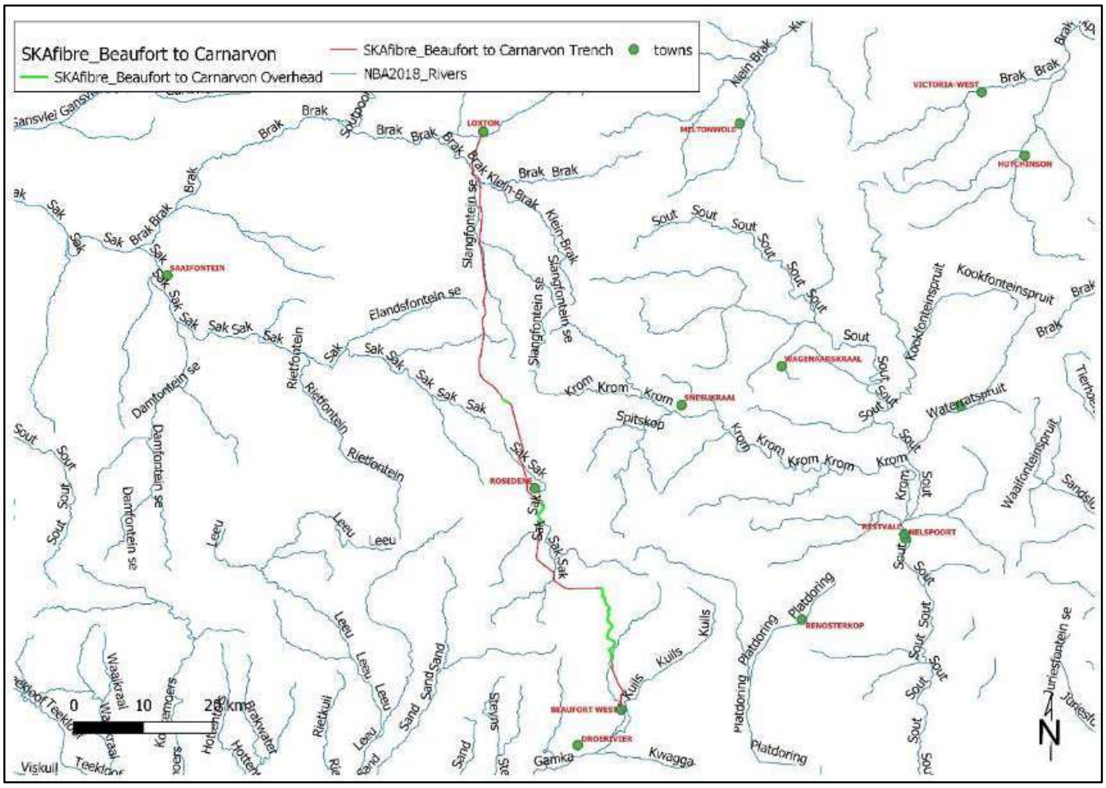


Figure 1: The buried and overhead cable sections between Beaufort West and Loxton, that spans Nuweveld mountains and the associated mainstem river systems (SANBI, 2018).

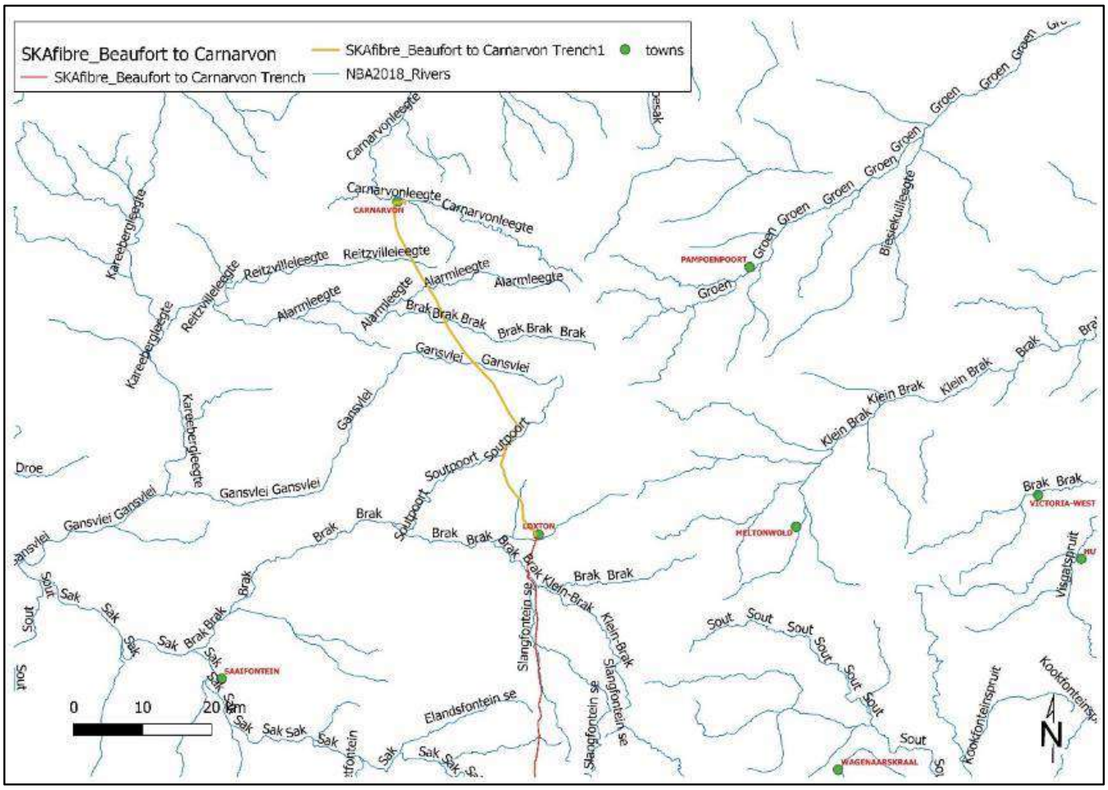


Figure 2: The buried cable sections between Loxton and Carnarvon, that span pediplains with associated alluvial mainstem river systems (SANBI, 2018), interspersed by inselbergs (Koppies).

1.1. Scope, Purpose and Objectives of this Specialist Report

The aim of this report is to provide a summary of the aquatic baseline and identify, discuss and assess the potential impacts that may arise should the project be authorised. The report also makes recommendations with regard to management and mitigation, to further reduce, avoid or mitigate the potential impacts, and ultimately ensure the responsible and sustainable use of South Africa's aquatic resources. This report, in part, aims to provide the Competent Authority with sufficient information regarding the projects impacts on aquatic resources to inform the taking of responsible decision on the application.

Certain aspects of the development, such as river crossings or any activities within 500 m of a wetland, will trigger the need for Section 21 Water Use License Applications (WULAs) or General Authorisation (GA) applications in terms of the National Water Act (Act No. 36 of 1998) (NWA). The pre-application process (Pre-application meeting) with the Department of Human Settlements, Water and Sanitation has been conducted to initiate the process, and GA has been confirmed.

Information regarding the state and function of the observed water bodies, including suitable no-go buffers areas and assessment of the potential direct and cumulative impact, where relevant, are also provided, but as the existing road already presents a solution to tie in the cable to existing bridges, the proposed buffer is thus only considered for areas that should be avoided.

Note that, with the exception of the "No Go" alternative (as required by the National Environmental Management Act (NEMA)), no alternatives apart from the preferred fibre-optic cable routing have been assessed.

1.2. Details of Specialist

This specialist assessment has been undertaken by Dr Brian Colloty of EnviroSci (Pty) Ltd who is registered with the South African Council for Natural and Scientific Professions (SACNASP), with Registration Number 400268/07 the field of Ecological Science. A curriculum vitae is included in Appendix A of this specialist assessment.

In addition, a signed specialist statement of independence is included in Appendix B of this specialist assessment.

1.3. Terms of Reference

- Initiate the assessment with a review of the available information for the region and the proposed project, this also included a review of the proposed project in relation to any conservation plans or assessments known for the area, e.g. Critical Biodiversity Area (CBA) maps, National Waterbody Inventory, and relevant Department of Environment, Forestry and Fisheries (DEFF) National Screening Tool data in preparation for the site assessment;
- Conduct a detailed site visit to inspect the surrounding waterbodies;
- Determine the Present Ecological State (PES) of any waterbodies incl. wetlands, estimating their biodiversity, conservation importance with regard ecosystem services during the site visit using recognised PES / Ecological Importance and Sensitivity (EIS) assessment methods to determine the state, importance and sensitivity of the respective wetland / watercourse systems;
- Prepare a map demarcating the respective watercourses or wetland/s, i.e. the waterbody, its respective catchment and other areas within a 500m radius of the study area. This will demonstrate, from a holistic point of view the connectivity between the site and the surrounding regions, i.e. the hydrological zone of influence while classifying the hydrogeomorphic type of the respective water courses / wetlands in relation to present land-use and their current state. The maps depicting demarcated waterbodies will be delineated to a scale of 1:10 000, following the methodology described by the DWS, together with an

estimation of their functionality, Habitat Integrity (IHI), Wet-Ecoservices (Wet-Health) and Socio-Cultural Importance of the delineated systems, whichever is relevant to the systems;

- Recommend buffer zones using the Macfarlane & Bredin (2017) approach to indicate any No-go / Sensitive areas around any delineated aquatic zones supported by any relevant legislation, e.g. any bioregional plans, conservation guidelines or best practice where relevant, noting the caveat with regards to the scale at which such plans are often derived.
- Assess the potential impacts, based on a supplied methodology, including cumulative impacts and for pre-construction, construction, operations and decommissioning phases.
- Provide mitigation measures regarding project-related impacts, including engineering services that could negatively affect demarcated wetland or water course areas.
- Supply geo-referenced GIS shape files of the wetland / riverine areas with buffers.
- Provide a separate Risk Assessment Matrix (RAM) as per the Department of Water and Sanitation (DWS) 2016 requirements to determine the WULA Requirements, i.e. indication of future permitting requirements if required.
- Provide an opinion / verification of the environmental sensitivities identified in the DEFF National Screening Tool as set out in the respective protocols published 20 March 2020.

2. Approach and Methodology

This study followed the approaches of several national guidelines with regards to aquatic and wetland assessment. These have been modified by the author, to provide a relevant mechanism of assessing the present state of the study area aquatic systems, applicable to the specific environment and, in a clear and objective manner, identify and assess the potential impacts associated with the proposed development site based on information collected within the relevant farm portions.

Current water resource classification systems make use of the Hydrogeomorphic (HGM) approach, and for this reason, the National Wetland Classification System (NWCS) approach will be used in this study.

For reference the following definitions are as follows:

Drainage line: A drainage line is a lower category or order of watercourse that does not have a clearly defined bed or bank. It carries water only during or immediately after periods of heavy rainfall i.e. non-perennial, and riparian vegetation may not be present.

Perennial and non-perennial: Perennial systems contain flow or standing water for all or a large proportion of any given year, while non-perennial systems are episodic or ephemeral and thus contains flows for short periods, such as a few hours or days in the case of drainage lines.

Riparian: the area of land adjacent to a stream or river that is influenced by stream-induced or related processes. Riparian areas which are saturated or flooded for prolonged periods would be considered wetlands and could be described as riparian wetlands. However, some riparian areas are not wetlands (e.g. an area where alluvium is periodically deposited by a stream during floods but which is well drained).

Wetland: land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which under normal circumstances supports or would support vegetation typically adapted to life in saturated soil (Water Act 36 of 1998); land where an excess of water is the dominant factor determining the nature of the soil development and the types of plants and animals living at the soil surface (Cowardin *et al*., 1979).

Water course: as per the NWA means -

(a) a river or spring;

(b) a natural channel in which water flows regularly or intermittently;

(c) a wetland, lake or dam into which, or from which, water flows; and

(d) any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks

2.1 Waterbody classification systems

Since the late 1960's, wetland classification systems have undergone a series of international and national revisions. These revisions allowed for the inclusion of additional wetland types, ecological and conservation rating metrics, together with a need for a system that would allude to the functional requirements of any given wetland (Ewart-Smith *et al*., 2006). Wetland function is a consequence of biotic and abiotic factors, and wetland classification should strive to capture these aspects. **Coupled to this was the inclusion of other criteria within the classification systems to differentiate between river, riparian and wetland systems, as well as natural versus artificial waterbodies.**

The South African National Biodiversity Institute (SANBI) in collaboration with several specialists and stakeholders developed the newly revised and now accepted NWCS (Ollis *et al*., 2013). This system comprises a hierarchical classification process of defining a wetland based on the principles of the HGM approach at higher levels, with including structural features at the finer or lower levels of classification (Ollis *et al*., 2013).

Wetlands develop in a response to elevated water tables, linked either to rivers, groundwater flows or seepage from aquifers (Parsons, 2004). These water levels or flows then interact with localised geology and soil forms, which then determines the form and function of the respective wetlands. Water is thus the common driving force, in the formation of wetlands (DWAF, 2005). It is significant that the HGM approach has now been included in the wetland classifications, as the HGM approach has been adopted throughout the water resources management realm with regards to the determination of the PES, EIS and WET-Health assessments for aquatic environments. All these systems are then easily integrated using the HGM approach in line with the Eco-classification process of river and wetland reserve determinations used by the DHSWS. The Ecological Reserve of a wetland or river is used by DHSWS to assess the water resource allocations when assessing WULAs and Gas.

The NWCS process is provided in more detail in Section 2.3 below, but some of the terms and definitions used in this document are present below:

Definition Box

Present Ecological State (PES) is a term for the current ecological condition of the resource. This is assessed relative to the deviation from the Reference State. Reference State/Condition is the natural or pre-impacted condition of the system. The reference state is not a static condition, but refers to the natural dynamics (range and rates of change or flux) prior to development. The PES is determined per component - for rivers and wetlands this would be for the drivers: flow, water quality and geomorphology; and the biotic response indicators: fish, macroinvertebrates, riparian vegetation and diatoms. PES categories for every component would be integrated into an overall PES for the river reach or wetland being investigated. This integrated PES is called the EcoStatus of the reach or wetland.

EcoStatus is the overall PES or current state of the resource. It represents the totality of the features and characteristics of a river and its riparian areas or wetland that bear upon its ability to support an appropriate natural flora and fauna and its capacity to provide a variety of goods and services. The EcoStatus value is an integrated ecological state made up of a combination of various PES findings from component EcoStatus assessments (such as for invertebrates, fish, riparian vegetation, geomorphology, hydrology and water quality).

Reserve: The quantity and quality of water needed to sustain basic *human needs* and *ecosystems* (e.g. estuaries, rivers, lakes, groundwater and wetlands) to ensure ecologically sustainable development and utilisation of a water resource. The *Ecological Reserve* pertains specifically to aquatic ecosystems.

Reserve requirements: The quality, quantity and reliability of water needed to satisfy the requirements of basic human needs and the Ecological Reserve (inclusive of instream requirements).

Ecological Reserve determination study: The study undertaken to determine Ecological Reserve requirements.

Licensing applications: Water users are required (by legislation) to apply for licenses prior to extracting water resources from a water catchment or any other activity that qualifies as a water use.

Ecological Water Requirements: This is the quality and quantity of water flowing through a natural stream course that is needed to sustain instream functions and ecosystem integrity at an acceptable level as determined during an EWR study. These then form part of the conditions for managing achievable water quantity and quality conditions as stipulated in the **Reserve Template**

Water allocation process (compulsory licensing): This is a process where all existing and new water users are requested to reapply for their licenses, particularly in stressed catchments where there is an over-allocation of water or an inequitable distribution of entitlements.

Ecoregions are geographic regions that have been delineated in a top-down manner on the basis of physical/abiotic factors. • NOTE: For purposes of the classification system, the 'Level I Ecoregions' for South Africa, Lesotho and Swaziland (Kleynhans *et al.* 2005), which have been specifically developed by the (former) Department of Water Affairs & Forestry (DWAF) for rivers but are used for the management of inland aquatic ecosystems more generally, are applied at Level 2A of the classification system. These Ecoregions are based on physiography, climate, geology, soils and potential natural vegetation.

2.2 Wetland definition

Although the NWCS (Ollis *et al*., 2013) is used to classify wetland types it is still necessary to understand the definition of a wetland. Terminology currently strives to characterise a wetland not only on its structure (visible form), but also to relate this to the function and value of any given wetland.

The Ramsar Convention definition of a wetland is widely accepted as "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres" (Davis, 1994). South Africa is a signatory to the Ramsar Convention and therefore its extremely broad definition of wetlands has been adopted for the proposed NWCS, with a few modifications.

Whereas the Ramsar Convention included marine water to a depth of six metres, the definition used for the NWCS extends to a depth of ten metres at low tide, as this is recognised as the seaward boundary of the shallow photic zone (Lombard *et al*., 2005). An additional minor adaptation of the definition is the removal of the term 'fen' as fens are considered a type of peatland. The adapted definition for the NWCS is, therefore, as follows (Ollis *et al*., 2013):

WETLAND: an area of marsh, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed ten metres.

This definition encompasses all ecosystems characterised by the permanent or periodic presence of water other than marine waters deeper than ten metres. The only legislated definition of wetlands in South Africa, however, is contained within the NWA, where wetlands are defined as "land which is transitional between terrestrial and aquatic systems, where the water table is usually at, or near the surface, or the land is periodically covered with shallow water and which land in normal circumstances supports, or would support, vegetation adapted to life in saturated soil." This definition is consistent with more precise working definitions of wetlands and therefore includes only a subset of ecosystems encapsulated in the Ramsar definition. It should be noted that the NWA definition is not concerned with marine systems and clearly distinguishes wetlands from estuaries, classifying the latter as a watercourse (Ollis *et al*., 2013). Table 1 below provides a comparison of the various wetlands included within the main sources of wetland definitions used in South Africa.

Table 1: Comparison of ecosystems considered to be 'wetlands' as defined by the proposed NWCS, the NWA and ecosystems included in DWAF's (2005) delineation manual.

Ecosystem	NWCS "wetland"	National Water Act wetland	DWAF (2005) delineation manual
Marine	YES	NO	NO
Estuarine	YES	NO	NO
Waterbodies deeper than 2 m (i.e. limnetic habitats often described as lakes or dams)	YES	NO	NO
Rivers, channels and canals	YES	NO[1]	NO
Inland aquatic ecosystems that are not river channels and are less than 2 m deep	YES	YES	YES
Riparian[2] areas that are permanently / periodically inundated or saturated with water within 50 cm of the surface	YES	YES	YES[3]
Riparian [3] areas that are not permanently / periodically inundated or saturated with water within 50 cm of the surface	NO	NO	YES[3]

[1] *Although river channels and canals would generally not be regarded as wetlands in terms of the National Water Act, they are included as a 'watercourse' in terms of the Act*

[2] *According to the National Water Act and Ramsar, riparian areas are those areas that are saturated or flooded for prolonged periods and would be considered riparian wetlands, as opposed to non –wetland riparian areas that are only periodically inundated and the riparian vegetation persists due to having deep root systems drawing on water many meters below the surface.*

[3] *The delineation of 'riparian areas' (including both wetland and non-wetland components) is treated separately to the delineation of wetlands in DWAF's (2005) delineation manual.*

Although a subset of Ramsar-defined wetlands was used as a starting point for the compilation of the first version of the National Wetland Inventory (i.e. "wetlands", as defined by the NWA, together with open waterbodies), it is understood that subsequent versions of the Inventory include the full suite of Ramsar-defined wetlands in order to ensure that South Africa meets its wetland inventory obligations as a signatory to the Convention (Ollis *et al.*, 2013).

Wetlands must therefore have one or more of the following attributes to meet the above definition (DWAF, 2005):

- A high-water table that results in the saturation at or near the surface, leading to anaerobic conditions developing in the top 50 cm of the soil.
- Wetland or hydromorphic soils that display characteristics resulting from prolonged saturation, i.e. mottling or grey soils
- The presence of, at least occasionally, hydrophilic plants, i.e. hydrophytes (water loving plants).

It should be noted that riparian systems that are not permanently or periodically inundated are not considered true wetlands, i.e. those associated with the drainage lines and rivers.

2.3 National Wetland Classification System method

Due to the nature of the wetlands and watercourses observed, it was determined that the newly accepted NWCS should be adopted. This classification approach has integrated aspects of the HGM approach used in the WET-Health system as well as the widely accepted eco-classification approach used for rivers.

The NWCS (Ollis *et al.*, 2013), as stated previously, uses hydrological and geomorphological traits to distinguish the primary wetland units, i.e. direct factors that influence wetland function. Other wetland assessment techniques, such as the DWAF (2005) delineation method, only infer wetland function based on abiotic and biotic descriptors (size, soils & vegetation) stemming from the Cowardin approach (Ollis *et al.,* 2013).

The classification system used in this study is thus based on Ollis *et al*. (2013) and is summarised below:

The NWCS has a six-tiered hierarchical structure, with four spatially nested primary levels of classification (Figure 3). The hierarchical system firstly distinguishes between Marine, Estuarine and Inland ecosystems (**Level 1**), based on the degree of connectivity the particular system has with the open ocean (greater than 10 m in depth). Level 2 then categorises the regional wetland setting using a combination of biophysical attributes at the landscape level, which operate at a broad bioregional scale.

This is opposed to specific attributes such as soils and vegetation. **Level 2** has adopted the following systems:

- Inshore bioregions (marine)
- Biogeographic zones (estuaries)
- Ecoregions (Inland)

Level 3 of the NWCS assess the topographical position of inland wetlands as this factor broadly defines certain hydrological characteristics of the inland systems. Four landscape units based on topographical position are used in distinguishing between Inland systems at this level. No subsystems are recognised for Marine systems, but estuaries are grouped according to their periodicity of connection with the marine environment, as this would affect the biotic characteristics of the estuary.

Level 4 classifies the HGM units discussed earlier. The HGM units are defined as follows:

- Landform – shape and localised setting of wetland
- Hydrological characteristics – nature of water movement into, through and out of the wetland
- Hydrodynamics – the direction and strength of flow through the wetland

These factors characterise the geomorphological processes within the wetland, such as erosion and deposition, as well as the biogeochemical processes.

Level 5 of the assessment pertains to the classification of the tidal regime within the marine and estuarine environments, while the hydrological and inundation depth classes are determined for inland wetlands. Classes are based on frequency and depth of inundation, which are used to determine the functional unit of the wetlands and are considered secondary discriminators within the NWCS.

Level 6 uses six descriptors to characterise the wetland types based on biophysical features. As with Level 5, these are non-hierarchal in relation to each other and are applied in any order, dependent on the availability of information. The descriptors include:

- Geology;
- Natural vs. Artificial;
- Vegetation cover type;
- Substratum;
- Salinity; and
- Acidity or Alkalinity.

It should be noted that where sub-categories exist within the above descriptors, hierarchical systems are employed, and these are thus nested in relation to each other. The HGM unit (Level 4) is the focal point of the NWCS, with the upper levels (Figure 4– Inland systems only) providing means to classify the broad bio-geographical context for grouping functional wetland units at the HGM level, while the lower levels provide more descriptive detail on the particular wetland type characteristics of a particular HGM unit. Therefore Level 1 – 5 deals with functional aspects, while Level 6 classifies wetlands on structural aspects.

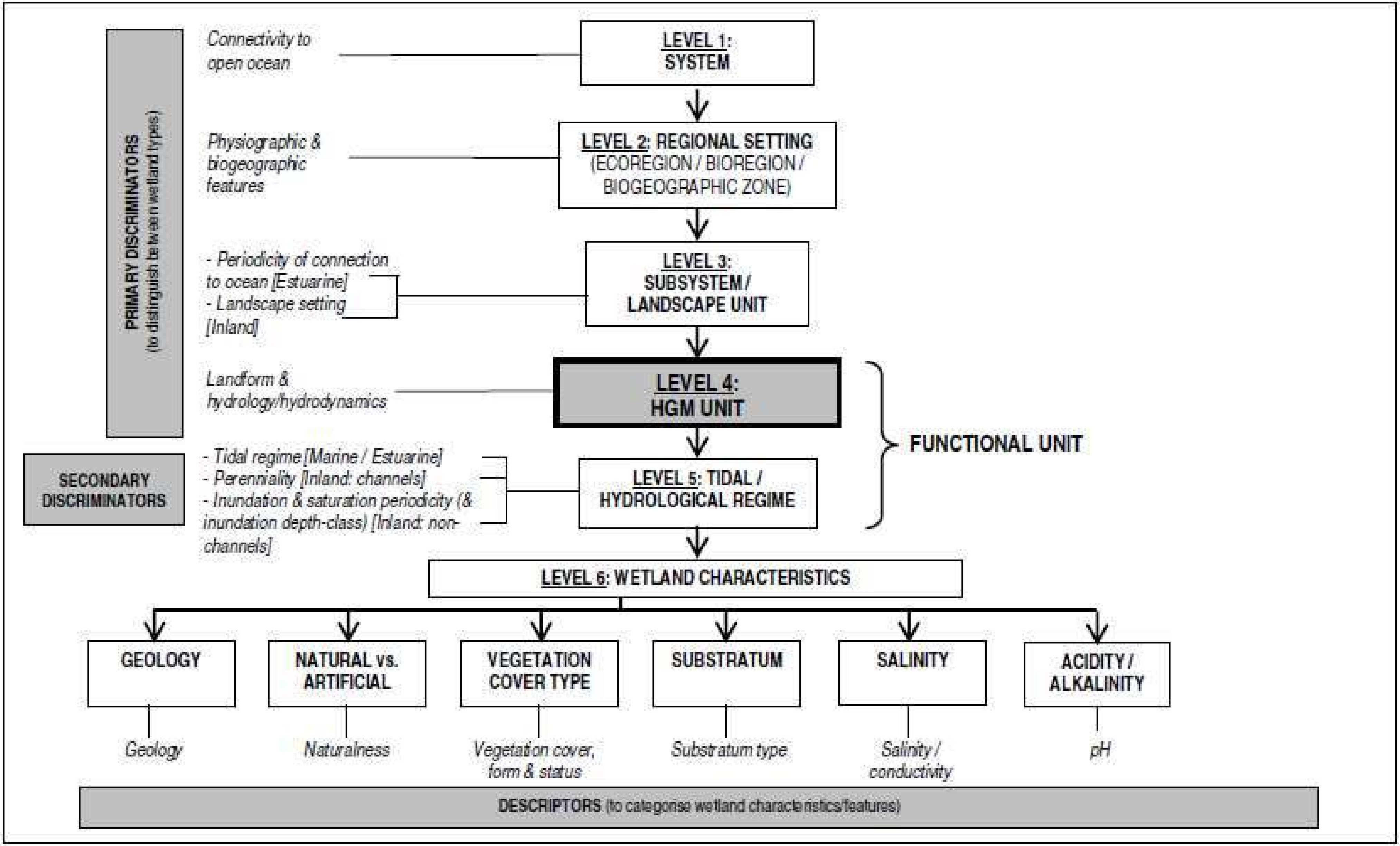


Figure 3: Basic structure of the NWCS, showing how 'primary discriminators' are applied up to Level 4 to classify Hydrogeomorphic (HGM) Units, with 'secondary discriminators' applied at Level 5 to classify the tidal/hydrological regime, and 'descriptors' applied (from Ollis *et al.*, 2013)

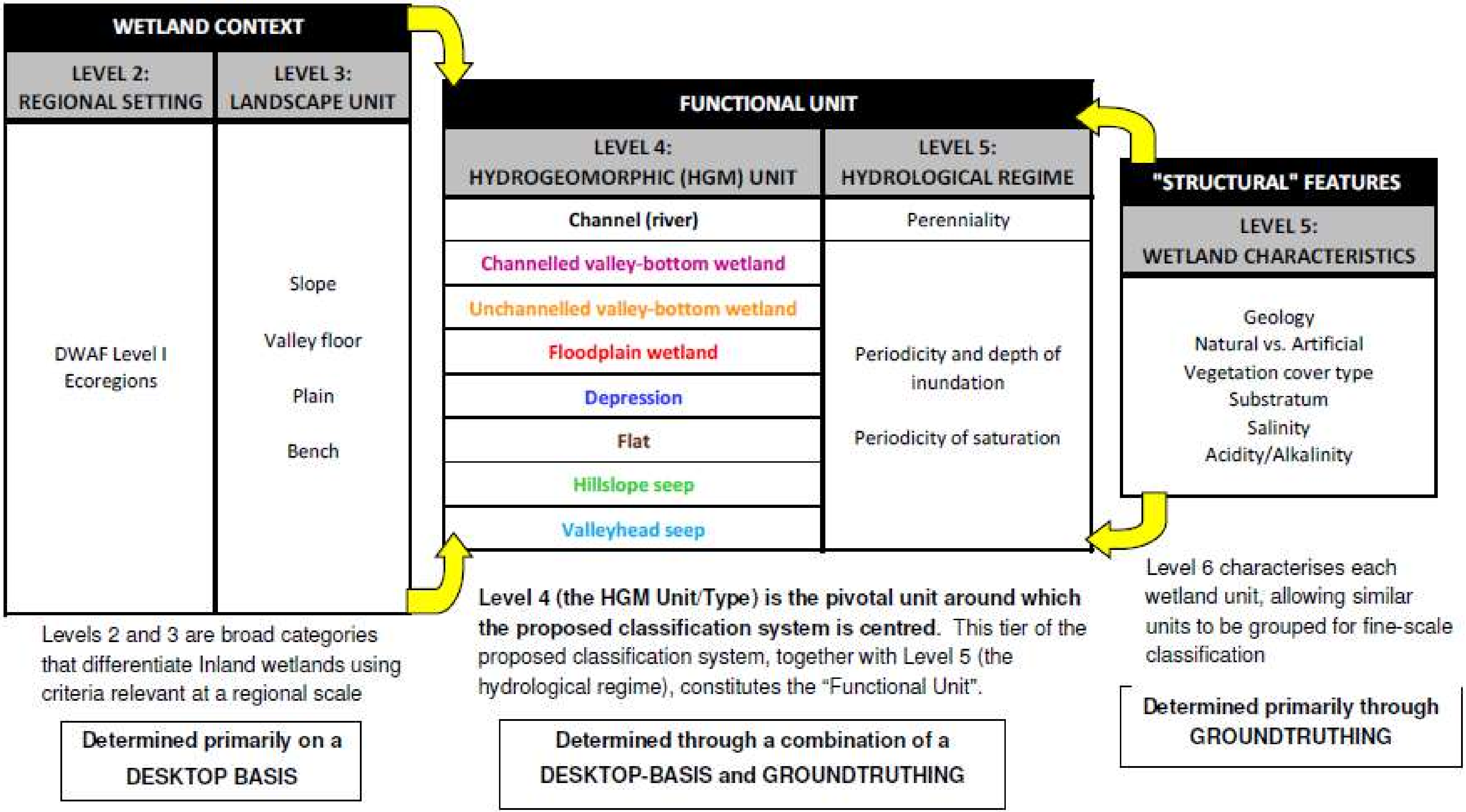


Figure 4: Illustration of the conceptual relationship of HGM Units (at Level 4) with higher and lower levels (relative sizes of the boxes show the increasing spatial resolution and level of detail from the higher to the lower levels) for Inland Systems (from Ollis *et al.*, 2013)

2.4 Waterbody condition

To assess the PES or condition of the observed wetlands, a modified Wetland Index of Habitat Integrity (DWAF, 2007) was used. The Wetland Index of Habitat Integrity (WETLAND-IHI) is a tool developed for use in the National Aquatic Ecosystem Health Monitoring Programme (NAEHMP), formerly known as the River Health Programme (RHP). The output scores from the WETLAND-IHI model are presented in the standard DWAF A-F ecological categories (Table 2) and provide a score of the PES of the habitat integrity of the wetland system being examined. The author has included additional criteria into the model-based system to include additional wetland types. This system is preferred when compared to systems such as WET-Health – wetland management series, as WET-Health (Level 1) (Macfarlane, *et al.*, 2009) was developed with wetland rehabilitation in mind and is not always suitable for impact assessments. This coupled with the degraded state of the wetlands in the study area, indicated that a complex study approach was not warranted, i.e. conduct a Wet-Health Level 2 and WET-Ecosystems Services study required for an impact assessment.

Table 2: Description of A – F ecological categories based on Kleynhans et al. (2005)

ECOLOGICAL CATEGORY	ECOLOGICAL DESCRIPTION	MANAGEMENT PERSPECTIVE
A	Unmodified, natural.	Protected systems; relatively untouched by human hands; no discharges or impoundments allowed.
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	Some human-related disturbance, but mostly of low impact potential.
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	**Multiple disturbances associated with need for socio-economic development, e.g. impoundment, habitat modification and water quality degradation.**
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	**Often characterized by high human densities or extensive resource exploitation. Management intervention is needed to improve health, e.g. to restore flow patterns, river habitats or water quality.**
F	Critically / Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	

The WETLAND-IHI model is composed of four modules. The “Hydrology”, “Geomorphology” and “Water Quality” modules all assess the contemporary driving processes behind wetland formation and maintenance. The last module, “Vegetation Alteration”, provides an indication of the intensity of human land use activities on the wetland surface itself and how these may have modified the condition of the wetland. The integration of the scores from these 4 modules provides an overall PES score for the wetland system being examined. The WETLAND-IHI model is an MS Excel-based model, and the data required for the assessment are generated during a site visit.

Additional data may be obtained from remotely sensed imagery (aerial photos; maps and/or satellite imagery) to assist with the assessment. The interface of the WETLAND-IHI has been developed in a format which is similar to DWA’s River EcoStatus models which are currently used for the assessment of PES in riverine environments.

2.5 Aquatic ecosystem importance and function

South Africa is a Contracting Party to the Ramsar Convention on Wetlands, signed in Ramsar, Iran, in 1971, and has thus committed itself to this intergovernmental treaty, which provides the framework for the national protection of wetlands and the resources they could provide. Wetland conservation is now driven by SANBI as a requirement under the National Environmental Management: Biodiversity Act (No 10 of 2004).

Wetlands are among the most valuable and productive ecosystems on earth, providing important opportunities for sustainable development (Davies and Day, 1998). However, wetlands in South Africa are still rapidly being lost or degraded through direct human induced pressures (Nel *et al.,* 2004).

The most common attributes or ecosystem goods and services provided by wetlands include:

- Improve water quality;
- Impede flow and reduce the occurrence of floods;
- Reeds and sedges used in construction and traditional crafts;
- Bulbs and tubers, a source of food and natural medicine;
- Store water and maintain base flow of rivers;
- Trap sediments; and
- Reduce the number of water-borne diseases.

In terms of this study, the wetlands provide ecological (environmental) value to the area acting as refugia for various wetland associated plants, butterflies and birds.

In the past, wetland conservation has focused on biodiversity as a means of substantiating the protection of wetland habitat. However, not all wetlands provide such motivation for their protection, thus wetland managers and conservationists began assessing the importance of wetland function within an ecosystem.

Table 3 below summarises the importance of wetland function when related to ecosystem services or ecoservices (Kotze *et al*., 2008). One such example is emergent reed bed wetlands that function as transformers converting inorganic nutrients into organic compounds (Mitsch and Gosselink, 2000).

Table 3: Summary of direct and indirect ecoservices provided by wetlands from Kotze et al., 2008

<table>
<tr><td rowspan="15">Ecosystem services supplied by wetlands</td><td rowspan="9">Indirect benefits</td><td rowspan="8">Hydro-geochemical benefits</td><td colspan="2">Flood attenuation</td></tr>
<tr><td colspan="2">Stream flow regulation</td></tr>
<tr><td rowspan="5">Water quality enhancement benefits</td><td>Sediment trapping</td></tr>
<tr><td>Phosphate assimilation</td></tr>
<tr><td>Nitrate assimilation</td></tr>
<tr><td>Toxicant assimilation</td></tr>
<tr><td>Erosion control</td></tr>
<tr><td colspan="2">Carbon storage</td></tr>
<tr><td colspan="3">Biodiversity maintenance</td></tr>
<tr><td rowspan="6">Direct benefits</td><td colspan="3">Provision of water for human use</td></tr>
<tr><td colspan="3">Provision of harvestable resources[2]</td></tr>
<tr><td colspan="3">Provision of cultivated foods</td></tr>
<tr><td colspan="3">Cultural significance</td></tr>
<tr><td colspan="3">Tourism and recreation</td></tr>
<tr><td colspan="3">Education and research</td></tr>
</table>

Conservation importance of the individual wetlands was based on the following criteria:

- Habitat uniqueness;
- Species of conservation concern;
- Habitat fragmentation or rather, continuity or intactness with regards to ecological corridors; and
- Ecosystem service (social and ecological).

The presence of any or a combination of the above criteria would result in a HIGH conservation rating if the wetland was found in a near natural state (high PES). Should any of the habitats be found modified the conservation importance would rate as MEDIUM, unless a Species of Conservation Concern (SCC) was observed, in which case it would receive a HIGH rating. Any system that was highly modified (low PES) or had none of the above criteria, received a LOW conservation importance rating. Wetlands with HIGH and MEDIUM ratings should thus be excluded from development with incorporation into a suitable open space system, with the maximum possible buffer being applied. Natural wetlands or Wetlands that resemble some form of the past landscape but receive a LOW conservation importance rating could be included into stormwater management features and should not be developed to retain the function of any ecological corridors.

2.6 Impact assessment

Refer to Appendix E for the Impact Assessment methodology.

2.7 Information Sources

Table 4: Key information sources used to conduct this assessment.

Data / Information	Source	Date	Type	Description
South African National Protected Areas Database (SAPAD)	Department of Environmental Affairs	2020, Q2	Spatial	Spatial delineation of protected areas in South Africa. Updated quarterly
Western Cape Biodiversity Spatial Plan (WCBSP)	Pool-Stanvliet, R., Duffell-Canham, A., Pence, G. & Smart, R. CapeNature / SANBI	2017	Report & Spatial	Spatial conservation planning units and associated management recommendations for the
National Biodiversity Assessment	South African National Biodiversity Institute	2018	Report and Spatial	Latest assessment of South African biodiversity and ecosystems, including, vegetation types, wetlands and rivers.
Review of available data for a South African Inventory of Inland Aquatic Ecosystems (SAIIAE). Water SA 44 (2) 184-199	van Deventer H., Smith-Adao, L. Petersen C., Mbona N., Skowno A., Nel, J.L.	2018	Report	Assessment of available spatial data regards aquatic ecosystems
Technical Report for the National Freshwater Ecosystem Priority Areas project. WRC Report No. K5/1801.	Nel, J.L., Murray, K.M., Maherry, A.M., Petersen, C.P., Roux, D.J., Driver, A., Hill, L., Van Deventer, H., Funke, N., Swartz, E.R., Smith-Adao, L.B., Mbona, N., Downsborough, L. and Nienaber, S.	2011	Report	NFEPA
FrogMAP. 2019.	Animal Demography Unit. Accessed from http://frogmap.adu.org.za/?sp=400; on 2020-10-09	2020	Spatial databases	Frog distribution map
Northern Cape Biodiversity Spatial Plan	Holness, S & Oosthuysen, E. 2016. Northern Cape Critical Biodiversity Area map, SANBI BGIS	2016	Spatial	Spatial conservation planning units and associated management recommendations for the province

The reference list at the end of this report (Section 12) also includes various sources of literature with regard the assessment of birds and, amphibia associated with aquatic systems.

2.8 Assumptions, Knowledge Gaps and Limitations

To obtain a comprehensive understanding of the dynamics of both the flora and fauna of communities within a study site, as well as the status of endemic, rare or threatened species in any area, assessments should always consider investigations at different time scales (across seasons/years) and through replication. However, due to time constraints these long-term studies are not feasible and the assessment is thus mostly based on instantaneous sampling. This limitation is common to many impact assessment type studies, but the findings are deemed adequate for the purposes of decision making support regarding project acceptability, unless otherwise stated.

Therefore, due to the scope of the work presented in this report, a long-term investigation of the proposed site was not possible and as such not perceived as part of the Terms of Reference. However, a concerted effort was made to sample and assess as much of the potential site, as well as make use of any supporting literature, species distribution data and aerial photography.

It should be emphasised that information, as presented in this document, only has reference to the study area as indicated on the accompanying maps. Therefore, this information cannot be applied to any other area without detailed investigation.

2.9 Consultation Processes Undertaken

None to date, other than informal discussions with some landowners regards the state / function and importance of aquatic ecosystems in the region.

The Water Use License Application has been initiated with detail from the report and the attached Risk Assessment Matrix (Appendix D) being used in the Pre-application meetings and site visit with the DHSWS in November 2020. A GA approach has been confirmed by the DHSWS as the appropriate water authorisation mechanism for the proposed fibre optic cable development.

The draft version of this report (this version) will be released for a 30-day commenting period. The comments will be considered, addressed and responded to as necessary in the final version of this report.

3. Description of Project Aspects relevant to Aquatic Biodiversity

3.1 Trenching, backfilling and compacting

Trenches will be dug 1 m deep and 200 mm – 300 mm wide. A combination of two types of machinery will be used to dig trenches: a Tractor Loader Backhoe (TLB) - used for more difficult terrain; and a Chain Trencher.

After the trench is dug, it will be prepared by adding soft soil where sharp rocks may damage the fibre duct. The fibre duct with cabling is then laid in the trench and the trench is backfilled first with approximately 400 mm of soft soil over the ducting. A compacting machine is used to compact the first 400 mm of the backfill, after which the remainder of the trench is the backfilled again to a level slightly above ground surface and then compacted to the same level and density as the surrounding soil.

3.2 Horizontal Directional Drilling (HDD)

Where the cabling needs to traverse sensitive environs, such as rivers, HDD techniques will be employed. For example, drilling will start 30 m away from the bank of the river, and will continue 2 m below the river bottom. The drill fluids / muds are not hazardous and do not pose any risk to the environment.

3.3 Overhead cabling

Some sections (notably the Molteno pass) are unfeasible to trench – here cabling will be installed overhead. Wooden poles with a total length of 9 m is buried 1.5 m deep, resulting in a total aboveground height of ~ 7.5 m. A combination of two techniques are used to dig holes: a drill mounted on the back of a truck; and a hand-held drill (used in areas inaccessible to the truck-mounted drill). Dug holes may remain open for a maximum of 3 days before the poles are planted.

Poles are planted using a truck with a mechanical arm. Where poles need to be planted in areas inaccessible by the pole-planting truck, manual labour will be used to plant the poles. Once the poles are planted the soil around the pole will be compacted. A dry cement mixture may also be used to secure the pole in place.

4. Baseline Environmental Description

The National Wetland Inventory (van Deventer *et al*., 2018) which is included into the National Biodiversity Assessment (SANBI, 2018), and the National Freshwater Ecosystems Priority Atlas (Nel *et al*. 2011), have indicated that several important as well Threatened riverine systems are traversed by the proposed cable alignment. These include portions of the Slangfontein, Sak, Brak, Alarmleegte, Soutpoort, and Gansvlei rivers that are listed as Endangered.

Furthermore, these spatial databases indicated that some of these systems are perennial, but having assessed and or travelled through the region for a number of years, all of the system would be considered non-perennial or ephemeral.

What is known is that the systems with larger valley bottom wetlands, do contain pools with moderate flows, but this is only within short river reaches along systems such as the Sak, Brak and Soutpoort Rivers. Substantial flows were observed within the Soutpoort River during high rainfall events that occurred in January and May 2020, when the report author travelled along the R381 during the time period (Plate 1).

Plate 1: Flows observed in the Southpoort River in May 2020, approximately 4 km upstream of the R381

4.1 Aquatic Biodiversity and Ecosystems

4.1.1 Aquatic Ecosystems

The study area is thus dominated by various aquatic features associated with catchments and rivers and are characterised as follows:

Riverine:	Alluvial Floodplain and tree riparian dominated systems, characterised by *Vachellia karroo* and or *Sersia* species.
Riverine:	Incised channels with limited riparian vegetation or part of an alluvial valley. These are mostly associated with the central and northern portions of the cable alignment from Rosedene (just north of the Molteno Pass), northwards onto Carnarvon.
Wetland:	Valley bottom wetlands (mostly channelled).
Pan (wetland):	Endorheic Pan/Depressions.
Artificial:	Dams, reservoirs and shallow borrowpits that were filled with surface water runoff.

Notably most these aquatic features within the study area are located within the riverine valleys and alluvial floodplains, linked to the rivers and their respective catchments (Figure 5 & 6) Wetlands can appear within riverine floodplains, while downstream riparian features are more dominant:

- Kuils / Gamka (J21A);
- Sak (D55A);
- Slangfontein se Leegte / Brak (D55C);
- Brak / Soutpoort (D55D);
- Gansvlei (D55G);
- Alarmleegte (D55F); and
- Carnarvonleegte (D54B).

These fall within the Great Karoo & Nama Karoo Ecoregions located in the Breede Gourits Catchment Management Agency and Orange Water Management Areas (WMAs), with the majority of the project falling within the latter WMA.

During the site specific assessment, all the mainstem systems were visited and groundtruthed in relation to the available aerial imagery to assess the difference between valley bottom wetland (Plate 2, 3 & 4), Riparian or alluvial areas (Plate 5, 6 & 7). Previous visits in the region in 2019, allowed for the inspection of additional areas and the endorheic pans within the greater region, but won’t be impacted upon by this development (i.e. > 500 m from proposed alignment). Several major bridge crossing occur along the alignment, such as that located on the Brak River (Plate 8 & 9), while several artificial systems such as water inundated borrowpits and dams are also prevalent in the area (Plate 10).

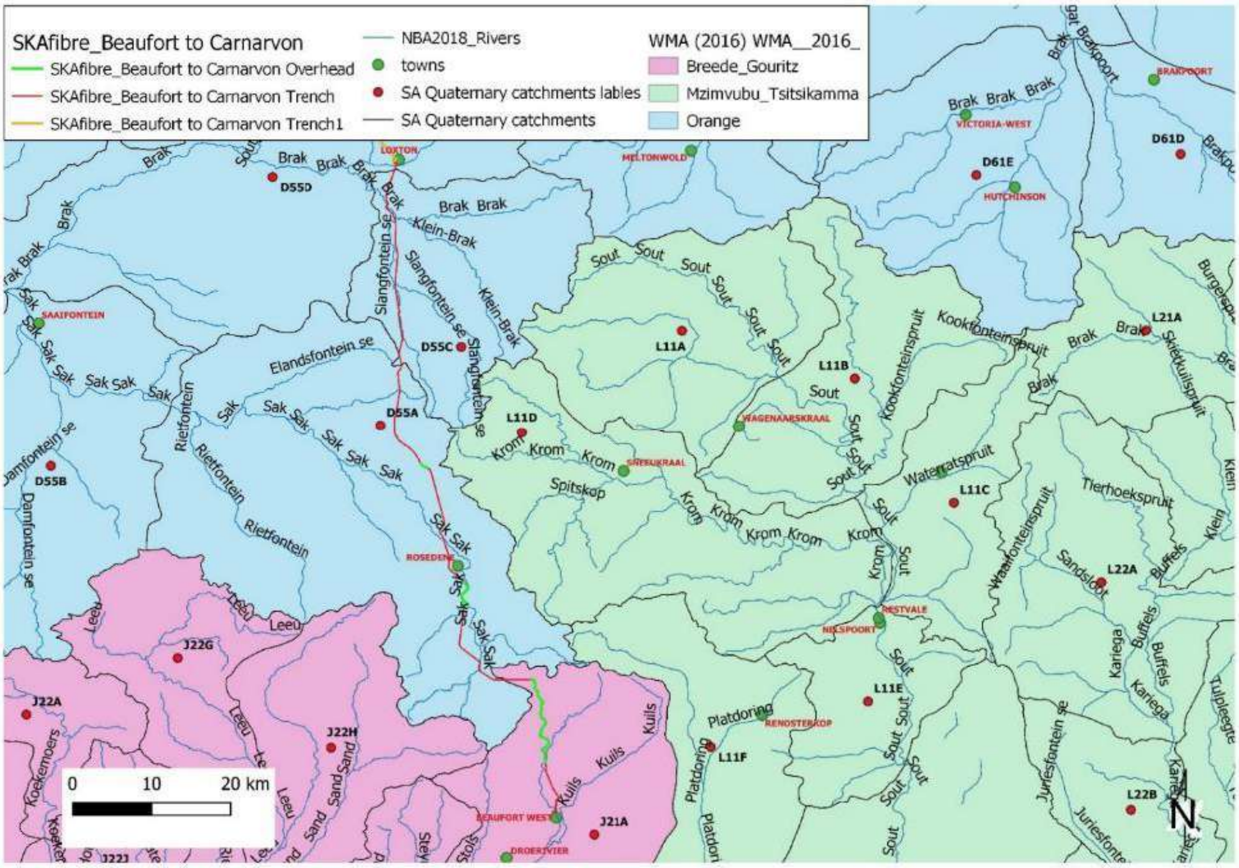


Figure 5: Mainstem rivers, quinary catchments and Water Management Areas traversed by the proposed cable between Beaufort West and Loxton

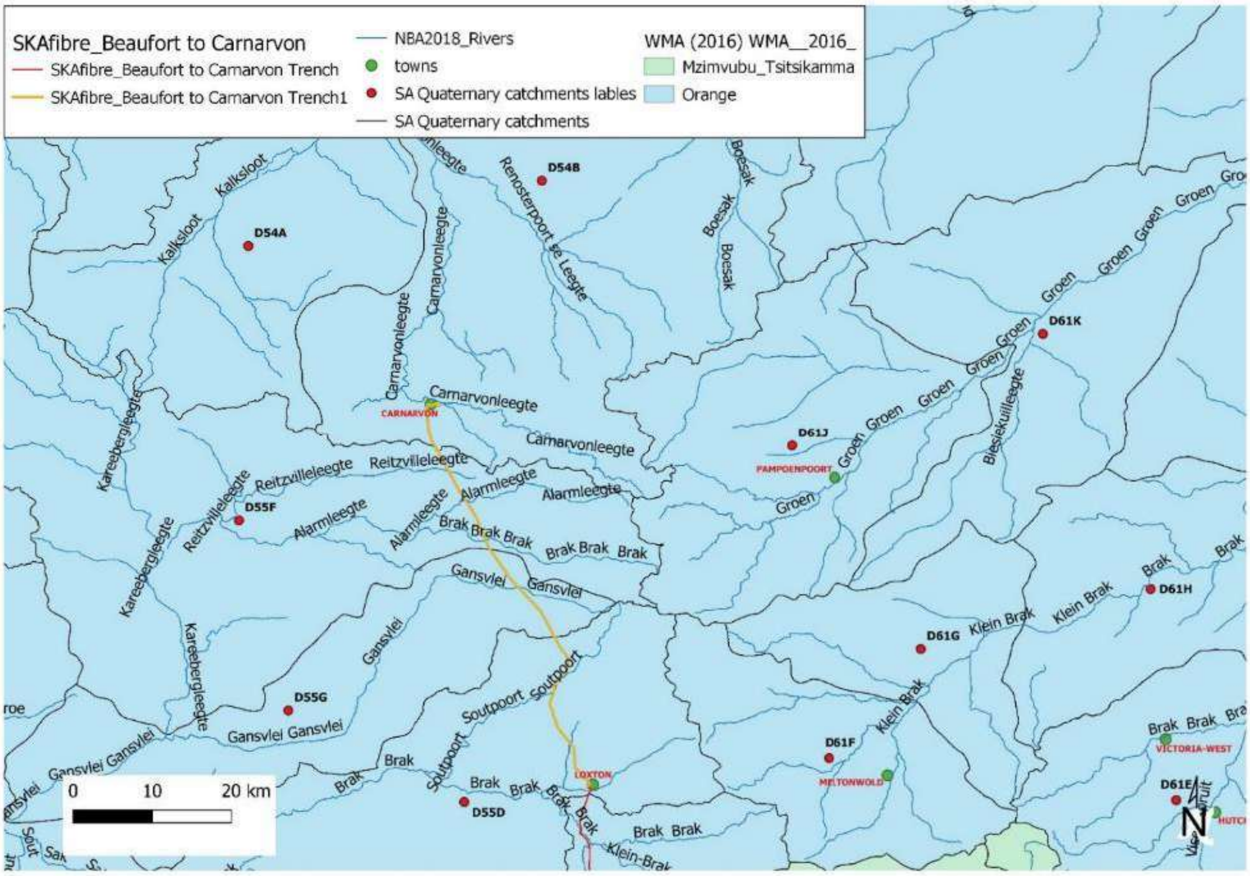


Figure 6: Figure 5: Mainstem rivers, quinary catchments and Water Management Areas traversed by the proposed cable between Loxton and Carnarvon

Plate 2: Large Valley Bottom wetland within Sak River, where the line will span via the overhead section of the cable (-32.070606S 22.454220E), noting that the wetland area must be avoided through means of HDD.

Plate 3: A channelled Valley Bottom Wetland on the Sak River along the surfaced section of the R381 (-32.1614S 22.4741E)

Plate 4: An aerial view of the same wetland shown in Plate 3 above, with a distinct channel meandering through the wetland areas (dark green = Sedges)

Plate 5: A alluvial riverine area with distinct riparian zone that develops intermittently along the floodplains more typical of the Brak and Slangfontein se Leegte systems

Plate 6: Aerial view of the drier alluvial systems (blue arrow, with little to no wetland features along the R381 closer to Loxton (road indicated by red arrow)

Plate 7: The sandy alluvial areas associated with the Gansvlei catchment along the R63 tarred portion of the alignment (-31.280294 S 22.301069 E)

Plate 8: Upstream view of the only major bridge along the cable alignment on the Brak River colonised by extensive *Phragmites australis* reedbeds. Here the proposed fibre optic cabling will be attached to the bridge

Plate 9: Downstream view of the wetland areas along the Brak River bridge crossing (-31.536364S 22.340223E)

Plate 10: Numerous small borrowpits are located along the road and these are inundated with water during high rainfall periods, but did not contain any significant aquatic species

4.1.2 Aquatic Species

Coupled to the aquatic delineations, information was collected on potential species that could occur within the wetlands and water courses, especially any areas that would contain open water for long periods and or conservation worthy species (Listed or Protected).

None of the dominant riparian / wetland associated plant species observed are listed or protected under any form of legislation. Plant species included the following;

- *Seersia lanceolata*
- *Vachellia karroo*
- *Ficinia nodusa*
- *Juncus effusus*
- *Carex spp*
- *Centella asiatica*
- *Erianthus capensis*
- *Sporobolus fimbriatus*
- *Cynodon incompletus*
- *Prosopis spp* (Exotic)
- *Eragrostis curvula*
- *Erharta calcynia*
- *Merxmuellera disticha*
- *Phragmites australis*
- *Cynodon dactylon*

Similarly, amphibian species are known to occur within the region based on collection data for Beaufort West and Karoo National Park, but little is known of the actual distribution of frogs within the study area. Therefore based on mapping data contained in Minter *et al*. (2004) and the FrogMAP spatial database, Table 5 indicates the potential frogs known to occur in the area and their preferred habitat, with three frog species being observed during this assessment.

None of these species are listed by the IUCN, but a special note is made by Minter *et al*. (2004), that detailed assessment of *Vandijkophrynus gariepensis gariepensis* (Karoo toad) is needed within the Nuweveld mountains. Two ectomorphic variations were collected (Karroo National Park - 3222BC), which possibly warrants subdivision into *Vandijkophrynus gariepensis gariepensis,* a larger and duller in colour variation found on the lower plains, and is different from the smaller and more brightly coloured specimens found only in isolated high lying mountain areas and should be raised to species status, namely, *Vandijkophrynus gariepensis nubicolus*.

Table 5: Potential and observed amphibians within the study area

FrogMAP. 2019. Animal Demography Unit. Accessed from http://frogmap.adu.org.za/?sp=400; on 2020.10.09.

Amphibian taxa	**Common Name**	**Conservation Status (IUCN)**	**Likelihood of occurring based on previous records and or availability of habitat**
Vandijkophrynus gariepensis gariepensis	Karoo toad	Least Concern	Observed
Cacosternum boettgeri	Common caco	Least Concern	Likely
Cacosternum karooicum	Karoo dainty frog	Least Concern	Unlikely
Strongylopus grayii	Clicking stream frog	Least Concern	Unlikely
Amietia fuscigula	Cape river frog	Least Concern	Observed
Xenopus laevis	African clawed toad	Least Concern	Observed
Tomopterna delanandii	Cape sand frog	Least Concern	Unlikely

No fish species were observed or have been recorded within the study area, although fish distributions in downstream areas, such as the Sak River, beyond the site boundaries (ca. 25km), indicate the following species, none of which are listed with conservation concern could occur:

- Chubbyhead Barb - *Enteromius anoplus*
- Vaal-orange Smallmouth Yellowfish - *Labeobarbus aeneus*
- Common carp - *Cyprinus carpio* (Exotic)
- Orange River Mudfish - *Labeo capensis*

5. Environmental Sensitivity

All of the systems that were assessed by DWS on a Subquaternary (quinary) level within the study area were rated as PES = B or Largely natural to C or Moderately Modified. While these were also rated as High to Moderate / Medium in terms of Ecological Sensitivity and Ecological Importance (DWS, 2014).

Based on the information collected during the field investigations, these ratings are verified and upheld for the riverine / alluvial systems. The natural wetlands were, however, rated independently and achieved PES scores of B & B/C, while the EIS was rated as HIGH. This high rating was due to the fact that these systems retained water during the dry periods, with small pools still evident in areas downstream of these wetlands area even after very little rainfall during 2020 (see Plate 4 above). These pools also create refugia for important fish and amphibians known to occur within the region, as well as provide drinking water to small mammals and livestock within the area.

The Moderate and High EIS rating for both natural water courses and wetlands, is further substantiated by the fact that the affected catchments are included in both the National Freshwater Priority Atlas and the provincial CBA spatial layers (Figure 7 and 8). These areas are highlighted as support areas for downstream rivers (Upstream FEPAs) and important corridors along the various river systems (Figure 7 & 8).

Overall, these catchment areas and subsequent rivers / watercourses are largely in a natural state with localised impacts in some areas, which include the following:

- Erosion and sedimentation associated with road crossings;
- Impeded water flow due to several in channel farm dams; and
- Sedimentation and scour of channels due to undersized culverts within present day road crossings.

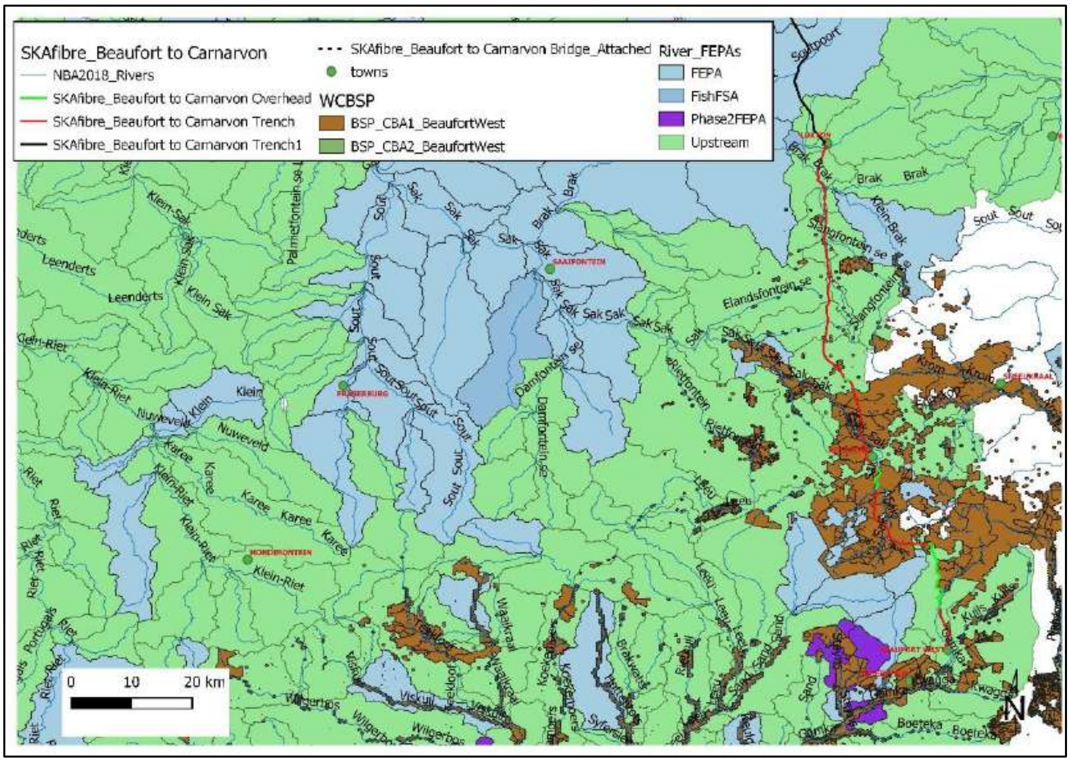


Figure 7: Spatial conservation plans and priority areas for the Beaufort West to Loxton portion of the cable alignment.

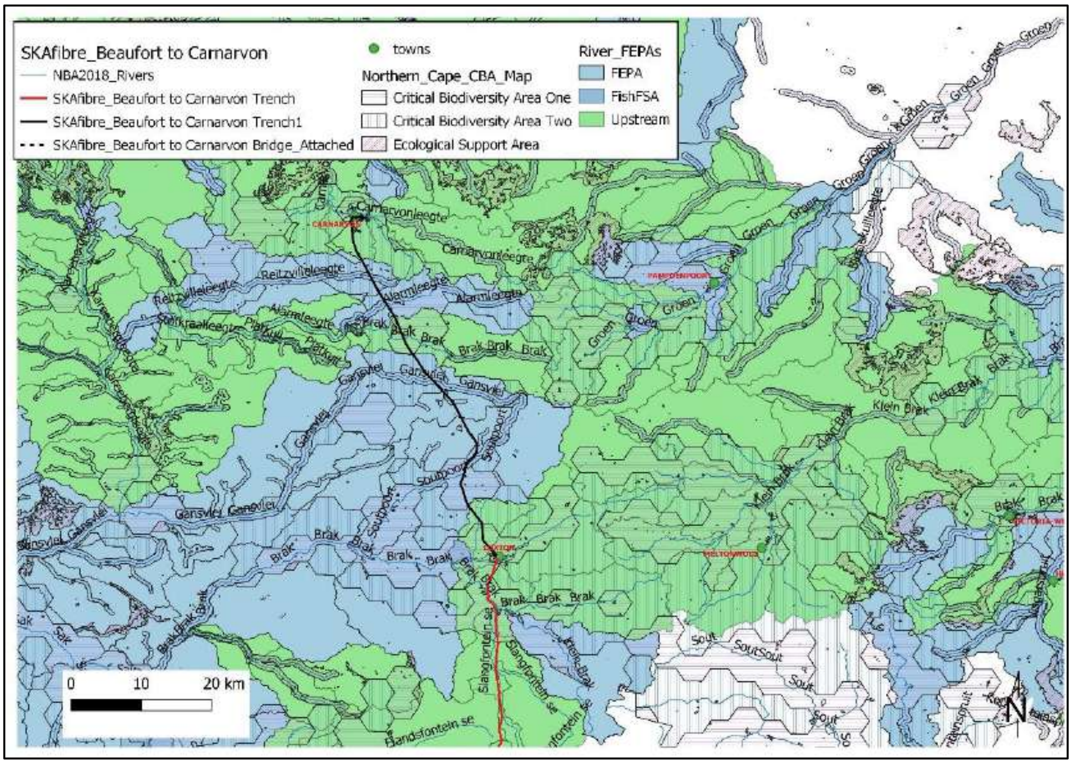


Figure 8: Spatial conservation plans and priority areas for the Loxton to Carnarvon portion of the cable alignment.

5.1 Sensitivities identified by the National Web-Based Environmental Screening Tool

Figure 9 below extracted from the DEFF Screening Tool does not indicate the exact position of the Very High sensitivity area, as indicated in the text of the report, but it is assumed that based on the importance of the known quinary catchments (NFEPAs), presence of wetlands, CBAs, and important rivers. A large number of the systems traversed by the project would have received this rating (Very High).

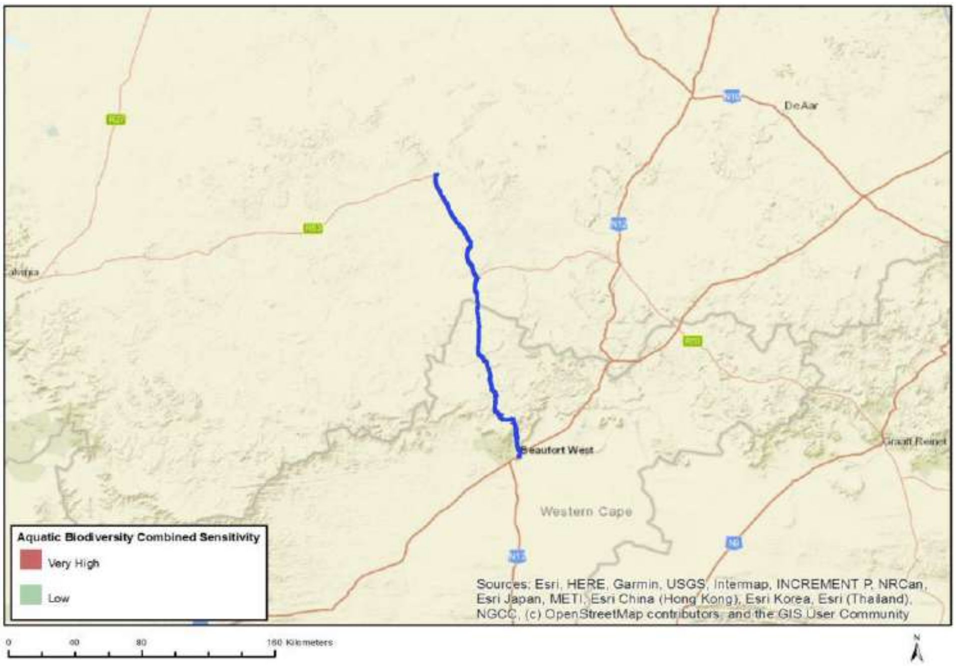


Figure 9: The map presented in the National Screening Tool results (note, due to the extent of the proposed fibre optic cable and the scale of the map automatically output by the Tool, the distribution of sensitivity classes within the study area is not visible).

5.2 Specialist Sensitivity Analysis and Verification

Using the baseline description and field data, while considering the current disturbances and site characteristics, the following features were identified and then categorised based on their sensitivity:

HIGH	All Valley Bottom Wetlands received the high sensitivity rating. Although these will be traversed, mostly by the overhead cable sections, it must be ensured that the towers are placed outside any of these delineated areas. Where the cable will be installed underground via trenching, it is advised that previously disturbed areas, or areas with minimal wetland plant growth be selected, or HDD be employed.
MEDIUM	This included all riverine systems, with or without riparian vegetation or that formed part of an alluvial system.
LOW	Areas of low sensitivity or constraints, such as artificial systems and minor 1:50 000 water courses
Neutral	Unconstrained areas (left blank in mapping)

Figure 10 a – k below indicates the proposed activities in relation to the delineated systems and the respective sensitivity ratings, noting that the delineated Pan / Depressions which would be considered having a High Sensitivity, are not shown in these maps as they are relatively far away from the proposed cable route and will thus be avoided by the proposed construction activities.

It is important to note that no buffers were proposed, as the alignment of the cable will follow the existing road and where buried will predominantly be located within the current servitude, and is thus installed in an existing footprint of disturbance, especially where the roads are maintained. The only caveat being that all stockpiles, laydown areas and construction camps must be located well outside of any delineated systems.

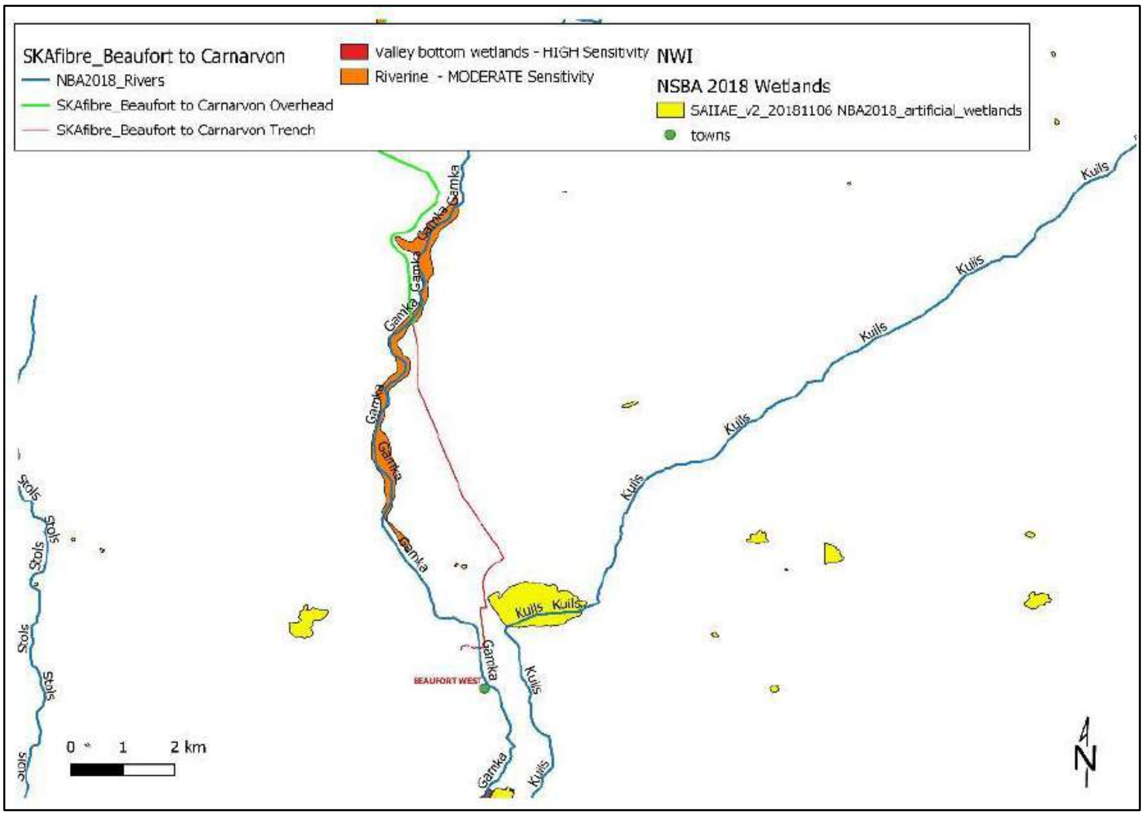


Figure 10a: The delineated waterbodies and their respective sensitivity ratings in relation to the proposed cable alignment, where all artificial systems are rated as LOW.

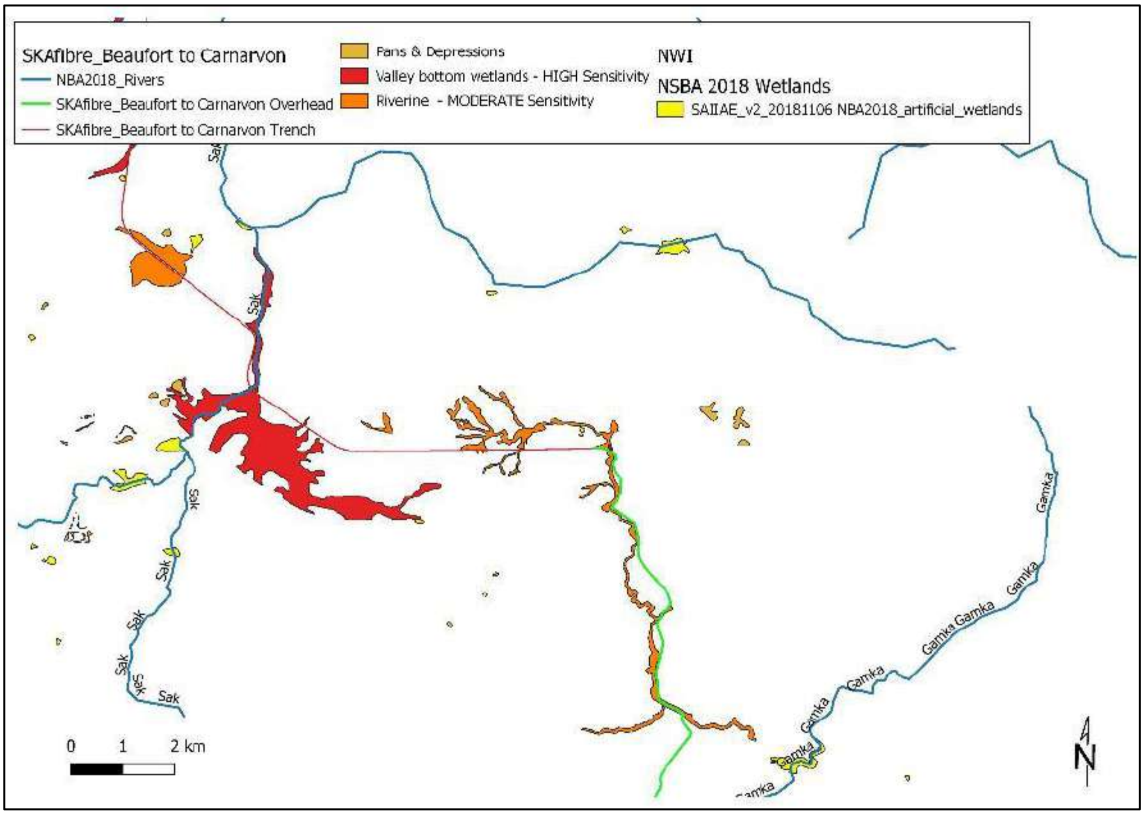


Figure 10b: The delineated waterbodies and their respective sensitivity ratings in relation to the proposed cable alignment, where all artificial systems are rated as LOW.

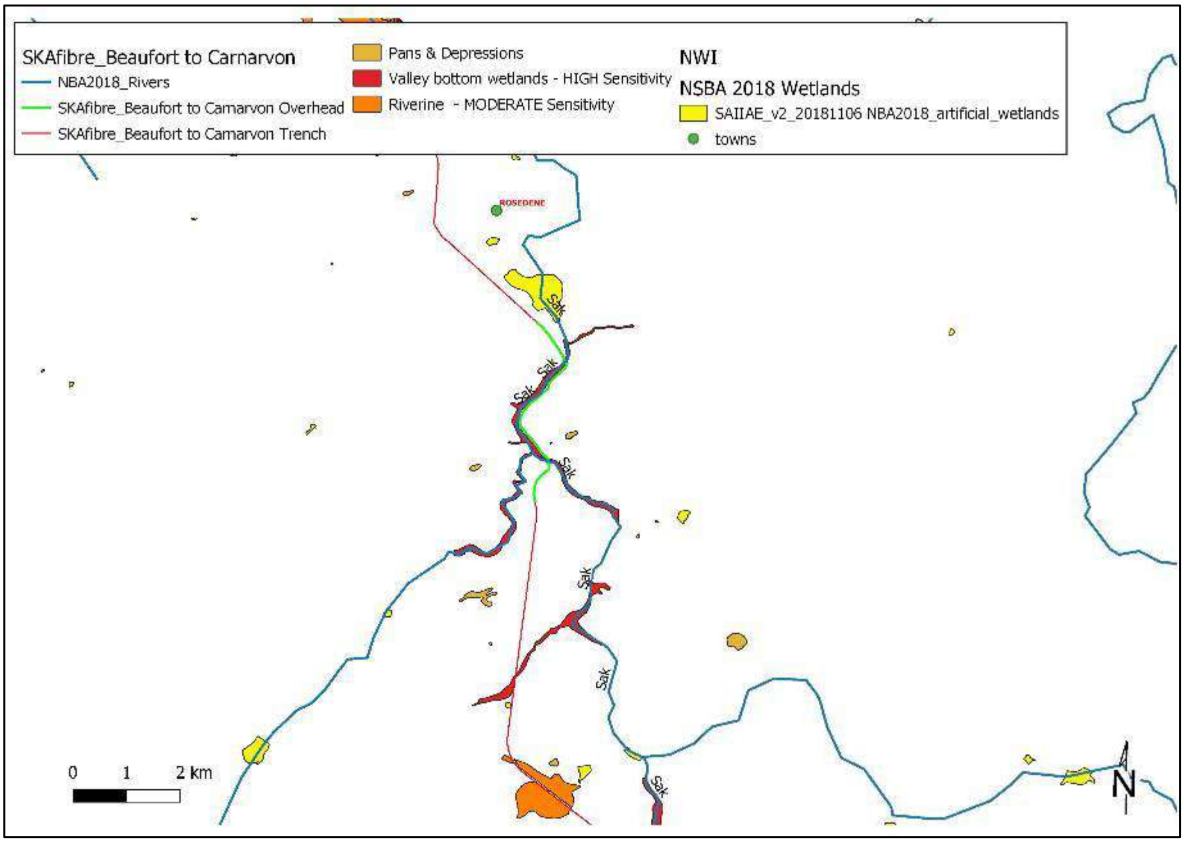


Figure 10c: The delineated waterbodies and their respective sensitivity ratings in relation to the proposed cable alignment, where all artificial systems are rated as LOW.

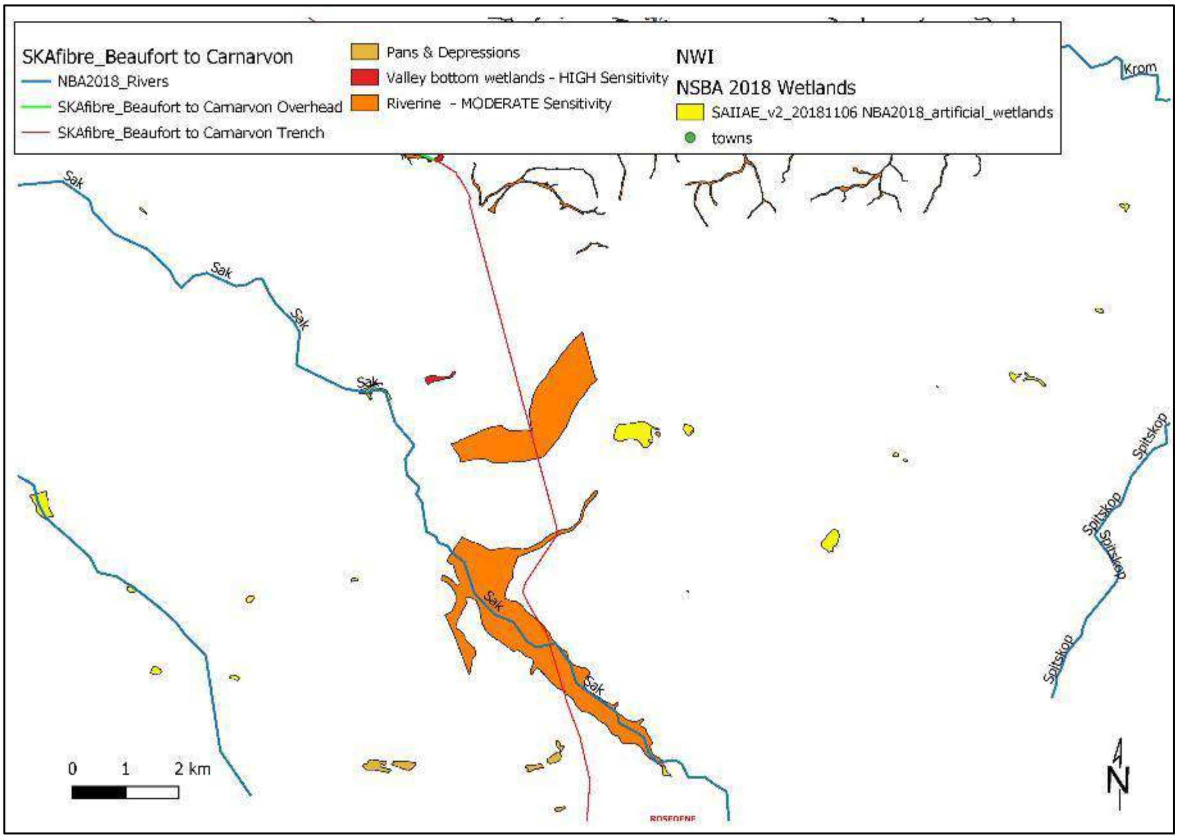


Figure 10d: The delineated waterbodies and their respective sensitivity ratings in relation to the proposed cable alignment, where all artificial systems are rated as LOW.

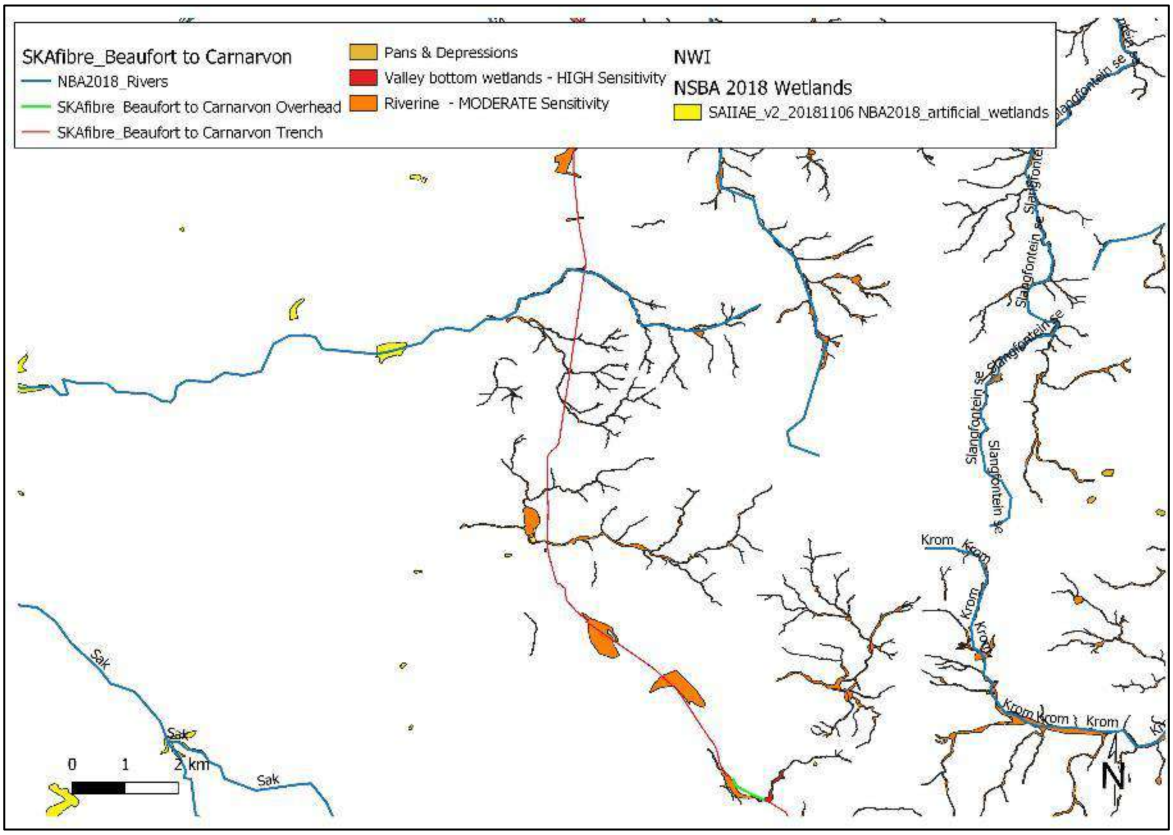


Figure 10e: The delineated waterbodies and their respective sensitivity ratings in relation to the proposed cable alignment, where all artificial systems are rated as LOW

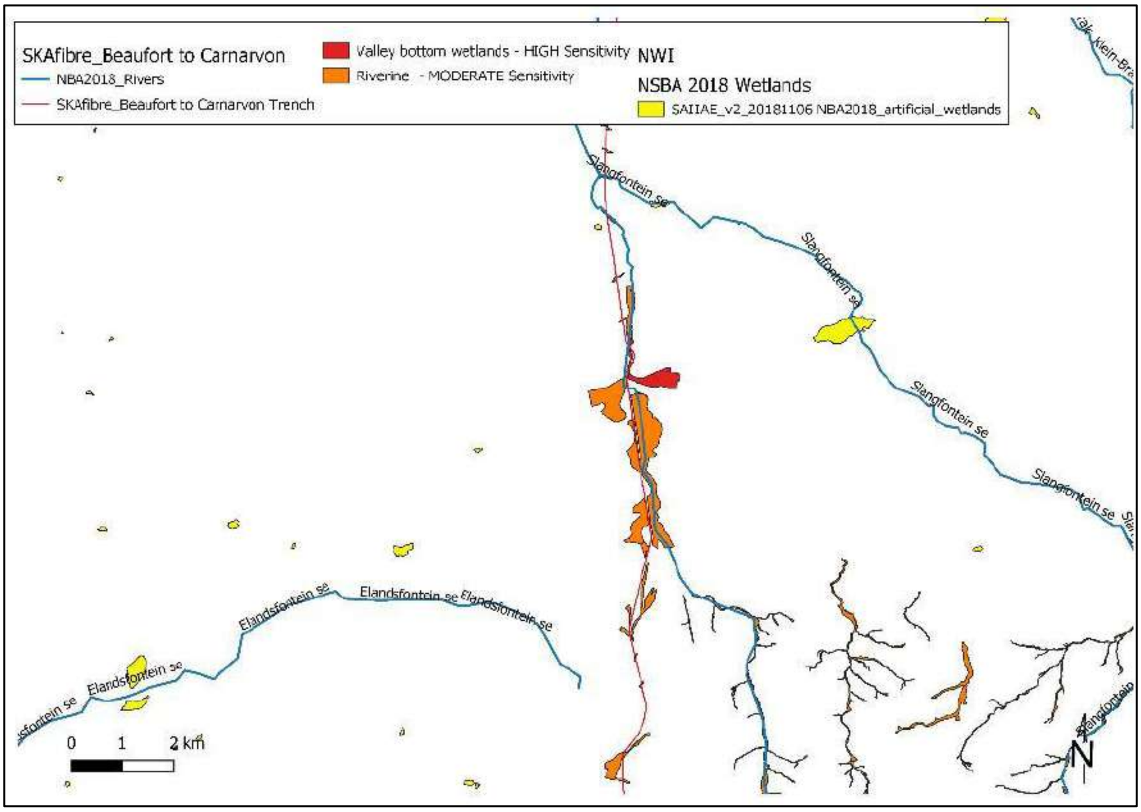


Figure 10f: The delineated waterbodies and their respective sensitivity ratings in relation to the proposed cable alignment, where all artificial systems are rated as LOW

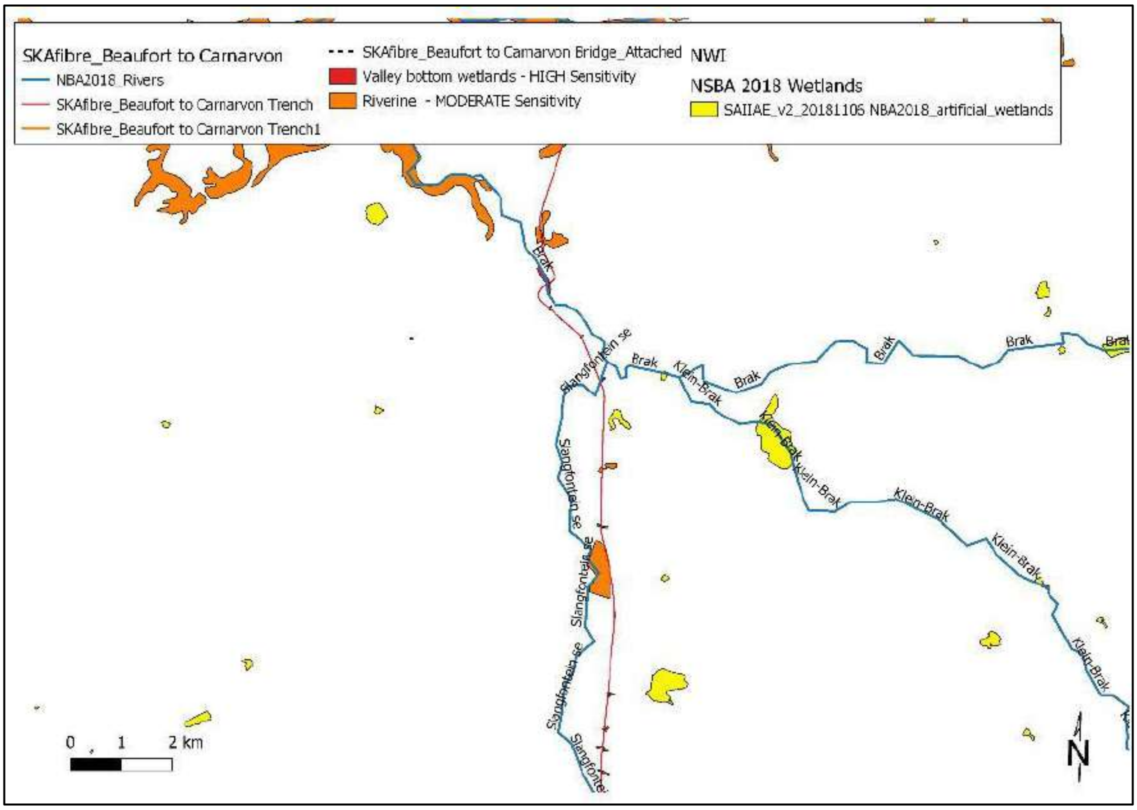


Figure 10g: The delineated waterbodies and their respective sensitivity ratings in relation to the proposed cable alignment, where all artificial systems are rated as LOW

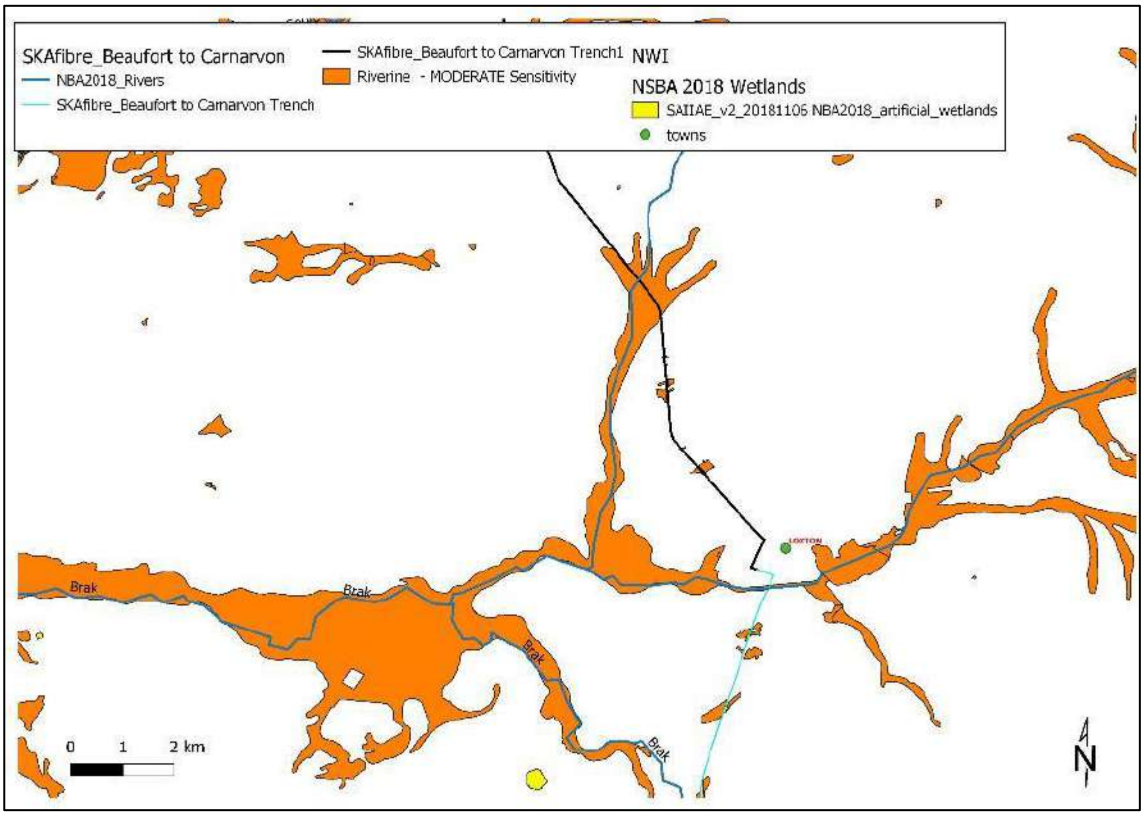


Figure 10h: The delineated waterbodies and their respective sensitivity ratings in relation to the proposed cable alignment, where all artificial systems are rated as LOW

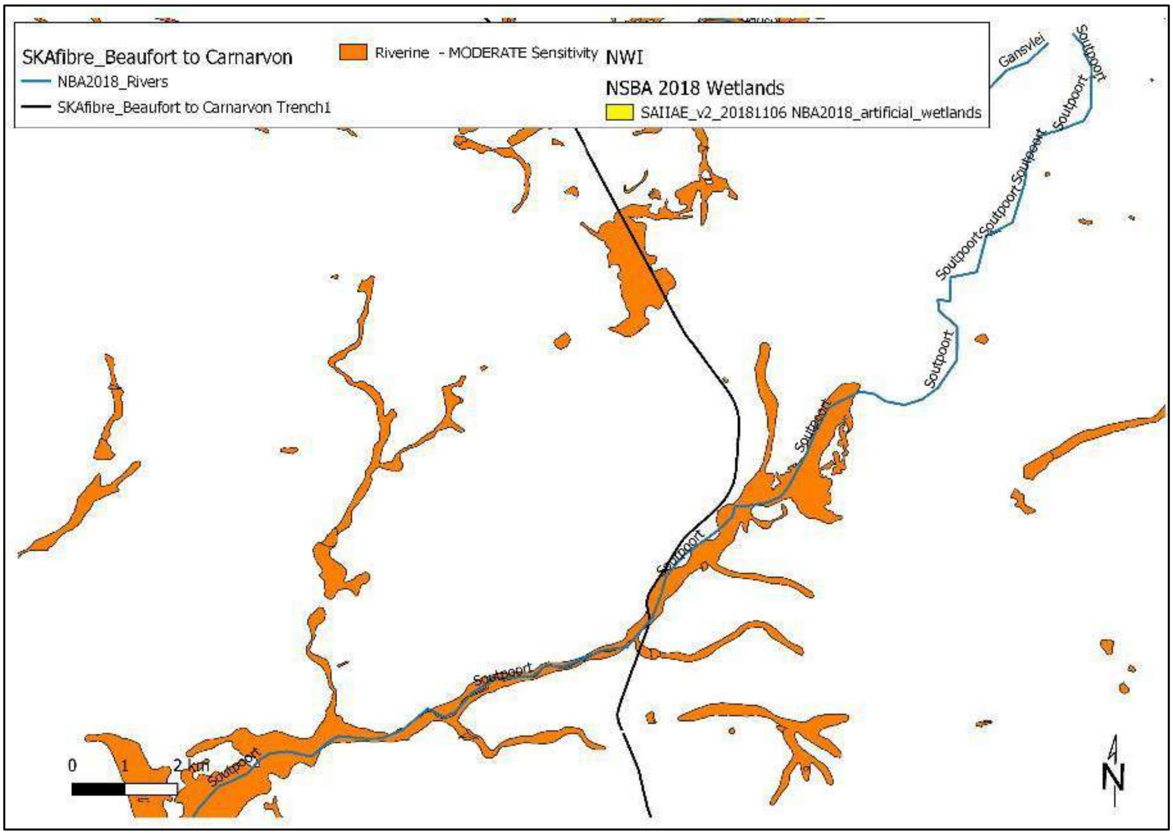


Figure 10i: The delineated waterbodies and their respective sensitivity ratings in relation to the proposed cable alignment, where all artificial systems are rated as LOW

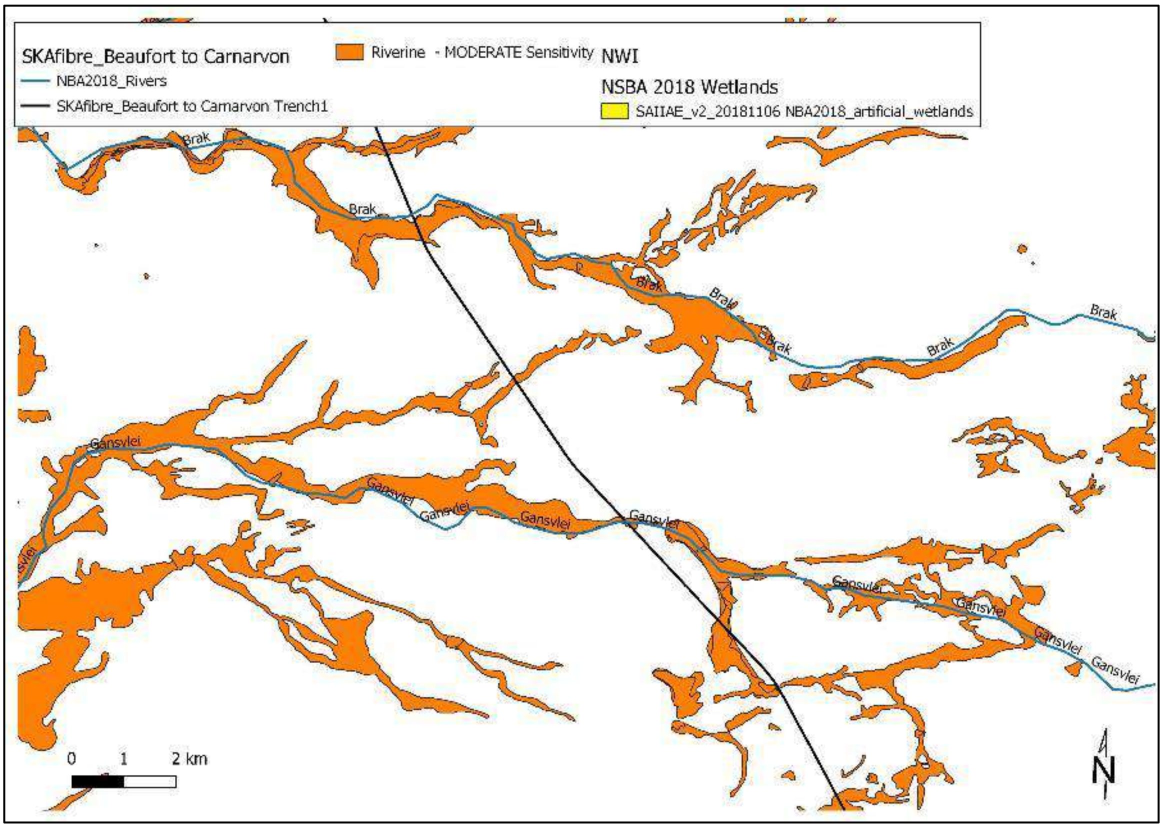


Figure 10j: The delineated waterbodies and their respective sensitivity ratings in relation to the proposed cable alignment, where all artificial systems are rated as LOW

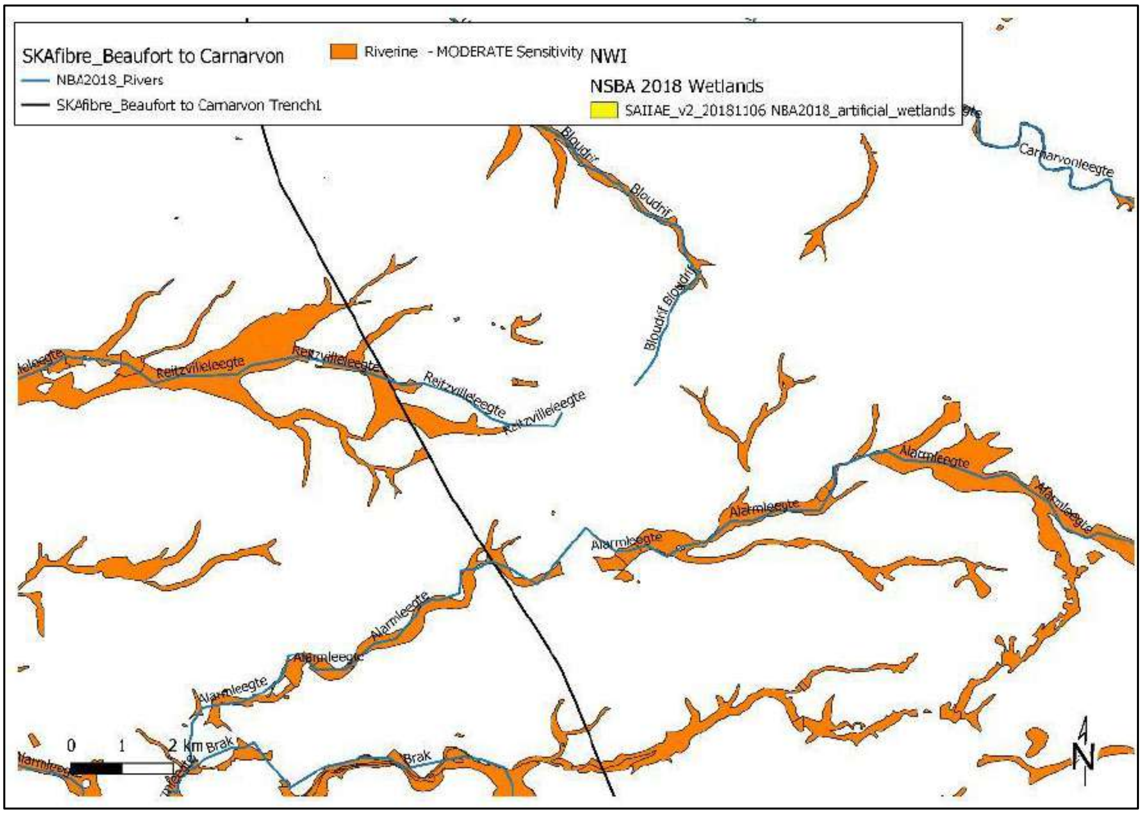


Figure 10k: The delineated waterbodies and their respective sensitivity ratings in relation to the proposed cable alignment, where all artificial systems are rated as LOW

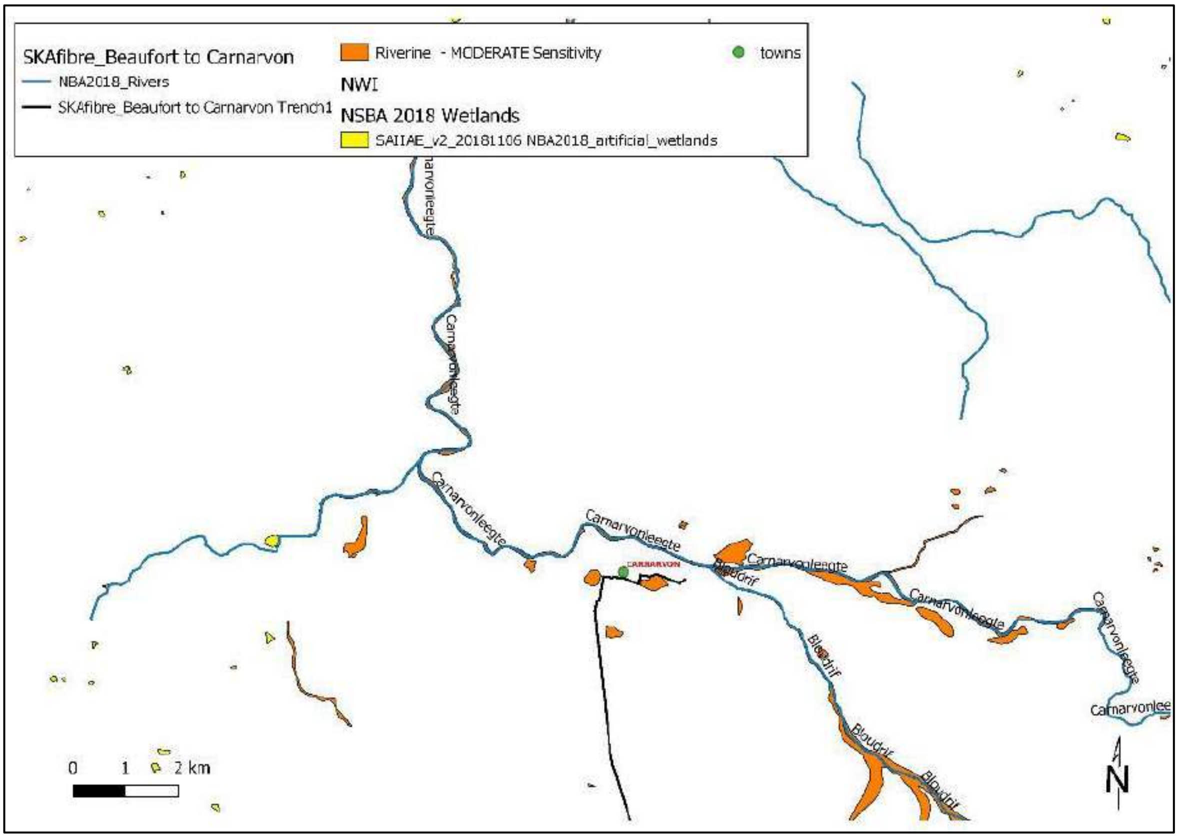


Figure 10l: The delineated waterbodies and their respective sensitivity ratings in relation to the proposed cable alignment, where all artificial systems are rated as LOW

5.2.1 Sensitivity Analysis Summary Statement

When compared to the results of the National Screening Tool results in relation to the receiving environment, i.e. cable predominantly within an existing road reserve, the Very High sensitivity ratings could be upheld for the wetland areas, while the remaining aquatic systems, based on their sensitivity and the disturbances mentioned, were rated as Moderate Sensitivity. Additional detail in this regard is provided in the site verification included in Appendix C.

6. Issues, Risks and Impacts

Due to the nature and limited width of the proposed cable footprint, the overall impacts are related to the construction and decommissioning phases of the project, i.e. when the soils are disturbed when the cables are placed or removed from the trenched sections of the alignment. It has been assumed that the overhead cable sections will have the poles placed outside of the demarcated wetland areas in particular and would thus have less of an impact.

The potential impacts identified during the assessment are:

Construction Phase

- Potential impact 1: Clearing of vegetation within wetland crossings.
- Potential impact 2: Clearing of vegetation within riverine (with riparian and or alluvial systems) crossings.
- Potential impact 3: Loss of species of special concern.
- Potential impact 4: Spills and leaks from construction vehicles / machinery when working in or near the delineated systems, impacting localised surface water quality.
- Potential impact 5: Erosion and Sedimentation.

Operational Phase

- Potential impact 1: Creation of hard surfaces, resulting in runoff, erosion and sedimentation

Decommissioning Phase

- Potential impact 1: Clearing of vegetation within wetland crossings.
- Potential impact 2: Clearing of vegetation within riverine (with riparian and or alluvial systems) crossings.
- Potential impact 3: Loss of species of special concern.
- Potential impact 4: Spills and leaks from construction vehicles / machinery when working in or near the delineated systems.
- Potential impact 5: Erosion and Sedimentation.

Cumulative Impacts

- Cumulative impact 1: All activities within delineated areas, when combined with present day activities.

7. Impact Assessment

7.1 Potential Impacts during the Construction Phase

IMPACT 1: Clearing of vegetation within wetland crossings – Direct impact

As several wetland were identified along the proposed route, especially in the southern portion of the cable alignment. There exists the potential for clearing of valley bottom wetland vegetation within the delineated systems, while Pans / Depression will be avoided.

Clearing of wetland vegetation would be limited as presently the R381 / R63 crosses these systems, while the larger systems south of Rosedene towards Beaufort West will have overhead lines, i.e. spanned and thus avoided.

Regardless, both means of crossing these system would thus limit the impact on flow regime through avoidance (spanned or buried), thus limiting the potential impact on water quality, habitat and biota in the long term or operational phases of the project once the vegetation has re-established.

IMPACT 2: Clearing of vegetation within riverine (with riparian and or alluvial systems) crossings – Direct Impact

Clearing of any riparian vegetation or disturbance of any bed or banks of alluvial systems would be limited as presently the R381 / R63 crosses these systems. This would limit the impact on flow regime through avoidance, thus reducing the potential impact on water quality, habitat and biota. This, coupled to the fact that limited habitat, that is accustomed to disturbance occupies the site, exists along the roads where the cabling is proposed – i.e. alluvial dominated systems that transport large volumes of sediment during high flow conditions.

IMPACT 3: Loss of species of special concern – Direct Impact

Several plant SCCs within the region are conservation worthy or are protected by the respective Provincial bodies of legislation, but no listed species were observed within any of the systems.

IMPACT 4: Spills and leaks from construction vehicles / machinery when working in or near the delineated systems, impacting localised surface water quality – Direct Impact

Leaks from machinery, vehicles or certain construction materials such as cement / concrete used during the construction phase have the potential to result in very localised pollution, should any spill / leaks occur within the watercourse / wetlands observed. These are likely to occur, but on a small scale, with quick remediation.

IMPACT 5: Erosion and Sedimentation – Direct Impact

Impact on localised surface water quality and habitat degradation, should the unstable soils will erode resulting in downstream sedimentation. This impact would have a limited effects on the natural watercourse / alluvial systems, as these already carry natural sediment loads when flowing, but this impact is more related to the wetland areas. Any disturbances within these areas, could impact on the flow and dynamics within the wetland areas in particular, although on a limited scale.

Impact Summary: Construction Phase

Impact 1	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
CONSTRUCTION PHASE						
Clearing of vegetation within wetland crossings	*Status*	*Negative*	*Low*	*Where wetland areas aren't spanned with the OHL, cables should be tied into the existing bridges. Should this not be an option, and the crossing distance suitable, then HDD is recommended. Failing these options, it is suggested that hand dug trenching occur in these areas (i.e. no mechanical trenching is allowed to*	***Very Low***	*High*
	Spatial Extent	*Site specific*				
	Duration	*Short term*				
	Consequence	*Moderate*				
	Probability	*Likely*				
	Reversibility	*Moderate*				
	Irreplaceability	*Low*				

				access these areas). Any of the activities, should also be monitored by the appointed aquatic specialist and EO/ECO on a daily basis, especially during periods of river flow. Any points of erosion should be stabilised immediately (sand bags in the short term) using gabions and reno mattress as required. No activities should take place outside of the demarcated servitude, to prevent additional cumulative impacts on these systems		

Impact 2	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
CONSTRUCTION PHASE						
Clearing of vegetation within riverine (with riparian and or alluvial systems) crossings	*Status*	*Negative*	*Low*	*Where riverine areas aren't spanned with the OHL, then the cables should be tied into the existing bridges. Should this not be an option, and the crossing distance suitable, then HDD is recommended. Any of the activities, should also be monitored by the appointed aquatic specialist and EO/ECO on a daily basis, especially during periods of river flow. Any points of erosion should be stabilised immediately (sand bags in the short term) using gabions and reno mattress as required. Activities should take place inside of the demarcated servitude / road reserve as far as possible, to prevent additional cumulative impacts on these systems*	***Very Low***	*High*
	Spatial Extent	*Site specific*				
	Duration	*Short term*				
	Consequence	*Moderate*				
	Probability	*Likely*				
	Reversibility	*Moderate*				
	Irreplaceability	*Low*				

Impact 3	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
CONSTRUCTION PHASE						
Loss of species of special concern	*Status*	*Negative*	*Low*	*Search and Rescue should be initiated prior to construction. Develop Construction EMP, Monitoring and Rehabilitation Plan*	***Very Low***	*High*
	Spatial Extent	*Regional*				
	Duration	*Long term*				
	Consequence	*Moderate*				
	Probability	*Unlikely*				
	Reversibility	*Moderate*				
	Irreplaceability	*Low*				

Impact 4	*Impact Criteria*		*Significance and Ranking*	*Potential mitigation measures*	*Significance and Ranking*	*Confidence Level*

			(Pre-Mitigation)		(Post-Mitigation)	
CONSTRUCTION PHASE						
Impact on localised surface water quality ***(Spills and leaks from construction vehicles / machinery when working in or near the delineated systems)***	*Status*	*Negative*	*Low*	*Construction EMP, Monitoring via appointed aquatic specialist and EO / ECO. No refuelling and or servicing of machinery and vehicles should occur within the delineated systems.*	***Very Low***	*High*
	Spatial Extent	*Site specific*				
	Duration	*Short term*				
	Consequence	*Moderate*				
	Probability	*Likely*				
	Reversibility	*Moderate*				
	Irreplaceability	*Low*				

Impact 5	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
CONSTRUCTION PHASE						
Erosion and Sedimentation	*Status*	*Negative*	*Low*	*Construction EMP, Monitoring via aquatic specialist and EO /ECO with daily inspection of works areas. Where any unstable soils occur, these must be protected with temporary stabilisation (sand bags or hay bales dependent on the scale of the operation) until areas become revegetated. In areas that have been identified after construction as requiring permanent erosion protection, active revegetation is encouraged. I.e. once construction has been completed, the disturbed areas are demarcated as exclusion areas from additional disturbance, thus preventing compaction / disturbance of area.*	***Very Low***	*High*
	Spatial Extent	*Site specific*				
	Duration	*Short term*				
	Consequence	*Moderate*				
	Probability	*Likely*				
	Reversibility	*Moderate*				
	Irreplaceability	*Low*				

7.2 Potential Impacts during the Operational Phase

IMPACT 1: Creation of hard surfaces, resulting in runoff, erosion and sedimentation – Indirect impact

This impact would be limited to any additional hard surface areas, although limited to manhole structures and any supporting infrastructure. Any such structures have then ability to generate surface water runoff, which then has the potential to create erosion with downstream sedimentation. Noting the alluvial nature of the receiving environment and the size and position of the structures, this impact is unlikely to occur.

Impact 1	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
OPERATIONAL PHASE						
Creation of hard surfaces resulting in runoff, erosion and sedimentation	Status	Negative	Low	Monitoring should occur on a monthly basis for 6 months post construction and where any unstable soils occur, these must be protected with temporary stabilisation dependent on the scale of the impact i.e. sand bags - hay bales) until areas become revegetated. If any areas require permanent erosion protection (e.g. gabions or stone pitching) then this must be include into the GA application.	**Very Low**	High
	Spatial Extent	Site specific				
	Duration	Short term				
	Consequence	Moderate				
	Probability	Unlikely				
	Reversibility	Moderate				
	Irreplaceability	Low				

7.3 Potential Impacts during the Decommissioning Phase

IMPACT 1: Clearing of vegetation within wetland crossings – direct impact

Any wetland vegetation that had re-established would need would be cleared, but as in the construction phase this would be limited as presently the R381 / R63 crosses these systems, while the larger systems south of Rosedene towards Beaufort West will have overhead lines, i.e. spanned and thus avoided.

IMPACT 2: Clearing of vegetation within riverine (with riparian and or alluvial systems) crossings – Direct Impact

Clearing of any riparian vegetation that re-established post construction or disturbance of any bed or banks of alluvial systems would be limited as presently the R381 / R63 crosses these systems. This would limit the impact on flow regime through avoidance, thus reducing the potential impact on water quality, habitat and biota. This coupled to the fact that limited habitat, that is accustomed to disturbance occupies the site, i.e. alluvial dominated systems that transport large volumes of sediment during high flow conditions would be affected.

IMPACT 3: Loss of species of special concern – Direct Impact

Several SCCs within the region are conservation worthy or are protected by the respective Provincial bodies of legislation, but no listed species were observed within any of the systems.

IMPACT 4: Spills and leaks from construction vehicles / machinery when working in or near the delineated systems, impacting localised surface water quality – Direct Impact

Leaks from plant / machinery or certain construction materials such as cement / concrete used during the decommissioning phase have the potential to result in very localised pollution, should any spill / leaks occur within the watercourse/wetlands observed. These are likely to occur, but on a small scale, with quick remediation.

IMPACT 5: Erosion and Sedimentation – Direct Impact

Impact on localised surface water quality and habitat degradation, should the unstable soils will erode resulting in downstream sedimentation. This impact would have a limited impact on the natural watercourse / alluvial systems, as these already carry natural sediment loads when flowing, but this impact is more related to the wetland areas. Any disturbances within these areas, could impact on the flow and dynamics within the wetland areas in particular, although on a limited scale.

Impact Summary: Decommissioning Phase

Impact 1	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
DECOMMISIONING PHASE						
Clearing of vegetation within wetland crossings	*Status*	*Negative*	*Low*	*Any of the activities, should also be monitored by the appointed EO/ECO on a daily basis, especially during periods of river flow. Any points of erosion should be stabilised immediately (sand bags in the short term) using gabions and reno mattress as required. No activities should take place outside of the demarcated servitude, to prevent additional cumulative impacts on these systems*	***Very Low***	*High*
	Spatial Extent	*Site specific*				
	Duration	*Short term*				
	Consequence	*Moderate*				
	Probability	*Likely*				
	Reversibility	*Moderate*				
	Irreplaceability	*Low*				

Impact 2	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
DECOMMISIONING PHASE						
Clearing of vegetation within riverine (with riparian and or alluvial systems) crossings	*Status*	*Negative*	*Low*	*Any of the activities, should also be monitored by the appointed EO/ECO on a daily basis, especially during periods of river flow. Any points of erosion should be stabilised immediately (sand bags in the short term) using gabions and reno mattress as required. No activities should take place outside of the demarcated servitude, to prevent additional cumulative impacts on these systems*	***Very Low***	*High*
	Spatial Extent	*Site specific*				
	Duration	*Short term*				
	Consequence	*Moderate*				
	Probability	*Likely*				
	Reversibility	*Moderate*				
	Irreplaceability	*Low*				

Impact 3	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
DECOMMISIONING PHASE						
Loss of species of special concern	*Status*	*Negative*	*Low*	*Search and Rescue of SCCs that may have established should be initiated prior to decommissioning.* *Implement EMP, Monitoring and Rehabilitation Plan*	***Very Low***	*High*
	Spatial Extent	*Regional*				
	Duration	*Long term*				
	Consequence	*Moderate*				
	Probability	*Unlikely*				
	Reversibility	*Moderate*				
	Irreplaceability	*Low*				

Impact 4	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
DECOMMISIONING						
Impact on localised surface water quality ***(Spills and leaks from construction vehicles / machinery when working in or near the delineated systems)***	*Status*	*Negative*	*Low*	*Construction EMP, Monitoring via EO / ECO and daily inspection of plant. No refuelling and or servicing of plant should occur within the delineated systems.*	***Very Low***	*High*
	Spatial Extent	*Site specific*				
	Duration	*Short term*				
	Consequence	*Moderate*				
	Probability	*Likely*				
	Reversibility	*Moderate*				
	Irreplaceability	*Low*				

Impact 5	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
DECOMMISIONING PHASE						
Erosion and Sedimentation	*Status*	*Negative*	*Low*	*Construction EMP, Monitoring via EO /ECO with daily inspection of works areas, where any unstable soils occur, these must be protected with temporary stabilisation (sand bags or hay bales dependent on the scale of the operation) until areas become revegetated. In areas that have been identified after construction as requiring permanent erosion protection, active revegetation is encouraged. I.e. once construction has been completed, the disturbed areas are demarcated as exclusion areas from additional disturbance, thus preventing compaction / disturbance of area.*	***Very Low***	*High*
	Spatial Extent	*Site specific*				
	Duration	*Short term*				
	Consequence	*Moderate*				
	Probability	*Likely*				
	Reversibility	*Moderate*				
	Irreplaceability	*Low*				

7.4 Cumulative Impacts

When assessing the impacts, it is unlikely that additional large scale impacts on the aquatic environment would occur, this being based on the fact that once stable / vegetated, the buried cable sleeves would not create any additional disturbances to the flow regime and or aquatic habitats observed. This is assuming that the mitigation in the construction, operational and decommissioning phases are adhered to.

Impact 1: All activities within delineated areas, when combined with present day activities

The cumulative impact of the present day roads combined with the proposed project activities that include disturbance of soils and movement of plant within any aquatic zones.

Impact Summary: Cumulative Impacts

Impact	*Impact Criteria*		*Significance and Ranking (Pre-Mitigation)*	*Potential mitigation measures*	*Significance and Ranking (Post-Mitigation)*	*Confidence Level*
CONSTRUCTION PHASE						
Additional activities within delineated aquatic areas within proximity to road reserves / servitudes	*Status*	*Negative*	*Low*	*All projects should adhere to the site-specific recommendations in their respective EMPrs to ensure that impacts are mitigated where possible – including avoidance of identified sensitive systems and usage of existing disturbance corridors.*	***Very low***	*High*
	Spatial Extent	*Site specific*				
	Duration	*Long term*				
	Consequence	*Moderate*				
	Probability	*Unlikely*				
	Reversibility	*Moderate*				
	Irreplaceability	*Low*				
OPERATIONAL PHASE						
Additional activities within delineated aquatic areas within proximity to road reserves / servitudes	*Status*	*Negative*	*Very Low*	*All projects should adhere to the site-specific recommendations in their respective EMPrs to ensure that impacts are mitigated where possible - including usage of existing disturbance corridors and stabilisation of erosion points (sand bags in the short term) using gabions and reno mattress as required.*	***Very Low***	*High*
	Spatial Extent	*Site specific*				
	Duration	*Short term*				
	Consequence	*Low*				
	Probability	*Unlikely*				
	Reversibility	*Moderate*				
	Irreplaceability	*Low*				
DECOMMISSIONING PHASE						
Additional activities within delineated aquatic areas within proximity to road reserves / servitudes	*Status*	*Negative*	*Low*	*All projects should adhere to the site-specific recommendations in their respective EMPrs to ensure that impacts are mitigated where possible. With regard the fibre line, Construction EMP, Monitoring via EO /ECO with daily inspection of works areas, where any unstable soils occur, these must be protected with temporary stabilisation (sand bags or hay bales dependent on the scale of the operation) until areas become revegetated. In areas that have been identified after construction as requiring permanent erosion protection, active revegetation is encouraged. I.e. once construction has been completed, the disturbed areas are demarcated as exclusion areas from additional disturbance, thus preventing compaction / disturbance of area.*	***Very Low***	*High*
	Spatial Extent	*Site specific*				
	Duration	*Short term*				
	Consequence	*Low*				
	Probability	*Unlikely*				
	Reversibility	*Moderate*				
	Irreplaceability	*Low*				

7.5 Impact Assessment Summary

An overall summary of the various impacts and within the various phases of the project are summarised below in Table 6:

Table 6: Overall Impact Significance (Post Mitigation)

Phase	**Overall Impact Significance**
Construction	Very Low
Operational	Very Low
Decommissioning	Very Low
Nature of Impact	**Overall Impact Significance**
Cumulative - Construction	Very Low
Cumulative - Operational	Very Low
Cumulative - Decommissioning	Very Low

8. Legislative and Permit Requirements

The following is pertinent to this study with regard protection of water resources or aquatic ecosystems for safe and equitable use, to provide human needs as per their rights contained in the following:

- Section 24 of The Constitution of the Republic of South Africa;
- Agenda 21 – Action plan for sustainable development of the Department of Environmental Affairs and Tourism (DEAT) 1998;
- National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998) inclusive of all amendments, as well as the NEM: Biodiversity Act
    - Outlines Activities that require Environmental Authorisation (EA) prior to commencement.
- National Water Act, 1998 (Act No. 36 of 1998)
    - Outlines Water Uses that require a WUL or GA prior to commencement (discussed in more detail below).
- Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983);
- Minerals and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002);
- National Forest Act (No. 84 of 1998); and
- National Heritage Resources Act (No. 25 of 1999) – applies if cultural use or heritage is linked to any aquatic resources (refer to the Heritage Specialist Study (CTS Heritage, 2020)).

Based on an assessment of the proposed activities (Table 7) and past engagement with DHWS, the following Water Use Authorisations may be required based on the following thresholds as listed in the following Government Notices, however ultimately the DHSWS must determine whether a GA or full WULA will be required during the pre-application process as it relates to the following.

DWS Notice 538 of 2016, 2 September in GG 40243– Section 21 a water uses relating to the Abstraction of water.
Government Notice 509 in GG 40229 of 26 August 2016 – Section 21 c & I water uses relating to the Impeding or diverting the flow of water in a watercourse and or altering the bed, banks, course or characteristics of a watercourse.
Government Notice 665, 6 September 2013 in GG 36820 Section 21g relating to disposing of waste in a manner that may detrimentally impact on a water source which includes temporary storage of domestic waste water i.e. conservancy tanks under Section 37 of the notice.

Table 7: Summary of potential water uses

	Water Use Activity	Applicable to this development proposal
S21(a)	Taking water from a water resource	Yes, if water is abstracted from new and or existing boreholes, dams or rivers.
S21(b)	Storing water	Only if water is stored within a dam. The use of tanks and reservoirs is thus advised as these don't require a license
S21(c)	Impeding or diverting the flow of water in a watercourse	If any works (permanent or temporary) are located within a watercourse or within 500m of a wetland boundary then a GA process can potentially be followed if the DWS Risk Assessment Matrix indicates that all impacts with mitigation are LOW (see Appendix D).
S21(d)	Engaging in a stream flow reduction activity	Not applicable
S21(e)	Engaging in a controlled activity	Not applicable
S21(f)	Discharging waste or water containing waste into a water resource through a pipe, canal, sewer or other conduit	Not applicable
S21(g)	Disposing of waste in a manner which may detrimentally impact on a water resource	Typically, the conservancy tanks at construction camps require a license (GA if volumes are below 5000 m^3)
S21(h)	Disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process	Not applicable
S21(i)	Altering the bed, banks, course or characteristics of a watercourse	If any works (permanent or temporary) are located within a watercourse or within 500m of a wetland boundary then a GA process can potentially be followed if the DWS Risk Assessment Matrix indicates that all impacts with mitigation are LOW (see Appendix D).
S21(j)	Removing, discharging or disposing of water found underground for the continuation of an activity or for the safety of persons	Not applicable
S21(k)	Using water for recreational purposes	Not applicable

DHSWS DETERMINES WHETHER A GA OR WULA APPLICATION WILL BE REQUIRED DURING THE PREAPPLICATION PHASE – FOR THE PROPOSED FIBRE OPTIC CABLE A GA HAS BEEN DETERMINED AS AN APPORIATE WATER USE AUTHORISATION MECHANISM.

9. Water Use License Risk Assessment Matrix

As indicated in the section above, if any of the Section 21c & i activities are considered Low risk, based on the outcomes of the DWS Risk Assessment Matrix (refer to Appendix D for full results), then a GA could be issued.

The Risk Assessment Matrix impacts are rated as LOW, and thus a GA process is recommended as being sufficient. DHSWS ultimately determines whether a GA process is acceptable, when coupled to any other of the proposed uses. Based on the Risk Assessment Matrix results, pre-application consultation and site visit by the DHSW, Environmental Assessment Practitioner and Project Proponent in November 2020, a GA has been confirmed as the appropriate WUA mechanism for the proposed fibre optic cable.

10. Environmental Management Programme Inputs

The following are key recommendations, which are also critical to the proposed mitigations:

- Where wetland areas aren't spanned with the OHL, the cables should be tied into the existing bridges. Should this not be an option, and the crossing distance suitable, then HDD is recommended. Failing these options, then it is suggested that hand dug trenching occur in these areas (i.e. no mechanical trenching is allowed to access these areas).

- Any of the activities, should also be monitored by the appointed aquatic ecologist and EO/ECO on a daily basis, especially during periods of river flow.
- Any points of erosion should be stabilised immediately (sand bags in the short term) using gabions and reno mattress as required. No activities should take place outside of the demarcated servitude, to prevent additional cumulative impacts on these systems.
- Search and Rescue should be initiated prior to construction.
- The EMPr, must include a Specific Monitoring and Rehabilitation Plan related to the water course and wetland crossings, and specifically to the prevention of erosion and sedimentation as these system are prone to scour, with rehabilitation options being limited due to the sparse nature of the vegetation.
- Monitoring should occur on a monthly basis for 6 months post construction and where any unstable soils occur, these must be protected with temporary stabilisation dependent on the scale of the impact i.e. sand bags - hay bales) until areas become revegetated. If any areas require permanent erosion protection (e.g. gabions or stone pitching) then the GA must be amended to include these areas.

11. Final Specialist Statement and Authorisation Recommendation

A variety of aquatic features, mostly ephemeral in nature were identified within the study area and, where required, the layout has taken some cognisance of these features through the inclusion of section of cable on overhead lines or attached to bridges. On these grounds the current overall impact on the aquatic environment is Very Low (with mitigation).

11.1. Statement and Reasoned Opinion

Based on the findings of this study, the specialist finds no reason to withhold an authorisation of any of the proposed activities, assuming that the key recommended mitigations measures are implemented.

11.2. EA Condition Recommendations

- A key recommendation is that that during the construction mobilisation process, that the temporary construction camps, stockpiles and laydown areas are located outside of any delineated aquatic systems and within any existing disturbed areas
- A final walkdown by an aquatic specialist must be conducted to ensure that any of the proposed structures are placed within disturbed areas within the servitude as far as possible, sensitive systems are avoided and appropriate construction methods (e.g. hand-dug trenching and HDD) are employed as necessary.

12. References

Agenda 21 – Action plan for sustainable development of the Department of Environmental Affairs and Tourism (DEAT) 1998.

Agricultural Resources Act, 1983 (Act No. 43 of 1983).

Berliner D. and Desmet P. 2007. Eastern Cape Biodiversity Conservation Plan: Technical Report. Department of Water Affairs and Forestry Project No 2005-012, Pretoria.

CTS Heritage. 2020. Heritage Impact Assessment in terms of Section 38(8) of the NHRA for the proposed Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon, Northern and Western Cape.

Cowardin L.M., Carter V, Golet F.C. and Laroe E.T. (1979) Classification of wetlands and deepwater habitats of the United States. FWS-OBS-79-31. US Fish and Wildlife Service, Washington, DC. Davies, B. and Day J., (1998). Vanishing Waters. University of Cape Town Press.

Davis, T.J. (Editor). 1994. The Ramsar Convention Manual: A guide for the Convention on Wetlands of International Importance especially as waterfowl habitat. Ramsar Convention Bureau, Gland, Switzerland. 207 p.

Department of Water Affairs and Forestry - DWAF (2005). A practical field procedure for identification and delineation of wetland and riparian areas Edition 1. Department of Water Affairs and Forestry , Pretoria.

Department of Water Affairs and Forestry - DWAF (2008). Manual for the assessment of a Wetland Index of Habitat Integrity for South African floodplain and channelled valley bottom wetland types by M. Rountree (ed); C.P. Todd, C. J. Kleynhans, A. L. Batchelor, M. D. Louw, D. Kotze, D. Walters, S. Schroeder, P. Illgner, M. Uys. and G.C. Marneweck. Report no. N/0000/00/WEI/0407. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria, South Africa.

Department of Water and Sanitation. 2014. A Desktop Assessment of the Present Ecological State, Ecological Importance and Ecological Sensitivity per Sub Quaternary Reaches for Secondary Catchments in South Africa. Compiled by RQIS-RDM: https://www.dwa.gov.za/iwqs/rhp/eco/peseismodel.aspx accessed on [15 August 2020].

Driver A., Sink, K.J., Nel, J.N., Holness, S., Van Niekerk, L., Daniels, F., Jonas, Z., Majiedt, P.A., Harris, L. & Maze, K. 2012. National Biodiversity Assessment 2011: An assessment of South Africa's biodiversity and ecosystems. Synthesis Report. South African National Biodiversity Institute and Department of Environmental Affairs, Pretoria.

Du Preez, L. And Carruthers, V. 2009. A Complete Guide To Frogs Of Southern Africa. Struik Nature, Cape Town

Ewart-Smith J.L., Ollis D.J., Day J.A. and Malan H.L. (2006). National Wetland Inventory: Development of a Wetland Classification System for South Africa. WRC Report No. KV 174/06. Water Research Commission, Pretoria.

IUCN (2019). Red List of Threatened Species. IUCN Species Survival Commission, Cambridge Available: http://www.iucnredlist.org/

Kleynhans C.J., Thirion C. and Moolman J. (2005). A Level 1 Ecoregion Classification System for South Africa, Lesotho and Swaziland. Report No. N/0000/00/REQ0104. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria.

Kotze D.C., Marneweck G.C., Batchelor A.L., Lindley D.S. and Collins N. (2008). WET-EcoServices A technique for rapidly assessing ecosystem services supplied by wetlands. WRC Report No: TT 339/08.

Lombard AT, Strauss T, Harris J, Sink K, Attwood C and Hutchings L (2005) South African National Spatial Biodiversity Assessment 2004. Technical Report, Volume 4: Marine Component. South African National Biodiversity Institute, Pretoria.

Macfarlane, D.M., Kotze, D.C., Ellery, W.N., Walters, D., Koopman, V., Goodman, P. & Goge, C. (2009). WET-Health: A technique for rapidly assessing wetland health. Water Research Commission Report TT, 340(09).

Macfarlane, D.M. & Bredin, I.P. 2017. Buffer Zone Guidelines for Rivers, Wetlands and Estuaries Buffer Zone Guidelines for Rivers, Wetlands and Estuaries. WRC Report No TT 715/1/17 Water Research Commission, Pretoria.

Minerals and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002), as amended.

Minter L.R., Burger M., Harrison J.A., Braack H.H., Bishop P.J. & Kloepfer D. (eds). 2004. *Atlas and Red Data book of the frogs of South Africa, Lesotho and Swaziland.* SI/MAB Series no. 9. Smithsonian Institution, Washington, D.C. Published by the Smithsonian Institution and the Avian Demography Unit (now Animal Demography Unit).

Mitsch, J.G. and Gosselink, G. (2000). Wetlands 3rd End, Wiley, NewYork, 2000, 920 pg.

Mucina, L., & Rutherford, M.C., 2006. The Vegetation of South Africa, Lesotho and Swaziland, Strelitzia 19, South Africa.

National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended.

National Water Act, 1998 (Act No. 36 of 1998), as amended

Nel, J., Maree, G., Roux, D., Moolman, J., Kleynhans, N., Silberbauer, M. and Driver, A. 2004. South African National Spatial Biodiversity Assessment 2004: Technical Report. Volume 2: River Component. CSIR Report Number ENV-S-I-2004-063. Council for Scientific and Industrial Research, Stellenbosch.

Nel, J.L., Murray, K.M., Maherry, A.M., Petersen, C.P., Roux, D.J., Driver, A., Hill, L., Van Deventer, H., Funke, N., Swartz, E.R., Smith-Adao, L.B., Mbona, N., Downsborough, L. and Nienaber, S. (2011). Technical Report for the National Freshwater Ecosystem Priority Areas project. WRC Report No. K5/1801.

Ollis, D.J., Snaddon, C.D., Job, N.M. & Mbona, N. 2013. Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems. SANBI Biodiversity Series 22. South African National Biodiversity Institute, Pretoria.

Parsons R. (2004). Surface Water – Groundwater Interaction in a Southern African Context. WRC Report TT 218/03, Pretoria.

Pool-Stanvliet, R., Duffell-Canham, A., Pence, G. & Smart, R. 2017. The Western Cape Biodiversity Spatial Plan Handbook. Stellenbosch: CapeNature.

Ramsar Convention, (1971) including the Wetland Conservation Programme (DEAT) and the National Wetland Rehabilitation Initiative (DEAT, 2000).

Rowntree, K., Wadesone, R. and O'Keeffe, J. 2000. The development of a geomorphological classification system for the longitudinal zonation of South African rivers. South African Geographical Journal 82(3): 163-172.

South African Bird Atlasing Project 2 (SABAP2). 2017. Animal Demographic Unit. Available online: http://sabap2.adu.org.za/

South African National Biodiversity Institute (SANBI). 2018. National Biodiversity Assessment (NBA). Available online: http://bgis.sanbi.org/Projects/Detail/221

Stuart, C and Stuart, T. 2007. A field guide to the mammals of Southern Africa. Struik Nature, Cape Town.

van Deventer H., Smith-Adao, L. Petersen C., Mbona N., Skowno A., Nel, J.L. (2018) Review of available data for a South African Inventory of Inland Aquatic Ecosystems (SAIIAE). Water SA 44 (2) 184-199

Appendix A - Specialist Expertise

CURRICULUM VITAE
Dr Brian Michael Colloty
7212215031083

1 Rossini Rd
Pari Park
Port Elizabeth, 6070
brianc@envirosci.co.za
083 498 3299

Profession: Ecologist (Pr. Sci. Nat. 400268/07) Member of the South African Wetland Society
Specialisation: Ecology and conservation importance rating of inland habitats, wetlands, rivers & estuaries
Years experience: 25 years

SKILLS BASE AND CORE COMPETENCIES

- 25 years experience in environmental sensitivity and conservation assessment of aquatic and terrestrial systems inclusive of Index of Habitat Integrity (IHI), WET Tools, Riparian Vegetation Response Assessment Index (VEGRAI) for Reserve Determinations, estuarine and wetland delineation throughout Africa. Experience also includes biodiversity and ecological assessments with regard sensitive fauna and flora, within the marine, coastal and inland environments. Countries include Mozambique, Kenya, Namibia, Central African Republic, Zambia, Eritrea, Mauritius, Madagascar, Angola, Ghana, Guinea-Bissau and Sierra Leone. Current projects also span all nine provinces in South Africa.
- 15 years experience in the coordination and management of multi-disciplinary teams, such as specialist teams for small to large scale EIAs and environmental monitoring programmes, throughout Africa and inclusive of marine, coastal and inland systems. This includes project and budget management, specialist team management, client and stakeholder engagement and project reporting.
- GIS mapping and sensitivity analysis

TERTIARY EDUCATION

- 1994: B Sc Degree (Botany & Zoology) - NMU
- 1995: B Sc Hon (Zoology) - NMU
- 1996: M Sc (Botany - Rivers) - NMU
- 2000: Ph D (Botany – Estuaries & Mangroves) – NMU

EMPLOYMENT HISTORY

- 1996 – 2000 Researcher at Nelson Mandela University – SAB institute for Coastal Research & Management. Funded by the WRC to develop estuarine importance rating methods for South African Estuaries
- 2001 – January 2003 Training development officer AVK SA (reason for leaving – sought work back in the environmental field rather than engineering sector)
- February 2003- June 2005 Project manager & Ecologist for Strategic Environmental Focus (Pretoria) – (reason for leaving – sought work related more to experience in the coastal environment)
- July 2005 – June 2009 Principal Environmental Consultant Coastal & Environmental Services (reason for leaving – company restructuring)
- June 2009 – August 2018 Owner / Ecologist of Scherman Colloty & Associates cc
- August 2018 Owner / Ecologist - EnviroSci (Pty) Ltd

SELECTED RELEVANT PROJECT EXPERIENCE

World Bank IFC Standards

- Botswana South Africa 400kv transmission line (400km) biodiversity assessment on behalf of Aurecon - current
- Farim phosphate mine and port development, Guinea Bissau – biodiversity and estuarine assessment on behalf of Knight Piesold Canada – 2016.
- Tema LNG offshore pipeline EIA – marine and estuarine assessment for Quantum Power (2015).
- Colluli Potash South Boulder, Eritrea, SEIA marine baseline and hydrodynamic surveys co-ordinator and coastal vegetation specialist (coastal lagoon and marine) (on-going).
- Wetland, estuarine and riverine assessment for Addax Biofeuls Sierra Leone, Makeni for Coastal & Environmental Services: 2009
- ESHIA Project manager and long-term marine monitoring phase coordinator with regards the dredge works required in Luanda bay, Angola. Monitoring included water quality and biological changes in the bay and at the offshore disposal outfall site, 2005-2011

South African

- Nuweveld Wind Farms aquatic assessment for RedCap renewables, (3 wind farms and 130km transmission line) - current
- Plant and animal search and rescue for the Karusa and Soetwater Wind Farms on behalf of Enel Green Power, Current
- Plant and animal search and rescue for the Nxuba, Oyster Bay and Garob Wind Farms on behalf of Enel Green Power, 2018 - 2019
- Plant and Animal Search and Rescue for the Port of Ngqura, Transnet Landside infrastructure Project, with development and management of on site nursery, Current
- Plant and Animal Search and Rescue for the Port of Ngqura, OTGC Tank Farm Project (2019)
- Plant search and rescue, for NMBM (Driftsands sewer, Glen Hurd Drive), Department of Social Development (Military veterans housing, Despatch) and Nxuba Wind Farm, - current
- Wetland specialist appointed to update the Eastern Cape Biodiversity Conservation Plan, for the Province on behalf of EOH CES appointment by SANBI – current. This includes updating the National Wetland Inventory for the province, submitting the new data to CSIR/SANBI.
- CDC IDZ Alien eradication plans for three renewable projects Coega Wind Farm, Sonop Wind Farm and Coega PV, on behalf of JG Afrika (2016 – 2017).
- Nelson Mandela Bay Municipality Baakens River Integrated Wetland Assessment (Inclusive of Rehabilitation and Monitoring Plans) for CEN IEM Unit - Current
- Gibson Bay Wind Farm implementation of the wetland management plan during the construction and operation of the wind farm (includes surface / groundwater as well wetland rehabilitation & monitoring plan) on behalf of Enel Green Power - 2018
- Gibson Bay Wind Farm 133kV Transmission Line wetland management plan during the construction of the transmission line (includes wetland rehabilitation & monitoring plan) on behalf of Eskom – 2016.
- Tsitsikamma Community Wind Farm implementation of the wetland management plan during the construction of the wind farm (includes surface / biomonitoring, as well wetland rehabilitation & monitoring plan) on behalf of Cennergi – completed May 2016.
- Alicedale bulk sewer pipeline for Cacadu District, wetland and water quality assessment, 2016
- Macindane bulk water and sewer pipelines wetland and wetland rehabilitation plan 2015
- Eskom Prieska to Copperton 132kV transmission line aquatic assessment, Northern Cape on behalf of Savannah Environmental 2015.
- Joe Slovo sewer pipeline upgrade wetland assessment for Nelson Mandela Bay Municipality 2014
- Cape Recife Waste Water Treatment Works expansion and pipeline aquatic assessment for Nelson Mandela Bay Municipality 2013
- Transnet Freight Rail – Swazi Rail Link (Current) wetland and ecological assessment on behalf of Aurecon for the proposed rail upgrade from Ermelo to Richards Bay
- Eskom Transmission wetland and ecological assessment for the proposed transmission line between Pietermaritzburg and Richards Bay on behalf of Aurecon (2012).
- Port Durnford Exarro Sands biodiversity assessment for the proposed mineral sands mine on behalf of Exxaro (2009)
- Fairbreeze Mine Exxaro (Mtunzini) wetland assessment on behalf of Strategic Environmental Services (2007).
- Wetland assessment for Richards Bay Minerals (2013) – Zulti North haul road on behalf of RBM.
- Biodiversity and aquatic assessments for 125 renewable projects in the past 9 years in the Western, Eastern, Northern Cape, KwaZulu-Natal and Free State provinces. Clients included RES-SA, Red Cap, ACED Renewables, Mainstream Renewable, GDF Suez, Globeleq, ENEL, Abengoa amongst others. . Several of these projects also required the assessment of the proposed transmission lines and switching stations, which were conducted on behalf of Eskom.
- Vegetation assessments on the Great Brak rivers for Department of Water and Sanitation, 2006 and the Gouritz Water Management Area (2014)
- Proposed FibreCo fibre optic cable vegetation assessment along the PE to George, George to Graaf Reinet, PE to Colesburg, and East London to Bloemfontein on behalf of SRK (2013-2015).

Appendix B - Specialist Statement of Independence

Note from the CSIR: Specialists to please complete this section. We will add the actual specialist declaration (on the DEFF prescribed form) as an appendix to the BA Report.

I, ____Brian Colloty____________________________, declare that –

- I act as the independent specialist in this application;
- I will 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;
- 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 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;
- all the particulars furnished by me in this form 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: ______EnviroSci (Pty) Ltd___________________

Date: _______29 / 10 / 2020__________________

Appendix C: Site Sensitivity Verification

Prior to commencing with the Aquatic Biodiversity Specialist Assessment in accordance with the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity (Government Notice 320, dated 20 March 2020), a site sensitivity verification was undertaken in order to confirm the current land use and environmental sensitivity of the proposed project area as identified by the National Web-Based Environmental Screening Tool (Screening Tool).

The details of the site sensitivity verification are noted below:

Date of Site Visit	28 August – 2 October 2020
Specialist Name	Dr Brian Colloty
Professional Registration Number	400268/07
Specialist Affiliation / Company	EnviroSci (Pty) Ltd

Government Notice No. 320, dated 20 March 2020, includes the requirement that an Initial Site Sensitivity Verification Report must be produced for a development footprint. As per Part 1, Section 2.3, the outcome of the Initial Site Verification must be recorded in the form of a report that-

(a) Confirms or disputes the current use of the land and environmental sensitivity as identified by the national web based environmental screening tool;

(b) Contains a motivation and evidence of either the verified or different use of the land and environmental sensitivity;

(c) Is submitted together with the relevant reports prepared in accordance with the requirements of the Environmental Impact Assessment Regulations.

This report has been produced specifically to consider the aquatic biodiversity theme and addresses the content requirements of (a) and (b) above. The report will be appended to the respective specialist study included in the Scoping and EIA Reports produced for the projects.

<u>Site sensitivity based on the aquatic biodiversity theme included in the Screening Tool and specialist assessment</u>

Based on the DEA Screening Tool, the site contains areas of very high sensitivity due to the presence of CBAs, wetlands and rivers. The remaining area within the development footprint is deemed to be of low sensitivity (See Figure 1).

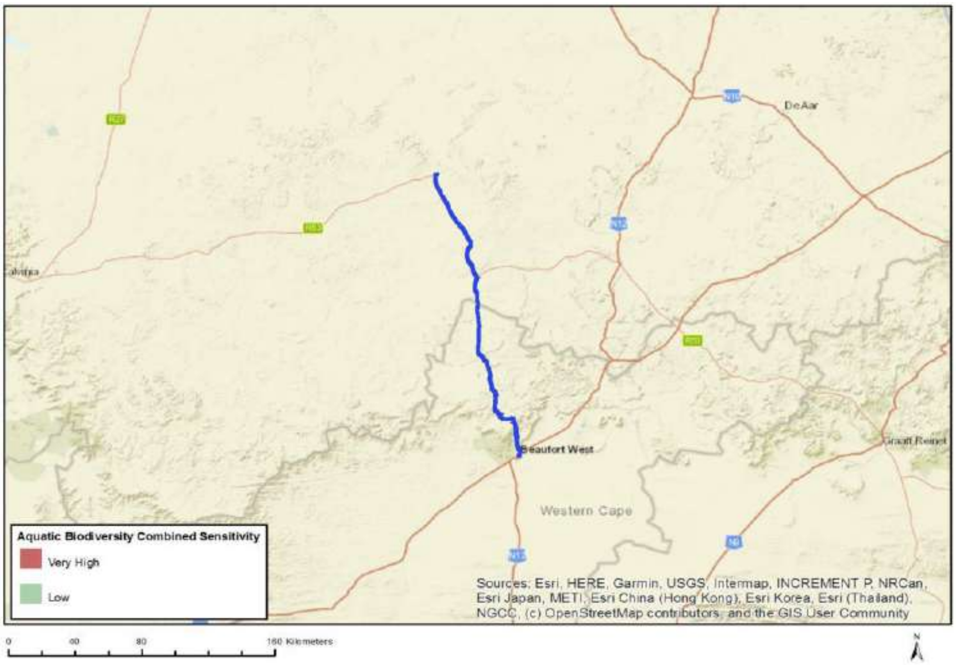


Figure 1. DEA Screening Tool outcome for the terrestrial biodiversity theme

Based on the above outcomes, the specialist **confirms** the environmental sensitivities identified on site, informed by a site visit undertaken by Dr Brian Colloty in March, May and September 2019 and August / October 2020. The photo plates below shows the various aquatic features present on site. This information was then compared to current wetland inventories, 1: 50 000 topocadastral surveys mapping and the site. A baseline map was then developed which was refined, noting that due to the complex of the topography and geology, the river lines were digitised at a scale of 1:2000.

Plate 1: Large Valley Bottom wetland within Sak River, where the line will span via the overhead section of the cable (-32.070606S 22.454220E), noting that the present tower location must be located outside of this wetland area

Plate 2: A channelled Valley Bottom Wetland on the Sak River along the surfaced section of the R381 (-32.1614S 22.4741E)

f

Plate 3: An aerial view of the same wetland shown in Plate 3 above, with a distinct channel meandering through the wetland areas (dark green = Sedges)

Plate 4: A alluvial riverine area with distinct riparian zone that develops intermittently along the floodplains more typical of the Brak and Slangfontein se Leegte systems

Plate 5: Aerial view of the drier alluvial systems (blue arrow_, with little to no wetland features along the R381 closer to Loxton (road indicated by red arrow)

Plate 6: The sandy alluvial areas associated with the Gansvlei catchment along the R63 tarred portion of the alignment (-31.280294 S 22.301069 E)

Plate 7: Upstream view of the only major bridge along the cable alignment on the Brak River colonised by extensive *Phragmites australis* reedbeds

Plate 8: Downstream view of the wetland areas along the Brak River bridge crossing (-31.536364S 22.340223E)

Plate 9: Numerous small borrowpits are located along the road and these are inundated with water during high rainfall periods, but did not contain any significant aquatic species

Figure 10 a-L of the specialist report above indicates the fine scale delineation and resultant sensitivity maps produced following the desktop assessment as well as a groundtruthing exercises. The PES of a river, watercourse or wetland represents the extent to which it has changed from the reference or near pristine condition (Category A) towards a highly impacted system where there has been an extensive loss of natural habit and biota, as well as ecosystem functioning (Category E).

With the exception of the Gamka River (PES = B or Largely natural), the remainder of the systems assessed by DWS were rated as PES = C or Moderately Modified. While all the rivers were rated as Moderate / Medium in terms of Ecological Sensitivity and Ecological Importance.

<u>Motivation of the outcomes of the sensitivity map and key conclusions</u>

In conclusion, the DEA Screening Tool identified two sensitivity ratings within the development footprint, namely, very high and low. Although there is some overlap with the findings on site and the Screening Tool's outcome, the development footprint contains various sensitivities (High, moderate, and low) that were identified following the undertaking of several site visits and spatial input considerations.

Appendix D: DWS Risk Assessment Matrix

RISK MATRIX (Based on DWS 2015 publication: Section 21 c and I water use Risk Assessment Protocol)

NAME and REGISTRATION No of SACNASP Professional member: ……Dr Brian Colloty………………………….. Reg no. ……Ecologist 400268/07……………………………..

Risk to be scored for construction and operational phases of the project. MUST BE COMPLETED BY SACNASP PROFESSIONAL MEMBER REGISTERED IN AN APPROPRIATE FIELD OF EXPERTISE.

#NAME?

					Severity																		
No.	**Phases**	**Activity**	**Aspect**	**Impact**	**Flow Regime**	**Physico & Chemical (Water Quality)**	**Habitat (Geomorph + Vegetation)**	**Biota**	**Severity**	**Spatial scale**	**Duration**	**Consequence**	**Frequency of activity**	**Frequency of impact**	**Legal Issues**	**Detection**	**Likelihood**	**Significance**	**Risk Rating**	**Confidence level**	**Control Measures**	**Borderline LOW MODERATE Rating Classes**	**PES AND EIS OF WATERCOURSE**
1	Construction & Decommissioning phase	**Clearing of vegetation within wetland crossings**	Clearing of valley bottom wetland vegetation within the delineated systems, while Pans/Depression will be avoided	Clearing of wetland vegetation would be limited as present the R381 crosses these systems, while the larger systems south of Rosedene towards Beaufort West will have overhead lines, i.e. spanned and thus avoided). Regardless, both means of crossing these system would thus limit the impact on flow regime through avoidance, thus limiting the potential impact on water quality, habitat and biota	1	1	1	1	1	2	2	5	2	3	5	1	11	55	LOW	90-100	Where wetland areas aren't spanned with the OHL, then the cables should be tied into the existing bridges. Should this not be an option, and the crossing distance suitable, then directional drilling is recommended. Failing these options, then it is suggested that hand dug trenching occur in these areas (i.e. no plant is allowed to access these areas). Any of the activities, should also be monitored by the appointed EO/ECO on a daily basis, especially during periods of river flow. Any points of erosion should be stabilised immediately (sand bags in the short term) using gabions and reno mattress as required. No activities should take place outside of the demarcated servitude, to prevent additional cumulative impacts on these systems		Wetland PES scores ranged between B & B/C within the road servitude assessed, with the exception of the road crossings the impacts within the greater area are minimal. The EIS was rated as High for the systems, as they provide habitat / refugia for several animal species, and contribute to downstream systems (Fish)
2	Construction & Decommissioning phase	**Clearing of vegetation within riverine (with riparian and or alluvial systems) crossings**	Clearing of within any of the delineated channel	Clearing of any riparian vegetation or disturbance of any bed or banks of alluvial systems would be limited as presently the R381 crosses these systems. This would limit the impact on flow regime through avoidance, thus reducing the potential impact on water quality, habitat and biota	1	1	1	1	1	1	2	4	2	3	5	1	11	44	LOW	90-100	Where riverine areas aren't spanned with the OHL, then the cables should be tied into the existing bridges. Should this not be an option, and the crossing distance suitable, then directional drilling is recommended. Any of the activities, should also be monitored by the appointed EO/ECO on a daily basis, especially during periods of river flow. Any points of erosion should be stabilised immediately (sand bags in the short term) using gabions and reno mattress as required. No activities should take place outside of the demarcated servitude, to prevent additional cumulative impacts on these systems		PES scores ranged between B - C within the road servitude assessed, with the exception of the road crossings, the impacts within the greater area are minimal. The EIS was rated as High to Moderate for the systems, as they provide habitat / refugia for several animal species, and contribute to downstream systems (Fish)
3	Construction & Decommissioning phase	**Loss of Species of Special Concern**	Several plant species within the region are conservation worthy or are protected by the respective Provincial bodies of legislation, but no listed species were observed within any of the systems.	Loss of threatened or protected plant species	1	1	1	3	1,5	1	1	3,5	1	1	5	1	8	28	LOW	100	Search and Rescue should be initiated prior to construction. Construction EMP, Monitoring and Rehabilitation Plan		Wetland PES = B & B/C Rivers B - C EIS High to Moderate
4	Construction & Decommissioning phase	**Spills and leaks from construction vehicles / machinery when working in or near the delineated systems**	Impact on localised surface water quality	Leaks from plant / machinery during the construction phase	1	2	1	3	1,75	1	1	3,75	2	2	5	1	10	37,5	LOW	90-100	Construction EMP, Monitoring via EO / ECO and daily inspection of plant. No refuelling and or servicing of plant should occur within the delineated systems.		Wetland PES = B & B/C Rivers B - C EIIS High to Moderate
5	Construction & Decommissioning phase	**Erosion and Sedimentation**	Impact on localised surface water quality and habitat degradation	Unstable soils will erode and create sedimentation downstream	1	2	2	2	1,75	1	1	3,75	2	2	5	1	10	37,5	LOW	90 - 100	Construction EMP, Monitoring via EO /ECO with daily inspection of works areas, where any unstable soils occur, these must be protected with temporary stabilisation (sand bags or hay bales dependent on the scale of the operation) until areas become revegetated. If any areas require permanent erosion protection (e.g. gabions or stone pitching) then this must be include into the GA application, however it is recommended that active revegetation of the area be encouraged, i.e. once construction has been completed, the disturbed areas are demarcated as exclusion areas, thus preventing compaction / disturbance of area.		Wetland PES = B & B/C Rivers B - C EIIS High to Moderate
6	Operational Phase	**Creation of hard surfaces**	Additional hard surface areas although limited to manhole structures and any supporting infrastructure	Unstable soils will erode and create sedimentation downstream	1	2	2	1	1,5	1	2	4,5	2	2	5	1	10	45	LOW	90-100	Monitoring should occur on a monthly basis for 6 months post construction and where any unstable soils occur, these must be protected with temporary stabilisation dependent on the scale of the impact i.e. sand bags - hay bales) until areas become revegetated. If any areas require permanent erosion protection (e.g. gabions or stone pitching) then this must be include into the GA application		Wetland PES = B & B/C Rivers B - C EIIS High to Moderate
7	Cumulative impacts	**All activities within delineated areas, when combined with present day activities**	The cumulative impact of the present day roads combined with the proposed project require assessment	When assessing the impacts, it is unlikely that additional large scale impacts on the aquatic environment would occur, this being based on the fact that once stable / vegetated the buried cable sleeves would not create any additional disturbances to the flow regime and or aquatic habitats observed. This is assuming that the mitigation in the construction and operational phase are adhered to.	1	1	1	1	1	1	1	3	1	1	5	1	8	24	LOW	90-100	With the combination of the proposed buried and OHL cables, limited to an existing road servitude it is envisaged that the impacts would remain LOW. This is assuming the mitigation listed above are implemented. It is therefore envisaged that the PES & EIS of the systems would remain the same		Wetland PES = B & B/C Rivers B - C EIIS High to Moderate

Appendix E: Impact Assessment Methodology

The impact assessment includes:

- the nature, significance and consequences of the impact and risk;
- the extent and duration of the impact and risk;
- the probability of the impact and risk occurring;
- the degree to which impacts and risks can be mitigated;
- the degree to which the impacts and risks can be reversed; and
- the degree to which the impacts and risks can cause loss of irreplaceable resources.

As per the DEFFT Guideline 5: Assessment of Alternatives and Impacts, the following methodology is applied to the prediction and assessment of impacts and risks. Potential impacts and risks have been rated in terms of the direct, indirect and cumulative:

- Direct impacts are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.
- Indirect impacts of an activity are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken or which occur at a different place as a result of the activity.
- Cumulative impacts are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.

The impact assessment methodology includes the following aspects:

- Nature of impact/risk - The type of effect that a proposed activity will have on the environment.

- Status - Whether the impact/risk on the overall environment will be:
    - Positive - environment overall will benefit from the impact/risk;
    - Negative - environment overall will be adversely affected by the impact/risk; or
    - Neutral - environment overall not be affected.

- Spatial extent – The size of the area that will be affected by the impact/risk:
    - Site specific;
    - Local (<10 km from site);
    - Regional (<100 km of site);
    - National; or
    - International (e.g. Greenhouse Gas emissions or migrant birds).

- Duration – The timeframe during which the impact/risk will be experienced:
    - Very short term (instantaneous);
    - Short term (less than 1 year);
    - Medium term (1 to 10 years);
    - Long term (the impact will cease after the operational life of the activity (i.e. the impact or risk will occur for the project duration)); or
    - Permanent (mitigation will not occur in such a way or in such a time span that the impact can be considered transient (i.e. the impact will occur beyond the project decommissioning)).

- Consequence – The anticipated consequence of the risk/impact:
    - Extreme (extreme alteration of natural systems, patterns or processes, i.e. where environmental functions and processes are altered such that they permanently cease);

- Severe (severe alteration of natural systems, patterns or processes, i.e. where environmental functions and processes are altered such that they temporarily or permanently cease);
- Substantial (substantial alteration of natural systems, patterns or processes, i.e. where environmental functions and processes are altered such that they temporarily or permanently cease);
- Moderate (notable alteration of natural systems, patterns or processes, i.e. where the environment continues to function but in a modified manner); or
- Slight (negligible alteration of natural systems, patterns or processes, i.e. where no natural systems/environmental functions, patterns, or processes are affected).

- Reversibility of the Impacts - the extent to which the impacts/risks are reversible assuming that the project has reached the end of its life cycle (decommissioning phase):
  - High reversibility of impacts (impact is highly reversible at end of project life i.e. this is the most favourable assessment for the environment);
  - Moderate reversibility of impacts;
  - Low reversibility of impacts; or
  - Impacts are non-reversible (impact is permanent, i.e. this is the least favourable assessment for the environment).

- Irreplaceability of Receiving Environment/Resource Loss caused by impacts/risks – the degree to which the impact causes irreplaceable loss of resources assuming that the project has reached the end of its life cycle (decommissioning phase):
  - High irreplaceability of resources (project will destroy unique resources that cannot be replaced, i.e. this is the least favourable assessment for the environment);
  - Moderate irreplaceability of resources;
  - Low irreplaceability of resources; or
  - Resources are replaceable (the affected resource is easy to replace/rehabilitate, i.e. this is the most favourable assessment for the environment).

Using the criteria above, the impacts have been further assessed in terms of the following:

- Probability – The probability of the impact/risk occurring:
  - Extremely unlikely (little to no chance of occurring);
  - Very unlikely (<30% chance of occurring);
  - Unlikely (30-50% chance of occurring)
  - Likely (51 – 90% chance of occurring); or
  - Very Likely (>90% chance of occurring regardless of prevention measures).

To determine the significance of the identified impact/risk, the consequence is multiplied by probability (qualitatively as shown in Figure 1).

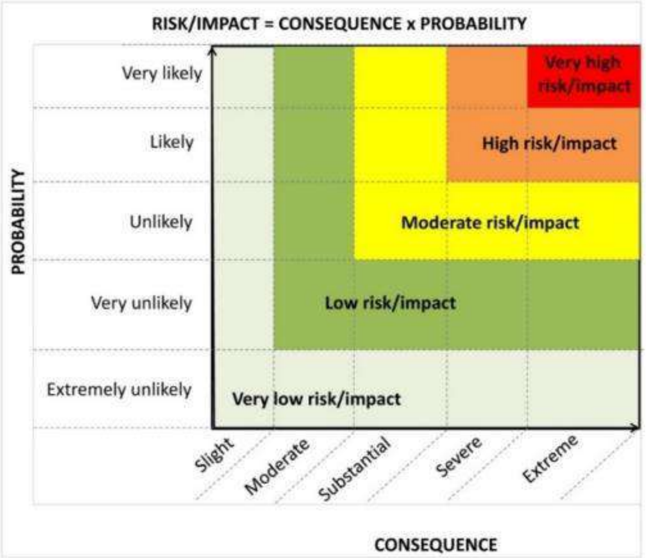


Figure 1. Guide to assessing risk/impact significance as a result of consequence and probability.

- Significance – Will the impact cause a notable alteration of the environment?
    - Very low (the risk/impact may result in very minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);
    - Low (the risk/impact may result in minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);
    - Moderate (the risk/impact will result in moderate alteration of the environment and can be reduced or avoided by implementing the appropriate mitigation measures, and will only have an influence on the decision-making if not mitigated);
    - High (the risk/impact will result in major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making); and
    - Very high (the risk/impact will result in very major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making (i.e. the project cannot be authorised unless major changes to the engineering design are carried out to reduce the significance rating)).

With the implementation of mitigation measures, the residual impacts/risks are ranked as follows in terms of significance:

- Very low = 5;
- Low = 4;
- Moderate = 3;
- High = 2; and
- Very high = 1.

Confidence – The degree of confidence in predictions based on available information and specialist knowledge:

- Low;
- Medium; or
- High.

Appendix F: Compliance with the Aquatic Biodiversity Protocol (GN 320, 20 March 2020)

COMPLIANCE WITH THE PROTOCOL FOR THE SPECIALIST ASSESSMENT AND MINIMUM REPORT CONTENT REQUIREMENTS FOR ENVIRONMENTAL IMPACTS ON AQUATIC BIODIVERSITY ISSUED 20 MARCH 2020, REPLACING REQUIREMENTS OF APPENDIX 6 – GN R326 EIA REGULATIONS OF 7 APRIL 2017

Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity	***Section where this has been addressed in the Specialist Report***
2.3. The assessment must provide a baseline description of the site which includes, as a minimum, the following aspects: 2.3.1. a description of the aquatic biodiversity and ecosystems on the site, including; a) aquatic ecosystem types; and b) presence of aquatic species, and composition of aquatic species communities, their habitat, distribution and movement patterns;	*Section 4 Page 21 of this report*
2.3.2. the threat status of the ecosystem and species as identified by the screening tool;	*Appendix C Page 55 of this report*
2.3.3. an indication of the national and provincial priority status of the aquatic ecosystem, including a description of the criteria for the given status (i.e. if the site includes a wetland or a river freshwater ecosystem priority area or sub catchment, a strategic water source area, a priority estuary, whether or not they are free -flowing rivers, wetland clusters, a critical biodiversity or ecologically sensitivity area); and	*Section 4 Page 21 of this report*
2.3.4. a description of the ecological importance and sensitivity of the aquatic ecosystem including: a) the description (spatially, if possible) of the ecosystem processes that operate in relation to the aquatic ecosystems on and immediately adjacent to the site (e.g. movement of surface and subsurface water, recharge, discharge, sediment transport, etc.); and b) the historic ecological condition (reference) as well as present ecological state of rivers (in- stream, riparian and floodplain habitat), wetlands and/or estuaries in terms of possible changes to the channel and flow regime (surface and groundwater).	*Section 4 Page 21 of this report*
2.4. The assessment must identify alternative development footprints within the preferred site which would be of a "low" sensitivity as identified by the screening tool and verified through the site sensitivity verification and which were not considered appropriate.	*Section 4 Page 21 and Sections 5, 6 and 7 of this report*
2.5. Related to impacts, a detailed assessment of the potential impacts of the proposed development on the following aspects must be undertaken to answer the following questions: 2.5.1. Is the proposed development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal?	*Section, 5, 6 and 7 of this report, but in essence the proposed development will have little to no impact on the receiving aquatic environment if the proposed alignment coupled to the listed mitigations*

Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity	***Section where this has been addressed in the Specialist Report***
2.5.2. Is the proposed development consistent with maintaining the resource quality objectives for the aquatic ecosystems present? *2.5.3. How will the proposed development impact on fixed and dynamic ecological processes that operate within or across the site? This must include:* *a) impacts on hydrological functioning at a landscape level and across the site which can arise from changes to flood regimes (e.g. suppression of floods, loss of flood attenuation capacity, unseasonal flooding or destruction of floodplain processes);* *b) will the proposed development change the sediment regime of the aquatic ecosystem and its sub -catchment (e.g. sand movement, meandering river mouth or estuary, flooding or sedimentation patterns);* *c) what will the extent of the modification in relation to the overall aquatic ecosystem be (e.g. at the source, upstream or downstream portion, in the temporary I seasonal I permanent zone of a wetland, in the riparian zone or within the channel of a watercourse, etc.); and* *d) to what extent will the risks associated with water uses and related activities change;*	*are adhered to. i.e. the risk to the aquatic environment are low due to the nature of the environment and the present disturbance already present (road servitude)*
2.5.4. how will the proposed development impact on the functioning of the aquatic feature? This must include: *a) base flows (e.g. too little or too much water in terms of characteristics and requirements of the system);* *b) quantity of water including change in the hydrological regime or hydroperiod of the aquatic ecosystem (e.g. seasonal to temporary or permanent; impact of over - abstraction or instream or off stream impoundment of a wetland or river);* *c) change in the hydrogeomorphic typing of the aquatic ecosystem (e.g. change from an unchannelled valley-bottom wetland to a channelled valley -bottom wetland);* *d) quality of water (e.g. due to increased sediment load, contamination by chemical and/or organic effluent, and/or eutrophication);* *e) fragmentation (e.g. road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal); and* *f) the loss or degradation of all or part of any unique or important features associated with or within the aquatic ecosystem (e.g. waterfalls, springs, oxbow lakes, meandering or braided channels, peat soils, etc.);*	*Section, 5, 6 and 7 of this report, but in essence the proposed development will have little to no impact on the receiving aquatic environment if the proposed alignment coupled to the listed mitigations are adhered to. i.e. the risk to the aquatic environment are low due to the nature of the environment and the present disturbance already present (road servitude)*
2.5.5. how will the proposed development impact on key ecosystems regulating and supporting services especially: *a) flood attenuation;* *b) streamflow regulation;* *c) sediment trapping;*	*Section, 5, 6 and 7 of this report, but in essence the proposed development will have little to no impact on the receiving aquatic environment*

Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity	*Section where this has been addressed in the Specialist Report*
d) phosphate assimilation; *e) nitrate assimilation;* *f) toxicant assimilation;* *g) erosion control; and* *h) carbon storage?*	*if the proposed alignment coupled to the listed mitigations are adhered to. i.e. the risk to the aquatic environment are low due to the nature of the environment and the present disturbance already present (road servitude)*
2.5.6. how will the proposed development impact community composition (numbers and density of species) and integrity (condition, viability, predator - prey ratios, dispersal rates, etc.) of the faunal and vegetation communities inhabiting the site?	*Section, 5, 6 and 7 of this report, but in essence the proposed development will have little to no impact on the receiving aquatic environment if the proposed alignment coupled to the listed mitigations are adhered to. i.e. the risk to the aquatic environment are low due to the nature of the environment and the present disturbance already present (road servitude)*
2.6. In addition to the above, where applicable, impacts to the frequency of estuary mouth closure should be considered, in relation to: *a) size of the estuary;* *b) availability of sediment;* *c) wave action in the mouth;* *d) protection of the mouth;* *e) beach slope;* *f) volume of mean annual runoff; and* *g) extent of saline intrusion (especially relevant to permanently open systems).*	*N/A as none of these environments were found present*
2.7. The findings of the specialist assessment must be written up in an Aquatic Biodiversity Specialist Assessment Report that contains, as a minimum, the following information:	*Yes*
2.7.1. contact details of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae;	*Appendix A Page 52*
2.7.2. a signed statement of independence by the specialist;	*Appendix B Page 54*
2.7.3. a statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	*Section 4 pg 21and Appendix C pg 55*
2.7.4. the methodology used to undertake the site inspection and the specialist assessment, including equipment and modelling used, where relevant;	*Section 2 pg 10*
2.7.5. a description of the assumptions made, any uncertainties or gaps in knowledge or data;	*Section 2.8 pg 20*

Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity	***Section where this has been addressed in the Specialist Report***
2.7.6. the location of areas not suitable for development, which are to be avoided during construction and operation, where relevant;	*Section 4.2 Pg 32*
2.7.7. additional environmental impacts expected from the proposed development;	*Section 5, 6 and 7*
2.7.8. any direct, indirect and cumulative impacts of the proposed development on site;	*Section 5, 6 and 7*
2.7.9. the degree to which impacts and risks can be mitigated;	*Section 5, 6 and 7*
2.7.10. the degree to which the impacts and risks can be reversed;	*Section 5, 6 and 7*
2.7.11. the degree to which the impacts and risks can cause loss of irreplaceable resources;	*Section 5, 6 and 7*
2.7.12. a suitable construction and operational buffer for the aquatic ecosystem, using the accepted methodologies;	*Section 4*
2.7.13. proposed impact management actions and impact management outcomes for inclusion in the Environmental Management Programme (EMPr);	*Section 5, 6 and 7*
2.7.14. a motivation must be provided if there were development footprints identified as per paragraph 2.4 above that were identified as having a "low" aquatic biodiversity sensitivity and that were not considered appropriate;	*N/A*
2.7.15. a substantiated statement, based on the findings of the specialist assessment, regarding the acceptability or not of the proposed development and if the proposed development should receive approval or not; and	*Section 11 pg 49*
2.7.16. any conditions to which this statement is subjected.	*Section 11 pg 49*
2.8. The findings of the Aquatic Biodiversity Specialist Assessment must be incorporated into the Basic Assessment Report or the Environmental Impact Assessment Report including the mitigation and monitoring measures as identified, that are to be included in the EMPr.	*Yes*
2.9. A signed copy of the assessment must be appended to the Basic Assessment Report or Environmental Impact Assessment Report.	*Yes*

Appendix 4 Risk matrix: Section 21 (c) and (i) water use Risk Assessment Protocol

No.	1	2	3	4	5	6	7
Phases	**Construction & Decommissioning phase**	**Construction & Decommissioning phase**	**Construction & Decommissioning phase**	**Construction & Decommissioning phase**	**Construction & Decommissioning phase**	**Operational Phase**	**Cumulative impacts**
Activity	**Clearing of vegetation within wetland crossings**	**Clearing of vegetation within riverine (with riparian and or alluvial systems) crossings**	**Loss of Species of Special Concern**	**Spills and leaks from construction vehicles / machinery when working in or near the delineated systems**	**Erosion and Sedimentation**	**Creation of hard surfaces**	**All activities within delineated areas, when combined with present day activities**
Aspect	Clearing of valley bottom wetland vegetation within the delineated systems, while Pans/Depression will be avoided	Clearing of within any of the delineated channel	Several plant species within the region are conservation worthy or are protected by the respective Provincial bodies of legislation, but no listed species were observed within any of the systems.	Impact on localised surface water quality	Impact on localised surface water quality and habitat degradation	Additional hard surface areas although limited to manhole structures and any supporting infrastructure	The cumulative impact of the present day roads combined with the proposed project require assessment
Impact	Clearing of wetland vegetation would be limited as present the R381 crosses these systems, while the larger systems south of Rosedene towards Beaufort West will have overhead lines, i.e. spanned and thus avoided). Regardless, both means of crossing these system would thus limit the impact on flow regime through avoidance, thus limiting the potential impact on water quality, habitat and biota	Clearing of any riparian vegetation or disturbance of any bed or banks of alluvial systems would be limited as presently the R381 crosses these systems. This would limit the impact on flow regime through avoidance, thus reducing the potential impact on water quality, habitat and biota	Loss of threatened or protected plant species	Leaks from plant / machinery during the construction phase	Unstable soils will erode and create sedimentation downstream	Unstable soils will erode and create sedimentation downstream	When assessing the impacts, it is unlikely that additional large scale impacts on the aquatic environment would occur, this being based on the fact that once stable / vegetated the buried cable sleeves would not create any additional disturbances to the flow regime and or aquatic habitats observed. This is assuming that the mitigation in the construction and operational phase are adhered to.
Flow Regime	**1**	**1**	**1**	**1**	**1**	**1**	**1**
Physico & Chemical (Water Quality)	**1**	**1**	**1**	**2**	**2**	**2**	**1**
Habitat (Geomorph + Vegetation)	**1**	**1**	**1**	**1**	**2**	**2**	**1**
Biota	**1**	**1**	**3**	**3**	**2**	**1**	**1**
Severity	**1**	**1**	**1.5**	**1.75**	**1.75**	**1.5**	**1**

No.	1	2	3	4	5	6	7
Phases	**Construction & Decommissioning phase**	**Construction & Decommissioning phase**	**Construction & Decommissioning phase**	**Construction & Decommissioning phase**	**Construction & Decommissioning phase**	**Operational Phase**	**Cumulative impacts**
Activity	**Clearing of vegetation within wetland crossings**	**Clearing of vegetation within riverine (with riparian and or alluvial systems) crossings**	**Loss of Species of Special Concern**	**Spills and leaks from construction vehicles / machinery when working in or near the delineated systems**	**Erosion and Sedimentation**	**Creation of hard surfaces**	**All activities within delineated areas, when combined with present day activities**
Spatial scale	2	1	1	1	1	1	1
Duration	2	2	1	1	1	2	1
Consequence	5	4	3.5	3.75	3.75	4.5	3
Frequency of activity	2	2	1	2	2	2	1
Frequency of impact	3	3	1	2	2	2	1
Legal Issues	5	5	5	5	5	5	5
Detection	1	1	1	1	1	1	1
Likelihood	11	11	8	10	10	10	8
Significance	55	44	28	37.5	37.5	45	24
Risk Rating	LOW	LOW	LOW	LOW	LOW	LOW	LOW
Confidence level	90-100	90-100	100	90-100	90 - 100	90-100	90-100
Control Measures	Where wetland areas aren't spanned with the OHL, then the cables should be tied into the existing bridges. Should this not be an option, and the crossing distance suitable, then directional drilling is recommended. Failing these options, then it is suggested that hand dug trenching occur in these areas (i.e. no plant is allowed to access these areas). Any of the activities, should also be monitored by the appointed EO/ECO on a daily basis, especially during periods of river flow. Any points of erosion should be stabilised immediately (sand bags in the short term) using gabions and reno mattress as required. No activities should take place outside of the demarcated servitude, to prevent additional cumulative impacts on these systems	Where riverine areas aren't spanned with the OHL, then the cables should be tied into the existing bridges. Should this not be an option, and the crossing distance suitable, then directional drilling is recommended. Any of the activities, should also be monitored by the appointed EO/ECO on a daily basis, especially during periods of river flow. Any points of erosion should be stabilised immediately (sand bags in the short term) using gabions and reno mattress as required. No activities should take place outside of the demarcated servitude, to prevent additional cumulative impacts on these systems	Search and Rescue should be initiated prior to construction. Construction EMP, Monitoring and Rehabilitation Plan	Construction EMP, Monitoring via EO / ECO and daily inspection of plant. No refuelling and or servicing of plant should occur within the delineated systems.	Construction EMP, Monitoring via EO /ECO with daily inspection of works areas, where any unstable soils occur, these must be protected with temporary stabilisation (sand bags or hay bales dependent on the scale of the operation) until areas become revegetated. If any areas require permanent erosion protection (e.g. gabions or stone pitching) then this must be include into the GA application, however it is recommended that active revegetation of the area be encouraged, i.e. once construction has been completed, the disturbed areas are demarcated as exclusion areas, thus preventing compaction / disturbance of area.	Monitoring should occur on a monthly basis for 6 months post construction and where any unstable soils occur, these must be protected with temporary stabilisation dependent on the scale of the impact i.e. sand bags - hay bales) until areas become revegetated. If any areas require permanent erosion protection (e.g. gabions or stone pitching) then this must be include into the GA application	With the combination of the proposed buried and OHL cables, limited to an existing road servitude it is envisaged that the impacts would remain LOW. This is assuming the mitigation listed above are implemented. It is therefore envisaged that the PES & EIS of the systems would remain the same

No.	1	2	3	4	5	6	7
Phases	**Construction & Decommissioning phase**	**Construction & Decommissioning phase**	**Construction & Decommissioning phase**	**Construction & Decommissioning phase**	**Construction & Decommissioning phase**	**Operational Phase**	**Cumulative impacts**
Activity	**Clearing of vegetation within wetland crossings**	**Clearing of vegetation within riverine (with riparian and or alluvial systems) crossings**	**Loss of Species of Special Concern**	**Spills and leaks from construction vehicles / machinery when working in or near the delineated systems**	**Erosion and Sedimentation**	**Creation of hard surfaces**	**All activities within delineated areas, when combined with present day activities**
PES AND EIS OF WATERCOURSE	Wetland PES scores ranged between B & B/C within the road servitude assessed, with the exception of the road crossings the impacts within the greater area are minimal. The EIS was rated as High for the systems, as they provide habitat / refugia for several animal species, and contribute to downstream systems (Fish)	PES scores ranged between B - C within the road servitude assessed, with the exception of the road crossings, the impacts within the greater area are minimal. The EIS was rated as High to Moderate for the systems, as they provide habitat / refugia for several animal species, and contribute to downstream systems (Fish)	Wetland PES = B & B/C Rivers B - C EIS High to Moderate	Wetland PES = B & B/C Rivers B - C EIIS High to Moderate	Wetland PES = B & B/C Rivers B - C EIIS High to Moderate	Wetland PES = B & B/C Rivers B - C EIIS High to Moderate	Wetland PES = B & B/C Rivers B - C EIIS High to Moderate

Appendix 5 Specialist assessment: Heritage Resources, including Archaeology and Palaeontology

HERITAGE IMPACT ASSESSMENT

In terms of Section 38(8) of the NHRA for the

Proposed Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon, Northern and Western Cape

Draft for Comment

HWC Ref: 20100206

SAHRIS Case ID: 15686

Prepared by CTS Heritage

CTS HERITAGE

For

CSIR

October 2020

CTS HERITAGE

EXECUTIVE SUMMARY

1. Site Name:

Square Kilometer Array (SKA) fibre optic line between Beaufort West (Western Cape) and Carnavon (Northern Cape)

2. Location:

Predominantly following the road reserves of roads R381 and R63, and 1 m from the fence of the private land between Beaufort West in the Western Cape and Carnavon in the Northern Cape. Some areas characterised complex / difficult terrain will be traversed by overhead fibre optic lines which may be located outside the road reserve.

3. Locality Plan:

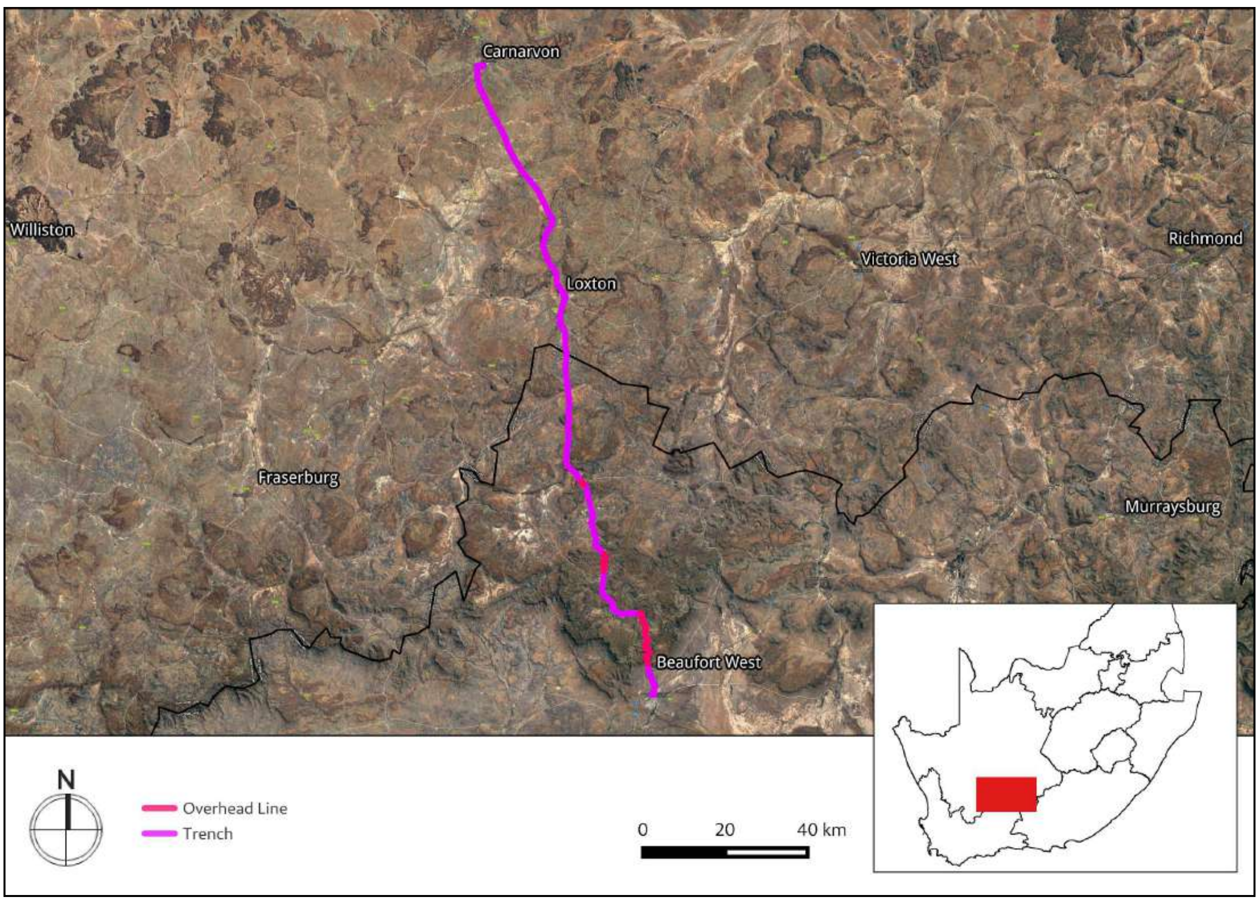


Figure 1: Location of the proposed fibre optic cable development area

4. Description of Proposed Development:

The South African Radio Astronomy Observatory (SARAO) spearheads South Africa's activities in the SKA Radio Telescope through engineering, science and construction. Connectivity is required between the SKA core site in the Northern Cape and a data processing facility in Cape Town to transport the science data for the SKA project and its precursor, MeerKAT. Access to dark fibre is required to transport this data due to the expected data throughputs for the SKA project. SARAO has built an overhead fibre route between Carnarvon and the SKA core site. Additionally, the South African National Research Network (SANReN) has procured access to fibre between Beaufort West area and Cape Town. A fibre optic cable connection must, therefore, be built between Carnarvon and Beaufort West.

5. Heritage Resources Identified:

Observations noted during the field assessments for archaeology and palaeontology

Site No.	Site Name	Description	Co-ordinates		Grading	Province	Mitigation
BTC01	**SKA Fibre_01**	Bridge (dated: 1970)	-32.28339	22.56525	NA	Western Cape	None Required
BTC02	**SKA Fibre_02**	Anniversary Monument/Dedication (dated: 3 August 2014)	-32.25241	22.56853	NA	Western Cape	Not to be disturbed - 10m buffer recommended
BTC03	**SKA Fibre_03**	Possible MSA chert artefact	-32.17230	22.48989	NCW	Western Cape	None Required
BTC04	**SKA Fibre_04**	Loxton Leiwater System	-31.47537	22.34922	IIIC	Northern Cape	No impact anticipated
BTC05	**SKA Fibre_05**	Loxton Leiwater System	-31.47604	22.35136	IIIC	Northern Cape	No impact anticipated
BTC06	**SKA Fibre_06**	Loxton Leiwater System	-31.47761	22.35630	IIIC	Northern Cape	No impact anticipated
BTC07	**SKA Fibre_07**	Bridge (dated: 1958)	-31.34858	22.30103	IIIC	Northern Cape	No impact anticipated
BTC08	**SKA Fibre_08**	Sandstone outcrop	-31.22497	22.26206	NA	Northern Cape	None Required
BTC09	**SKA Fibre_09**	Trace fossils from the Abrahamskraal Formation located On top of road cutting on the western side of the road.	-32.3043	22.5698	IIIC	Western Cape	None Required
BTC10	**SKA Fibre_10**	Mudflakes in sandstone "mud flake conglomerate" from the Abrahamskraal Formation. Not *in situ.*	-32.2906	22.5666	NCW	Western Cape	None Required

6. Anticipated Impacts on Heritage Resources:

The proposed development will not have a negative impact on the heritage resources situated within the footprint of the proposed fibre optic line between Beaufort West and Carnarvon. The lithic material identified is of low significance, and even though the resources may be destroyed during the construction, the impact is inconsequential.

The heritage resources identified are largely located some distance from the proposed line (BTC02, BTC04, BTC05, BTC06, SAHRIS Site ID 32495) and will not be impacted by the proposed development or are not conservation-worthy (BTC01, BTC03 and BTC07). Due to the fact that some cultural remains along the roadside are likely covered in gravel from road grading/construction, the possibility exists that some artefacts may only be uncovered during the digging of the trenches for the proposed fiber line.

The proposed installation of the SKA fibre line may proceed. It is unlikely that this construction will have a great effect on significant palaeontological heritage. Although the area has a rich occurrence of multiple fossil assemblages, fossil finds are often isolated as individuals. Only one site was identified to contain some trace fossils (BTC09). This trace fossil has contextual significance only and no further mitigation measures are recommended.

The trench for the SKA fibre line will run along highly disturbed and fractured roadside material. This decreases the chance of finding fossils dramatically. As such, the overall sensitivity of the proposed fibre optic route to impacts to heritage resources is MEDIUM TO LOW, and LOW with mitigation.

7. Recommendations:

There is no objection to the proposed development on heritage grounds and the following is recommended:

- No mitigation is required prior to construction operations commencing.
- During the construction phase all excavations must be monitored for fossil remains by the responsible Environmental Control Officer (ECO) using the HWC Chance Fossil Finds Procedure. Should substantial fossil remains such as vertebrate bones and teeth, petrified wood, plant-rich fossil lenses or dense fossil burrow assemblages be exposed during construction, the responsible ECO should safeguard these, preferably in situ, and alert the South African Heritage Resources Authority (SAHRA) in the Northern Cape and HWC in the Western Cape so that appropriate action can be taken by a professional palaeontologist,

- Should any evidence of archaeological sites or remains (e.g. remnants of stone-made structures, indigenous ceramics, bones, stone artefacts, ostrich eggshell fragments, charcoal and ash concentrations), fossils or other categories of heritage resources be found during the proposed development, SAHRA APM Unit (Natasha Higgitt/Phillip Hine 021 462 5402) in the Northern Cape and HWC (Colette Scheermeyer 021 483 5959) in the Western Cape must be alerted.
- If unmarked human burials are uncovered in the Northern Cape, the SAHRA Burial Grounds and Graves (BGG) Unit (Mimi Seetelo 012 320 8490), and in the Western Cape, HWC (Colette Scheermeyer 021 483 5959) must be alerted immediately as per section 36(6) of the NHRA. A professional archaeologist must be contracted as soon as possible to inspect the findings. A Phase 2 rescue excavation operation may be required subject to permits issued by SAHRA and/or HWC
- The above recommendations must be included in the Environmental Management Programme (EMPr) for the project

8. Author/s and Date:
Jenna Lavin
October 2020

CTS HERITAGE

NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (ACT NO. 107 OF 1998) (NEMA) AND ENVIRONMENTAL IMPACT ASSESSMENT (EIA) REGULATIONS, 2014 (AS AMENDED) - REQUIREMENTS FOR SPECIALIST REPORTS (APPENDIX 6)

Regulation GNR 326 of 4 December 2014, as amended 7 April 2017, Appendix 6	Section of Report
1. (1) A specialist report prepared in terms of these Regulations must contain- 1. **details of-** 1. **the specialist who prepared the report; and** 2. **the expertise of that specialist to compile a specialist report including a curriculum vitae;**	Page 7 Appendix 4
2. **a declaration that the specialist is independent in a form as may be specified by the competent authority;**	Appendix 5
3. **an indication of the scope of, and the purpose for which, the report was prepared;**	Section 2.1
(cA) an indication of the quality and age of base data used for the specialist report;	Section 2.4
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 3 Section 5..1 and 5.2
4. **the date and season of the site investigation and the relevance of the season to the outcome of the assessment;**	Section 2.2
5. **a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;**	Section 2.2
6. **details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;**	Section 4.1 and 5.4
7. **an identification of any areas to be avoided, including buffers;**	Section 5.1
8. **a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;**	Section 4.3
9. **a description of any assumptions made and any uncertainties or gaps in knowledge;**	Section 2.3

10. **a description of the findings and potential implications of such findings on the impact of the proposed activity, (including identified alternatives on the environment) or activities;**	Section 5.1 and 5.2
11. **any mitigation measures for inclusion in the EMPr;**	Section 8
12. **any conditions for inclusion in the environmental authorisation;**	Section 8
13. **any monitoring requirements for inclusion in the EMPr or environmental authorisation;**	Section 8
14. **a reasoned opinion-** 1. **(as to) whether the proposed activity, activities or portions thereof should be authorised;** **(iA) regarding the acceptability of the proposed activity or activities; and** 2. **if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;**	Section 9
15. **a description of any consultation process that was undertaken during the course of preparing the specialist report;**	Section 6
16. **a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and**	Appendix 8
17. **any other information requested by the competent authority.**	Included throughout report
2) Where a government notice *gazetted* by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Section 38(3) of the NHRA instructs the minimum requirements for an HIA. In addition, HWC has Guidelines for HIAs and SAHRA has Minimum Standards for AIAs and PIAs - all of which are complied with
General requirements for undertaking an initial site sensitivity verification where no specific assessment protocol has been identified (GN 320, 20 March 2020)	**Section of Report**
1. Site sensitivity verification and minimum report content requirements Prior to commencing with a specialist assessment, the current use of the land and the environmental sensitivity of the site under consideration identified by the national web	Section 3.2

based environmental screening tool (screening tool), where determined, must be confirmed by undertaking a site sensitivity verification. **(1.1) The site sensitivity verification must be undertaken by an environmental assessment practitioner or a specialist.**	Appendix 4 and page 8
(1.2) The site sensitivity verification must be undertaken through the use of: **a) a desktop analysis, using satellite imagery;** **b) a preliminary on -site inspection; and** **c) any other available and relevant information**	Section 3.1 Section 4.1 Section 4.2
(1.3) The outcome of the site sensitivity verification must be recorded in the form of a report that- **a) confirms or disputes the current use of the land and the environmental sensitivity as identified by the screening tool, such as new developments or infrastructure, the change in vegetation cover or status** **b) contains a motivation and evidence (e.g. photographs) of either the verified or different use of the land and environmental sensitivity; and** **c) is submitted together with the relevant assessment report prepared in accordance with the requirements of the Environmental Impact Assessment Regulations1 (EIA Regulations).**	Section 4.2 Section 5

Details of Specialist who prepared the HIA

This specialist assessment has been undertaken by **Jenna Lavin** of CTS Heritage. Jenna Lavin is registered with the Association of Professional Heritage Practitioners and with the Association of Southern African Professional Archaeologists. A curriculum vitae is included in Appendix A of this specialist assessment.

In addition, a signed specialist statement of independence is included in Appendix B of this specialist assessment.

Jenna Lavin, an archaeologist with an MSc in Archaeology and Palaeoenvironments, and currently completing an MPhil in Conservation Management , heads up the heritage division of the organisation, and has a wealth of experience in the heritage management sector. Jenna's previous position as the Assistant Director for Policy, Research and Planning at Heritage Western Cape has provided her with an in-depth understanding of national and international heritage legislation. Her 8 years of experience at various heritage authorities in South Africa means that she has dealt extensively with permitting, policy formulation, compliance and heritage management at national and provincial level and has also been heavily involved in rolling out training on SAHRIS to the Provincial Heritage Resources Authorities and local authorities.

Jenna is on the Executive Committee of the Association of Professional Heritage Practitioners (APHP), and is also an active member of the International Committee on Monuments and Sites (ICOMOS) as well as the International Committee on Archaeological Heritage Management (ICAHM). In addition, Jenna has been a member of the Association of Southern African Professional Archaeologists (ASAPA) since 2009. Recently, Jenna has been responsible for conducting training in how to write Wikipedia articles for the Africa Centre's WikiAfrica project.

Since 2016, Jenna has drafted over 50 Heritage Impact Assessments throughout South Africa.

CONTENTS

APPENDICES

1 Archaeological Impact Assessment 2020

2 Palaeontological Impact Assessment 2020

3 Heritage Screening Assessment

4 Specialist Expertise

5 Specialist Statement of Independence

6 Site sensitivity verification

7 Impact Assessment Methodology

8 Consultation Process

1. INTRODUCTION

1.1 Background Information on Project

The South African Radio Astronomy Observatory (SARAO) spearheads South Africa's activities in the Square Kilometer Array (SKA) Radio Telescope through engineering, science and construction. SARAO is a National Facility, managed by the National Research Foundation, which incorporates radio astronomy instruments and programmes such as the MeerKAT and KAT-7 telescopes in the Karoo, the Hartebeesthoek Radio Astronomy Observatory (HartRAO) in Gauteng, the African Very Long Baseline Interferometry (AVN) programme in nine African countries, as well as the associated human capital development and commercialisation endeavours.

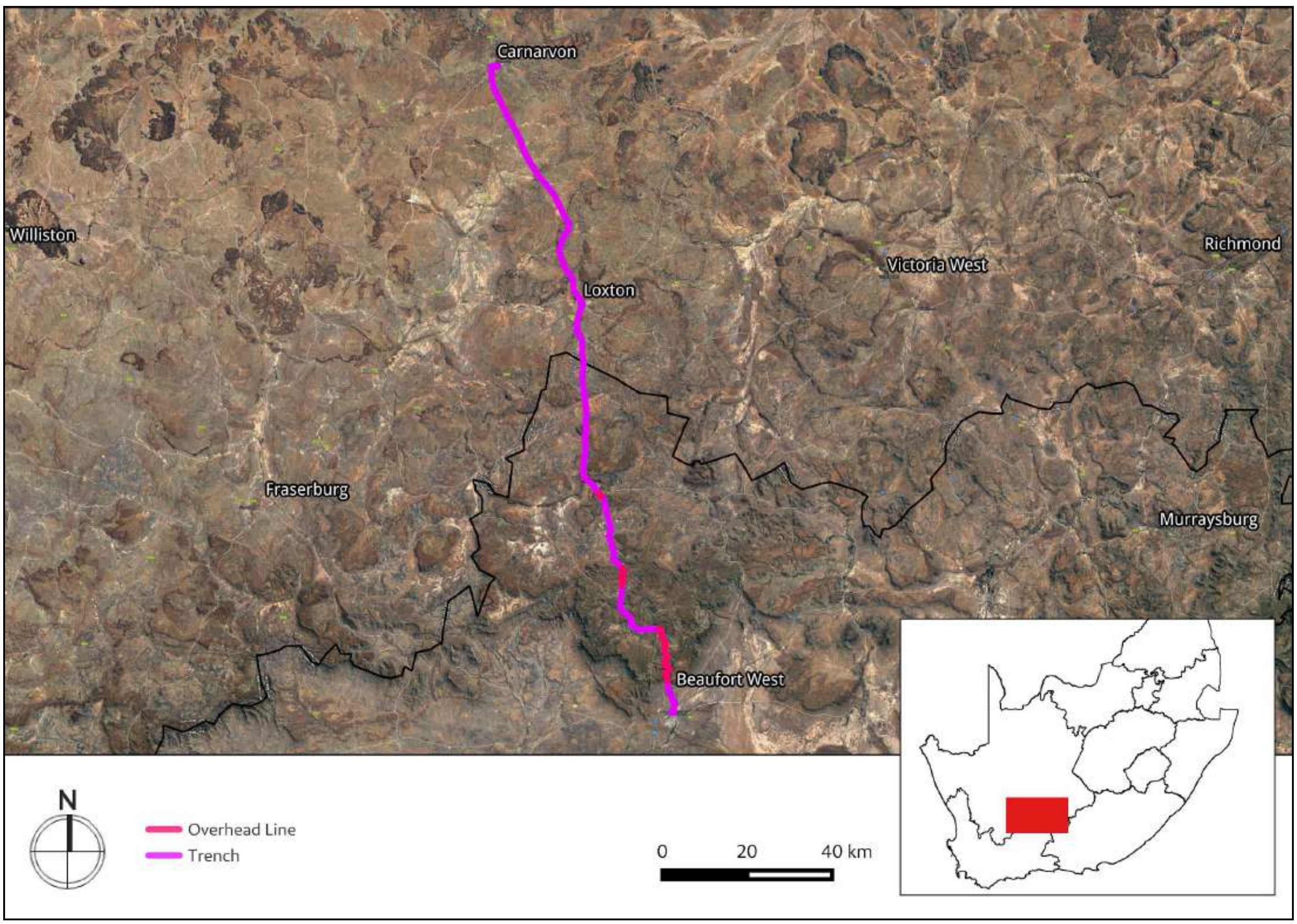
Connectivity is required between the SKA core site in the Northern Cape and a data processing facility in Cape Town to transport the science data for the SKA project and its precursor, MeerKAT. Access to dark fibre is required to transport this data due to the expected data throughputs for the SKA project. SARAO has built an overhead fibre route between Carnarvon and the SKA core site. Additionally, the South African National Research Network (SANReN) has procured access to fibre between Beaufort West area and Cape Town. A fibre optic cable connection must, therefore, be built between Carnarvon and Beaufort West.

The details of the preferred and selected SKA fibre route (Route A) is as follows:

1. The fibre route starts from Beaufort West Transnet building, to a 3 m x 6 m signal repeater station at Loxton, and then on to the Carnarvon SKA Point of Presence (PoP) site (location where networking equipment may be accessed).
2. The fibre duct and cable will be laid in a 1 m deep and 300 mm wide trench and be buried by backfilling and compacting the trench.
3. The full fibre route will predominantly be installed within the road reserves of roads R381 and R63, and 1 m from the fence of the private land.
4. 155 km will be underground and 25 km will be overhead due to it not being technically or financially feasible to trench on the Molteno Pass section. Here the proposed routing may deviate from the road reserve. The total pole length is 9 m, buried 1.5 m deep, with a resultant above-ground height of 7.5 m
5. There are several streams / rivers and associated wetlands to cross. Rivers will be crossed using directional drilling 2 m below the riverbed starting 32 m away from river banks.
6. There is only one river with solid bedrock (the Brak River near Loxton) where directional drilling is not technically or financially feasible. Here the fibre cable will be attached to the existing road bridge.

1.2 Description of Property and Affected Environment

The area proposed for development is located within a dry rural landscape. The topography of the Karoo region is mainly determined by the geology. The areas that were surveyed directly adjacent to the road (R381) were relatively flat. The land use in the study area is characterised by agriculture which is dominantly sheep and game farming. The soil surface in the surveyed area is very stony, consisting of thick dolerite or sandstone deposits with large boulders. The vegetation is typical of the Karoo Biome and includes knee high shrubs, grasses and Acacias.



Map 1a: The proposed development area for the SKA fibre optic cable connection between Beaufort West (Western Cape) and Carnarvon (Northern Cape)

2. APPROACH AND METHODOLOGY

2.1 Scope, Purpose and Objectives of this Specialist Report

The purpose of this Heritage Impact Assessment (HIA) is to satisfy the requirements of section 38(8), and therefore section 38(3) of the National Heritage Resources Act (Act 25 of 1999) and in so doing, identify and assess the significance of all heritage resources that may be impacted by the proposed development. As such, the area to be directly and indirectly impacted by the proposed development has been assessed herein. A NID was submitted to HWC in October 2020. In HWC's NID Response dated 27 October 2020, HWC required that an HIA be submitted that satisfies the requirements of section 38(3) and assesses impacts to archaeological and palaeontological heritage.

2.2 Summary of steps followed

- A Desktop Study was conducted of relevant reports previously written (please see the reference list for the age and nature of the reports used)
- Two archaeologists conducted an assessment of archaeological resources likely to be disturbed by the proposed development. The archaeologist conducted his site visit from 28 to 29 September 2020.
- A palaeontologist conducted an assessment of palaeontological resources likely to be disturbed by the proposed development. The palaeontologist conducted his site visit from 28 to 29 September 2020.
- The identified resources were assessed to evaluate their heritage significance
- An assessment of the potential impacts to heritage resources were conducted (see Appendix 6: Impact Assessment Methodology).
- Alternatives and mitigation options were discussed with the Environmental Assessment Practitioner

2.3 Assumptions and uncertainties

- The *significance* of the sites and artefacts is determined by means of their historical, social, aesthetic, technological and scientific value in relation to their uniqueness, condition of preservation and research potential. It must be kept in mind that the various aspects are not mutually exclusive, and that the evaluation of any site is done with reference to any number of these.

- It should be noted that archaeological and palaeontological deposits often occur below ground level. Should artefacts or skeletal material be revealed at the site during construction, such activities should be halted, and it would be required that the heritage consultants are notified for an investigation and evaluation of the find(s) to take place.

However, despite this, sufficient time and expertise was allocated to provide an accurate assessment of the heritage sensitivity of the area.

2.4 Information Sources

List of main articles, maps, databases (spatial and non-spatial) and other literature on which this assessment is based.

Table 1: Information Sources

Data/Information	Source	Date	Type	Description
Previous heritage assessments	SAHRIS	28/08/2020	Spatial	Spatial delineation of HIAs completed in South Africa, updated daily
Known heritage resources	SAHRIS	28/08/2020	Spatial	Spatial delineation of known heritage resources in South Africa, updated daily
Palaeontological sensitivity	SAHRIS	28/08/2020	Reports and Spatial	Spatial delineation of areas sensitive for impacts to palaeontology (2013)
Geology	Council of GeoScience	Various	Spatial	CGS 3222 Beaufort West Map CGS 3122 Victoria West Map CGS 3022 Britstown Map

2.5 Constraints & Limitations

A portion of the area proposed for development was inaccessible as it was located along steep hillslopes. There were also a few narrow stretches of road where it was not possible to safely park and walk. As such, the field assessment focussed on areas that were accessible along the road.

The experience of the heritage practitioner, and observations made during the study, allow us to predict with some accuracy the archaeological sensitivity of the receiving environment.

CTS HERITAGE

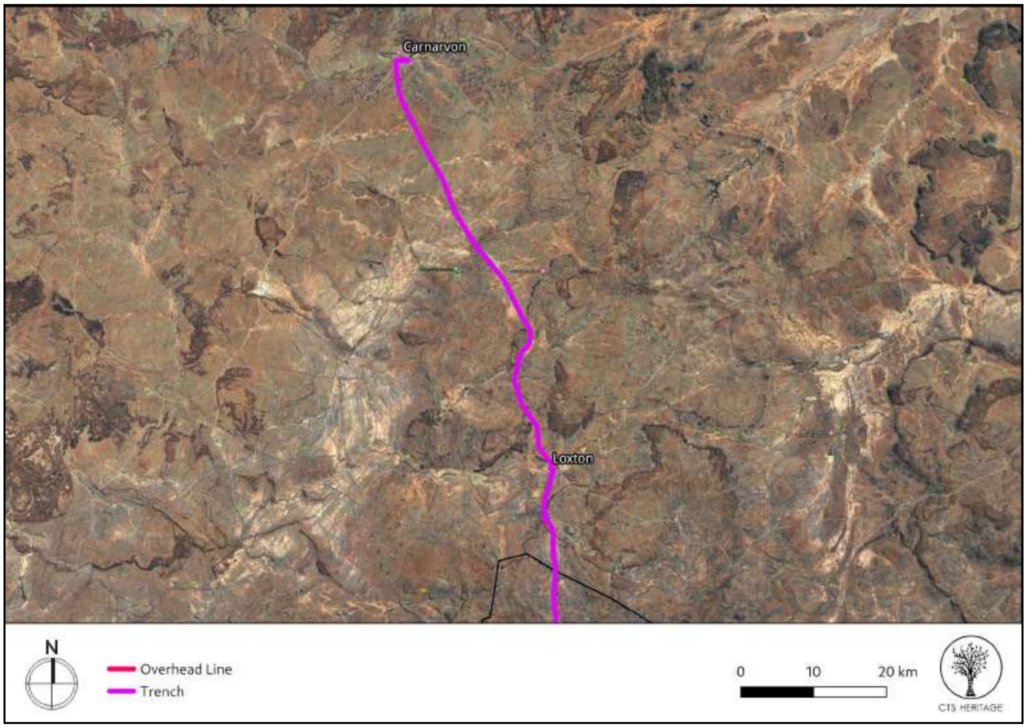


Figure 1.2: Area proposed for development including the proposed layout

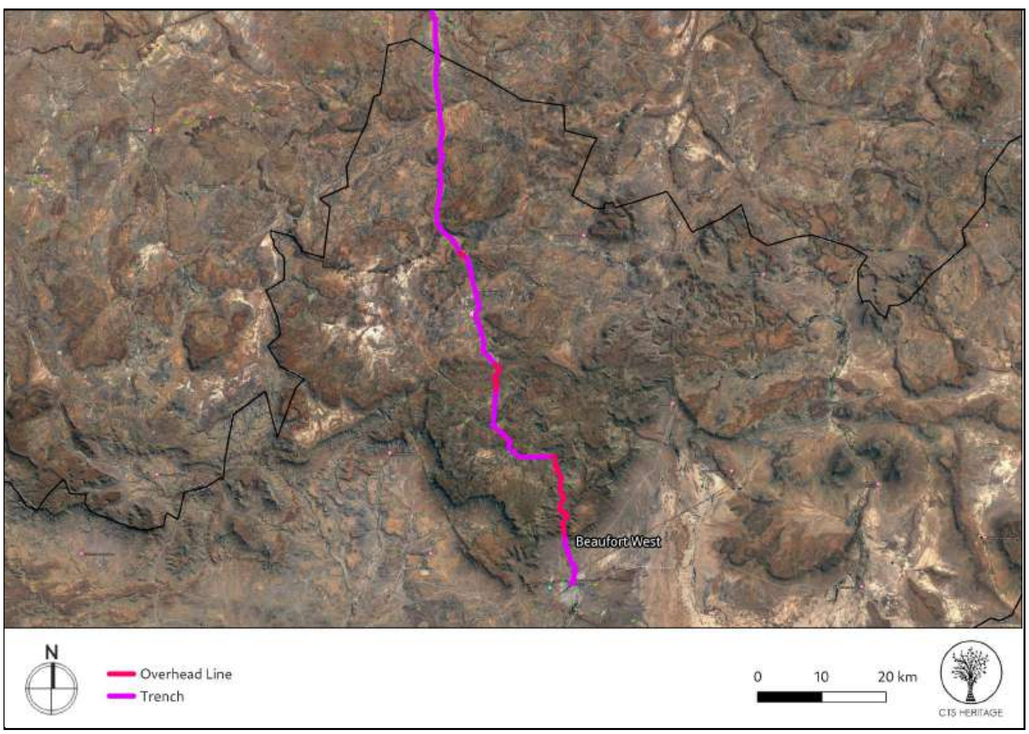


Figure 1.3: Area proposed for development including the proposed layout

2.6 Project Aspects relevant to heritage

This application is for the proposed installation of a fibre optic line from Carnavon to Loxton in the Northern Cape, and from Loxton to Beaufort West in the Western Cape in order to connect the SKA to the internet for the purposes of sending and receiving data. The proposed fibre optic line will be allocated within the existing road reserve for the majority of the route and will supplement existing overhead lines where trenching is not possible. Based on the known heritage sensitivity of the area, the proposed trenching may negatively impact on significant archaeological and palaeontological heritage and as such, it is recommended that an HIA is required in order to assess the nature of these impacts and proposed methods for mitigating this impact.

3. HISTORY AND EVOLUTION OF THE SITE AND CONTEXT

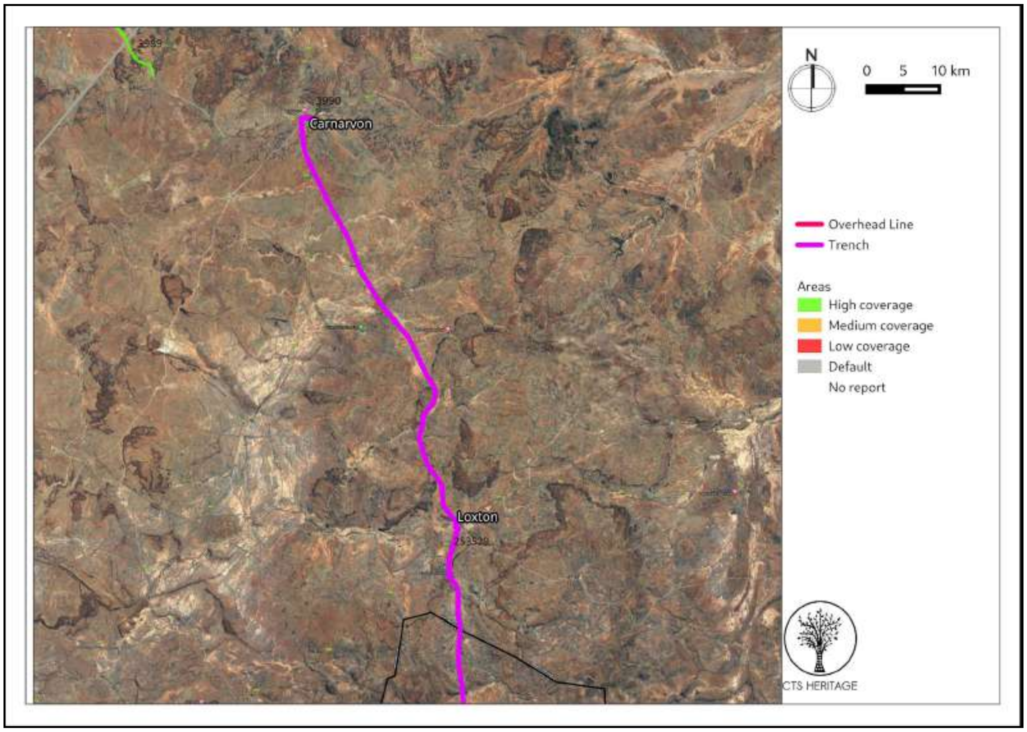
3.1 Baseline Heritage Assessment

Carnarvon was established in 1853 on a route between Cape Town and Botswana that was followed by early explorers and traders. It was originally established as a mission station of the Rhenish Missionary Society and named Harmsfontein. Loxton's first church building and schoolhouse was built in 1900. Tree-lined streets and flood irrigation channels that run alongside the town's main roads were completed in the same year. The town became a municipality in 1905 as it developed to serve the region's sheep-farming community. The church that stands in the town's centre was constructed in 1924. Beaufort West was the first town to be established in the central Karoo. The town was founded in 1818 and became the first municipality in South Africa on 3 February 1837 and had the country's first town hall. When the railroad reached the town in 1880 it became a marshalling yard and locomotive depot and today it is the largest town in the Karoo. All of these towns have significant historic town centres with a unique sense of place. It is not anticipated that the proposed trenching for the SKA Fibre Line will negatively impact on any historic fabric or on this unique sense of place. However, care must be taken to ensure that historic features such as leiwater systems are not negatively impacted by the proposed trenches.

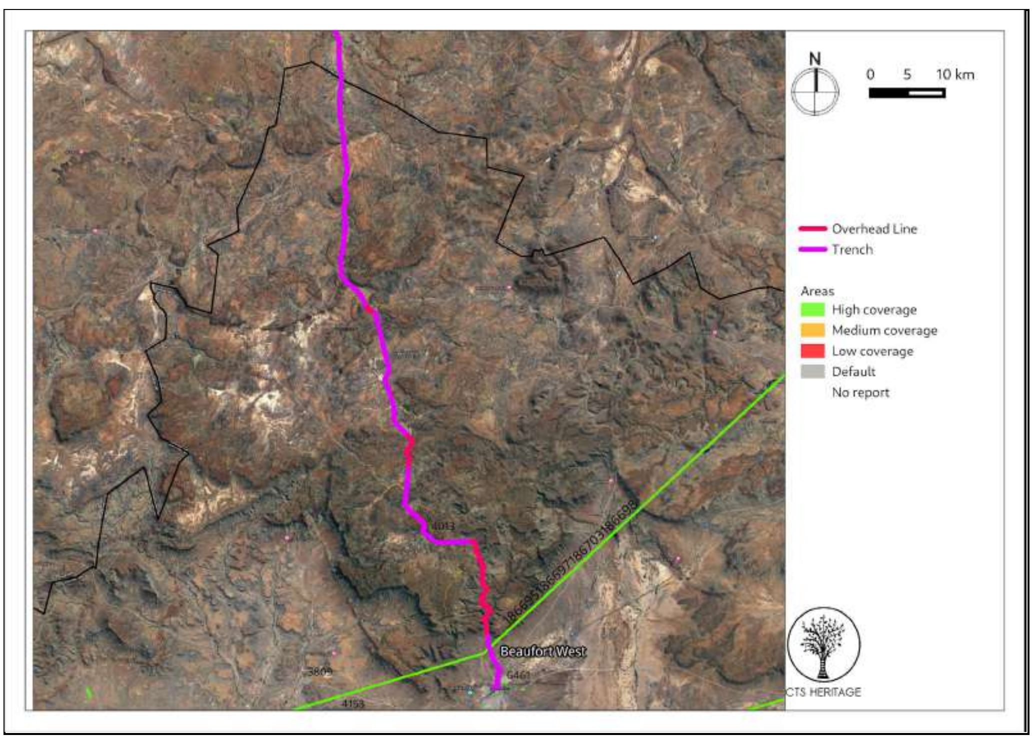
According to Tusenius (2012, SAHRIS NID 503050), "with the notable exception of the research done by Sampson in the Seacow Valley (1985), the rich archaeological heritage of the Karoo has not been systematically studied... Sites and scatters of Early, Middle and Late Stone Age (ESA, MSA and LSA) material have been recorded, as well as pastoralist occurrences, historical sites, rock paintings and engravings." According to a concise summary of the heritage of the area provided by Rossouw (2019, SAHRIS NID 521555), Rock engravings located to the southeast of Loxton, suggest the possibility that a giant long-horned buffalo (*Syncerus antiquus)*, which became extinct more than 10 000 years ago, previously occurred in the area. Furthermore, "multiple rock engraving sites have been recorded in the region and are mainly attributed to San hunter-gatherers who inhabited the area and had done so for thousands of years while the pastoralist Khoekhoe had been present in the Karoo for at least 2 000 years. The historical footprint is largely represented by the vernacular architecture of the well-known corbelled houses in the region, which is related to 19th century trekboers who occupied these buildings, and whose cultural history dates back to their 18th century movement onto the VOC ("Verenigde Oostindische Compagnie" / United East India Company) Cape frontier that resulted in ongoing interaction with indigenous people in the Karoo." As the proposed development is anticipated to be restricted to existing road reserve, it is not anticipated that the proposed development will have a negative impact on significant archaeological heritage. However, it is well established that ESA, MSA and LSA archaeological occurrences are prevalent throughout the broader Karoo landscape and these resources may be impacted by the proposed development.

Palaeontology

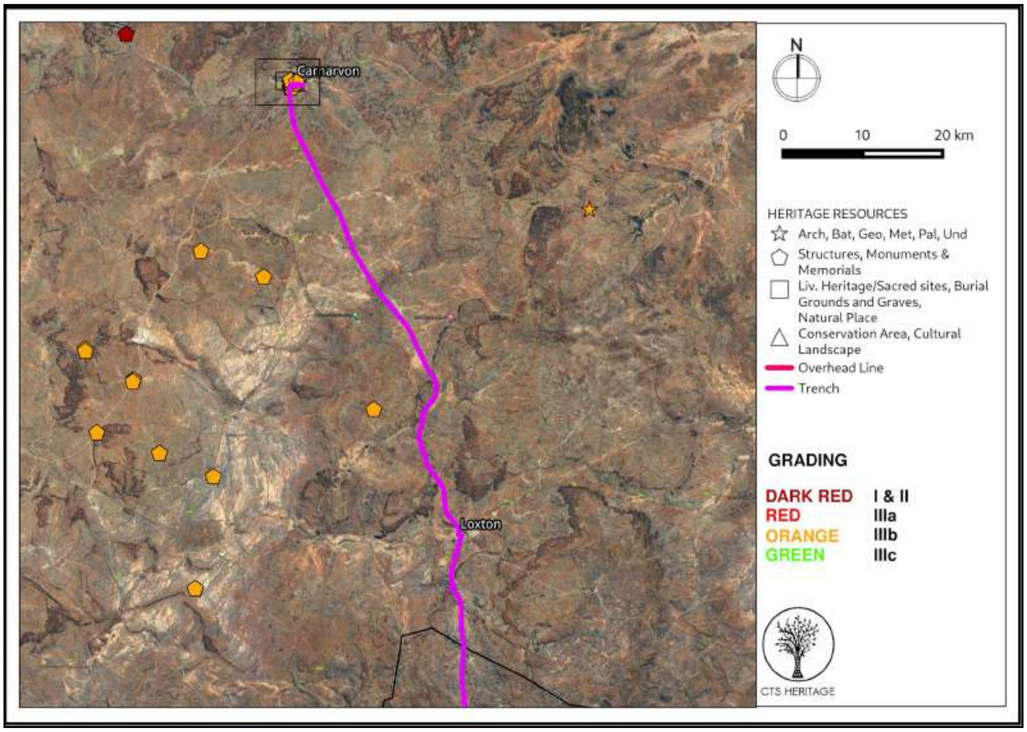
Based on the SAHRIS Palaeosensitivity Map (Figure 4a and 4b), most of the area proposed for development is underlain by sediments that have very high palaentological sensitivity. According to geology maps from the Council for Geoscience (CGS), these sediments include the Poortjie Member and Hoedemaker Member of the Teekloof Formation, and the Abrahamskraal Formation of the Beaufort Group. According to Rossouw (2019, SAHRIS NID 521555), the study area is located within "early Permian Abrahamskraal Formation rocks of the Adelaide Subgroup (Karoo Supergroup) that is capped by severely degraded, superficial sheet wash and channel related (Quaternary) deposits bounded by Jurassic age dolerite intrusions to the north. The Loxton area lies within the outcrop area of the Tapinocephalus Assemblage Zone (AZ) which spans the middle part of the Abrahamskraal Formation. Vertebrate fossils of the Tapinocephalus AZ are not as common as in succeeding biozones and are usually found as individual specimens in the mudrock sequences in association with, and often enveloped by, brown-weathering calcareous nodular material. This faunal assemblage is mainly represented by small dicynodonts, large dinocephalians, pareiasaurs and pristerognathid therocephalians." It is therefore likely that any excavation conducted within this palaeontologically sensitive area is likely to negatively impact on significant palaeontological heritage.



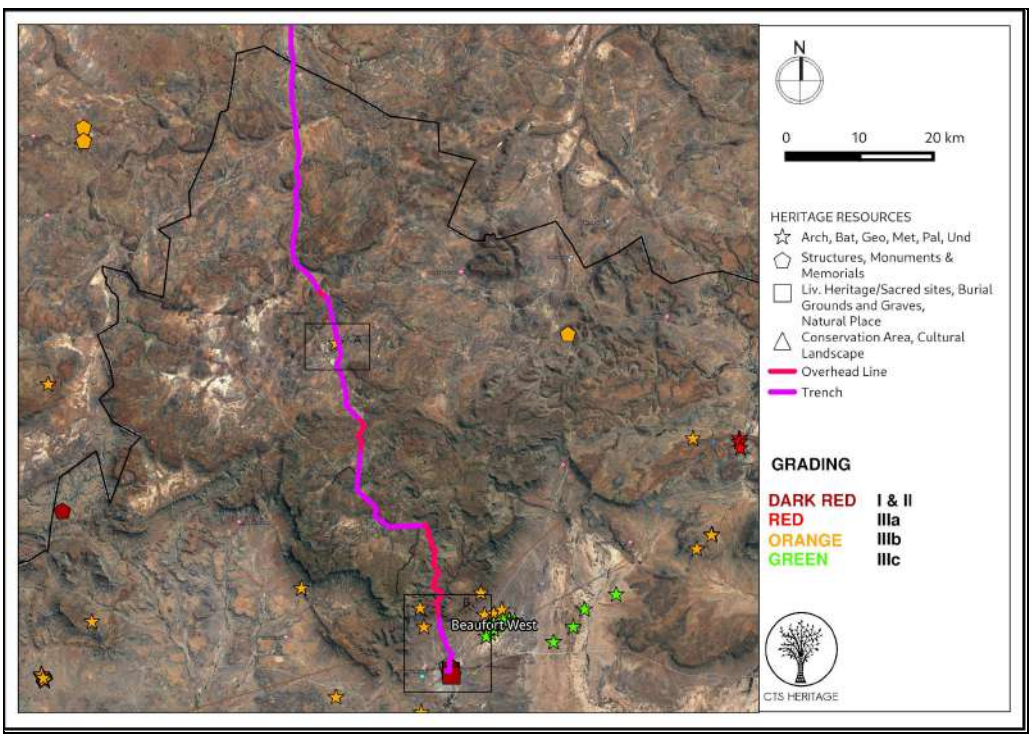
Map 2.1: Spatial distribution of heritage assessments conducted in proximity to the proposed development in the Northern Cape



Map 2.2: Spatial distribution of heritage assessments conducted in proximity to the proposed development in the Western Cape



Map 2.3: Spatial distribution of heritage resources known in proximity to the proposed development (see Appendices for insets)

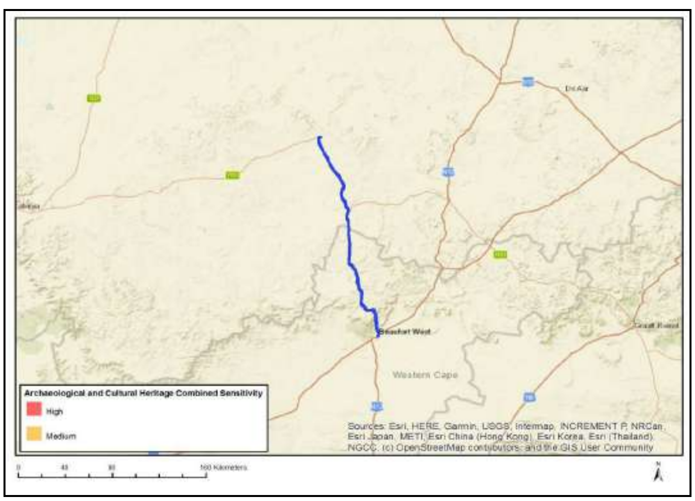


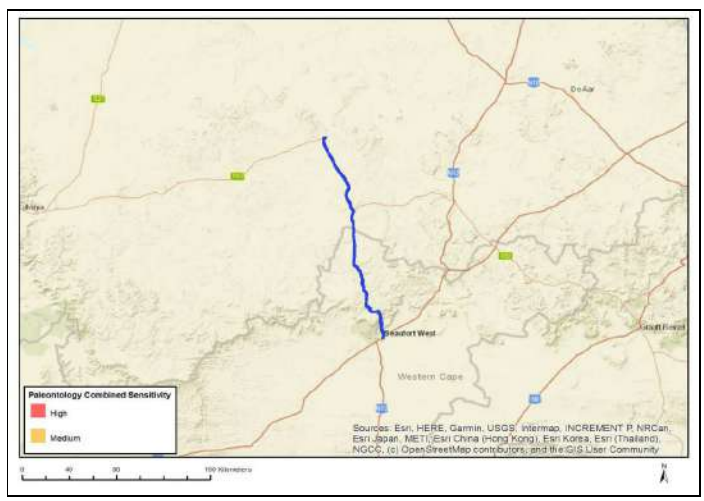
Map 2.4: Spatial distribution of heritage resources known in proximity to the proposed development (see Appendices for insets)

3.2 Sensitivities identified by the National Web-Based Environmental Screening Tool

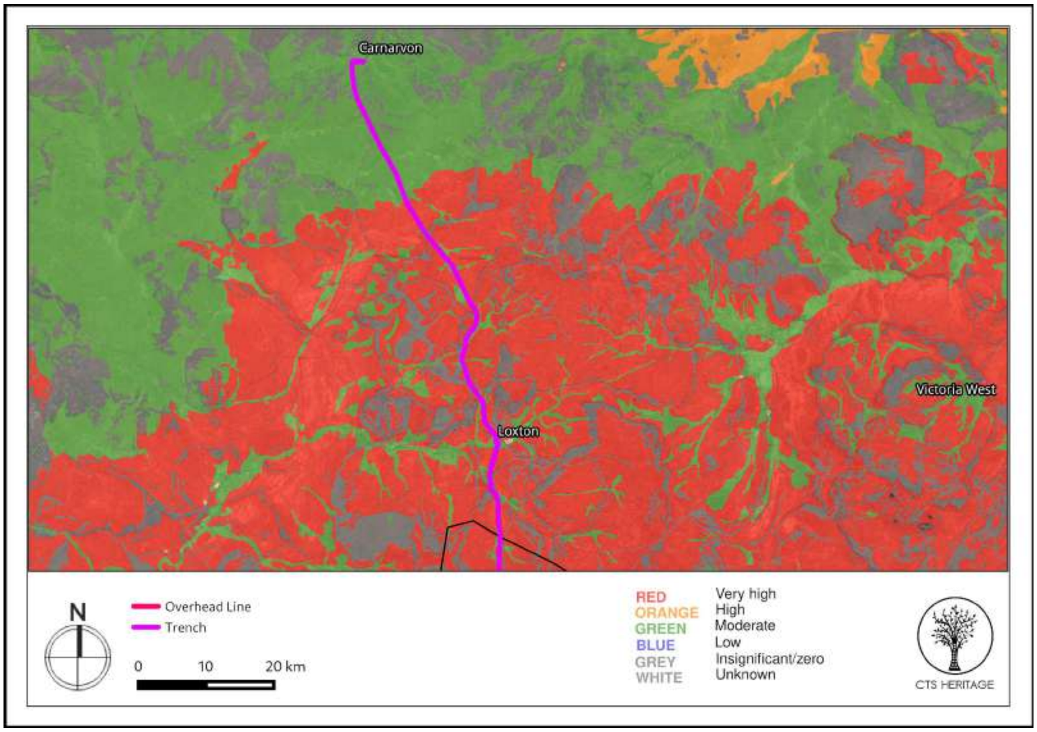
According to the Environmental Screening Study completed by the CSIR (2020:17), "Recorded heritage features in the proposed project area are mainly buildings, cemeteries and trees concentrated within the towns of Beaufort West and Carnarvon (SAHRA, 2018). The regional palaeontological (fossil) sensitivity of the project area proposed for the SKA fibre optic cable route is predominantly Very High (Figure 3.1 and 3.2), which entails the requirement for a desktop palaeontology assessment and field investigation if necessary. One palaeontology find exists within proximity of road R381 between Beaufort West and Loxton (SAHRA, 2018)." Furthermore, the DEFF Screening Tool indicates that the area proposed for development has high - medium sensitivity for impacts to archaeological and cultural heritage, as well as palaeontological heritage. These sensitivities are verified and impacts are assessed in this report (see Appendix 6).

The sensitivity of the proposed development area with regard to likely impacts to significant heritage resources is LOW, mainly due to the nature of the project site, which is predominantly within areas previously disturbed by road construction (road reserve). Recorded heritage features have been graded in terms of their levels of cultural significance as per section 3 of the NHRA, and the guideline titled "Grading: Purpose and Management Implications" (2016). More detail regarding the cultural significance and related sensitivity of the heritage resources identified within the development area is included below in sections 4 and 5.

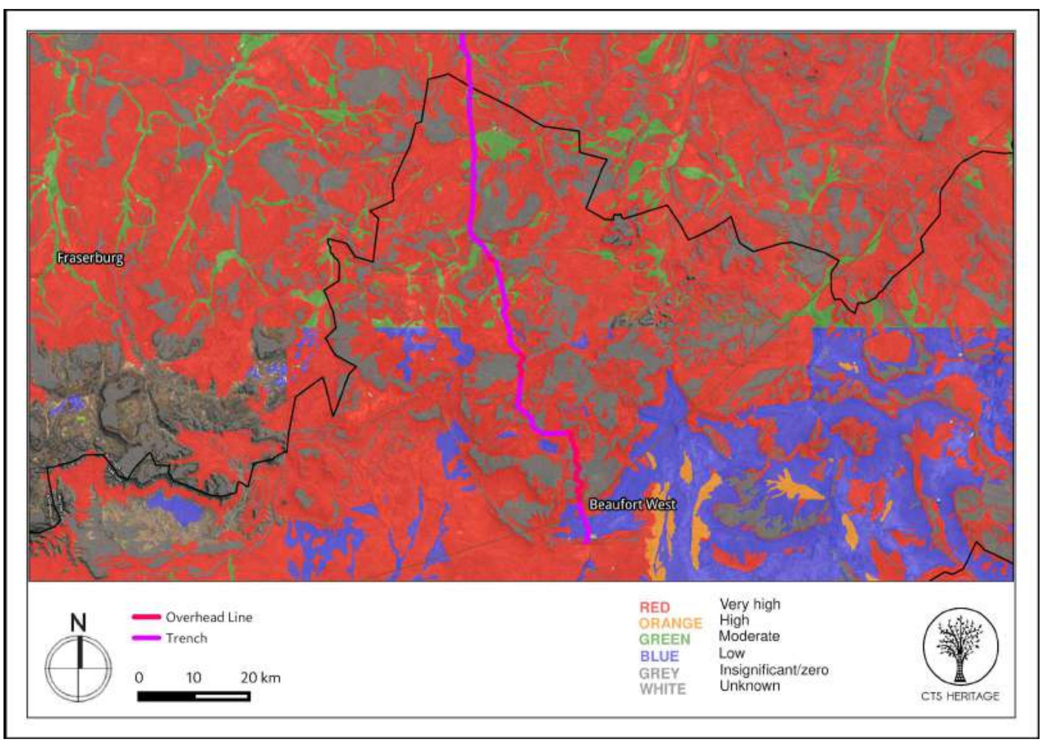




Map 2.5 and 2.6: Screening Tool sensitivity Maps for Archaeology and Cultural Heritage, and Palaeontology (due to the extent of the linear study area the sensitivities cannot be observed at the scale of the automatically generate Screening Tool maps)



Map 3.1: Palaeontological sensitivity of the proposed development area in the Northern Cape



Map 3.2: Palaeontological sensitivity of the proposed development area in the Western Cape

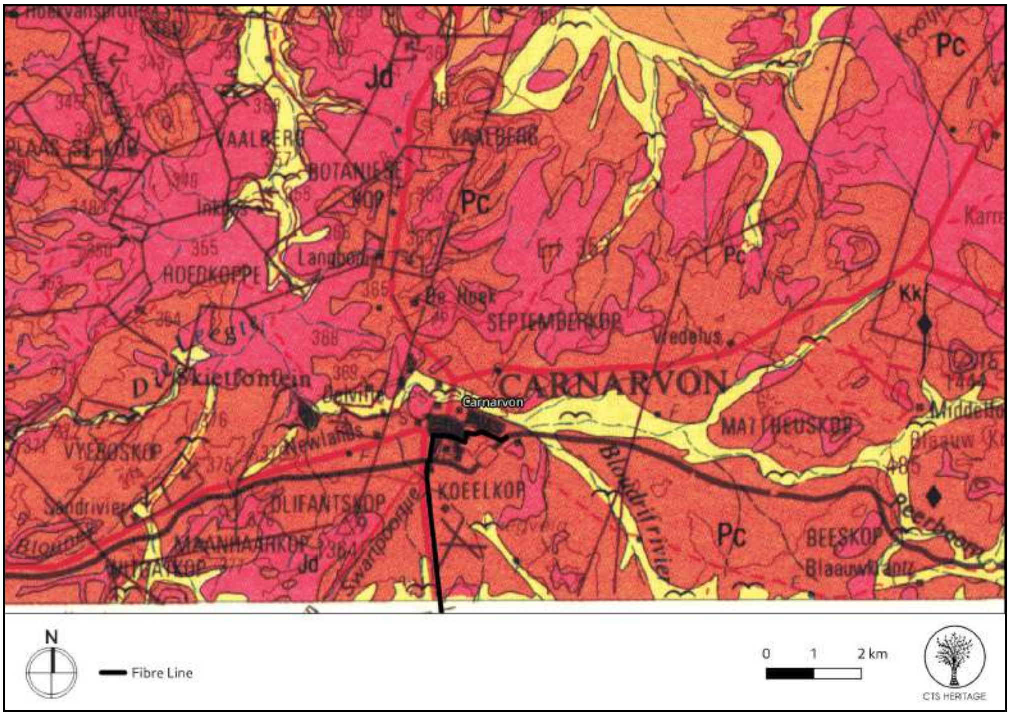


Figure 4.1: Extract from the CGS 3022 Britstown Map indicating that the development area is underlain by Pc: Carnavon Formation of the Ecca Group, Quaternary Sands and Jd: Jurassic Dolerite

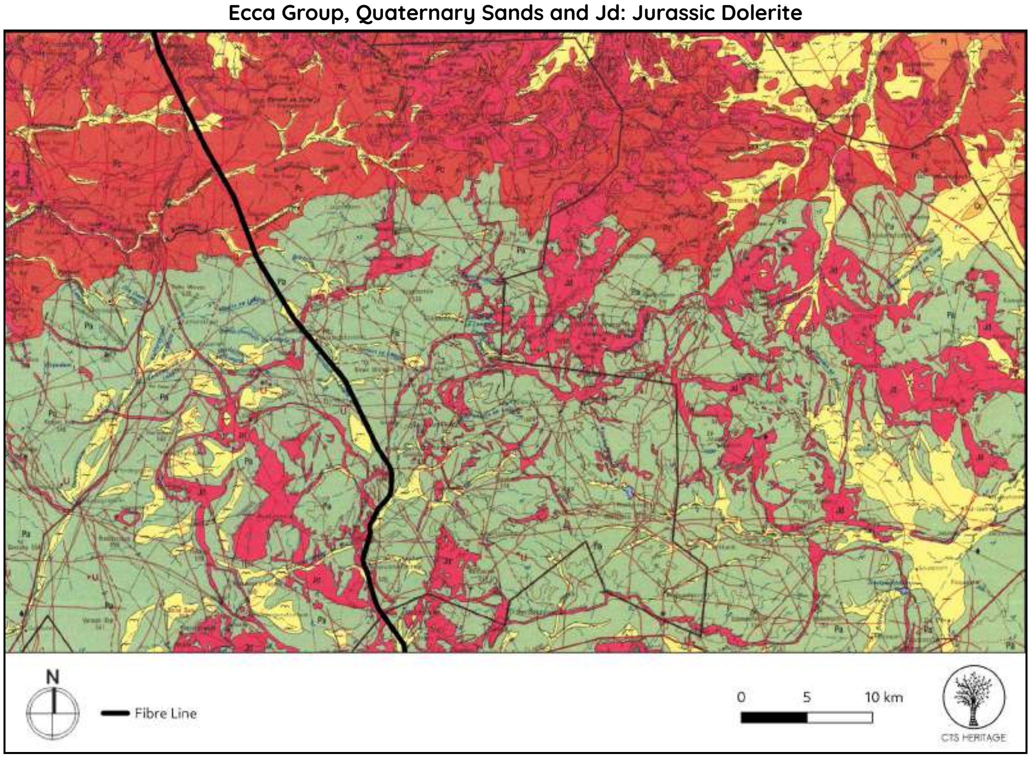


Figure 4.2: Extract from the CGS 3122 Victoria West Map indicating that the development area is underlain by Pa: Abramskraal Formation of the Beaufort Group, Pc: Carnavon Formation of the Ecca Group, Quaternary Sands and Jd: Jurassic Dolerite

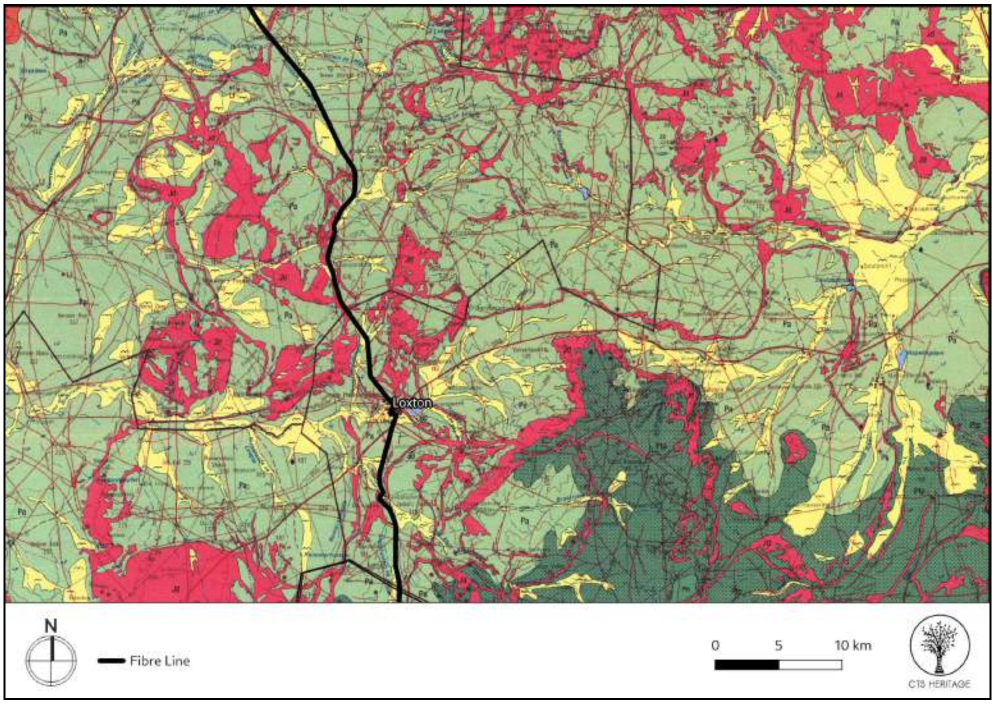


Figure 4.3: Extract from the CGS 3122 Victoria West Map indicating that the development area is underlain by Pa: Abramskraal Formation of the Beaufort Group, Pc: Carnavon Formation of the Ecca Group, Quaternary Sands and Jd: Jurassic Dolerite

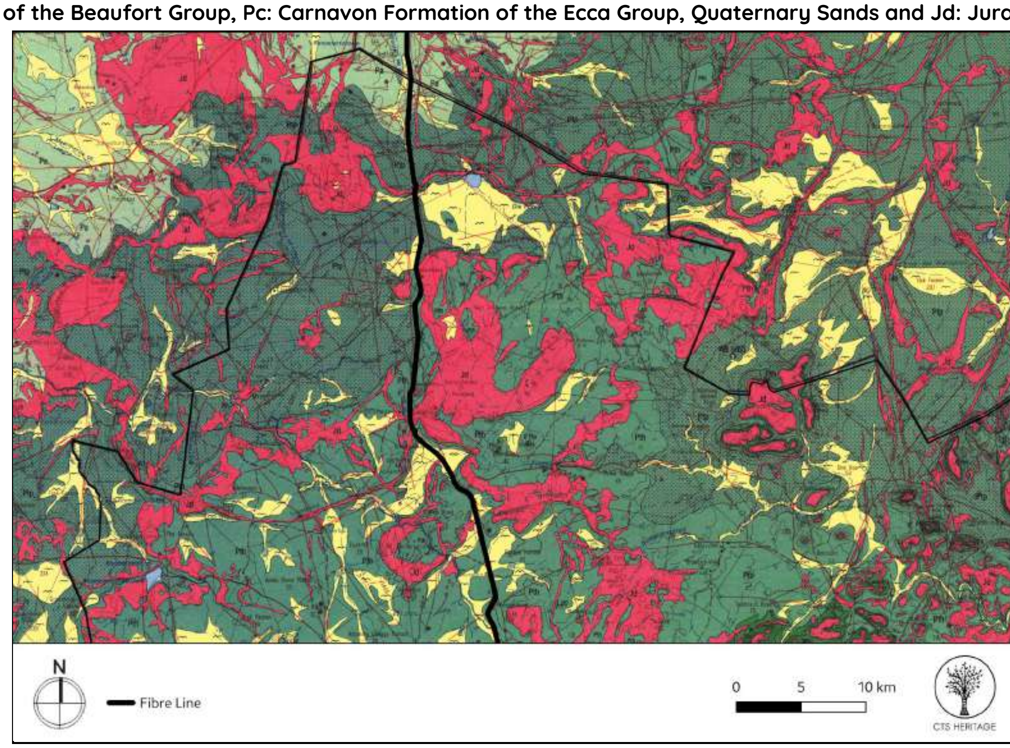


Figure 4.4: Extract from the CGS 3122 Victoria West Map indicating that the development area is underlain by Ptp: Poortjie Member and Pth: Hoedemaker Member of the Teekloof Formation, Pa: Abramskraal Formation of the Beaufort Group, Pc: Carnavon Formation of the Ecca Group, Quaternary Sands and Jd: Jurassic Dolerite

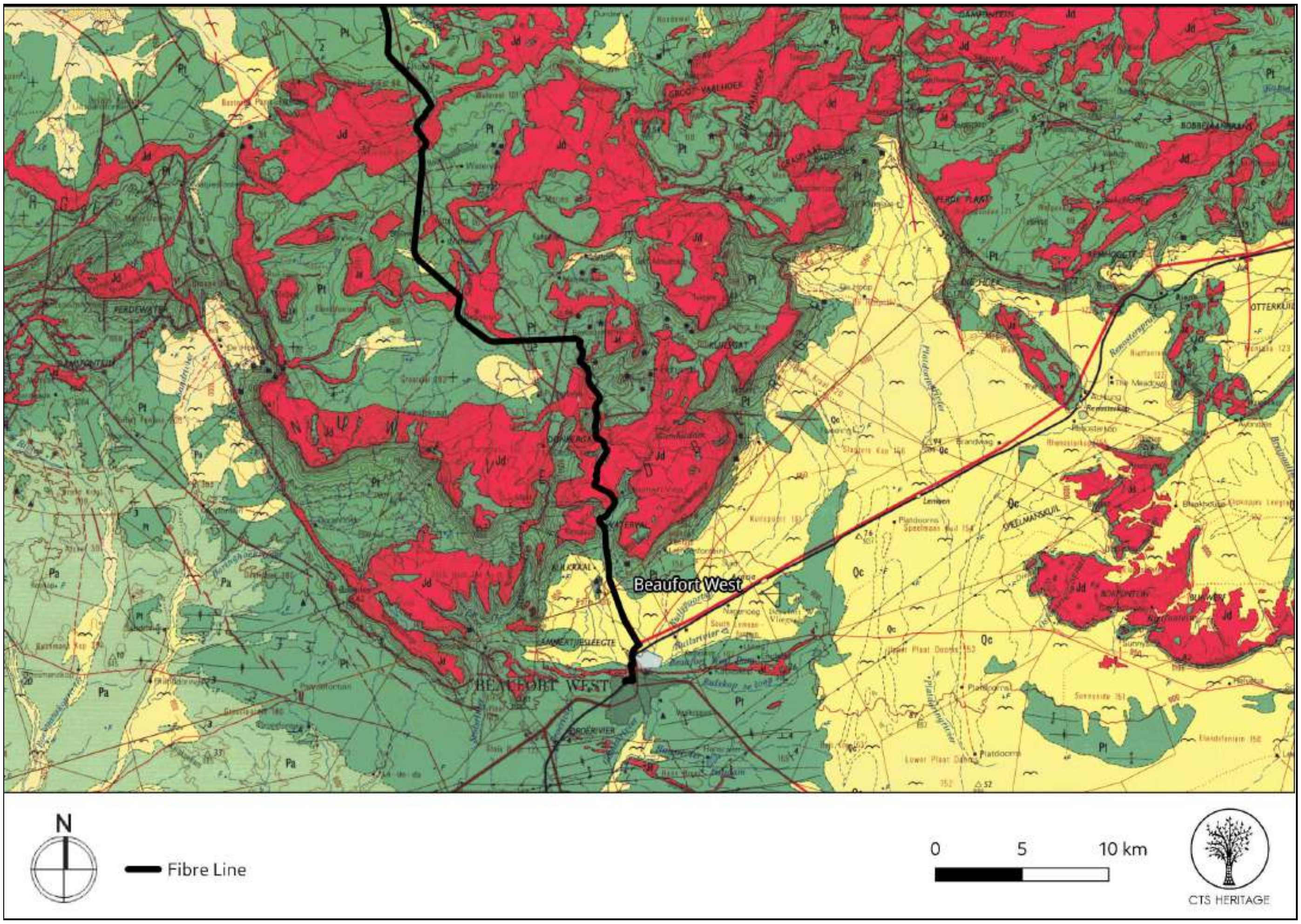


Figure 4.5: Extract from the CGS 3222 Beaufort West Map indicating that the development area is underlain by Ptp: Poortjie Member and Pth: Hoedemaker Member of the Teekloof Formation, Pa: Abramskraal Formation of the Beaufort Group, Pc: Carnavon Formation of the Ecca Group, Quaternary Sands and Jd: Jurassic Dolerite

Table 2: Explanation of symbols for the geological map and approximate ages

Symbol	Group/Formation	Notes
Pth	Teekloof, Hoedemaker member, Beaufort Group, Adelaide Subgroup	266 – 250 Ma Raindrop imprints, desiccation cracks Tropidostoma Assemblage Zone
Ptp	Teekloof, Poortjie member, Beaufort Group, Adelaide Subgroup	266 – 250 Ma Raindrop imprints, desiccation cracks Pristerognathus Assemblage Zone
Pa	Abrahamskraal, Beaufort Group, Adelaide Subgroup	266 – 250 Ma Bioturbation, Trance fosils ~Tapinocephalus Assemblage Zone
Pc	Water Ford Formation (Previously Carnarvon), Ecca Group	290 – 266 Ma Trace Fossils
Pt	Tierberg Formation, Ecca Group	290 – 266 Ma Trace fossils, fish scales, and sponge spicules
Jd	Jurassic Dolerites	182-183 Ma
Qs	Quaternary Sediment	2.6Ma to present

4. IDENTIFICATION OF HERITAGE RESOURCES

4.1 Summary of findings of Specialist Reports

Archaeology

Two large bridges (BTC01 and BTC07) were investigated during the field assessment, one of which could be dated to older than 60 years old (BTC07). BTC07 is located at the Soutpoot River near Loxton. No negative impact to this structure is anticipated. BTC01 is located north of Beaufort West at the start of the Molteno Pass - here the proposed fibre optic cable will be installed overhead on wooden poles.

An anniversary monument (dedication) was also identified (BTC02), although it is not yet considered to be historical (dated 2014), this monument does form part of the cultural landscape and falls within the definition of Monuments and Memorials in terms of HWC's Guideline. This monument reads:

"DUISENDE JARE GELEDE HET SALOMO IN SPREUKE 31:10-31 GESKRYF OOR 'N DEURSAME VROU HIERDIE STEEN IS 'N EERBETOON AAN SO 'N DROOM VROU LOUNIE BADENHORST DANKIE VIR ALLES WAT JY VIR MY BETEKEN LIEFDE CHRIS 25STE HUWELIKS HERDENKING 3.8.1994 - 35 JAAR 3 AUG 2004 - 45 JAAR 3 AUG 2014"

Based on the significance criteria included in the HWC Guide, it is likely that this monument is not conservation-worthy. However, it is recommended that this monument not be negatively impacted by the proposed development (as we are hoping that the Badenhorst's make it to 55 years!).

Although it is well established that ESA, MSA and LSA archaeological finds as well as engraved boulders are prevalent throughout the broader Karoo landscape, only one possible MSA artefact (BTC03) was recorded. The proposed fibre line route has been previously degraded (heavily disturbed) by the construction of the existing road between Beaufort West and Carnarvon and as such, this explains the lack of conservation worthy archaeological finds. An additional explanation for the lack of stone tools may relate to the lack of rocky outcrops (suitable raw material sources) within the proposed development area. With regards to rock engravings, although rocky Karoo dolerite outcrops, consisting of large boulders were observed, no boulders with rock engravings were identified.

There are a few farmhouses situated near the road but no historical farmsteads, dwellings, structures or cemeteries were located within close proximity to the proposed fiber line footprint. The Loxton leiwater system (narrow water canals, examples: BTC04, BT05, BTC06), which are used for irrigation, are set up in a grid system across the Karoo village. These historical features, which are lined with some trees which are older than 100 years, are significant in terms of their contribution to the historical context of Loxton and are therefore graded IIIC. However these resources were not within the layout of the proposed fiber line and will not be impacted by the proposed development.

As such, despite the findings of the DEFF Screening Tool that the area proposed for development has high - medium sensitivity for impacts to archaeological and cultural heritage, the results of the fieldwork indicate that the area in reality has low sensitivity for impacts to significant archaeological and cultural heritage resources. Refer to Appendix 1 for detailed archaeology description and assessment.

Palaeontology

Most of the area proposed for development is underlain by sediments that have very high palaentological sensitivity. According to geology maps from the CGS, these sediments include the Poortjie Member and Hoedemaker Member of the Teekloof Formation, and the Abrahamskraal Formation of the Beaufort Group. According to Rossouw (2019, SAHRIS ID 521555), the study area is located within "early Permian Abrahamskraal Formation rocks of the Adelaide Subgroup (Karoo Supergroup) that is capped by severely degraded, superficial sheet wash and channel related (Quaternary) deposits bounded by Jurassic age dolerite intrusions to the north.

The Loxton area lies within the outcrop area of the Tapinocephalus Assemblage Zone (AZ) which spans the middle part of the Abrahamskraal Formation. Vertebrate fossils of the Tapinocephalus AZ are not as common as in succeeding biozones and are usually found as individual specimens in the mudrock sequences in association with, and often enveloped by, brown-weathering calcareous nodular material. This faunal assemblage is mainly represented by small dicynodonts, large dinocephalians, pareiasaurs and pristerognathid therocephalians. The dinocephalians which consist of Synapsida and Therapsida dominated as one of the tetrapod groups in the Middle Permian. The Tapinocephalus AZ in the Main Karoo Basin holds the most abundant record these dinocephalians. The top of the Abrahamskraal Formation marks the extinction of the dinocephalians. Their disappearance is one of the criterion that marks the beginning of the Pristerognathus AZ. The Pristerognathus AZ correlated with the Poortjie member of the Teekloof Formation. This assemblage zone is followed by the Tropidostoma Assemblage Zone which coronates with the Hoedemaker Member of the Teekloof Formation (Day et al. 2015).

Day et al. (2015) reported new specimens of the rare tapinocephalid dinocephalian Criocephalosaurus in the lower Poortjie Member, which extends the Tapinocephalus AZ from the Abrahamskraal Formation up into the Teekloof Formation. The area in the road reserve where the fibre line will be laid is highly degraded, with large amounts of external material brought in during road construction. The mudstones in the area are also extremely fractured, decreasing the chance of fossil preservation. Only one site was identified to contain trace fossils during the field work.

As such, despite the findings of the DEFF Screening Tool that the area proposed for development has high - medium sensitivity for impacts to palaeontological heritage, and the very high sensitivity of the geology for impacts to significant palaeontological heritage indicated by the SAHRA Palaeosensitivity map, the results of the fieldwork indicate that the area in reality has low sensitivity for impacts to significant palaeontological heritage resources. Refer to Appendix 2 for detailed palaeontological description and assessment.

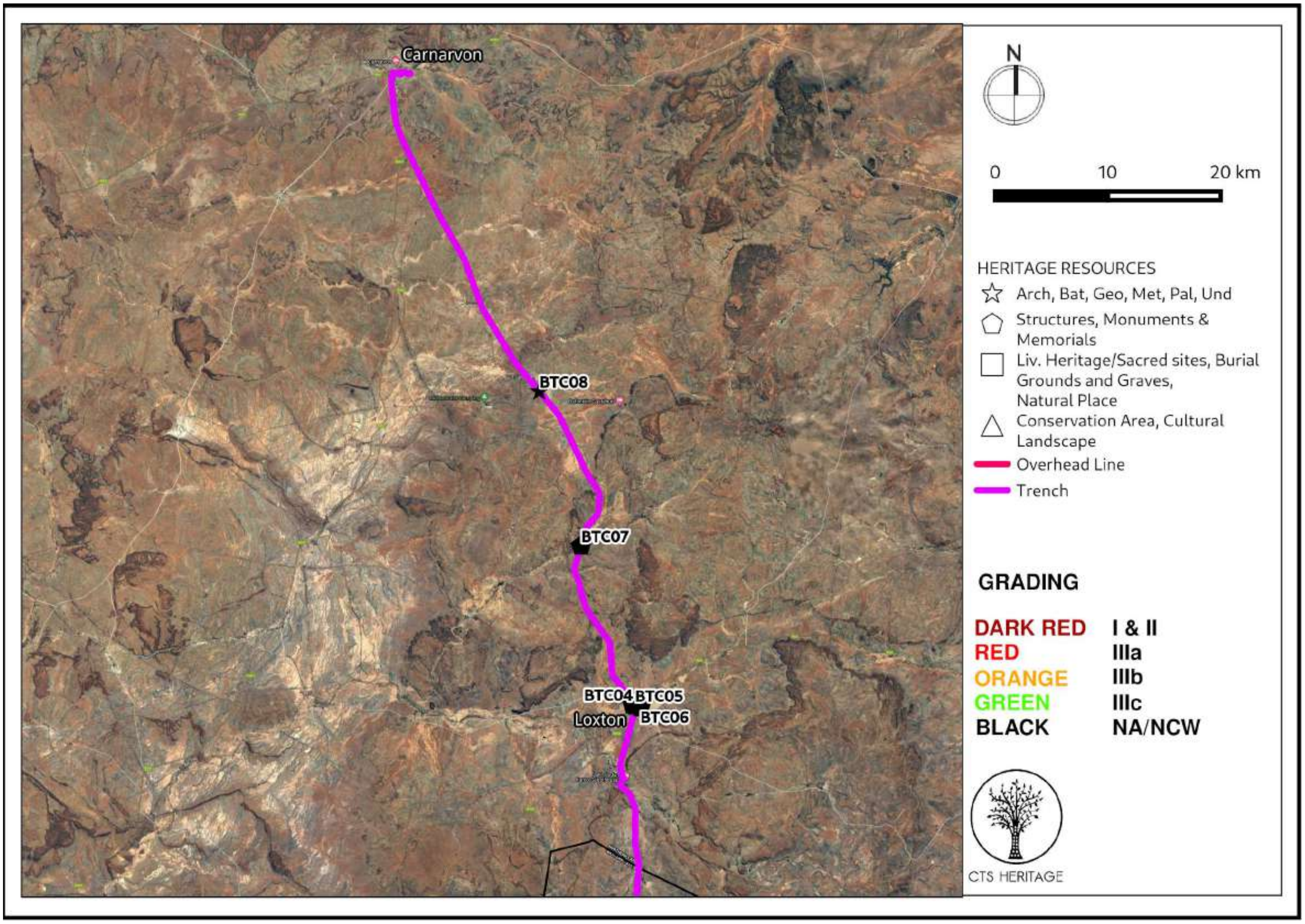
4.2 Heritage Resources identified

Table 3: Observations noted during the field assessments for archaeology and palaeontology

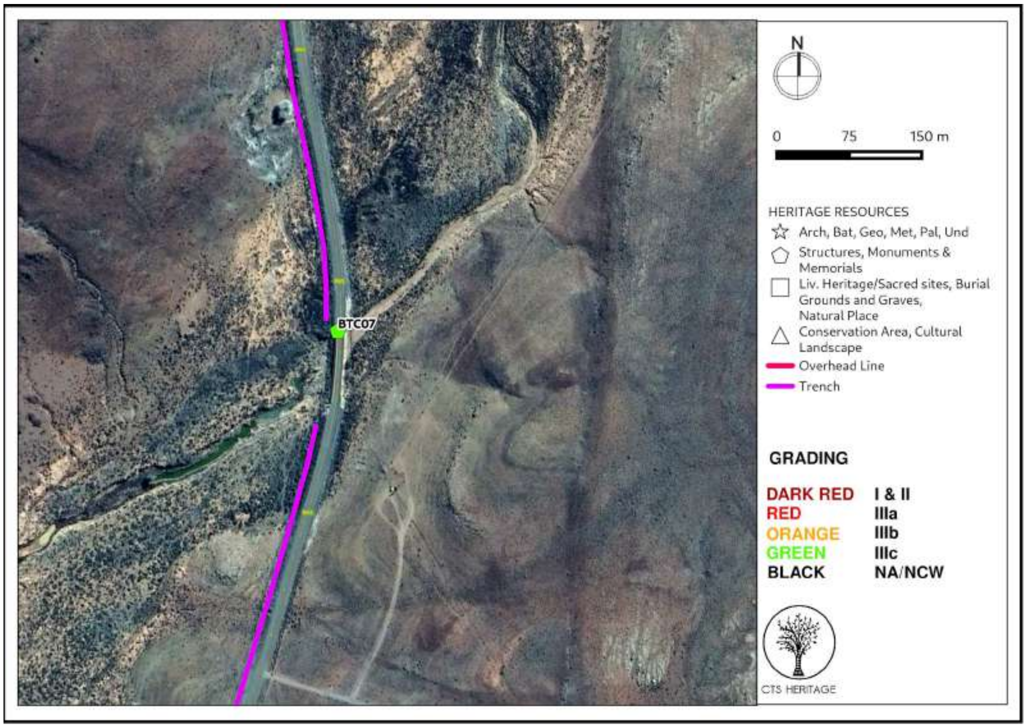
Site No.	Site Name	Description	Co-ordinates		Grading	Province	Mitigation
BTC01	**SKA Fibre_01**	Bridge (dated: 1970)	-32.28339	22.56525	NA	Western Cape	None Required
BTC02	**SKA Fibre_02**	Anniversary Monument/Dedication (dated: 3 August 2014)	-32.25241	22.56853	NA	Western Cape	Not to be disturbed - 10m buffer recommended
BTC03	**SKA Fibre_03**	Possible MSA chert artefact	-32.17230	22.48989	NCW	Western Cape	None Required
BTC04	**SKA Fibre_04**	Loxton Leiwater System	-31.47537	22.34922	IIIC	Northern Cape	No impact anticipated
BTC05	**SKA Fibre_05**	Loxton Leiwater System	-31.47604	22.35136	IIIC	Northern Cape	No impact anticipated
BTC06	**SKA Fibre_06**	Loxton Leiwater System	-31.47761	22.35630	IIIC	Northern Cape	No impact anticipated
BTC07	**SKA Fibre_07**	Bridge (dated: 1958)	-31.34858	22.30103	IIIC	Northern Cape	No impact anticipated
BTC08	**SKA Fibre_08**	Sandstone outcrop	-31.22497	22.26206	NA	Northern Cape	None Required
BTC09	**SKA Fibre_09**	Trace fossils from the Abrahamskraal Formation located On top of road cutting on the western side of the road.	-32.3043	22.5698	IIIC	Western Cape	None Required
BTC10	**SKA Fibre_10**	Mudflakes in sandstone "mud flake conglomerate" from the Abrahamskraal Formation. Not *in situ*.	-32.2906	22.5666	NCW	Western Cape	None Required

CTS HERITAGE

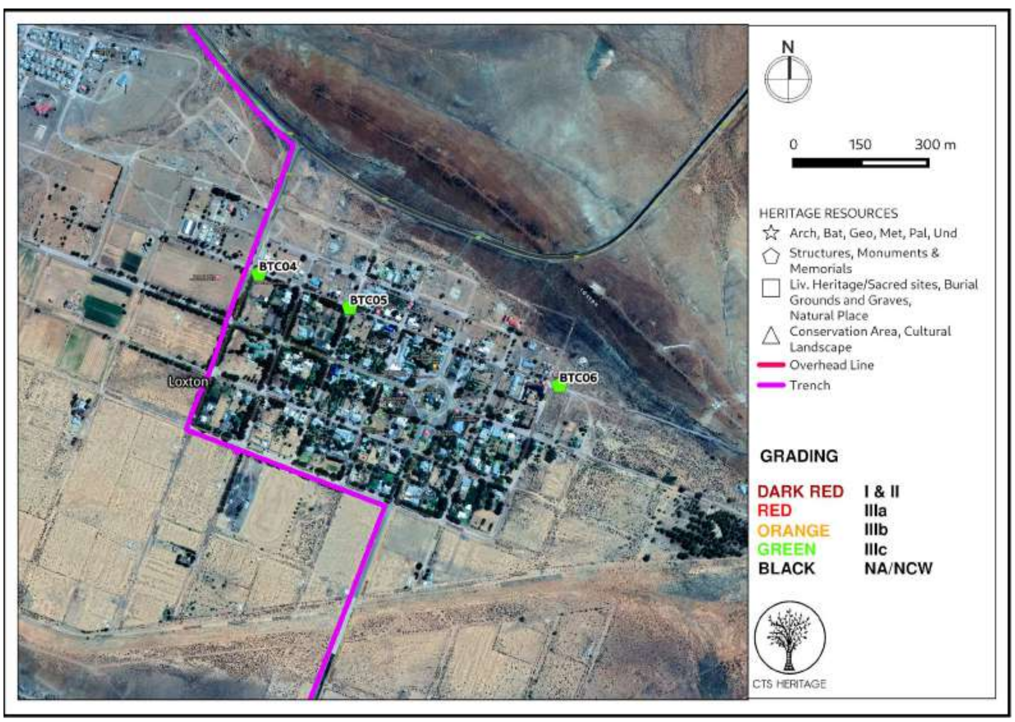
4.3 Mapping and spatialisation of heritage resources



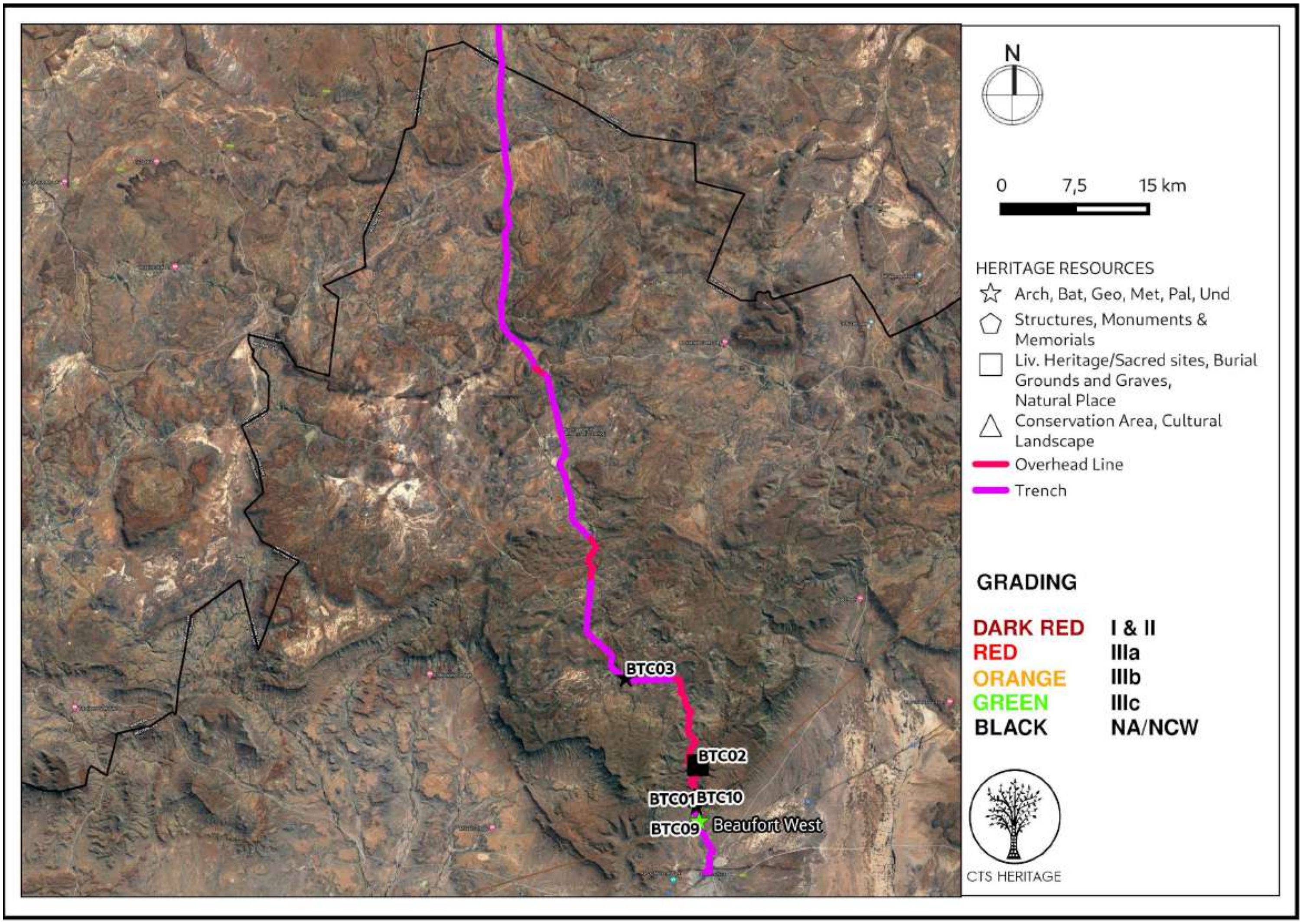
Map 5.1: Heritage resources in the vicinity of the proposed development in the Northern Cape



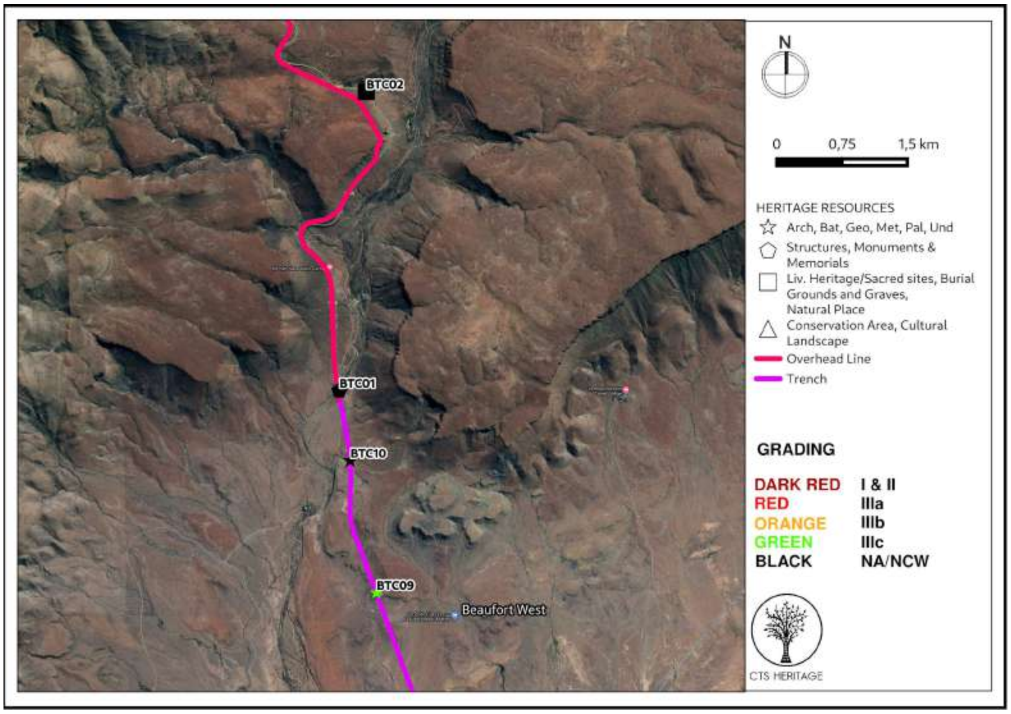
Map 5.2: Heritage resources in the vicinity of the proposed fibre line - BTC07 bridge over the Soutpoot river south of Loxton



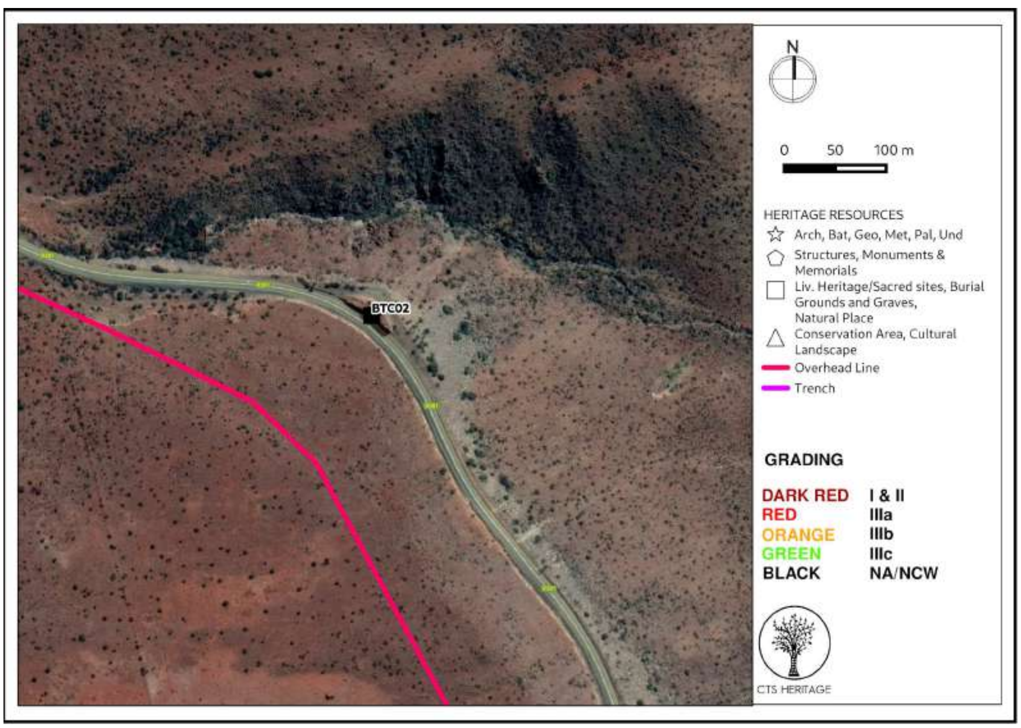
Map 5.3: Heritage resources in the vicinity of the proposed fibre line - BTC04, BTC05 and BTC06 Loxton leiwater



Map 5.4: Heritage resources in the vicinity of the proposed development in the Western Cape



Map 5.5: Heritage resources in the vicinity of the proposed development in the Western Cape



Map 5.6: Heritage resources in the vicinity of the of the proposed fibre line - BTC02 monument

Map 5.4: Heritage resources in the vicinity of the of the proposed fibre line - BTC09 Trace Fossils

5. ASSESSMENT OF THE IMPACT OF THE DEVELOPMENT

5.1 Assessment of impact to Heritage Resources

Construction Phase

The primary impact to heritage resources is likely to take place during the construction phase with excavation activities associated with trenching and the digging of holes to plant poles. The activities are likely to destroy any heritage resources that are located within the proposed fibre line route. Based on the assessment completed, the area proposed for development has a low archaeological sensitivity. No evidence was found of *in situ* archaeological material, rock engraving sites, or graves along the proposed trench or overhead alignments. Neither were historical buildings or structures older than 60 years observed within the footprint of the proposed fibre line, apart from the bridge crossing the Soutpoot River (BTC07, dated 1958) for which no negative impact is anticipated.

Due to the fact that some cultural remains along the roadside are likely covered in gravel from road grading/construction, the possibility exists that some artefacts may only be uncovered during the digging of the trenches or holes for the proposed fiber line.

The area in the road reserve where the fibre line will predominantly be trenched is highly degraded, with large amounts of external material brought in during road construction. The mudstones in the area are also extremely fractured, decreasing the chance of fossil preservation. Only one site was identified to contain trace fossils during the field work. For these reasons it is unlikely that the trenching to lay the fibre line will have a significant effect on the area, provided that the chance fossil find procedure is followed in the possible case of a fossil being found during excavation activities during the construction phase.

Operational Phase

No impacts to heritage resources anticipated.

Decommissioning Phase

No impacts to heritage resources anticipated.

Table 4: Impacts of the proposed fibre optic line to heritage resources

Impact	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
CONSTRUCTION PHASE						
Damage to /destruction of significant heritage resources	**Status**	Negative	**Very low risk**	During the construction phase excavations should be monitored for fossil remains, archaeological resources and burial sites/graves by the responsible Environmental Control Officer (ECO) by implementing the HWC Chance Fossils Finds Procedure (Appendix 2)	**Very low risk**	**High**
	Spatial Extent	Site specific				
	Duration	Short term				
	Consequence	Extreme				
	Probability	Extremely unlikely				

	Reversibility	Impacts are non-reversible		Should substantial fossil remains such as vertebrate bones and teeth, petrified wood, plant-rich fossil lenses or dense fossil burrow assemblages be exposed during construction, the responsible ECO should safeguard these, preferably in situ, and alert the South African Heritage Resources Authority (SAHRA) in the Northern Cape and/or HWC in the Western Cape so that appropriate action can be taken by a professional palaeontologist or archaeologist as required.		
	Irreplaceability	High irreplaceability				

5.2 Cumulative Impacts

Construction Phase

No impacts anticipated

Operational Phase

Cumulative impacts are only anticipated during the Operational Phase of the development. The proposed fibre line alignment runs predominantly along an existing road between Beaufort West and Carnarvon. For the majority of this route, the proposed fibre line will be buried below ground. For only a portion of the route, the proposed line will run overhead. There is an existing overhead line that runs along much of the route (Figure 6). In general, in terms of impacts to heritage resources, it is preferable to consolidate and concentrate like infrastructure into one location in order to avoid disruption of the integrity of intact wilderness Karoo landscapes. As such, it is not anticipated that the proposed fibre line will have a negative cumulative impact on heritage resources including the cultural landscape as long as the proposed line runs along existing similar infrastructure.

Decommissioning Phase

No impacts anticipated

Figure 6: Existing overhead line that runs along the existing road

Table 5: Cumulative Impact Table

Impact	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
CONSTRUCTION PHASE						
Cumulative Impact to heritage resources	**Status**	Negative	**Very low risk**	No impacts are anticipated and as such, no mitigation is required	**Very low risk**	**High**
	Spatial Extent	Site specific				
	Duration	Short term				
	Consequence	Extreme				
	Probability	Extremely unlikely				
	Reversibility	Impacts are non-reversible				
	Irreplaceability	High irreplaceability				

5.3 Sustainable Social and Economic Benefit

In summary, direct socio-economic opportunities are mainly limited to local employment during construction including short term job creation where the main contractor will hire local people to do hand trenching instead of machinery for about 10km on each town (Beaufort West, Loxton and Carnarvon). The distance for hand trenching will be determined close to the start of the project. Spin-off opportunities may include the introduction and expansion of Information and Communications Technology (ICT) services in the region. As part of the bigger SKA project there are opportunities to provide wi-fi services in Carnarvon which will be made possible by this fibre installation project. Discussions in this regard are ongoing.

In addition, as part of the broader SKA project, connectivity is required between the SKA core site in the Northern Cape and a data processing facility in Cape Town to transport the science data for the SKA project and its precursor, MeerKAT. Access to dark fibre is required to transport this data due to the expected data throughputs for the SKA project. As such, the anticipated impact to heritage resources does not outweigh the socio-economic benefits associated with the proposed development in terms of the role of South Africa in astronomical research, as well as the associated benefits of fibre connectivity in rural areas.

5.4 Proposed development alternatives

Alternative 1 (Preferred):

This route is assessed in this report. It initiates in Beaufort West and extends north to Loxton and ends in Carnarvon. There is limited impact to heritage resources anticipated for this route alternative and as such, it is the preferred alternative for the development in terms of impacts to heritage resources.

Alternative 2 (Excluded)

This route initiates at Leeu Gamka and extends to Loxton. From Loxton, this alternative route follows the same alignment as Alternative 1, the alternative considered in this report, and ends in Carnarvon. This alternative has been excluded due to its increased length. This increased length of impact also makes this alternative the least preferred in terms of impacts to heritage.

No-Go Alternative

This alternative describes a scenario where no development takes place. Should no development proceed, no impacts to heritage resources will take place.

6. RESULTS OF PUBLIC CONSULTATION

There are no registered heritage conservation bodies for the area proposed for development (HWC Website checked 28/10/2020). The Beaufort West Municipality will be provided with the opportunity to comment on the Draft HIA for 30 days as per the requirements of HWC. Additional public consultation processes will be undertaken by the EAP during the EIA. No heritage-related comments have been received to-date. Should any heritage-related comments be received during the PPP, this report will be updated to include them. The evidence and outcomes of the heritage commenting process are included in Appendix 7.

7. LEGISLATIVE AND PERMIT REQUIREMENTS

This proposed development triggers sections 38(1) and 38(8) of the National Heritage Resources Act (NHRA, Act 25 of 1999) as this proposed development constitutes a linear development exceeding 300m and this proposed development requires an evaluation of impacts to heritage resources in terms of other legislation (NEMA). This section states that the consenting authority (the Department of Environmental Affairs and Development Planning (DEADP) in the Western Cape and the Department of Environment and Nature Conservation (DENC) in the Northern Cape) must ensure that the assessment completed for impacts to heritage satisfies the requirements of the relevant heritage authority in terms of section 38(3) of the NHRA (HWC in the Western Cape and SAHRA in the Northern Cape), and that the recommendations of the relevant heritage authority must be taken into consideration prior to the granting of consent.

Section 38(3) of the NHRA details the information that MUST be included in a Heritage Impact Assessment (HIA) drafted in terms of section 38 of the NHRA. Furthermore, HWC has published guidelines on their minimum requirements for Heritage Impact Assessments and SAHRA has published Minimum Standards for Archaeological and Palaeontological Impact Assessments. All such guidelines and minimum standards have been complied with in the drafting of this HIA.

In terms of section 38(10) of the NHRA, if the applicant complies with the recommendations and requirements of the relevant heritage authority issued in terms of section 38(8) of the NHRA, then the applicant MUST be exempted from compliance with all other (general) protections included in the NHRA. As such, as long as the requirements of the heritage authority are satisfied, no permit application is required for the destruction of or impact to any heritage resource that has been identified in the HIA.

Should any heritage resources be newly uncovered during excavation activities (ie. heritage resources that were not identified in the HIA), then as per the recommendations of the HIA, work must cease in that area and the relevant heritage authority must be contacted regarding a way forward. This HIA recommends that the HWC Chance Fossils Finds procedure be implemented in order to direct such actions.

8. ENVIRONMENTAL MANAGEMENT PROGRAMME INPUTS

The following recommendations must be included in the EMPr for this project:

- During the construction phase all excavations must be monitored for fossil remains by the responsible ECO using the HWC Chance Fossil Finds Procedure (Appendix 2). Should substantial fossil remains such as vertebrate bones and teeth, petrified wood, plant-rich fossil lenses or dense fossil burrow assemblages be exposed during construction, the responsible ECO should safeguard these, preferably in situ, and alert SAHRA in the Northern Cape and HWC in the Western Cape so that appropriate action can be taken by a professional palaeontologist,
- Should any evidence of archaeological sites or remains (e.g. remnants of stone-made structures, indigenous ceramics, bones, stone artefacts, ostrich eggshell fragments, charcoal and ash concentrations), fossils or other categories of heritage resources be found during the proposed development, SAHRA Archaeology, Palaeontology and Meteorites Unit (Natasha Higgitt/Phillip Hine 021 462 5402) in the Northern Cape and HWC (Colette Scheermeyer, 021 483 5959) in the Western Cape must be alerted.
- If unmarked human burials are uncovered in the Northern Cape, the SAHRA Burial Grounds and Graves (BGG) Unit (Mimi Seetelo 012 320 8490), and in the Western Cape, HWC (Colette Scheermeyer, 021 483 5959) must be alerted immediately as per section 36(6) of the NHRA. A professional archaeologist must be contracted as soon as possible to inspect the findings. A Phase 2 rescue excavation operation may be required subject to permits issued by SAHRA and/or HWC

9. FINAL SPECIALIST STATEMENT AND AUTHORISATION RECOMMENDATION

9.1 Statement and Reasoned Opinion

The proposed development will not have a negative impact on the heritage resources situated within the footprint of the proposed fibre optic line between Beaufort West and Carnarvon. The lithic material identified is of low significance, and even though the resources may be destroyed during the construction, the impact is inconsequential. The heritage resources identified are largely located some distance from the proposed line (BTC02, BTC04, BTC05, BTC06, SAHRIS Site ID 32495) and will not be impacted by the proposed development or are not conservation-worthy (BTC01, BTC03 and BTC07). Due to the fact that some cultural remains along the roadside are likely covered in gravel from road grading/construction, the possibility exists that some artefacts may only be uncovered during the digging of the trenches and holes for the proposed fiber optic line installation.

The proposed installation of the SKA fibre optic line may proceed. It is unlikely that this construction will have a great effect on significant palaeontological heritage. Although the area has a rich occurrence of multiple fossil assemblages, fossil finds are often isolated as individuals. Only one site was identified to contain some trace fossils (BTC09). This trace fossil has contextual significance only and no further mitigation measures are recommended. The trench for the SKA fibre line will predominantly run along highly disturbed and fractured roadside material. This decreases the chance of finding fossils dramatically.

Despite the findings of the DEFF Screening Tool that the area proposed for development has high - medium sensitivity for impacts to archaeological and cultural heritage, and palaeontological heritage, the results of the fieldwork indicate that the overall impacts of the proposed fibre optic cable to heritage resources is MEDIUM TO LOW, and LOW with mitigation.

9.2 EA Condition Recommendations

There is no objection to the proposed development on heritage grounds and the following is recommended:

- No mitigation is required prior to construction operations commencing.
- During the construction phase all excavations must be monitored for fossil remains by the responsible ECO using the HWC Chance Fossil Finds Procedure. Should substantial fossil remains such as vertebrate bones and teeth, petrified wood, plant-rich fossil lenses or dense fossil burrow assemblages be exposed during construction, the responsible ECO should safeguard these, preferably in situ, and alert SAHRA in the Northern Cape and HWC in the Western Cape so that appropriate action can be taken by a professional palaeontologist,
- Should any evidence of archaeological sites or remains (e.g. remnants of stone-made structures, indigenous ceramics, bones, stone artefacts, ostrich eggshell fragments, charcoal and ash concentrations), fossils or other categories of heritage resources be found during the proposed development, SAHRA APM Unit (Natasha Higgitt/Phillip Hine 021 462 5402) in the Northern Cape and HWC (Colette Scheermeyer, 021 483 5959) in the Western Cape must be alerted.
- If unmarked human burials are uncovered in the Northern Cape, the SAHRA BGG Unit (Mimi Seetelo 012 320 8490), and in the Western Cape, HWC (Colette Scheermeyer, 021 483 5959) must be alerted immediately as per section 36(6) of the NHRA. A professional archaeologist must be

contracted as soon as possible to inspect the findings. A Phase 2 rescue excavation operation may be required subject to permits issued by SAHRA and/or HWC

- The above recommendations must be included in the Environmental Management Programme (EMPr) for the project

9. REFERENCES

Heritage Impact Assessments				
Nid	Report Type	Author/s	Date	Title
3989	AIA Phase 1	Cobus Dreyer	19/04/2007	First Phase Archaeological and Cultural Heritage Assessment of the Proposed Borrow Pit Sites Along the P02996 Road Between Carnarvon & the Ska Site, Northern Cape
3990	AIA Phase 1	Cobus Dreyer	17/09/2007	First Phase Archaeological and Cultural Heritage Investigation of the Proposed Upgrading of the Oxidation Pond System at Carnarvon, Northern Cape
4013	AIA Phase 1	Jonathan Kaplan	01/02/2006	Phase 1 Archaeological Impact Assessment Proposed Klavervlei Powerline Karoo National Park
6461	AIA Phase 1	Jonathan Kaplan	01/02/2008	Phase 1 Archaeological Impact Assessment: Proposed Development Remainder of Farm 185 (Now Called Plot 8419) Beaufort West, Western Cape Province
253529	HIA Phase 1	Cobus Dreyer	20/12/2014	First phase archaeological and heritage assessment of the proposed solid waste disposal site at Loxton, Northern Cape
186695	HIA Phase 1	McEdward Murimbika	01/08/2014	Proposed Gamma-Kappa 2nd 765kV Eskom Transmission Powerline and Substations Upgrade Development in Western Cape PHASE 1 HERITAGE IMPACT ASSESSMENT STUDY REPORT
186697	AIA Desktop	Foreman Bandama, Shadreck Chirikure	01/08/2014	An Archaeological Scoping and Assessment report for the proposed Gamma (Victoria West, Northern Cape) - Kappa (Ceres â€“ Western Cape) 765Kv (2) Eskom power transmission line
186698	PIA Desktop	JF Durand	09/06/2013	GAMMA-KAPPA 765kV Transmission Line, Western Cape Province SCOPING REPORT PALAEONTOLOGY
503050	AIA Phase 1	Madelon Tusenius	01/03/2012	ARCHAEOLOGICAL IMPACT ASSESSMENT OF A PROPOSED BORROW PIT AT RIETKUIL 307, BEAUFORT WEST, CENTRAL KAROO DISTRICT, WESTERN CAPE
521555	Letter of Exemption	Lloyd Rossouw	13/02/2019	Exemption from further Heritage Impact Assessment: Rectification in terms of Section 24G for Residential Development in Loxton, Northern Cape Province.

Other References:

CSIR. 2020. Environmental Screening Study for the proposed Square Kilometre Array (SKA) fibre optic cable from Beaufort West to Carnarvon. May 2020

Day, M.O.; Güven. S.; Abdala; F.; Jirah; S. Rubidge, B.; Almond, J. 2015. Youngest dinocephalian fossils extend the Tapinocephalus Zone, Karoo Basin, South Africa S. Afr. j. sci. vol.111 n.3-4 Pretoria Mar./Apr. 2015 Evolutionary Studies Institute, School of Geosciences, University of the Witwatersrand, Johannesburg, South Africa

HWC. 2016. Grading: Purpose and Management Implications. Guideline published by Heritage Western Cape. https://www.hwc.org.za/sites/default/files/2_3_6%20Grading_Implications%20and%20Management_Approved.pdf

SAHRA. 2018. Heritage resources database, All sites, End 2018.

APPENDICES

CTS HERITAGE

APPENDIX 1: Archaeological Assessment

APPENDIX 2: Palaeontological Assessment

CTS HERITAGE

APPENDIX 3: Heritage Screening Assessment

CTS HERITAGE

APPENDIX 4: Specialist Expertise

CTS HERITAGE

APPENDIX 5: Specialist Statement of Independence

I, ____Jenna Lavin______________________________, declare that –

- I act as the independent specialist in this application;
- I will 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;
- 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 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;
- all the particulars furnished by me in this form 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: __CTS Heritage_________________________

Date: __18 January 2021_________________________

APPENDIX 6: Site Sensitivity Verification

Prior to commencing with the specialist assessment in accordance with Appendix 6 of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) Environmental Impact Assessment (EIA) Regulations of 2014, a site sensitivity verification was undertaken in order to confirm the current land use and environmental sensitivity of the proposed project area as identified by the National Web-Based Environmental Screening Tool (Screening Tool).

The details of the site sensitivity verification are noted below:

Date of Site Visit	28 and 29 September 2020
Specialist Name	Jenna Lavin, Dewald Wilken, Nikki Mann
Professional Registration Number	ASAPA, APHP, PSSA
Specialist Affiliation / Company	CTS Heritage

Note from the CSIR: The specialist must include the following information in this section of the report:

- Provide a description on how the site sensitivity verification was undertaken using the following means:

  (a) desktop analysis, using satellite imagery;

  See attached Desktop Heritage Screening Assessment (Appendix 3)

  (b) preliminary on-site inspection; and

  See Specialist Archaeology and Palaeontology Reports (Appendix 1 and 2)

  (c) any other available and relevant information.

- Provide a description of the outcome of the site sensitivity verification in order to:

(a) confirm or dispute the current use of the land and the environmental sensitivity as identified by the screening tool, such as new developments or infrastructure, the change in vegetation cover or status etc.;

Overall site sensitivity is LOW for impacts to archaeology and palaeontology

(b) include a motivation and evidence (e.g. photographs) of either the verified or different use of the land and environmental sensitivity.

See body of HIA

CTS HERITAGE

Appendix 7: Impact Assessment Methodology

Note from the CSIR: The following impact assessment must be used.

The impact assessment includes:

- the nature, significance and consequences of the impact and risk;
- the extent and duration of the impact and risk;
- the probability of the impact and risk occurring;
- the degree to which impacts and risks can be mitigated;
- the degree to which the impacts and risks can be reversed; and
- the degree to which the impacts and risks can cause loss of irreplaceable resources.

As per the DEFFT Guideline 5: Assessment of Alternatives and Impacts, the following methodology is applied to the prediction and assessment of impacts and risks. Potential impacts and risks have been rated in terms of the direct, indirect and cumulative:

- Direct impacts are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.
- Indirect impacts of an activity are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken or which occur at a different place as a result of the activity.
- Cumulative impacts are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.

The impact assessment methodology includes the following aspects:

- Nature of impact/risk - The type of effect that a proposed activity will have on the environment.
- Status - Whether the impact/risk on the overall environment will be:
  - Positive - environment overall will benefit from the impact/risk;
  - Negative - environment overall will be adversely affected by the impact/risk; or
  - Neutral - environment overall not be affected.
- Spatial extent – The size of the area that will be affected by the impact/risk:
  - Site specific;
  - Local (<10 km from site);

  - Regional (<100 km of site);
  - National; or
  - International (e.g. Greenhouse Gas emissions or migrant birds).
- Duration – The timeframe during which the impact/risk will be experienced:
  - Very short term (instantaneous);
  - Short term (less than 1 year);
  - Medium term (1 to 10 years);
  - Long term (the impact will cease after the operational life of the activity (i.e. the impact or risk will occur for the project duration)); or
  - Permanent (mitigation will not occur in such a way or in such a time span that the impact can be considered transient (i.e. the impact will occur beyond the project decommissioning)).
- Consequence – The anticipated consequence of the risk/impact:
  - Extreme (extreme alteration of natural systems, patterns or processes, i.e. where environmental functions and processes are altered such that they permanently cease);
  - Severe (severe alteration of natural systems, patterns or processes, i.e. where environmental functions and processes are altered such that they temporarily or permanently cease);
  - Substantial (substantial alteration of natural systems, patterns or processes, i.e. where environmental functions and processes are altered such that they temporarily or permanently cease);
  - Moderate (notable alteration of natural systems, patterns or processes, i.e. where the environment continues to function but in a modified manner); or
  - Slight (negligible alteration of natural systems, patterns or processes, i.e. where no natural systems/environmental functions, patterns, or processes are affected).
- Reversibility of the Impacts - the extent to which the impacts/risks are reversible assuming that the project has reached the end of its life cycle (decommissioning phase):
  - High reversibility of impacts (impact is highly reversible at end of project life i.e. this is the most favourable assessment for the environment);
  - Moderate reversibility of impacts;
  - Low reversibility of impacts; or
  - Impacts are non-reversible (impact is permanent, i.e. this is the least favourable assessment for the environment).
- Irreplaceability of Receiving Environment/Resource Loss caused by impacts/risks – the degree to which the impact causes irreplaceable loss of resources assuming that the project has reached the end of its life cycle (decommissioning phase):

- ○ High irreplaceability of resources (project will destroy unique resources that cannot be replaced, i.e. this is the least favourable assessment for the environment);
- ○ Moderate irreplaceability of resources;
- ○ Low irreplaceability of resources; or
- ○ Resources are replaceable (the affected resource is easy to replace/rehabilitate, i.e. this is the most favourable assessment for the environment).

Using the criteria above, the impacts have been further assessed in terms of the following:

- Probability – The probability of the impact/risk occurring:
  - Extremely unlikely (little to no chance of occurring);
  - Very unlikely (<30% chance of occurring);
  - Unlikely (30-50% chance of occurring)
  - Likely (51 – 90% chance of occurring); or
  - Very Likely (>90% chance of occurring regardless of prevention measures).

To determine the significance of the identified impact/risk, the consequence is multiplied by probability (qualitatively as shown in Figure 1).

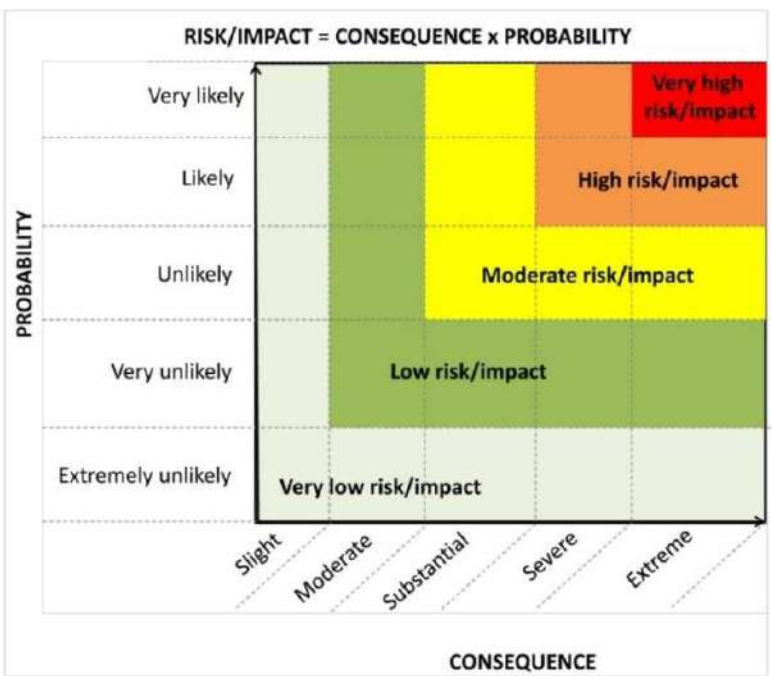


Figure 1. Guide to assessing risk/impact significance as a result of consequence and probability.

- Significance – Will the impact cause a notable alteration of the environment?
  - Very low (the risk/impact may result in very minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);
  - Low (the risk/impact may result in minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);
  - Moderate (the risk/impact will result in moderate alteration of the environment and can be reduced or avoided by implementing the appropriate mitigation measures, and will only have an influence on the decision-making if not mitigated);
  - High (the risk/impact will result in major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making); and
  - Very high (the risk/impact will result in very major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making (i.e. the project cannot be authorised unless major changes to the engineering design are carried out to reduce the significance rating)).

With the implementation of mitigation measures, the residual impacts/risks are ranked as follows in terms of significance:

- Very low = 5;
- Low = 4;
- Moderate = 3;
- High = 2; and
- Very high = 1.

Confidence – The degree of confidence in predictions based on available information and specialist knowledge:

- Low;
- Medium; or
- High.

APPENDIX 8: Consultation Process

ARCHAEOLOGICAL SPECIALIST STUDY

In terms of Section 38(8) of the NHRA for a

Proposed Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon, Northern and Western Cape

HWC Ref:

Prepared by

CTS HERITAGE

In Association with

CSIR

October 2020

CTS HERITAGE

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

I Jenna Lavin, as the appointed independent specialists hereby declare that we:

• act/ed as the independent specialist in this application;

• regard the information contained in this report as it relates to my specialist input/study to be true and correct, and

• do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2010 and any specific environmental management Act;

• have and will not have 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, 2010 and any specific environmental management Act;

• am fully aware of and meet the responsibilities in terms of NEMA, the Environmental Impact Assessment Regulations, 2010 (specifically in terms of regulation 17 of GN No. R. 543) 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 our disposal regarding the application, whether such information is favourable to the applicant or not; and

• are aware that a false declaration is an offence in terms of regulation 71 of GN No. R. 543.

Signature of the specialist

CTS Heritage
Name of company

October 2020
Date

CTS Heritage
34 Harries Street, Plumstead, Cape Town
Tel: +27 (0)87 073 5739 **Email:** info@ctsheritage.com **Web:** www.ctsheritage.com

EXECUTIVE SUMMARY

The South African Radio Astronomy Observatory (SARAO) spearheads South Africa's activities in the SKA Radio Telescope through engineering, science and construction. SARAO is a National Facility, managed by the National Research Foundation, which incorporates radio astronomy instruments and various programmes across Africa including MeerKAT. Connectivity is required between the SKA core site in the Northern Cape and a data processing facility in Cape Town to transport the science data for the SKA project and its precursor, MeerKAT. Access to dark fibre is required to transport this data due to the expected data throughputs for the SKA project.

Seven heritage resources were identified within the vicinity of the proposed fibre line route including two bridges (BTC01 and BTC07, graded IIIC), the Loxton leiwater (BTC04, BTC05 and BTC06, all graded IIIC), one possible stone artefact (out of context, BTC03, not conservation-worthy), a privately erected monument (BTC02, not conservation-worthy) and a sandstone outcrop (BTC08, not conservation-worthy).

Based on the outcomes of this report, it is not anticipated that the proposed development of the fibre line will negatively impact on significant archaeological heritage. The proposed fibre line route has been previously degraded (heavily disturbed) by the construction of the existing road between Beaufort West and Carnarvon and as such, this explains the lack of conservation worthy archaeological finds. An additional explanation for the lack of stone tools may relate to the lack of rocky outcrops (suitable raw material sources) within the proposed development area.

The heritage resources identified are largely located some distance from the proposed line (BTC02, BTC04, BTC05, BTC06, SAHRIS Site ID 32495) and will not be impacted by the proposed development or are not conservation-worthy (BTC01, BTC03, BTC07 and BTC08).

Due to the fact that some cultural remains along the roadside are likely covered in gravel from road grading/construction, the possibility exists that some artefacts may only be uncovered during the digging of the trenches for the proposed fiber line.

As such, there is no objection to the proposed development in terms of impacts to archaeological heritage however it is recommended that, should any archaeological resources or burial grounds or graves be identified during the course of trenching or excavation activities, work must cease in the area and SAHRA (Northern Cape) or Heritage Western Cape (in the Western Cape) must be contacted regarding an appropriate way forward.

CONTENTS

CTS Heritage
34 Harries Street, Plumstead, Cape Town
Tel: +27 (0)87 073 5739 **Email:** info@ctsheritage.com **Web:** www.ctsheritage.com

1. INTRODUCTION

1.1 Background Information on Project

The South African Radio Astronomy Observatory (SARAO) spearheads South Africa's activities in the SKA Radio Telescope through engineering, science and construction. SARAO is a National Facility, managed by the National Research Foundation, which incorporates radio astronomy instruments and programmes such as the MeerKAT and KAT-7 telescopes in the Karoo, the Hartebeesthoek Radio Astronomy Observatory (HartRAO) in Gauteng, the African Very Long Baseline Interferometry (AVN) programme in nine African countries, as well as the associated human capital development and commercialisation endeavours.

Connectivity is required between the SKA core site in the Northern Cape and a data processing facility in Cape Town to transport the science data for the SKA project and its precursor, MeerKAT. Access to dark fibre is required to transport this data due to the expected data throughputs for the SKA project.

The details of the preferred and selected SKA fibre route (Route A) is as follows:

1. The fibre route starts from Beaufort West Transnet building, to a 3 m x 6 m signal repeater station at Loxton, and then on to the Carnarvon SKA Point of Presence (PoP) site (location where networking equipment may be accessed).
2. The fibre duct and cable will be laid in a 1 m deep and 300 mm wide trench and be buried by backfilling and compacting the trench.
3. The fibre route will predominantly be installed within the road reserves of roads R381 and R63, and 1 m from the fence of the private land.
4. 155 km will be underground and 25 km will be overhead due to it not being technically or financially feasible to trench on the Molteno Pass section. The total pole length is 9 m, buried 1.5 m deep, with a resultant above-ground height of 7.5 m
5. There are several streams / rivers and associated wetlands to cross. Rivers will be crossed using directional drilling 2 m below the riverbed starting 32 m away from river banks.
6. There is only one river with solid bedrock (the Brak River near Loxton) where directional drilling is not technically or financially feasible. Here the fibre cable will be attached to the existing road bridge.

1.2 Description of Property and Affected Environment

The area proposed for development is located within a dry rural landscape. The topography of the Karoo region is mainly determined by the geology. The areas that were surveyed directly adjacent to the road (R381) were relatively flat. The land use in the study area is characterised by agriculture which is dominantly sheep and game farming. The soil surface in the surveyed area is very stony, consisting of thick dolerite or sandstone deposits with large boulders. The vegetation is typical of the Karoo Biome and includes knee high shrubs, grasses and Acacias.

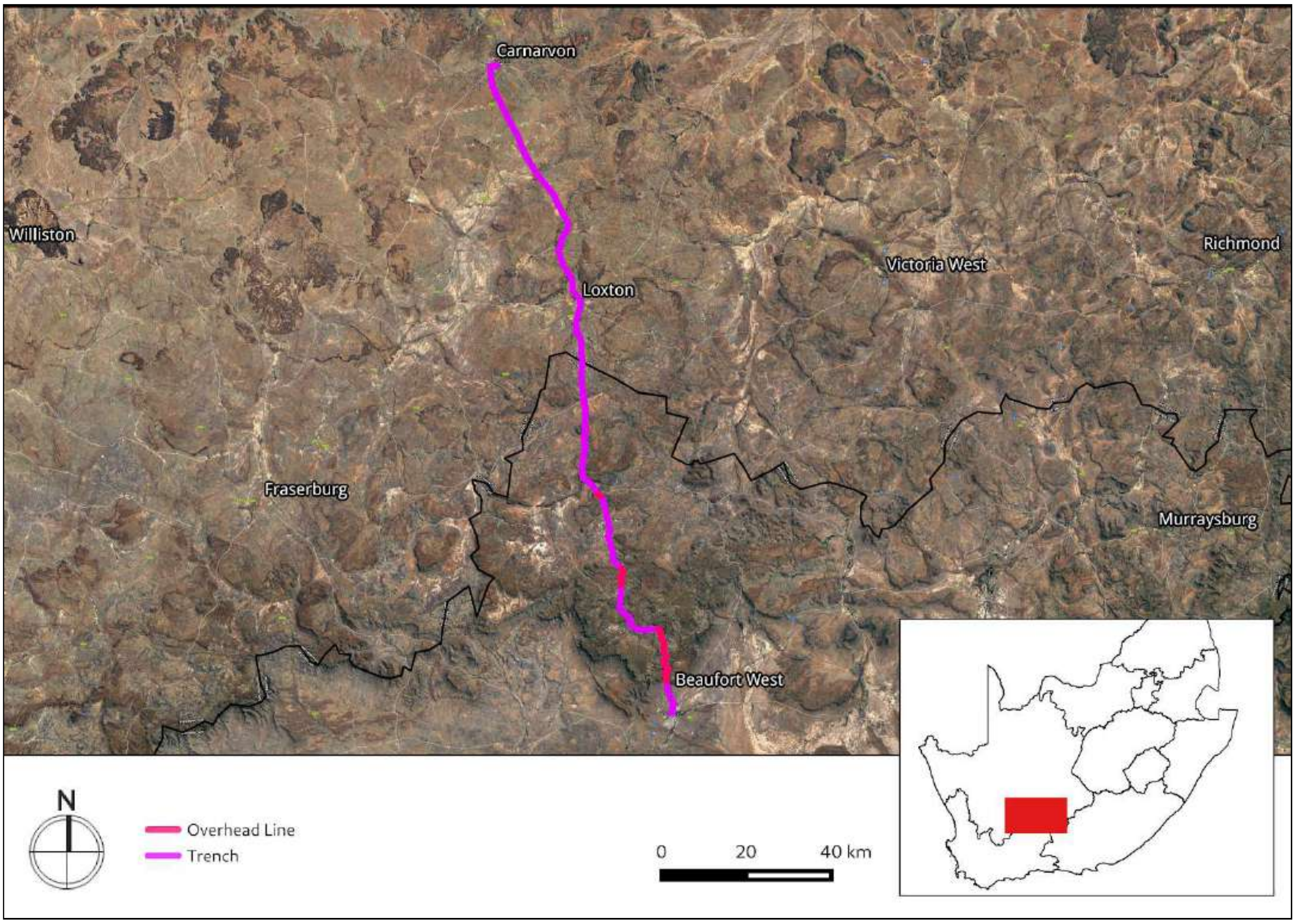


Figure 1.1: Close up satellite image indicating proposed location of development

Figure 1.2: Area proposed for development including the proposed layout

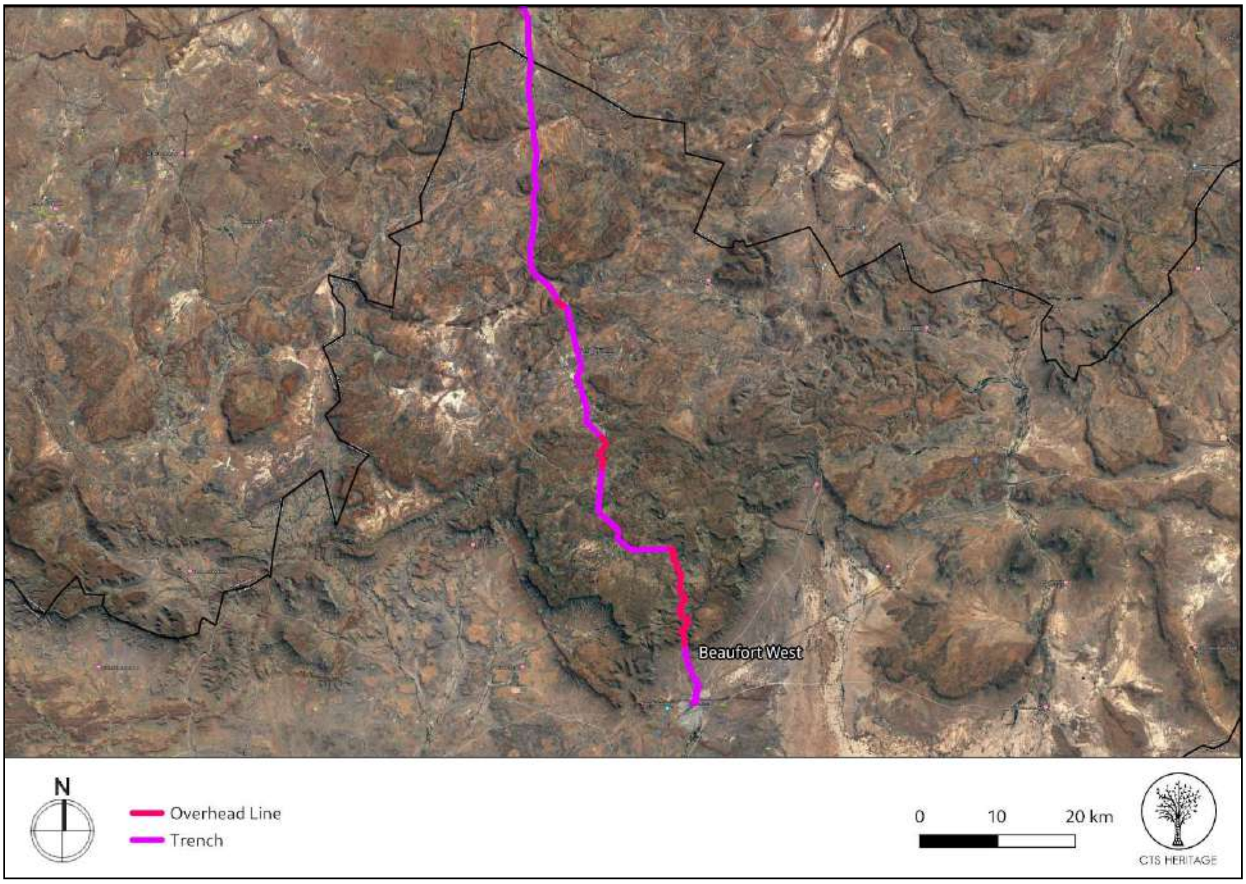


Figure 1.3: Area proposed for development including the proposed layout

CTS Heritage
34 Harries Street, Plumstead, Cape Town
Tel: +27 (0)87 073 5739 **Email:** info@ctsheritage.com **Web:** www.ctsheritage.com

2. METHODOLOGY

2.1 Purpose of Archaeological Study

The purpose of this archaeological study is to satisfy the requirements of section 38(8), and therefore section 38(3) of the National Heritage Resources Act (Act 25 of 1999) in terms of impacts to archaeological resources.

2.2 Summary of steps followed

- An archaeologist conducted a survey of the site and its environs on 28 and 29 September 2020 to determine what archaeological resources are likely to be impacted by the proposed development.
- The area proposed for development was assessed on foot, photographs of the context and finds were taken, and tracks (taken at 100m intervals) were recorded using a GPS.
- The identified resources were assessed to evaluate their heritage significance in terms of the grading system outlined in section 3 of the NHRA (Act 25 of 1999).
- Alternatives and mitigation options were discussed with the Environmental Assessment Practitioner.

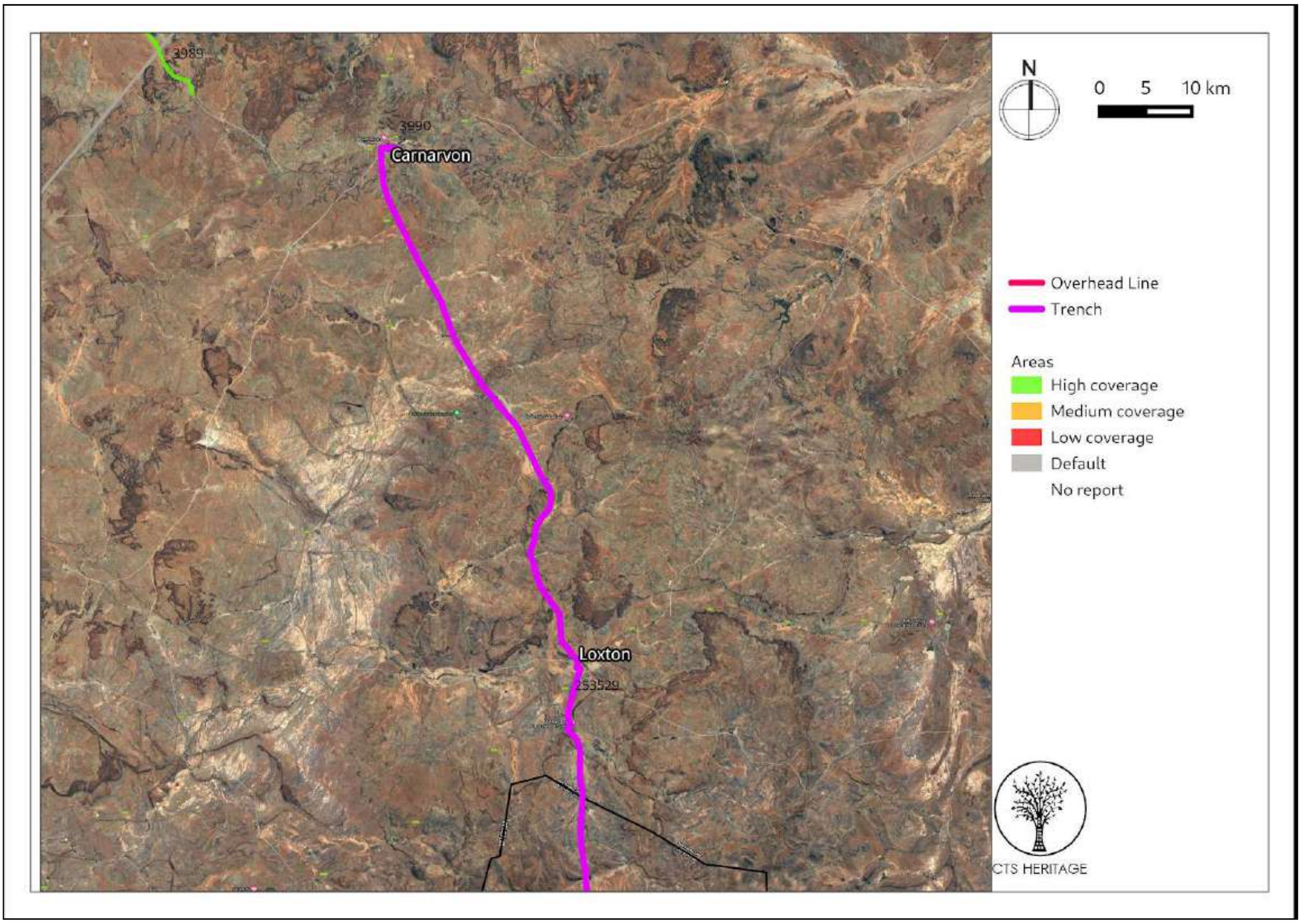


Figure 2.1: Close up satellite image indicating proposed location of development in relation to heritage studies previously conducted in the Northern Cape

CTS Heritage
34 Harries Street, Plumstead, Cape Town
Tel: +27 (0)87 073 5739 **Email:** info@ctsheritage.com **Web:** www.ctsheritage.com

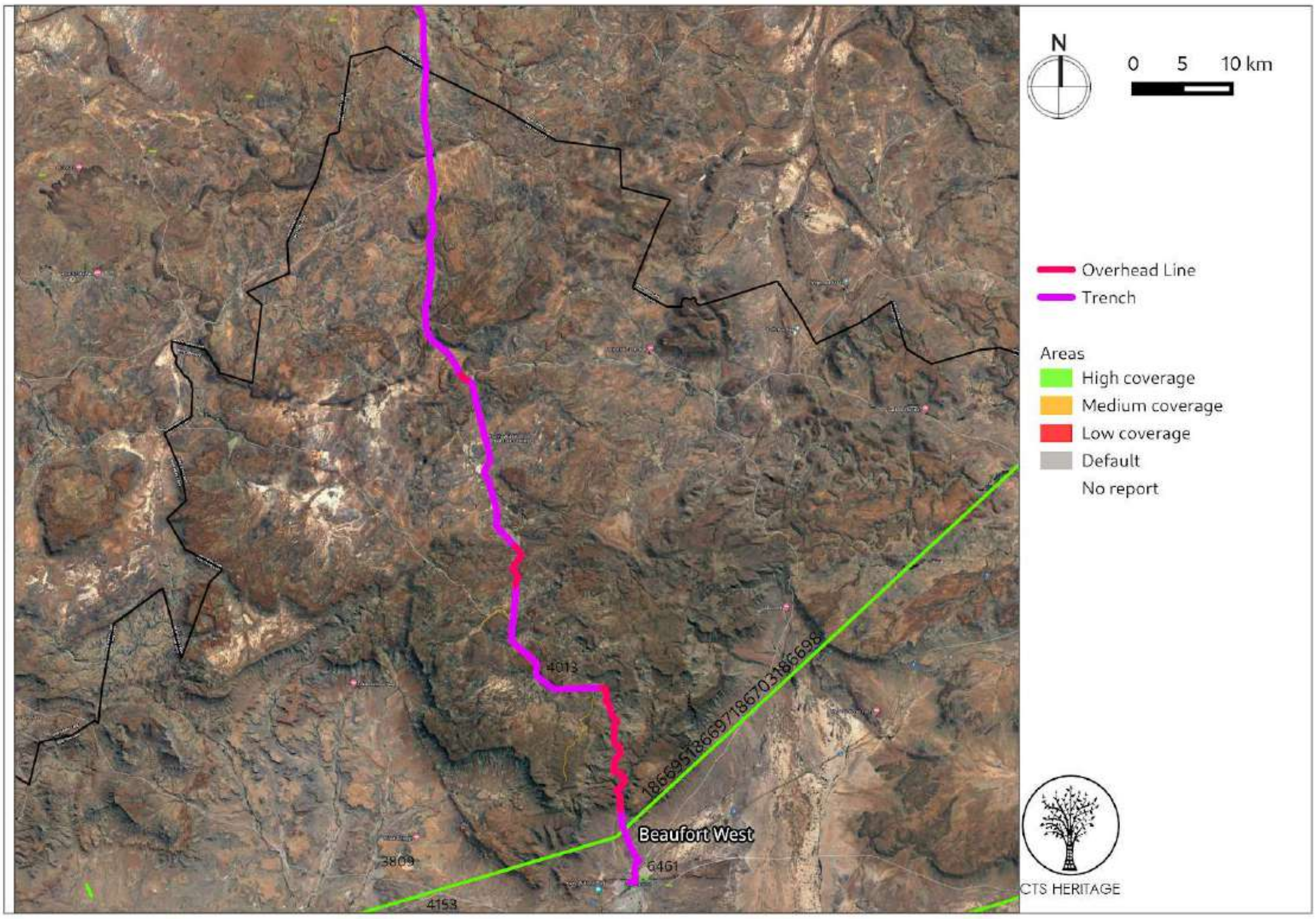


Figure 2.2: Close up satellite image indicating proposed location of development in relation to heritage studies previously conducted in the Western Cape

2.3 Constraints & Limitations

A portion of the area proposed for development was inaccessible as it was located along steep hillslopes. There were also a few narrow stretches of road where it was not possible to safely park and walk. As such, the field assessment focussed on areas that were accessible along the road.

The experience of the archaeologist, and observations made during the study, allow us to predict with some accuracy the archaeological sensitivity of the receiving environment.

3. HISTORY AND EVOLUTION OF THE SITE AND CONTEXT

Carnarvon was established in 1853 on a route between Cape Town and Botswana that was followed by early explorers and traders. It was originally established as a mission station of the Rhenish Missionary Society and named Harmsfontein. Loxton's first church building and schoolhouse was built in 1900. Tree-lined streets and flood irrigation channels that run alongside the town's main roads were completed in the same year. The town became a municipality in 1905 as it developed to serve the region's sheep-farming community. The church that stands in the town's centre was constructed in 1924. Beaufort West was the first town to be established in the central Karoo. The town was founded in 1818 and became the first municipality in South Africa on 3 February 1837 and had the country's first town hall. When the railroad reached the town in 1880 it became a marshalling yard and locomotive depot and today it is the largest town in the Karoo. All of these towns have significant historic town centres with a unique sense of place. It is not anticipated that the proposed trenching for the SKA Fibre Line will negatively impact on any historic fabric or on this unique sense of place. However, care must be taken to ensure that historic features such as leiwater systems are not negatively impacted by the proposed trenches.

According to Tusenius (2012, SAHRIS NID 503050), "with the notable exception of the research done by Sampson in the Seacow Valley (1985), the rich archaeological heritage of the Karoo has not been systematically studied… Sites and scatters of Early, Middle and Late Stone Age (ESA, MSA and LSA) material have been recorded, as well as pastoralist occurrences, historical sites, rock paintings and engravings." According to a concise summary of the heritage of the area provided by Rossouw (2019, SAHRIS NID 521555), Rock engravings located to the southeast of Loxton, suggest the possibility that a giant long-horned buffalo (*Syncerus antiquus)*, which became extinct more than 10 000 years ago, previously occurred in the area. Furthermore, "multiple rock engraving sites have been recorded in the region and are mainly attributed to San hunter-gatherers who inhabited the area and had done so for thousands of years, while the pastoralist Khoekhoe had been present in the Karoo for at least 2 000 years. The historical footprint is largely represented by the vernacular architecture of the well-known corbelled houses in the region, which is related to 19th century trekboers who occupied these buildings, and whose cultural history dates back to their 18th century movement onto the VOC ("Verenigde Oostindische Compagnie" / United East India Company) Cape frontier that resulted in ongoing interaction with indigenous people in the Karoo." As the proposed development is anticipated to be restricted to existing road reserve, it is not anticipated that the proposed development will have a negative impact on significant archaeological heritage. However, it is well established that ESA, MSA and LSA archaeological occurrences are prevalent throughout the broader Karoo landscape and these resources may be impacted by the proposed development.

CTS Heritage
34 Harries Street, Plumstead, Cape Town
Tel: +27 (0)87 073 5739 **Email:** info@ctsheritage.com **Web:** www.ctsheritage.com

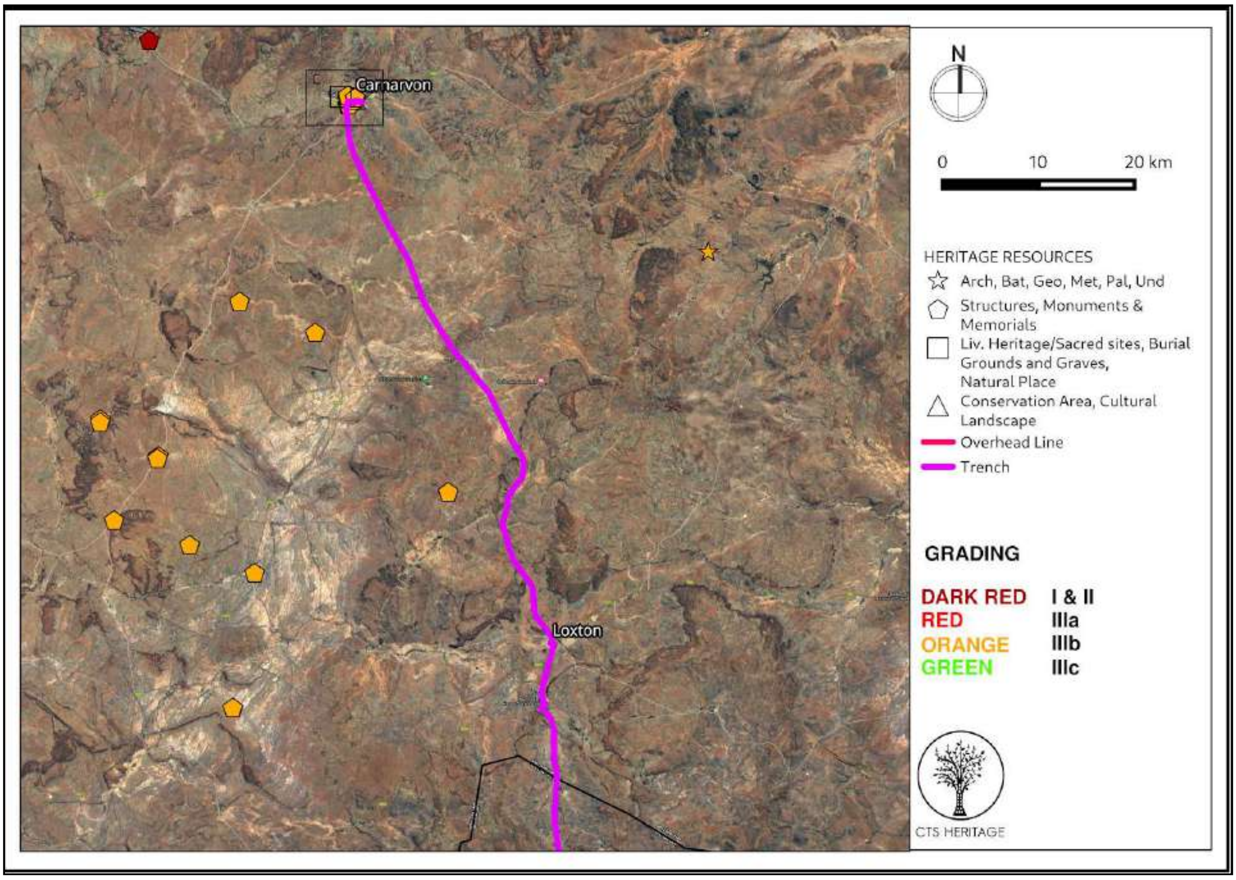


Figure 3.1. Heritage Resources Map. Heritage Resources previously identified in and near the study area, with gradings indicated

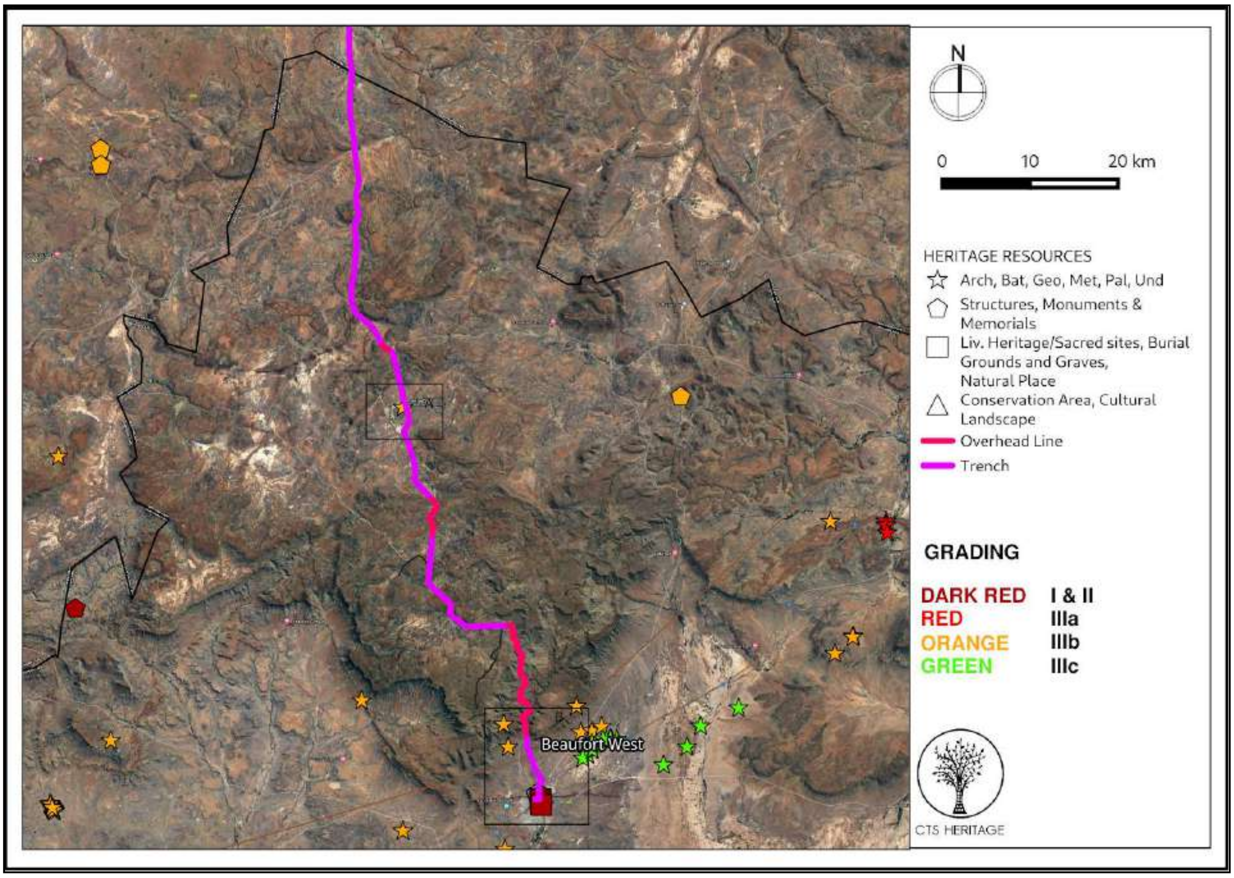


Figure 3.2. Heritage Resources Map. Heritage Resources previously identified in and near the study area, with gradings indicated

4. IDENTIFICATION OF HERITAGE RESOURCES

4.1 Field Assessment

An archaeologist conducted an assessment of the area proposed for development on 28 and 29 September 2020. A portion of the area proposed for development was inaccessible as it was located along steep hillslopes. There were also a few narrow stretches of road where it was not possible to safely park and walk. As such, the field assessment focussed on areas that were accessible along the road. Overall the visibility of archaeological remains on the ground was good as the vegetation was predominantly sparse

The soil surface in the surveyed area is very stony, consisting of brown sols covered by thick dolerite or sandstone deposits with large boulders. The vegetation is typical of the Karoo Biome and includes knee high shrubs, grasses and Acacias. Figure 4.1 to 4.12 provide contextual images of the landscapes in which the fibre optic cable development is proposed.

Figure 4.1: Contextual Image of development area in the south, just outside of Beaufort West

Figure 4.2: Contextual Image of development area facing North (from the south)

CTS Heritage
34 Harries Street, Plumstead, Cape Town
Tel: +27 (0)87 073 5739 **Email:** info@ctsheritage.com **Web:** www.ctsheritage.com

Figure 4.3: Contextual Image of development area facing North towards the Slanghoek Mountains

Figure 4.4: Contextual Images of Development Area indicating Sandstone cross-bedding

Figure 4.5: Contextual Images of Development Area indicating boulders and sheep grazing along the roadside

CTS Heritage
34 Harries Street, Plumstead, Cape Town
Tel: +27 (0)87 073 5739 **Email:** info@ctsheritage.com **Web:** www.ctsheritage.com

Figure 4.6: Contextual Images of Development Area indicating chert source on eastern side of the road

Figure 4.8: Contextual Images of Landscape where road becomes gravel

Figure 4.9: Contextual Images of Development Area indicating interesting geology

Figure 4.10: Contextual Images of Landscape indicating that the gravel road has been graded up until the fence line

Figure 4.11: Contextual Images of the proposed fibre line route indicating farm structures located outside of alignment

Figure 4.12: Contextual Images indicating the disturbed road surface

CTS Heritage
34 Harries Street, Plumstead, Cape Town
Tel: +27 (0)87 073 5739 **Email:** info@ctsheritage.com **Web:** www.ctsheritage.com

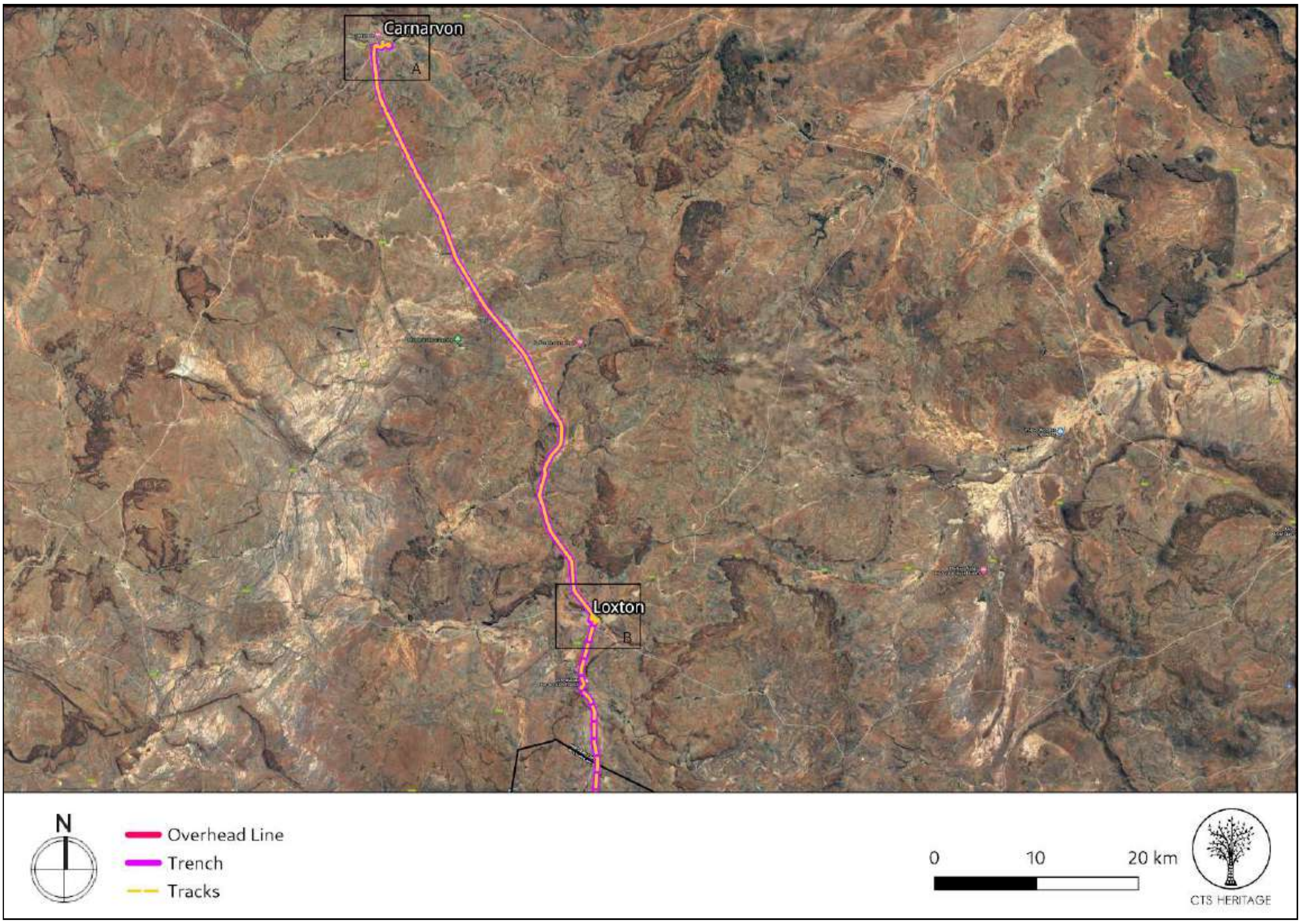


Figure 5.1: Track paths - Northern Cape

Figure 5.1a: Track paths - Northern Cape Inset A, Carnarvon

Figure 5.1b: Track paths - Northern Cape Inset B, Loxton

CTS Heritage
34 Harries Street, Plumstead, Cape Town
Tel: +27 (0)87 073 5739 **Email:** info@ctsheritage.com **Web:** www.ctsheritage.com

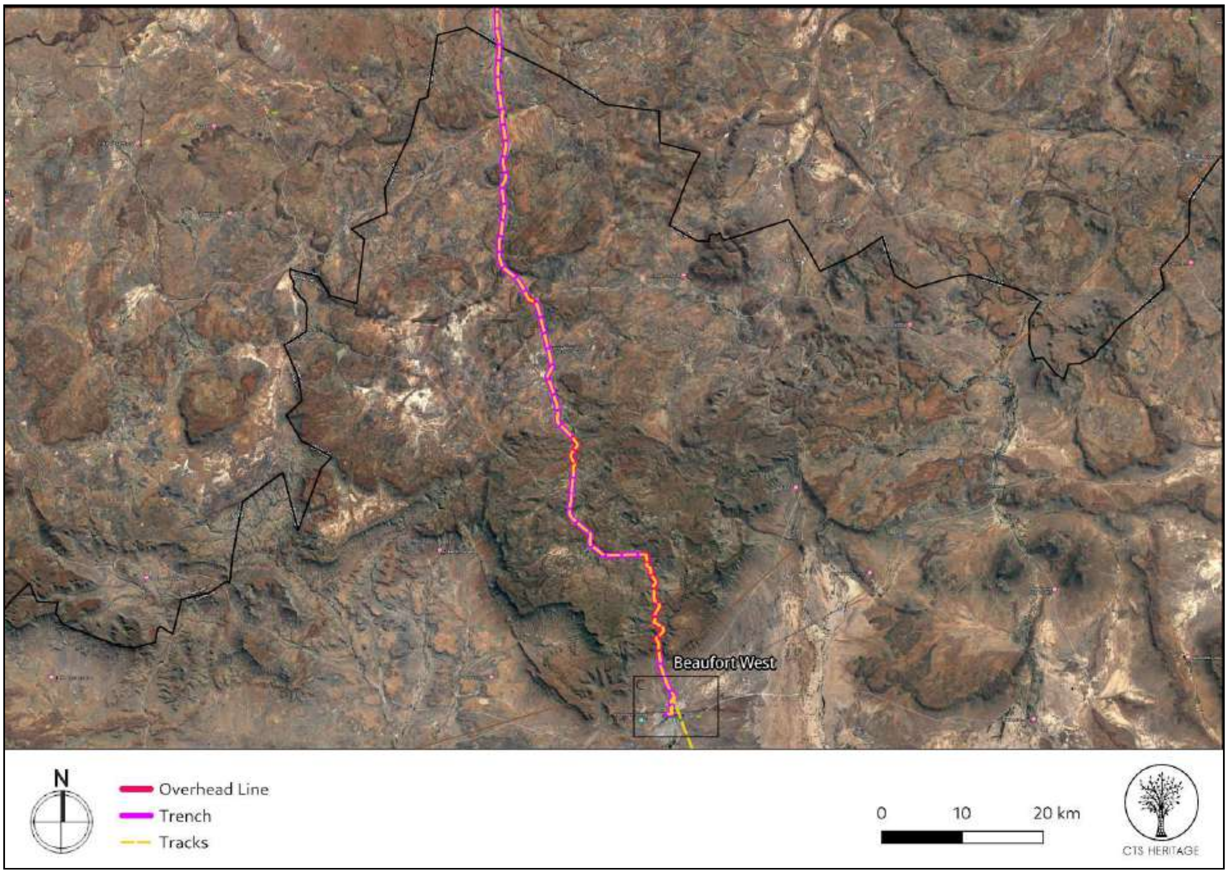


Figure 5.2: Track paths - Westen Cape

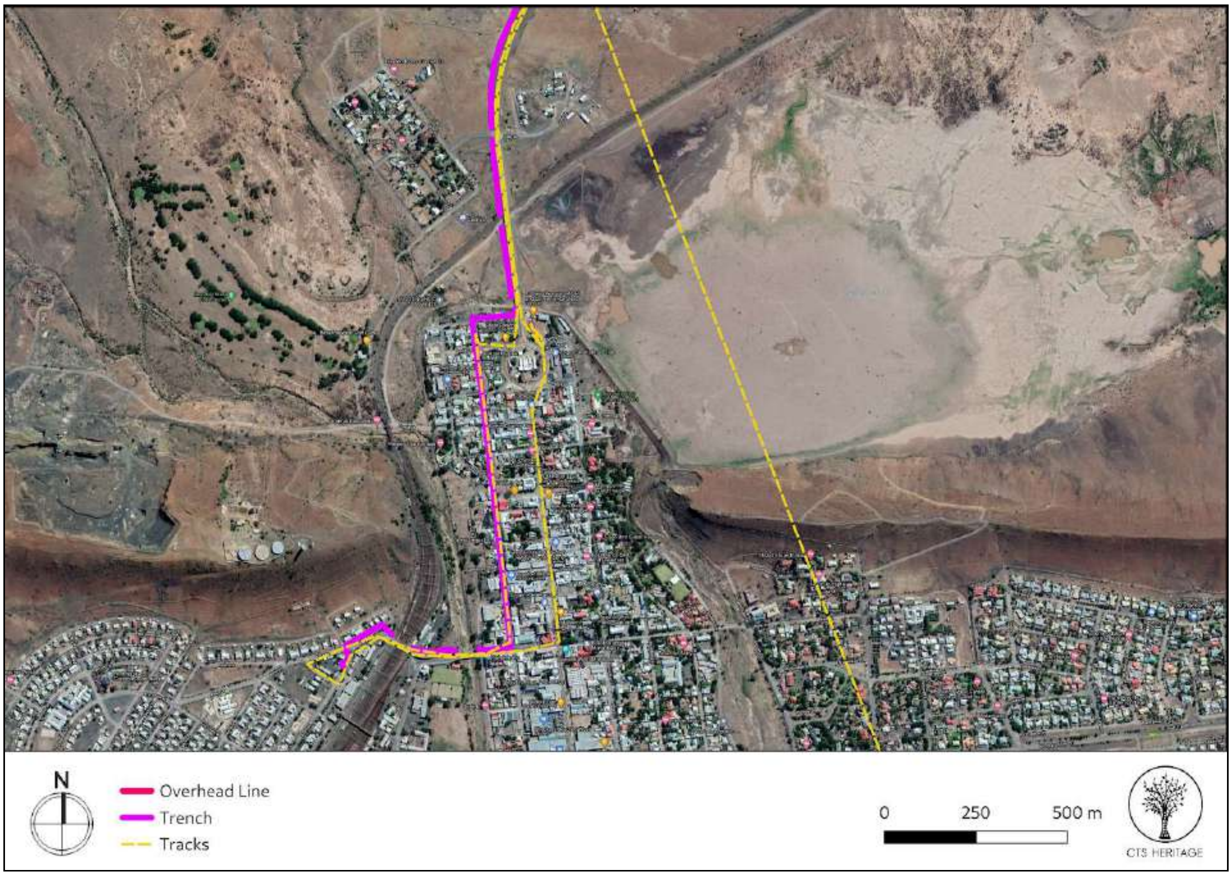


Figure 5.2c: Track paths - Westen Cape Inset C, Beaufort West

CTS Heritage
34 Harries Street, Plumstead, Cape Town
Tel: +27 (0)87 073 5739 **Email:** info@ctsheritage.com **Web:** www.ctsheritage.com

4.2 Archaeological Resources identified

Two large bridges (BTC01 and BTC07) were investigated during the field assessment, one of which could be dated to older than 60 years old (BTC07). BTC07 is located at the Soutpoot River near Loxton. An anniversary monument (dedication) was also identified (BTC02), although it is not yet considered to be historical (dated 2014), this monument does form part of the cultural landscape and falls within the definition of Monuments and Memorials in terms of HWC's Guideline. This monument reads:

"DUISENDE JARE GELEDE HET SALOMO IN SPREUKE 31:10-31 GESKRYF OOR 'N DEURSAME VROU HIERDIE STEEN IS 'N EERBETOON AAN SO 'N DROOM VROU LOUNIE BADENHORST DANKIE VIR ALLES WAT JY VIR MY BETEKEN LIEFDE CHRIS 25STE HUWELIKS HERDENKING 3.8.1994 - 35 JAAR 3 AUG 2004 - 45 JAAR 3 AUG 2014"

Based on the significance criteria included in the HWC Guide, it is likely that this monument is not conservation-worthy. However, it is recommended that this monument not be negatively impacted by the proposed development (as we are hoping that the Badenhorst's make it to 55 years!).

Although it is well established that ESA, MSA and LSA archaeological finds as well as engraved boulders are prevalent throughout the broader Karoo landscape, only one possible MSA artefact (BTC03) was recorded. The proposed fibre line route has been previously degraded (heavily disturbed) by the construction of the existing road between Beaufort West and Carnarvon and as such, this explains the lack of conservation worthy archaeological finds. An additional explanation for the lack of stone tools may relate to the lack of rocky outcrops (suitable raw material sources) within the proposed development area. With regards to rock engravings, although rocky Karoo dolerite outcrops, consisting of large boulders were observed, no boulders with rock engravings were identified.

There are a few farmhouses situated near the road but no historical farmsteads, dwellings, structures or cemeteries were located within close proximity to the proposed fiber line footprint. The Loxton leiwater system (narrow water canals, examples: BTC04, BT05, BTC06), which are used for irrigation, are set up in a grid system across the Karoo village. These historical features, which are lined with some trees which are older than 100 years, are significant in terms of their contribution to the historical context of Loxton and are therefore graded IIIC. However these resources were not within the layout of the proposed fiber line and will not be impacted by the proposed development.

Table 1: Observations noted during the field assessment

Site No.	Site Name	Description	Co-ordinates		Grading	Province	Mitigation
BTC01	**SKA Fibre_01**	Bridge (dated: 1970)	-32.28339	22.56525	NA	Western Cape	None Required
BTC02	**SKA Fibre_02**	Anniversary Monument/Dedication (dated: 3 August 2014)	-32.25241	22.56853	NA	Western Cape	Not to be disturbed - 10m buffer recommended
BTC03	**SKA Fibre_03**	Possible MSA chert artefact	-32.17230	22.48989	NCW	Western Cape	None Required
BTC04	**SKA Fibre_04**	Loxton Leiwater System	-31.47537	22.34922	IIIC	Northern Cape	No impact anticipated
BTC05	**SKA Fibre_05**	Loxton Leiwater System	-31.47604	22.35136	IIIC	Northern Cape	No impact anticipated
BTC06	**SKA Fibre_06**	Loxton Leiwater System	-31.47761	22.35630	IIIC	Northern Cape	No impact anticipated
BTC07	**SKA Fibre_07**	Bridge (dated: 1958)	-31.34858	22.30103	IIIC	Northern Cape	No impact anticipated
BTC08	**SKA Fibre_08**	Sandstone outcrop	-31.22497	22.26206	NA	Northern Cape	None Required

4.3 Selected photographic record

(a full photographic record is available upon request)

Figure 6.1: BTC01 - Bridge (1970)

Figure 6.2: BTC02 - Anniversary Monument/Dedication

Figure 6.3: BTC03 - Possible MSA Chert Artefact

Figure 6.4: BTC04, 05 and 06 - Loxton Leiwater System

Figure 6.5 BTC07 - Bridge over the Soutpoot River (1958)

Figure 6.6 BTC07 - Bridge over the Soutpoot River (1958), northern side with basic structure evident

Figure 6.7 BTC08 - Sandstone outcrop

5. ASSESSMENT OF THE IMPACT OF THE DEVELOPMENT

5.1 Assessment of impact to Archaeological Resources

Based on the assessment completed, the area proposed for development has a low archaeological sensitivity. No evidence was found of *in situ* archaeological material, rock engraving sites, or graves. Historical buildings or structures older than 60 years were not observed within the footprint of the proposed fibre line.

Due to the fact that some cultural remains along the roadside are likely covered in gravel from road grading/construction, the possibility exists that some artefacts may only be uncovered during the digging of the trenches for the proposed fiber line.

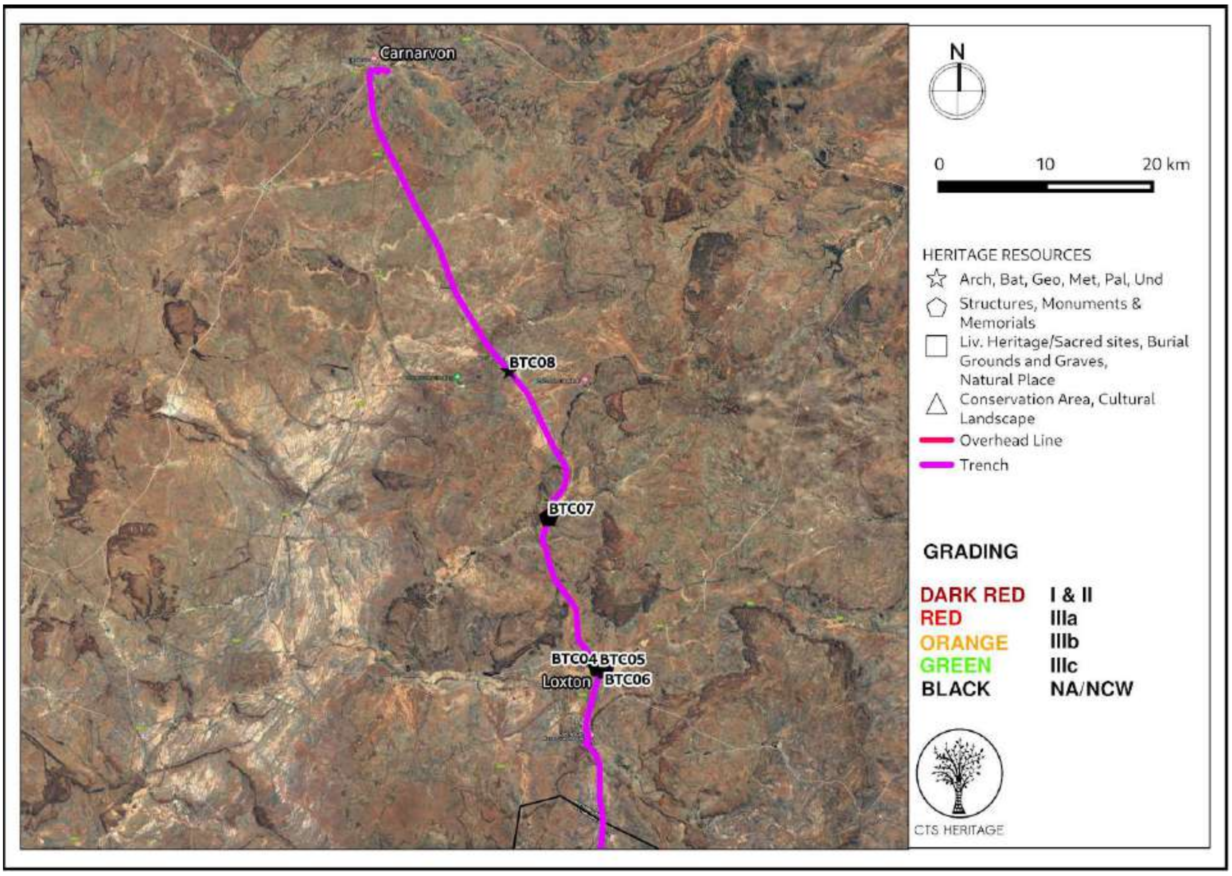


Figure 7.1: Map of heritage resources identified relative to the proposed development footprint in the Northern Cape

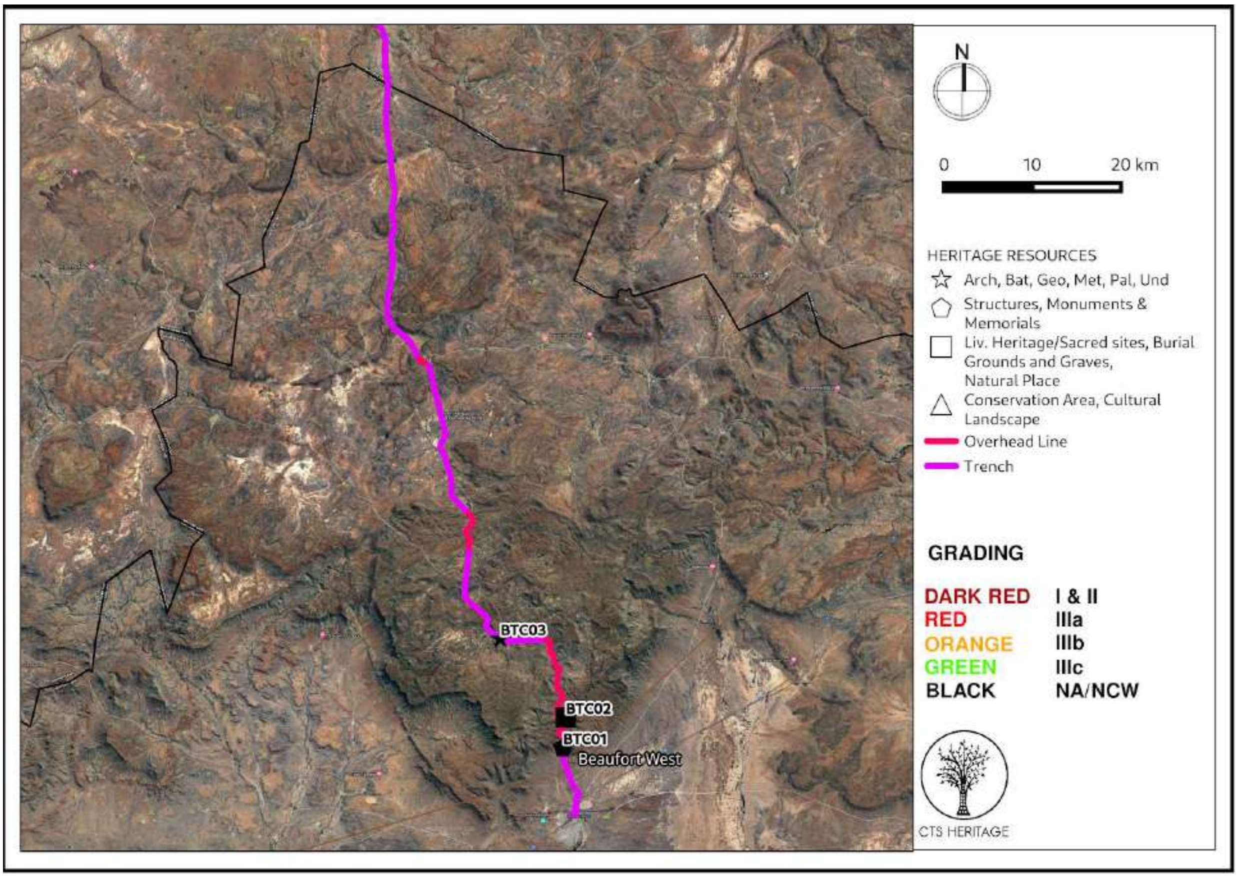


Figure 7.2: Map of heritage resources identified relative to the proposed development footprint in the Western Cape

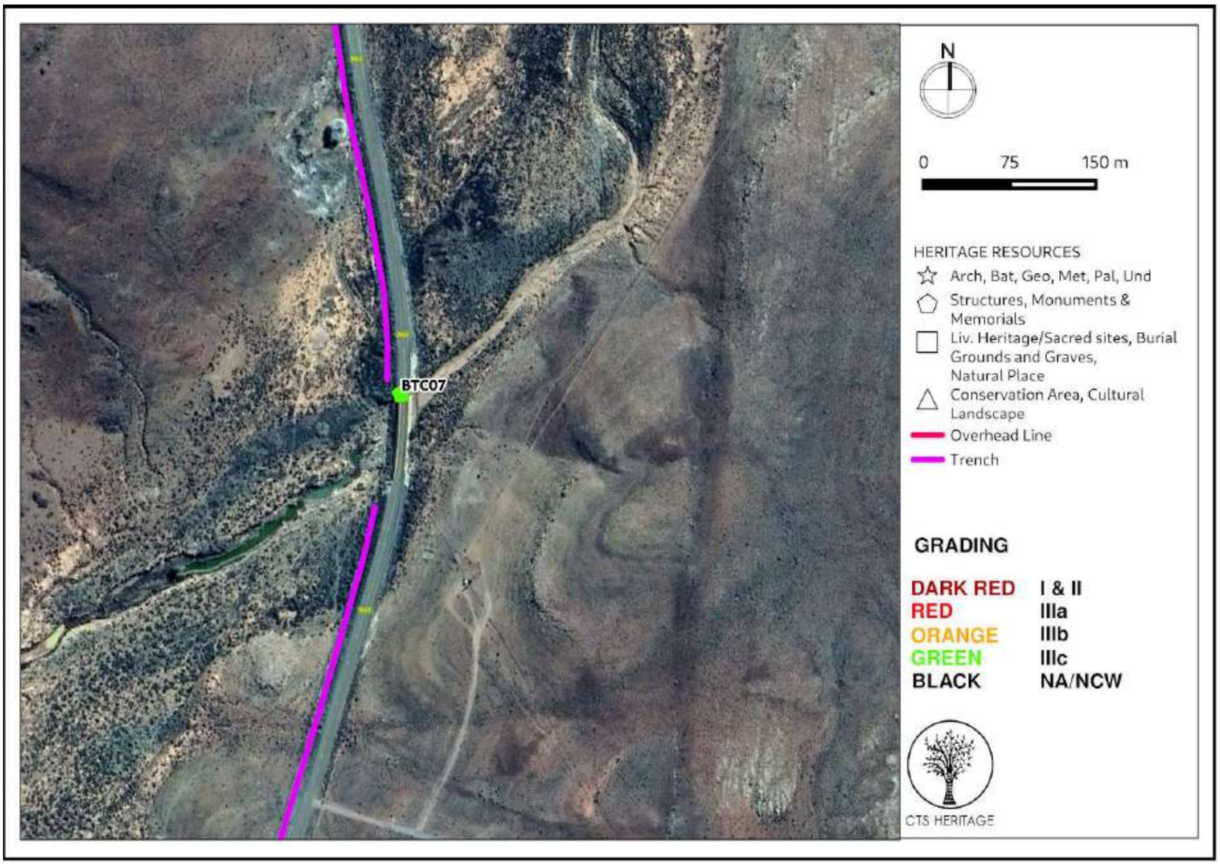


Figure 7.1a: Map of bridge at BTC07 crossing the Soutpoot river south of Loxton

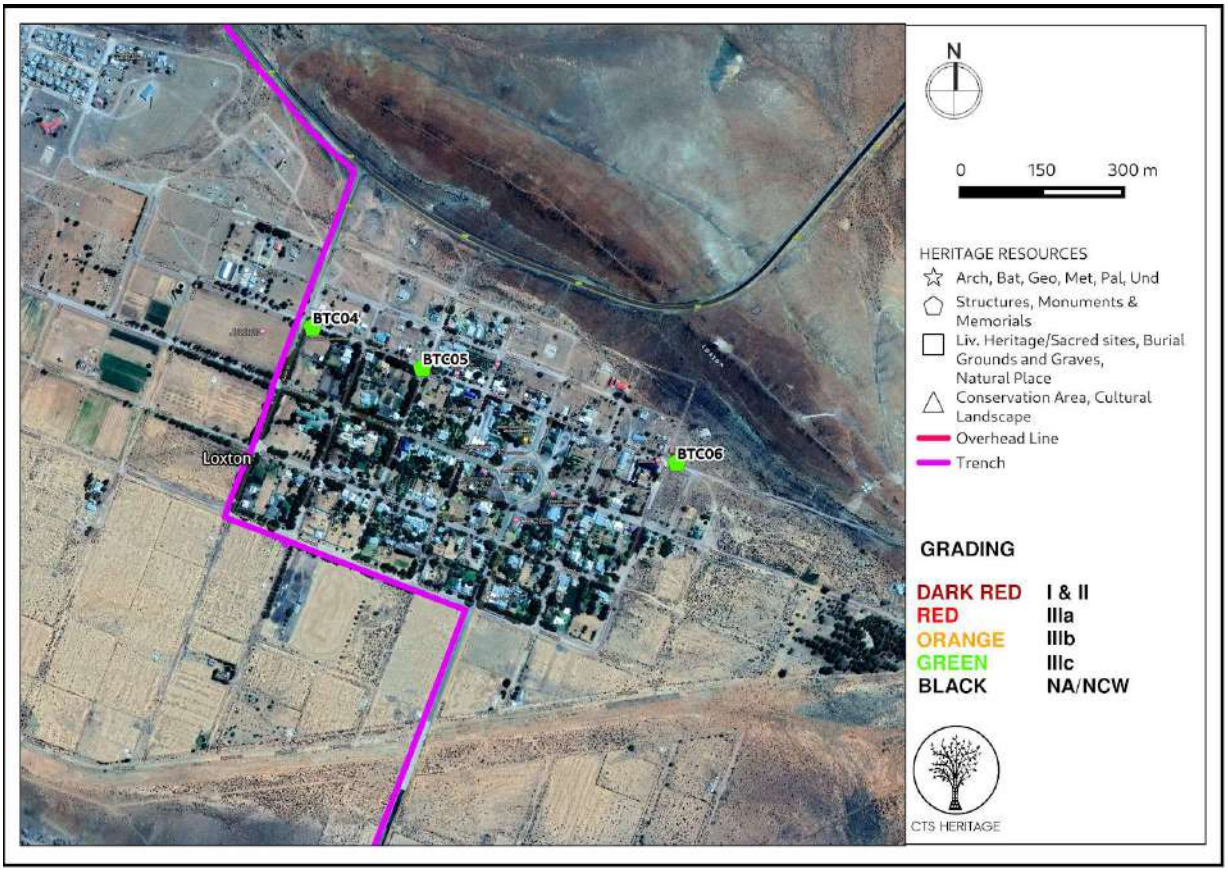


Figure 7.1b: Map of Loxton Leiwater System at BTC04, 05 and 06

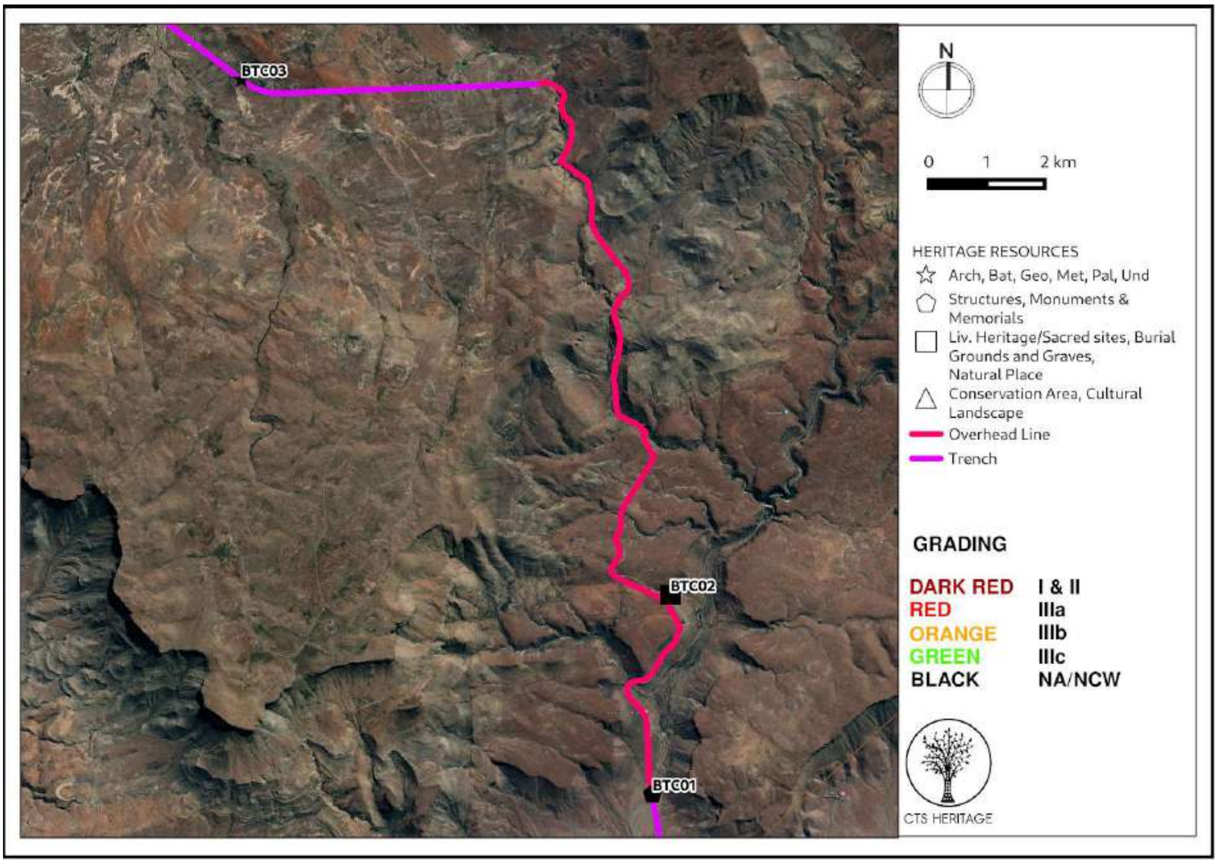


Figure 7.2c: Map of heritage resources identified at BTC01 (1970 bridge), 02 (monument) and 03 (possible MSA chert artifact)

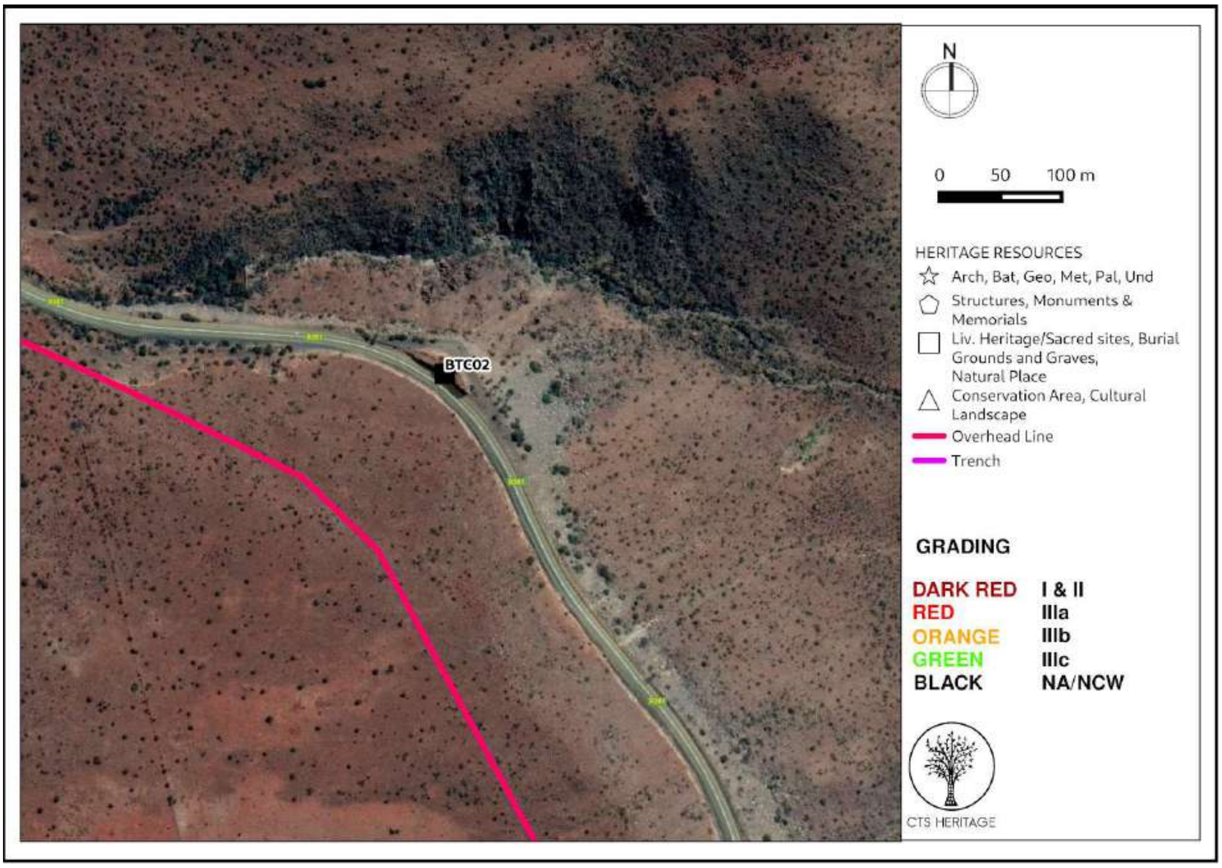


Figure 7.2d: Map of heritage resources identified at BTC02 - the Monument

6. CONCLUSION AND RECOMMENDATIONS

Based on the outcomes of this report, it is not anticipated that the proposed development of the fibre line will negatively impact on significant archaeological heritage. The proposed fibre line route has been previously degraded (heavily disturbed) by the construction of the existing road between Beaufort West and Carnarvon and as such, this explains the lack of conservation worthy archaeological finds. An additional explanation for the lack of stone tools may relate to the lack of rocky outcrops (suitable raw material sources) within the proposed development area.

The heritage resources identified are largely located some distance from the proposed line (BTC02, BTC04, BTC05, BTC06, SAHRIS Site ID 32495) and will not be impacted by the proposed development or are not conservation-worthy (BTC01, BTC03 and BTC07).

Due to the fact that some cultural remains along the roadside are likely covered in gravel from road grading/construction, the possibility exists that some artefacts may only be uncovered during the digging of the trenches for the proposed fiber line.

As such, there is no objection to the proposed development in terms of impacts to archaeological heritage. However it is recommended that, should any archaeological resources or burial grounds or graves be identified during the course of trenching or excavation activities, work must cease in the area and SAHRA (Northern Cape) or Heritage Western Cape (in the Western Cape) must be contacted regarding an appropriate way forward.

CTS Heritage
34 Harries Street, Plumstead, Cape Town
Tel: +27 (0)87 073 5739 **Email:** info@ctsheritage.com **Web:** www.ctsheritage.com

CTS HERITAGE

7. REFERENCES

Heritage Impact Assessments				
Nid	**Report Type**	**Author/s**	**Date**	**Title**
3989	AIA Phase 1	Cobus Dreyer	19/04/2007	First Phase Archaeological and Cultural Heritage Assessment of the Proposed Borrow Pit Sites Along the P02996 Road Between Carnarvon & the Ska Site, Northern Cape
3990	AIA Phase 1	Cobus Dreyer	17/09/2007	First Phase Archaeological and Cultural Heritage Investigation of the Proposed Upgrading of the Oxidation Pond System at Carnarvon, Northern Cape
4013	AIA Phase 1	Jonathan Kaplan	01/02/2006	Phase 1 Archaeological Impact Assessment Proposed Klavervlei Powerline Karoo National Park
6461	AIA Phase 1	Jonathan Kaplan	01/02/2008	Phase 1 Archaeological Impact Assessment: Proposed Development Remainder of Farm 185 (Now Called Plot 8419) Beaufort West, Western Cape Province
253529	HIA Phase 1	Cobus Dreyer	20/12/2014	First phase archaeological and heritage assessment of the proposed solid waste disposal site at Loxton, Northern Cape
186695	HIA Phase 1	McEdward Murimbika	01/08/2014	Proposed Gamma-Kappa 2nd 765kV Eskom Transmission Powerline and Substations Upgrade Development in Western Cape PHASE 1 HERITAGE IMPACT ASSESSMENT STUDY REPORT
186697	AIA Desktop	Foreman Bandama, Shadreck Chirikure	01/08/2014	An Archaeological Scoping and Assessment report for the proposed Gamma (Victoria West, Northern Cape) - Kappa (Ceres â€“ Western Cape) 765Kv (2) Eskom power transmission line
186698	PIA Desktop	JF Durand	09/06/2013	GAMMA-KAPPA 765kV Transmission Line, Western Cape Province SCOPING REPORT PALAEONTOLOGY
186703	Visual Impact Assessment		01/01/2014	THE PROPOSED GAMMA KAPPA 2ND 765KV TRANSMISSION POWERLINE AND SUBSTATIONS UPGRADE, NORTHERN AND WESTERN CAPE (NEAS REFERENCE DEA/EIA/0001267/2012 DEA REFERENCE14/12/16/3/3/2/353) VISUAL IMPACT ASSESSMENT
503050	AIA Phase 1	Madelon Tusenius	01/03/2012	ARCHAEOLOGICAL IMPACT ASSESSMENT OF A PROPOSED BORROW PIT AT RIETKUIL 307, BEAUFORT WEST, CENTRAL KAROO DISTRICT, WESTERN CAPE
521555	Letter of Exemption	Lloyd Rossouw	13/02/2019	Exemption from further Heritage Impact Assessment: Rectification in terms of Section 24G for Residential Development in Loxton, Northern Cape Province.

CTS Heritage
34 Harries Street, Plumstead, Cape Town
Tel: +27 (0)87 073 5739 **Email:** info@ctsheritage.com **Web:** www.ctsheritage.com

PALAEONTOLOGICAL SPECIALIST STUDY

In terms of Section 38(8) of the NHRA

Proposed Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon, Northern and Western Cape

Prepared by

Dewald Wilken

and

CTS HERITAGE

In Association with

CSIR

October 2020

CTS HERITAGE

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

I, **Dewald Wilken**, as the appointed independent specialist hereby declare that I:

• act/ed as the independent specialist in this application;

• regard the information contained in this report as it relates to my specialist input/study to be true and correct, and

• do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2010 and any specific environmental management Act;

• have and will not have 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 (as amended) and any specific environmental management Act;

• am fully aware of and meet the responsibilities in terms of NEMA, the Environmental Impact Assessment Regulations, 2014 (specifically in terms of regulation 13 of GN No. R. 326) 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 favorable to the applicant or not; and

• am aware that a false declaration is an offence in terms of regulation 14 of GN No. R. 326.

Signed

Name

Dewald Wilken

Date
8 October 2020

CTS Heritage
34 Harries Street, Plumstead
Tel: +27 (0)87 073 5739 **Email:** info@ctsheritage.com **Web:** www.ctsheritage.com

EXECUTIVE SUMMARY

A Palaeontological Impact Assessment (PIA) was requested for the proposed Square Kilometre Array fibre optic line connection between the Towns of Beaufort West via Loxton to Carnarvon. This PIA was conducted to comply with the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA).

The trenching for this line will predominantly be carried out within the road reserve at about 1 m form the fence line. Some areas characterised complex / difficult terrain will be traversed by overhead fibre optic lines – wooden poles on which the cabling is mounted will be planted in 1.5 m deep holes. The area covers multiple palaeontologically sensitive strata. These are the Poortjie and Hoedemaker Members of the Teekloof Formation, in the Adelaide subgroup, of the Beaufort Group, in the Karoo Suppergroup, and the Abrahamskraal Formation in the Adelaide subgroup, of the Beaufort Group, in the Karoo Suppergroup. The area covers some strata of the Ecca Group of the Karoo Suppergroup, however these strata, although fossiliferous is of low concern. The area has been intruded by multiple dolerite sills and dykes of Jurassic age.

The road reserve area has been greatly degraded, and mudstones and have been highly weathered and fractured. The chance of finding a fossil in the area during trenching is low, but possible. For this reason, a Chance Fossil Find Procedure is added to the end of this report. As far as the palaeontology is concerned the project may proceed.

CTS Heritage
34 Harries Street, Plumstead
Tel: +27 (0)87 073 5739 **Email:** info@ctsheritage.com **Web:** www.ctsheritage.com

CONTENTS

CTS Heritage
34 Harries Street, Plumstead
Tel: +27 (0)87 073 5739 **Email:** info@ctsheritage.com **Web:** www.ctsheritage.com

1. INTRODUCTION

1.1 Background Information on Project

The South African Radio Astronomy Observatory (SARAO) spearheads South Africa's activities in the SKA Radio Telescope through engineering, science and construction. SARAO is a National Facility, managed by the National Research Foundation, which incorporates radio astronomy instruments and programmes such as the MeerKAT and KAT-7 telescopes in the Karoo, the Hartebeesthoek Radio Astronomy Observatory (HartRAO) in Gauteng, the African Very Long Baseline Interferometry (AVN) programme in nine African countries, as well as the associated human capital development and commercialisation endeavours.

Connectivity is required between the SKA core site in the Northern Cape and a data processing facility in Cape Town to transport the science data for the SKA project and its precursor, MeerKAT. Access to dark fibre is required to transport this data due to the expected data throughputs for the SKA project.

The details of the preferred and selected SKA fibre route (Route A) is as follows:

1. The fibre route starts from Beaufort West Transnet building, to a 3 m x 6 m signal repeater station at Loxton, and then on to the Carnarvon SKA Point of Presence (PoP) site (location where networking equipment may be accessed).
2. The fibre duct and cable will be laid in a 1 m deep and 300 mm wide trench and be buried by backfilling and compacting the trench.
3. The fibre route will predominantly be installed within the road reserves of roads R381 and R63, and 1 m from the fence of the private land.
4. 155 km will be underground and 25 km will be overhead due to it not being technically or financially feasible to trench on the Molteno Pass section. The total pole length is 9 m, buried 1.5 m deep, with a resultant above-ground height of 7.5 m
5. There are several streams / rivers and associated wetlands to cross. Rivers will be crossed using directional drilling 2 m below the riverbed starting 32 m away from river banks.
6. There is only one river with solid bedrock (the Brak River near Loxton) where directional drilling is not technically or financially feasible. Here the fibre cable will be attached to the existing road bridge.

CTS Heritage
34 Harries Street, Plumstead
Tel: +27 (0)87 073 5739 **Email:** info@ctsheritage.com **Web:** www.ctsheritage.com

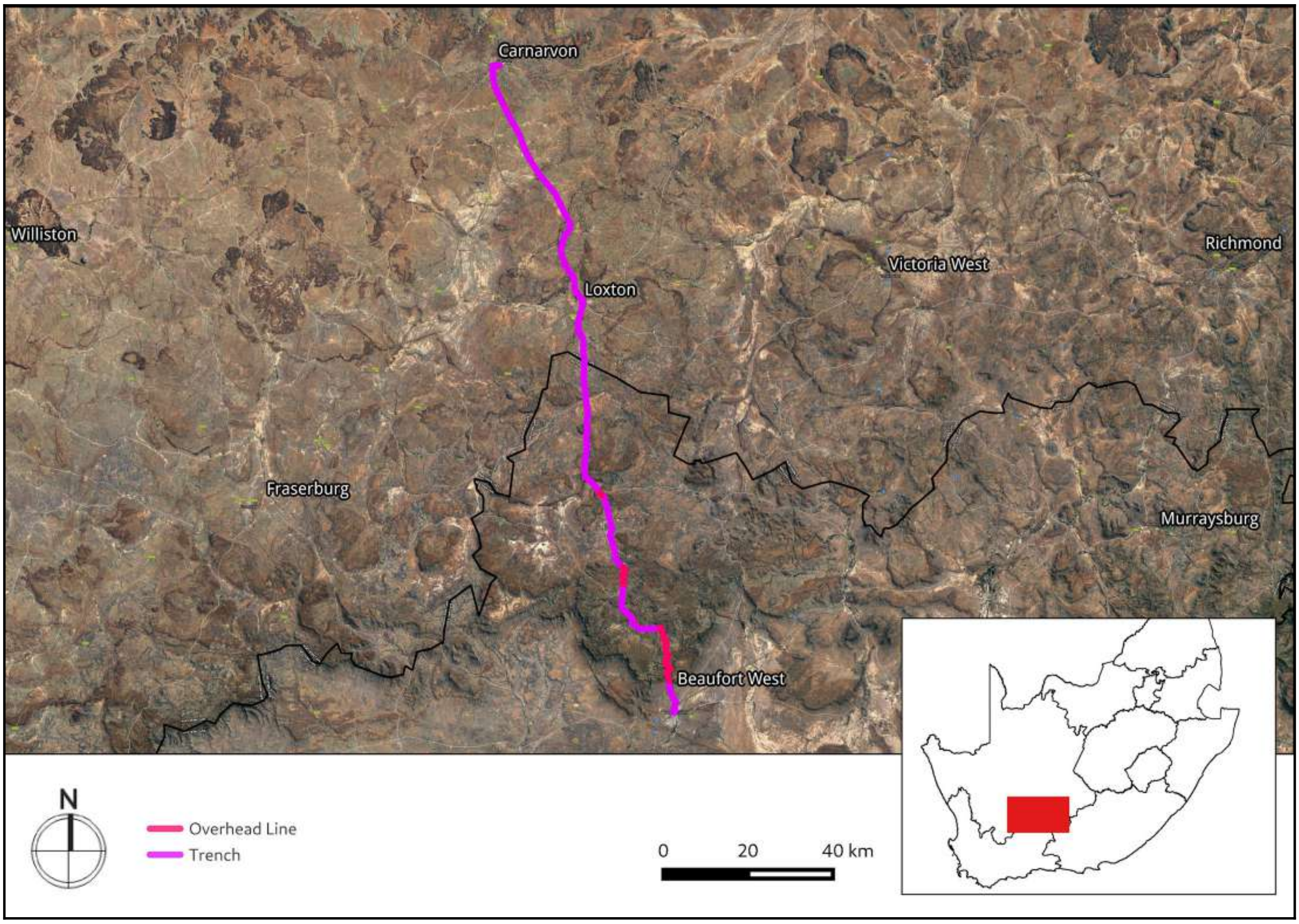


Figure 1 Google Earth© satellite image of the proposed Fibre line between Beaufort West and Carnarvon. Please see the following two figures for more detail.

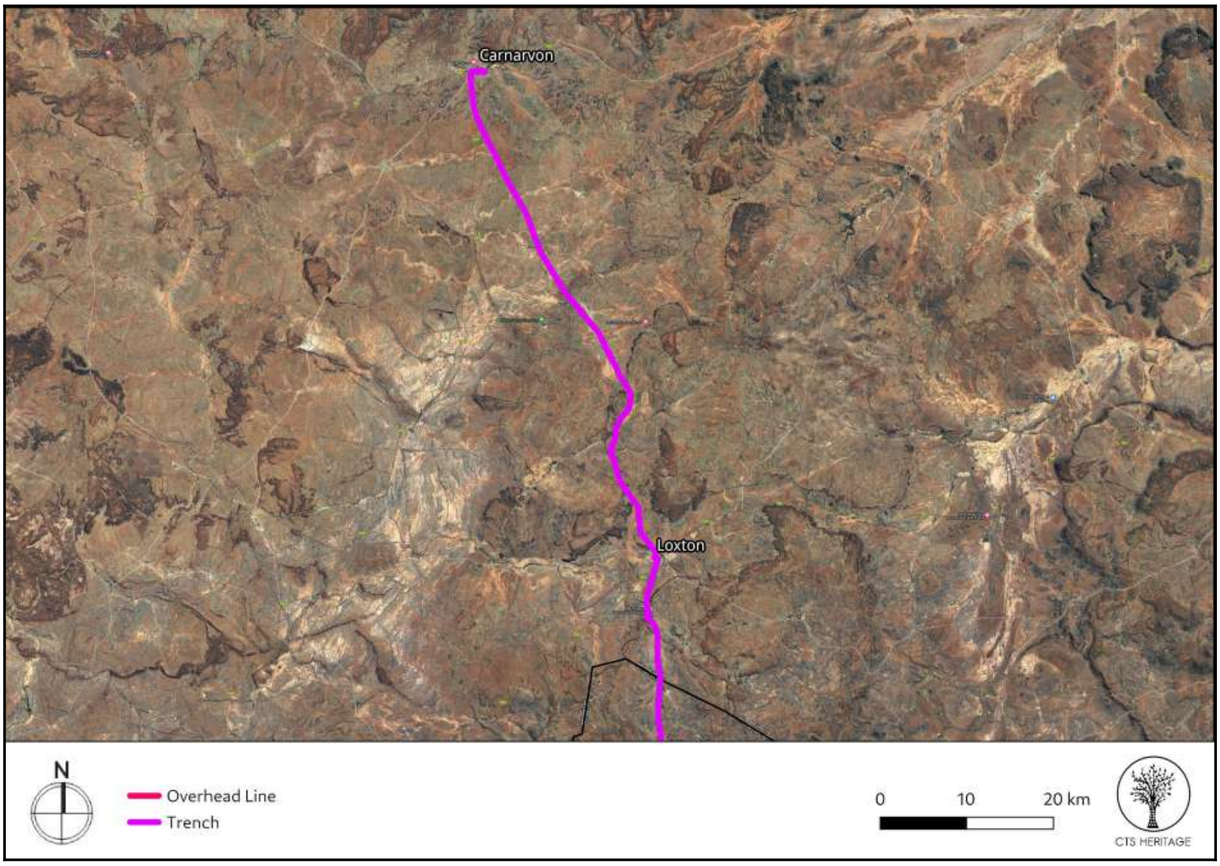


Figure 2 Google Earth© satellite image of the study area in the Northern Cape

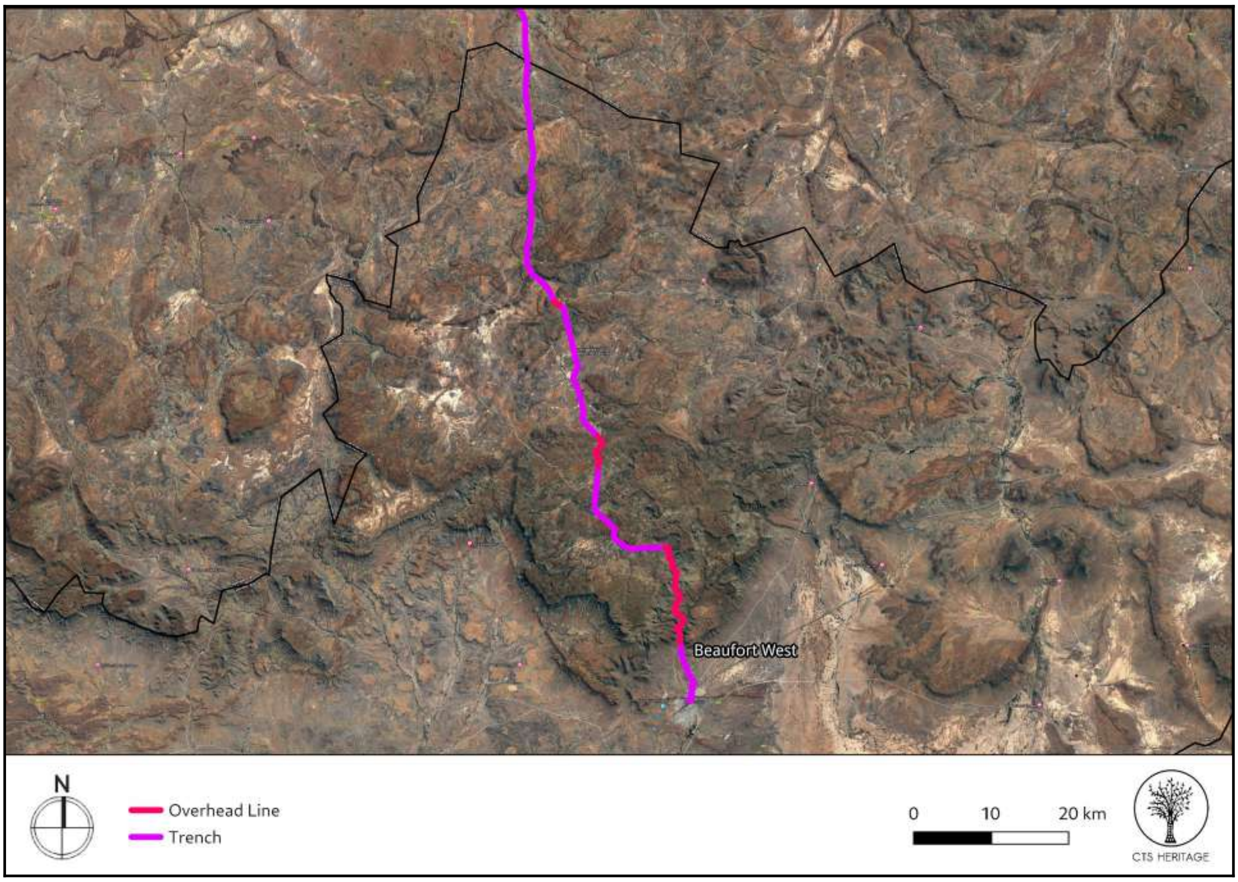


Figure 3 Google Earth© satellite image of the study area in the Western Cape

CTS Heritage
34 Harries Street, Plumstead
Tel: +27 (0)87 073 5739 **Email:** info@ctsheritage.com **Web:** www.ctsheritage.com

2. METHODOLOGY

2.1 Purpose of Palaeontological Study

The SKA fibre route project area is underlain by potentially fossiliferous sediments of the Poortjie Member and Hoedemaker Member of the Teekloof Formation, and the Abrahamskraal Formation of the Beaufort Group. It is therefore likely that any excavation conducted within this palaeontologically sensitive area is likely to negatively impact on significant palaeontological heritage. A palaeontological heritage assessment of the road project has been recommended in a recent Heritage Screener by CTS Heritage, Cape Town (CTS Heritage 2019). The purpose of this palaeontological heritage study is to satisfy the requirements of section 38(8), and therefore section 38(3) of the National Heritage Resources Act (Act 25 of 1999) in terms of impacts to palaeontological resources. It contributes to the broader environmental assessment for the road project being coordinated by the CSIR.

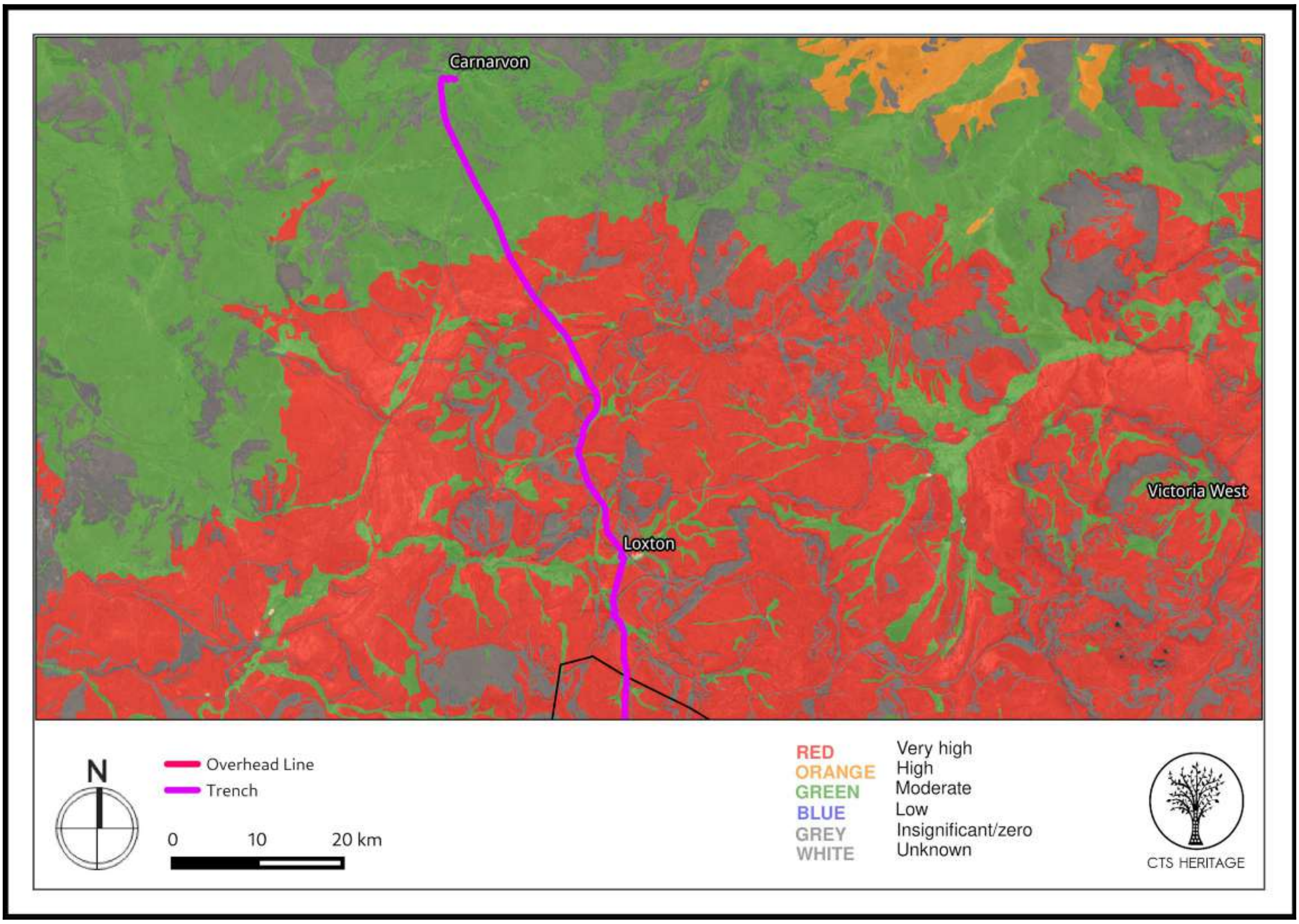


Figure 4 Palaeosensitivity Map. Indicating Moderate to Very High fossil sensitivity underlying the study area in the Northern Cape.

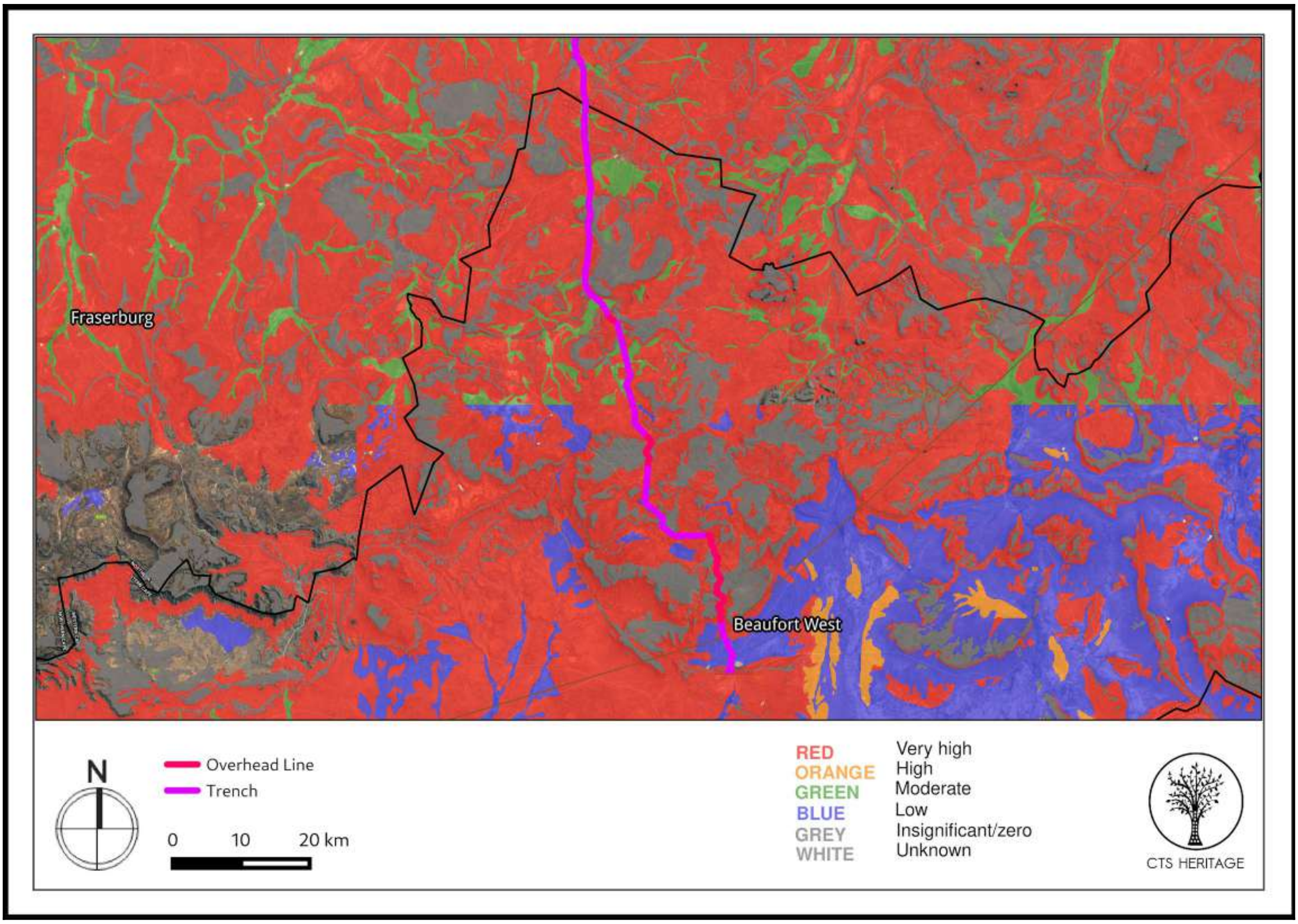


Figure 5 Palaeosensitivity Map. Indicating Moderate to Very High fossil sensitivity underlying the study area in the Western Cape.

2.2 Study approach

This Palaeontology Impact Assessment (PIA) report provides a record of the observed or inferred palaeontological heritage resources within the broader SKA fibre route project study area. The identified resources have been assessed to evaluate their heritage significance in terms of the grading system outlined in Section 3 of the NHRA (Act 25 of 1999). Recommendations for specialist palaeontological mitigation are made where this is considered necessary. The report is based on (1) a review of the relevant scientific literature, including previous palaeontological impact assessments in the broader study region (*e.g.* Almond 2016, Rossouw 2019), (2) published geological maps and accompanying sheet explanations, and (3) a palaeontological field study of the SKA fibre route project area between Beaufort West and Carnarvon, via Loxton on 28 & 29 September 2020. GPS locality data for numbered sites mentioned in the text are provided in Appendix 2.

3. Geological and Paleontological context of the study area

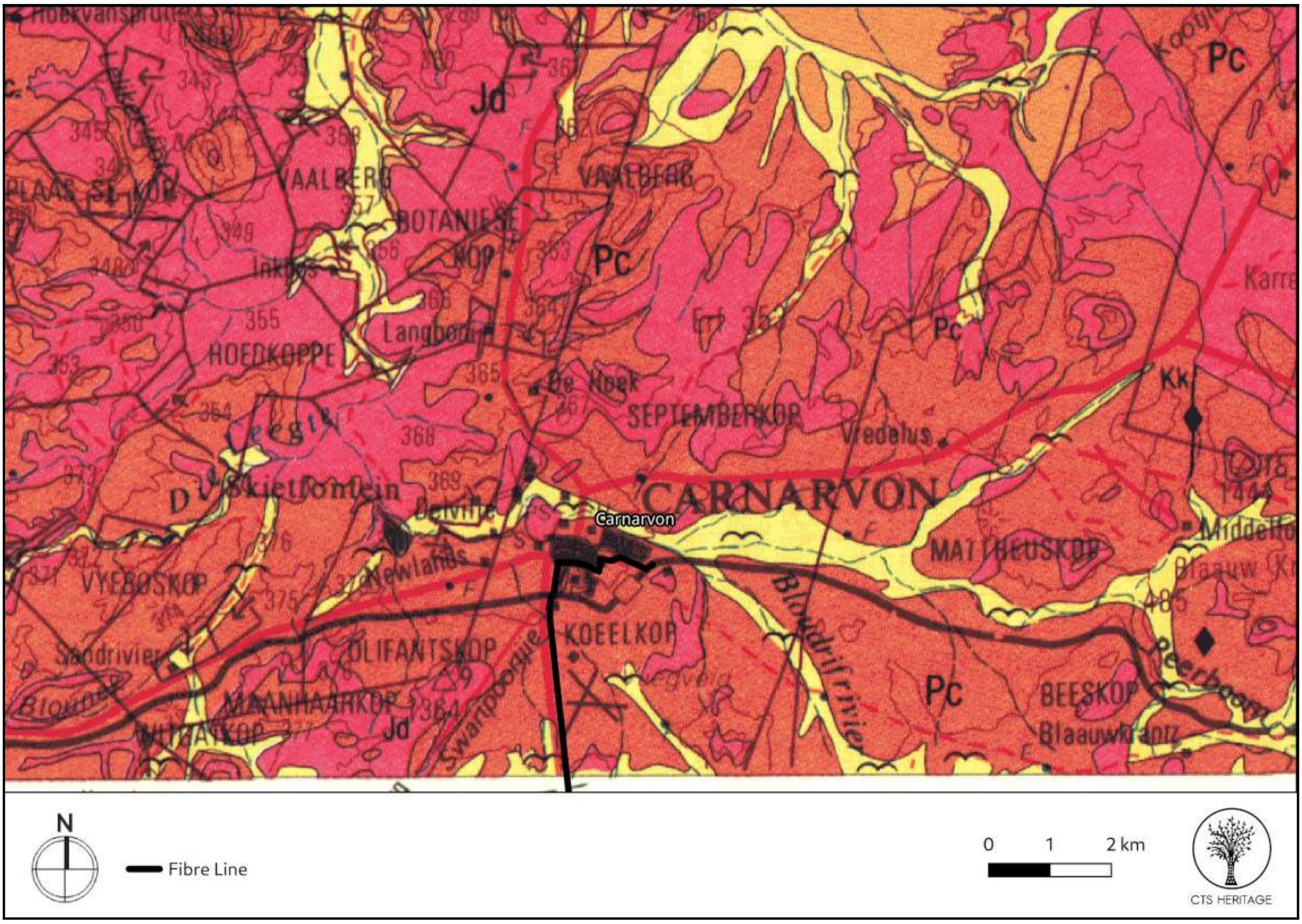


Figure 6 Extract from the CGS 3022 Britstown Map indicating that the development area is underlain by Pc: Waterford Formation previously, Carnarvon Formation of the Ecca Group, Quaternary Sands and Jd: Jurassic Dolerite

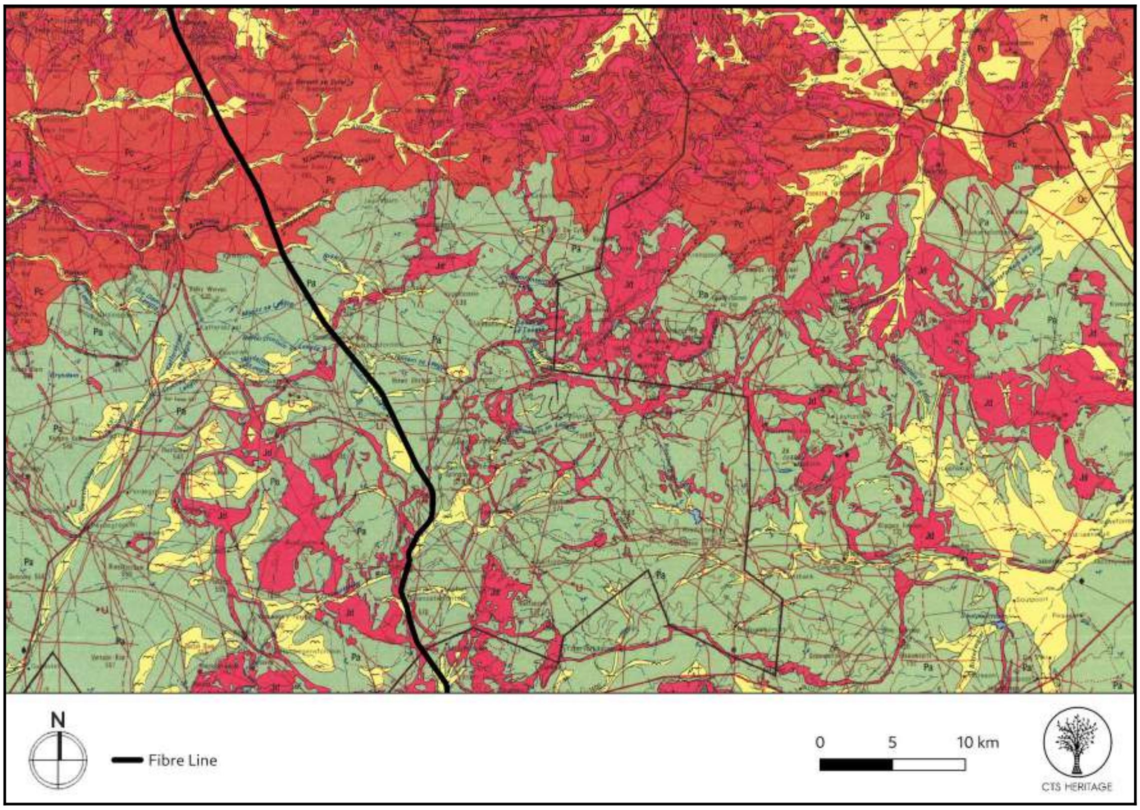


Figure 7 Extract from the CGS 3122 Victoria West Map indicating that the development area is underlain by Pa: Abrahamskraal Formation of the Beaufort Group, Pc: Waterford Formation previously, Carnarvon Formation of the Ecca Group, Quaternary Sands and Jd: Jurassic

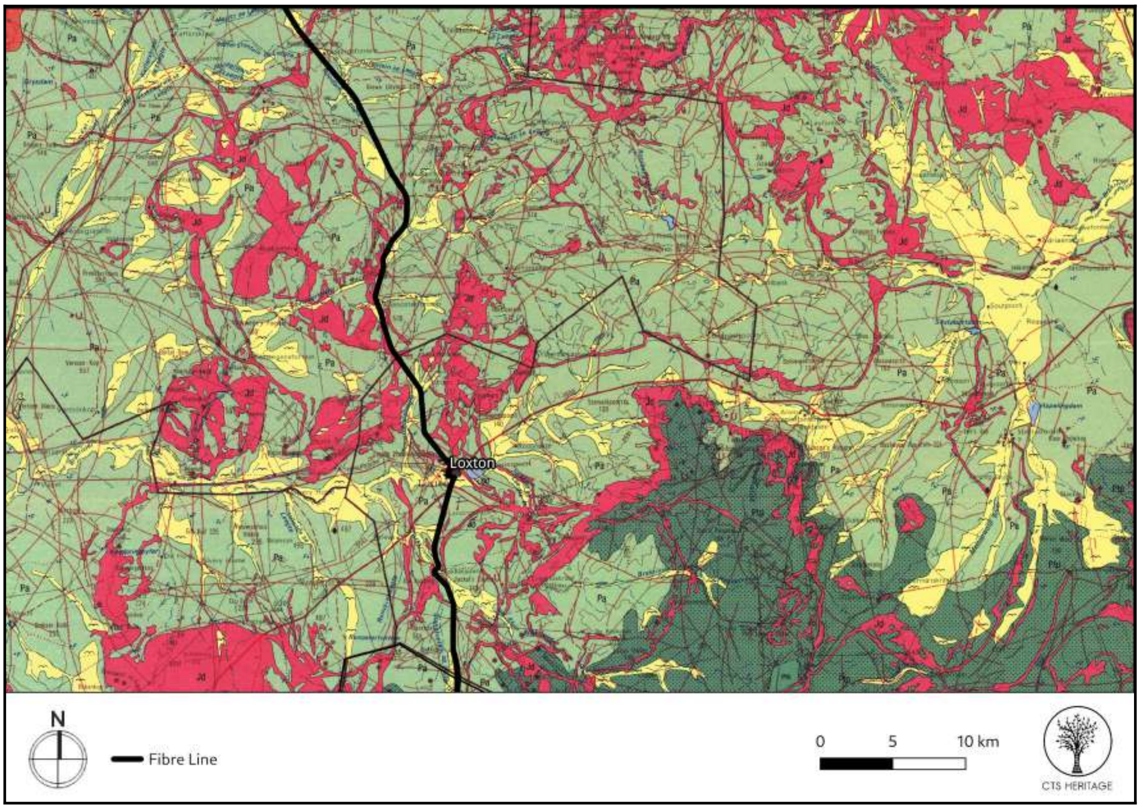


Figure 8 Extract from the CGS 3122 Victoria West Map indicating that the development area is underlain by Pa: Abrahamskraal Formation of the Beaufort Group, Pc: Waterford Formation previously, Carnarvon Formation of the Ecca Group, Quaternary Sands and Jd: Jurassic

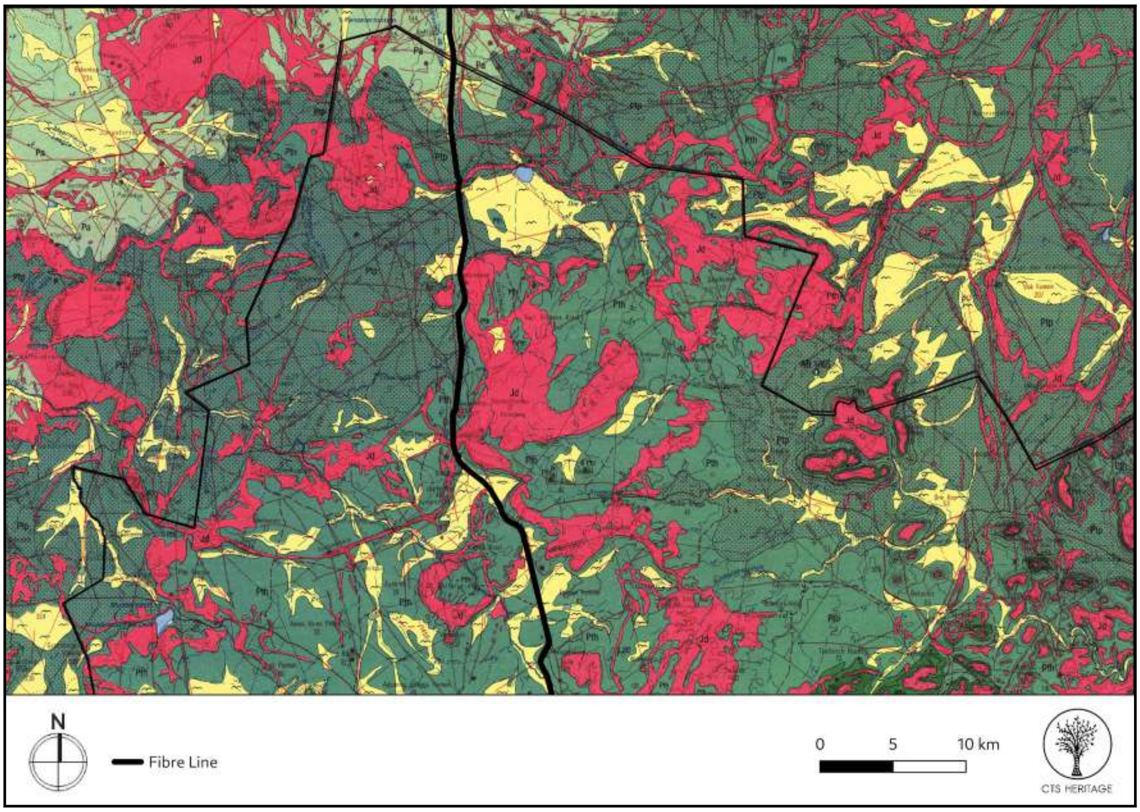


Figure 9 Extract from the CGS 3122 Victoria West Map indicating that the development area is underlain by Ptp: Poortjie Member and Pth: Hoedemaker Member of the Teekloof Formation, Pa: Abrahamskraal Formation of the Beaufort Group, Pc: Waterford Formation, previously Carnarvon Formation.

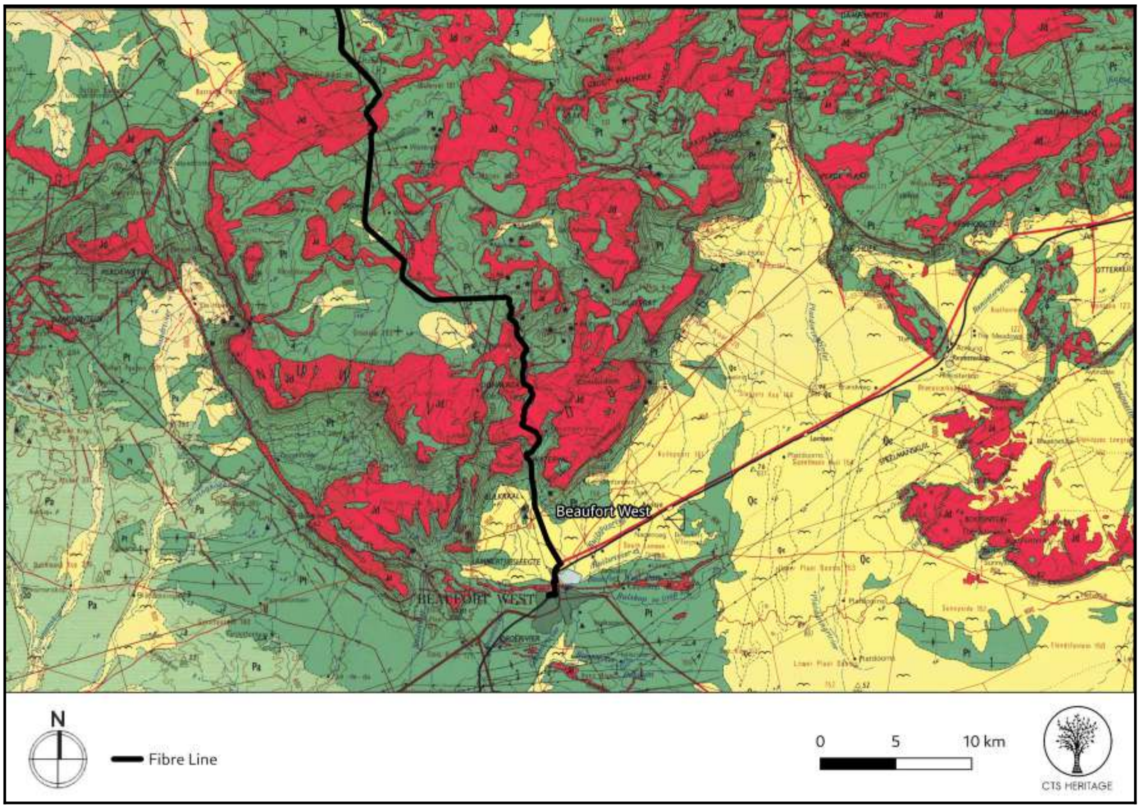


Figure 10 Extract from the CGS 3222 Beaufort West Map indicating that the development area is underlain by Ptp: Poortjie Member and Pth: Hoedemaker Member of the Teekloof Formation, Pa: Abrahamskraal Formation of the Beaufort Group, Pc: Carnarvon Formation of the Ec

Table 1 Explanation of symbols indicating geological strata in Figure 6 to Figure 10.

Symbol	Group	Formation	Lithology	Approximate Age	Palaeontology
Pth	Beaufort, Adelaide Subgroup	Teekloof, Hoedemaker member	Arenaceous sandstone	266 – 250 Ma	Raindrop imprints, desiccation cracks Tropidostoma Assemblage Zone
Ptp	Beaufort, Adelaide Subgroup	Teekloof, Poortjie member	Red Mudstone		Raindrop imprints, desiccation cracks Pristerognathu s Assemblage Zone
Pa	Beaufort, Adelaide Subgroup	Abrahamskraal	Green to blue-grey mudstones		Bioturbation, Trance fossils ~Tapinocephal us Assemblage Zone
Pc	Ecca	Water Ford (Previously Carnarvon)		290 – 266 Ma	Trace Fossils
Pt	Ecca	Tierberg	Dark shales, yellow tuffs.		Trace fossils, fish scales, and sponge spicules
Jd	Jurassic Dolerites		Dolerite	182-183 Ma	
Qs	Quaternary Sediment		Sand/Clay/ silt	2.6Ma to present	
Ma: million years					

The following section will provide a basic review of the relevant geology and palaeontology in the study area.

3.1. Beaufort Group

3.1.1. Teekloof Formation

The Teekloof Formation overlies the Abrahamskraal Formation and is not capped by any other preserved sedimentation. There is some continuation of Beaufort Groups rocks preservation East of 24ºE, but no preservation in the western-southwestern portions of the Karoo Basin (Day (2014), Day et al. (2015), Viglietti et al. (2018))

CTS Heritage
34 Harries Street, Plumstead
Tel: +27 (0)87 073 5739 **Email:** info@ctsheritage.com **Web:** www.ctsheritage.com

The Teekloof Formation consists of five Members as seen in Table 2, however only the oldest two members occur in the study area.

Table 2 The Five Members of the Teekloof Formation from youngest to oldest

Javanerskop Member	Correlates with the Daptocephalus Assemblage Zone
Steenkampsvlakte Member	
Oukloof Member	Correlates with the Cistecephalus Assemblage Zone
Hoedemaker Member	Correlates with the Tropidostoma Assemblage Zone
Poortjie Member	Correlates with the Pristerognathus Assemblage Zone

Rocks of the teekloof Formation consist mostly of reddish (with minor green) mudstones. These are either structureless, horizontally laminated, or medium to thickly bedded. These beds can contain Pedogenic and diagenetic carbonate nodules and fossil gypsum rosettes.

The mudstones are interbedded with fine to medium sandstones which show an upward fining sequence (Johnson et al., 2006).

The depositional environment of the Teekloof Formation is thought to be a meandering river environment, showing evidence for seasonal flooding and drying (to the point of playa lake formation), as indicated by the upward fining, and occurrence of gypsum rosettes (Smith, 1989).

The Teekloof Formation contains the richest Permo-Triassic tetrapod fauna from Pangaea / Gondwana. It also provided vital evidence of mammal like characteristics developing in therapsids. This Formation also recorded two Mass Extinction Events (260 Ma and 52 Ma). The Formation also contain non-marine bivalves, phyllopod crustaceans, and trace fossils, and six successive assemblage zones.

3.1.2. Abrahamskraal Formation

The rocks of the Abrahamskraal Formation are generally green-grey to blue-grey mudstones, although grey-red, red-brown, or purple mudstones are also found. Calcareous nodules are present, these nodules tend to weather out brown. Within these mudstone layers fine grained green-grey sandstones are found, usually showing an upward fining trend. These sandstones can range from metres to tens of metres in thickness in some areas, and are important stratigraphic markers for geologists and palaeontologists. These mudstones are also interbedded with siltstone beds. These sedimentary rocks tend to reveal a depositional environment in a retro-arc foreland basin (Karoo Basin), where sediment was deposited in a low energy alluvial plain flowing to the north. As indicated by fluvial and lacustrine sediments. (Johnson et al., 2006)

The lower part of the Formation in seen as deltaic (green-grey, blue-grey mudstones) while the upper part of the Formation is seen as fully terrestrial (often indicated by the red mudstones).

The Abrahamskraal Formation correlates well with the Tapinocephalus Assemblage Zone. Therapsids, pareiasaur reptiles and fish fossils have been sparsely reported in this Formation. Plant material (e.g. sphenophyte ferns, fossil wood), freshwater invertebrates (principally smooth-shelled bivalves; and a range of trace fossils including tetrapod trackways (e.g. temnospondyl amphibians, therapsids) have been found.

3.2. Ecca

3.2.1. Waterford Formation (previously Carnarvon Fm /Koedoesberg Fm)

The thickness of the Waterford Formation fluctuates between 200 m and 800 m. The Formation consists of fine grained sandstones and mudrock or clastic rhythmite units. The individual sandstone units have an average thickness of 6 m, with 18 m being the maximum. These units are mostly structureless, but horizontal lamination, low angle crossbedding and ripple lamination is found in some areas. Oscillation ripples are more common. The Formation is characterised by ball and pillow structures, as well as other water escape features. Thin mud-flake conglomerates area occasionally found. Brown weathering calcareous concretions can be found in the sandstone and mudstone. Wave ripples indicate a shallow sedimentary environment, in a delta front area / storm dominated shelf. (Johnson et al., 2006)

The Formation is mostly known for petrified wood and other plant material of the Glossopteris Flora (e.g. Glossopteris, Phyllotheca). Large fossil logs (“Dadoxylon”) showing seasonal growth rings are found. Two different genera of gymnospermous woods, Prototaxoxylon and Australoxylon, have been identified (Bamford, 1999, 2004). Rolled vertebrate bone fragments, low intensity bioturbation, and trace fossils also found.

3.2.2. Tierberg Formation

The Tierberg Formation ranges in thickness form 700 m in the west to 350 m in the north east. It is a predominantly argillaceous Formation which grades upwards into the Waterford Formation. These grey mudrock and fine sandstones where deposited offshore in an inland sea, with influences of offshore fans, and distal pro-deltaic deposition. There is some occurrence of yellow tuffaceous layers of up to 10 cm thick in the lower part of the succession.

The Tierberg Formation is known for a wide range of both vertebrate and invertebrate trace fossils, these include include, fish swimming trails (Undichna), crustacean trackways (Umfolozia), arthropod feeding marks (Vadoscavichna) and resting traces (Quadrispinichna / Broomichnium). Boddy fossils are mostly found in the form of plant remains of glossopteris including fossilised wood. Some micro vertebrate remains have been reported (Prinsloo, 1989)

3.3. Jurassic Dolerites

Before discussing the karoo dolerite system two terms must be explained, namely, sills and dykes. Dykes are igneous intrusions that run vertically, forcing through cracks in the overlying rock, while sills are offshoot intrusions running horizontally into weaknesses between or through layers as seen in Figure 11 (Marshak, 2008).

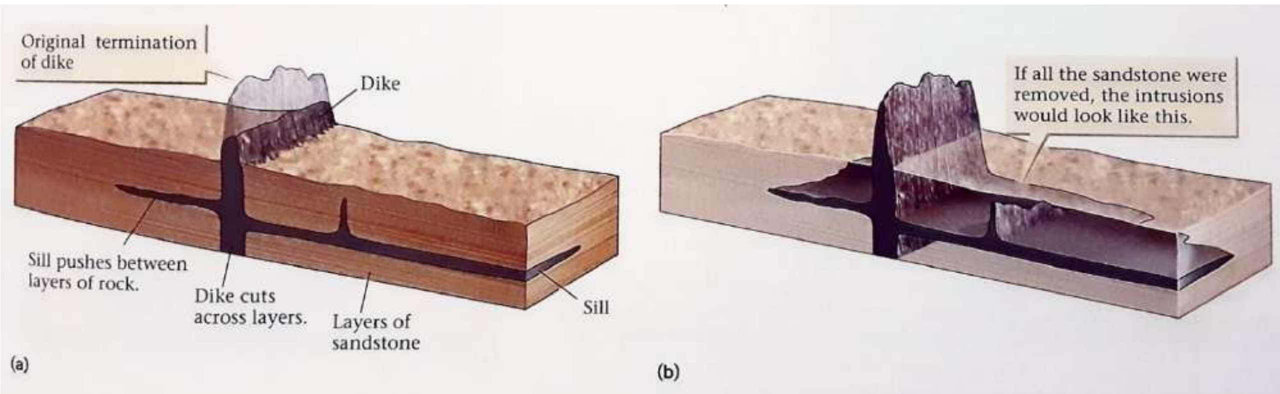


Figure 11 (a) Dykes and sills are vertical or horizontal bands of intrusive igneous rocks (b) if the surrounding rock is stripped away the igneous rock would look like vertical and horizontal planes. (Marshak, 2008)

The Karoo dolerites is an extensive interconnected network of dykes and sills (Figure 12), which intruded in between the sedimentary layers of the Karoo Suppergroup. The dolerite intrusions signify the origin of a volcanic system and is thought to be of the same age as their extrusive counterpart, the Drakensberg basaltic eruption at 183 Ma (Bamfort, 2019; Woodford and Chevallier, 2002; Molaba, 2017). Dolerites are intrusive igneous bodies which does not contain fossils and will destroy fossils they come in contact with (Bamfort; 2019)

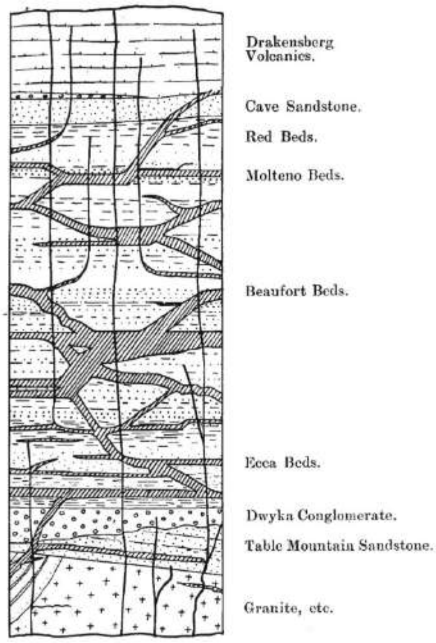


Figure 12 Diagram of basalt sills and dykes intruded into the Karoo Suppergroup (sills running horizontally, dykes running vertically) (du Toit, 1920)

CTS Heritage
34 Harries Street, Plumstead
Tel: +27 (0)87 073 5739 **Email:** info@ctsheritage.com **Web:** www.ctsheritage.com

Figure 13 Road cutting showing highly fractured mudstones, with more resistant sandstone

Figure 14 Road cutting showing highly fractured mudstones, with more resistant sandstone

Figure 15 Road cutting showing highly fractured mudstones, with more resistant sandstone, note how the broken sandstone sheets cover much of the finely fractured mudstones

CTS Heritage
34 Harries Street, Plumstead
Tel: +27 (0)87 073 5739 **Email:** info@ctsheritage.com **Web:** www.ctsheritage.com

Figure 16 horizontal layers of alternating mud- and sandstone (to the left) cut by a dolerite dyke.

Figure 17 Typical outcrop of dolerite forming stacked pillars.

CTS Heritage
34 Harries Street, Plumstead
Tel: +27 (0)87 073 5739 **Email:** info@ctsheritage.com **Web:** www.ctsheritage.com

Figure 18 Highly fractured mudstones

Figure 19 Highly fractured mudstones

Figure 20 Highly fractured mudstones

Figure 21 Ancient river channel, filed with fine grained fractured sandstone, in a more resistant sandstone bed.

4. PALAEONTOLOGICAL HERITAGE RESOURCES

4.1. Review of regional palaeontology

Most of the area proposed for development is underlain by sediments that have very high palaentological sensitivity. According to geology maps from the CGS, these sediments include the Poortjie Member and Hoedemaker Member of the Teekloof Formation, and the Abrahamskraal Formation of the Beaufort Group. According to Rossouw (2019), the study area is located within "early Permian Abrahamskraal Formation rocks of the Adelaide Subgroup (Karoo Supergroup) that is capped by severely degraded, superficial sheet wash and channel related (Quaternary) deposits bounded by Jurassic age dolerite intrusions to the north.

The Loxton area lies within the outcrop area of the Tapinocephalus Assemblage Zone (AZ) (see Figure 22) which spans the middle part of the Abrahamskraal Formation. Vertebrate fossils of the Tapinocephalus AZ are not as common as in succeeding biozones and are usually found as individual specimens in the mudrock sequences in association with, and often enveloped by, brown-weathering calcareous nodular material. This faunal assemblage is mainly represented by small dicynodonts, large dinocephalians, pareiasaurs and pristerognathid therocephalians. The dinocephalians, which consist of

Synapsida and Therapsida, dominated as one of the tetrapod groups in the Middle Permian. The Tapinocephalus AZ in the Main Karoo Basin holds the most abundant record these dinocephalians. The top of the Abrahamskraal Formation marks the extinction of the dinocephalians. Their disappearance is one of the criterion that marks the beginning of the Pristerognathus AZ. The Pristerognathus AZ correlated with the Poortjie member of the Teekloof Formation. This assemblage zone is folowed by the Tropidostoma Assemblage Zone which coronates with the Hoedemaker Member of the Teekloof Formation (Day et al., 2015).

Day et al. (2015) reported new specimens of the rare tapinocephalid dinocephalian Criocephalosaurus in the lower Poortjie Member, which extends the Tapinocephalus AZ from the Abrahamskraal Formation up into the Teekloof Formation.

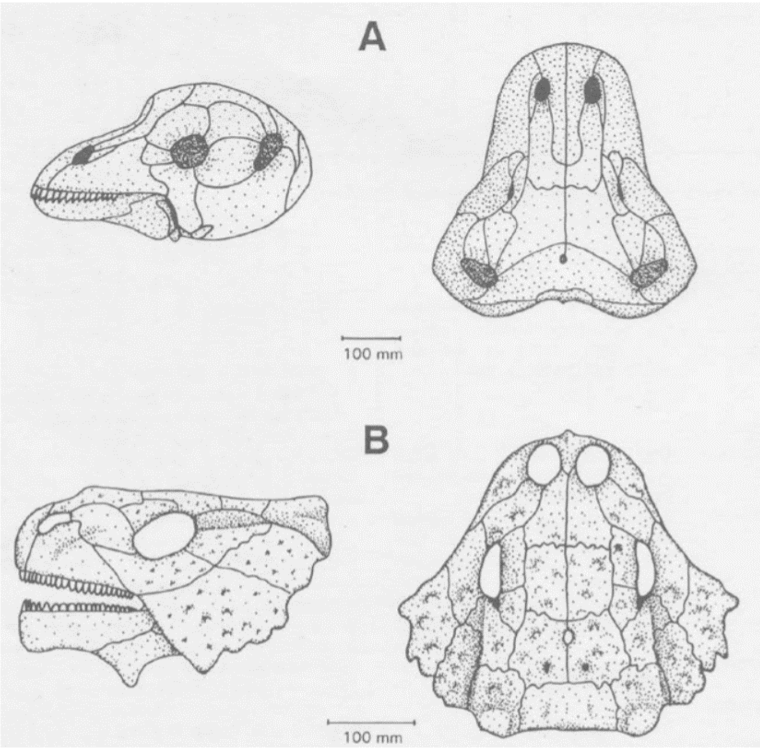


Figure 22 Lateral and dorsal views of biozons-defining fossils of the Tapinocephalus Assemlage Zone. A. Tapinocephalus; B. Bradysaurus modified after Boonstra, 1969 (Rossouw, 2019)

Table 3 sumary of Regional palaeontology, adapted from Almond (2016).

Group	Subgroup	Formation	Member	Rock type	Fossil heritage
Karoo Dollerite Suite (Jd) Early Jurassic (182-183 Ma)				Intrusive dolerites (dykes, sills), associated diatremes	NO fossils recorded
Lower Beaufort Group Middle	Adelaide Subgroup	Abrahamskraal Fm (Pa)		Fluvial sediments with channel sandstones (meandering rivers), thin mudflake conglomerates	Diverse continental biota dominated by a variety of therapsids (e.g. dinocephalians,

Group	Subgroup	Formation	Member	Rock type	Fossil heritage
Permian – Early Triassic (c. 266 – 250 Ma)				interbedded with floodplain mudrocks (greygreen, purplish), pedogenic calcretes, playa lake and pond deposits, occasional reworked volcanic ashes	dicynodonts, gorgonopsians, therocephalians, cynodonts) and primitive reptiles (e.g. pareiasaurs), sparse Glossopteris Flora (petrified wood, rarer leaves of Glossopteris, horsetail stems), tetrapod trackways, burrows & coprolites. Freshwater assemblages include temnospondyl amphibians, palaeoniscoid. fish, non-marine bivalves, phyllopod crustaceans and trace fossils (esp. arthropod trackways and burrows, “worm” burrows, fish fin trails, plant rootlet horizons).
Lower Beaufort Group		Teekloof Fm (Pt)	Poortjie Member. (Ptp)		
Lower Beaufort Group			Hoedemaker Member (Pth)		
Ecca Group – Middle Permian (290 – 266 Ma)		Waterford Fm (Pwa/Pw=Pko, Pc in part)		Prodelta to delta plain sediments	Low diversity non-marine trace assemblages (especially arthropod scratch burrow Scoyenia), common petrified logs (silicified/ calcified), twigs and other remains of Glossopteris Flora (e.g. horsetails), palaeoniscoid fish scales, rare rolled fragments of tetrapod bone (probably from large temnospondyl amphibians)
Ecca Group		Tierberg Fm (Pt)		Offshore non-marine mudrocks with distal turbidite beds, prodeltaic sediments	Disarticulated microvertebrate remains (e.g. fish teeth, scales), sponge spicules, spare vascular plants (leaves, petrified wood), moderate diversity trace fossil assemblages (as below plus variety of additional taxa such as large ribbed pellet burrows, arthropod scratch burrows, Siphonichnus etc)

CTS Heritage
34 Harries Street, Plumstead
Tel: +27 (0)87 073 5739 **Email:** info@ctsheritage.com **Web:** www.ctsheritage.com

4.2. Summary of palaeontological resources identified

Table 1: Summary of geology and palaeontological heritage significance

Site No.	GPS	GEOLOGY	FOSSILS OBSERVED	COMMENTS	PHOTO
BTC09	32°18'15.57" S 22°34'11.19" E	Abrahamskraal Formation	Trace Fossils	On top of road cutting on the western side of the road.	
BTC10	32°17'26.33" S 22°33'59.72" E	Abrahamskraal Formation	Mudflakes in sandstone “mud flake conglomerate”	Not in situ	

5. ASSESSMENT OF THE IMPACT OF THE DEVELOPMENT

The area in the road reserve where the fibre line will predominantly be lain is highly degraded, with large amounts of external material brought in during road construction. The mudstones in the area are also extremely fractured, decreasing the chance of fossil preservation. Only one site was identified to contain trace fossils during the field work. For this reasons it is unlikely that the trenching to lay the fibre line or digging to plant poles for overhead installation will have a significant effect on the area, provided that the chance fossil find procedure is followed in the possible case of a fossil being found.

Table 2: Impact Assessment Criteria

Criteria	Category	Explanation
Overall Nature	***Negative***	Possible fossils in the construction footprint could be destroyed Impact will remain negligible if the Chance Fossil Find Procedure is followed
Type	***Direct***	The development will directly impact these resources
Extent	***Site***	Impact is mainly limited to the trenching area
Duration	***Permanent***	Likely impacts will affect the heritage resources identified permanently
Severity	***Low negative***	The site is partly located on very sensitive palaeontological strata but has been bisected by Jurassic Dolerites. Impact will remain negligible if the Chance Fossil Find Procedure is followed in the case of any fossil finds.
Reversibility	***Irreversible***	The impact cannot be reversed, regardless of the mitigation or rehabilitation measures.
Irreplaceable Loss	***Resource may be partly destroyed***	Partial loss or destruction of the resource might occur but can be mitigated if the Chance Fossil Find Procedure is followed.
Probability	***low***	The site is partly located on very sensitive palaeontological strata but has been bisected by Jurassic Dolerites. Impact will remain negligible if the Chance Fossil Find Procedure is followed in the case of any fossil finds.
Mitigation Potential	***High***	If the Chance Fossil Find Procedure is followed in the case of any fossil finds.
Impact Significance	***Negligible***	Impact significance will remain negligible if the Chance Fossil Find Procedure is followed

6. ASSUMPTIONS AND UNCERTENTIES

The Jurassic dolerites (Dykes and Sills) of the Karoo will not contain any preserved fossil material.

Based on the palaeontological record and the geology of the area it is assumed that the area contains plant, invertebrate and vertebrate fossils, trace fossils should also be common. These fossils are often found as individual specimens and might have been destroyed by the Jurassic Dolerites.

The key assumption for this study is that "existing geological maps and datasets used to assess site sensitivity are correct and reliable. However, the geological maps used were not intended for fine scale planning work and are largely based on aerial photographs alone, without ground-truthing. There is also an inadequate database for fossil heritage for much of the RSA (South Africa), due to the small number of professional palaeontologist carrying out fieldwork in RSA. Most development study areas have never been surveyed by a palaeontologist.

These factors may have a major influence on the assessment of the fossil heritage significance of a given development and without supporting field assessments may lead to either:

- an underestimation of the palaeontological significance of a given study area due to ignorance of significant recorded or unrecorded fossils preserved there, or

CTS Heritage
34 Harries Street, Plumstead
Tel: +27 (0)87 073 5739 **Email:** info@ctsheritage.com **Web:** www.ctsheritage.com

- an overestimation of the palaeontological sensitivity of a study area, for example when originally rich fossil assemblages inferred from geological maps have in fact been destroyed by weathering, or are buried beneath a thick mantle of unfossiliferous “drift” (soil, alluvium etc.). (Groenewald, 2016).

7. CONCLUSION AND RECOMMENDATIONS

The proposed installation of the SKA fibre line may proceed. It is unlikely that this construction will have a great effect on the national palaeontological heritage.

Although the area has a rich occurrence of multiple fossil assemblages fossil finds are often isolated as individuals. Only one site was identified to contain some trace fossils. The trench for the SKA fibre line will predominantly run along highly disturbed and fractured (Figure 18 to Figure 21) roadside material. This decreases the chance of finding fossils dramatically. It is recommended that the responsible Environmental Control Officer (ECO) monitor the material extracted during excavation.

Should important new fossil remains - such as insects, vertebrate bones and teeth, petrified wood, plant-rich fossil lenses or dense fossil burrow assemblages - be exposed during construction, the responsible ECO should alert Heritage Western Cape (HWC) for finds in the Western Cape Province (Contact details: Colette Scheermeyer, 021 483 5959 or colette.scheermeyer@westerncape.gov.za) or SAHRA for finds in the Northern Cape Province (Contact details: Phillip Hine, 021 462 4502, phine@sahra.org.za) as soon as possible. This is so that appropriate action can be taken in good time by a professional palaeontologist at the developer’s expense. Palaeontological mitigation would normally involve the scientific recording and judicious sampling or collection of fossil material as well as of associated geological data (*e.g.* stratigraphy, sedimentology, taphonomy). The palaeontologist concerned with mitigation work will need a valid fossil collection permit from HWC / SAHRA and any material collected would have to be curated in an approved depository (*e.g.* museum or university collection). All palaeontological specialist work should conform to international best practice for palaeontological fieldwork and the study (*e.g.* data recording fossil collection and curation, final report) should adhere as far as possible to the minimum standards for Phase 2 palaeontological studies recently developed by SAHRA (2013). These recommendations are summarised in tabular form in Appendix 1 (Chance Fossil Finds Procedure) and should be incorporated into the Environmental Management Programme (EMPr) for the proposed development.

7. REFERENCES

Almond, J. E. 2016, SKA Core And Phase 1 Development Area, Great Karoo, Northern Cape – Plaeontological Herritage, Unpublished PIA, Natura Viva

Bamford, M. 1999. Permo-Triassic fossil woods from the South African Karoo Basin. Palaeontologia africana 35, 25-40.

Bamford, M.K. 2004. Diversity of woody vegetation of Gondwanan southern Africa. Gondwana Research 7, 153-164

Bamford, M. 2019 Palaeontological Impact Assessment for the proposed construction of three residential townships in Kroonstad, Free State Province, Archaeological and Heritage Services Africa (Pty) Ltd

CTS Heritage. 2020. Desktop Heritage Screening Assessment for the Proposed Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon, Northern and Western Cape. Unpublished.

Day, M.O.; Güven. S.; Abdala; F.; Jirah; S. Rubidge, B.; Almond, J. 2015. Youngest dinocephalian fossils extend the Tapinocephalus Zone, Karoo Basin, South Africa S. Afr. j. sci. vol.111 n.3-4 Pretoria Mar./Apr. 2015 Evolutionary Studies Institute, School of Geosciences, University of the Witwatersrand, Johannesburg, South Africa

Day, M.O. 2013. Charting the fossils of the Great Karoo: a history of tetrapod biostratigraphy in the Lower Beaufort Group, South Africa ISSN 0078-8554.

Day, M. O. 2014. Middle Permian continental biodiversity changes as reflected in the Beaufort Group of South Africa: a bio- and lithostratigraphic review of the Eodicynodon, Tapinocephalus and Pristerognathus assemblage zones (PhD thesis).

du Toit, A. L. 1920 The Karoo dolerites of South Africa, a study in hypabyssal injection, Transactions of the Geological Society of South

Groenewald, G. 2016. palaeontological desktop assessment for the proposed TETRA4 development near Matjhabeng (Virginia), Matjhabeng Local Municipality, Lejweleputswa District Municipality, Free State Province. HIA Consultants.

Johnson, M.R, van Vuuren, C.J. Visser, J.N.J. Cole, D.I. de v. Wickens, H. Christie, A.D.M. Roberts, D.L. Brandl, G. 2006. Sedimentary Rocks Of The Karoo Suppergroup. In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J., (Eds.), The Geology of South Africa, Johannesburg/Councel for Geoscience, Pretoria, 461-499 pp.

Marshak, S. 2008, Portrait of a planet. 3dr edition. W.W. Norton & Company, London, 832pp.

Molaba, G.L. 2017. Investigating the possibility of targeting major dolerite intrusive to supplement municipal water supply in Bloemfontein: a Geophysical approach, MSc thesis, Faculty of Natural and Agricultural Sciences (Institute for Groundwater Studies) at the University of the Free State 110pp.

Prinsloo, M.C. 1989. Die geologie van die gebied Britstown. Explanation to 1: 250 000 geology Sheet 3022 Britstown, 40 pp. Council for Geoscience, Pretoria.

Rossouw, L. 2019 Exemption from further Heritage Impact Assessment: Rectification in terms of Section 24G for Residential Development in Loxton, Northern Cape Province. Palaeo Field Services PIA Report

Smith, R. M. H. 1989. Fluvial facies, vertebrate taphonomy and palaeosols of the Teekloof Formation (Permian) near Beaufort West, Cape Province, South Africa. Unpublished PhD Thesis, UCT

Viglietti, P. A.; Smith, Roger M.H.; Rubidge, Bruce S. 2018. "Changing palaeoenvironments and tetrapod populations in the Daptocephalus Assemblage Zone (Karoo Basin, South Africa) indicate early onset of the Permo-Triassic mass extinction". Journal of African Earth Sciences. 138: 102–111 Bibcode:2018JAfES.138..102V

Woodford, A.C., and Chevallier, L. 2002. Hydrogeology of the Main Karoo Basin: Current Knowledge and Future Research Needs. Water research commission, Report No TT 179/02, 466pp.

Appendix 1

Chance Fossil Finds Procedure

(Adopted from the HWC Chance Fossils Finds Procedure: June 2016)

Introduction

This document is aimed to inform workmen and foremen working on a construction and/or mining site. It describes the procedure to follow in instances of accidental discovery of palaeontological material (please see attached poster with descriptions of palaeontological material) during construction/mining activities. This protocol does not apply to resources already identified under an assessment undertaken under s. 38 of the National Heritage Resources Act (no 25 of 1999).

Fossils are rare and irreplaceable. Fossils tell us about the environmental conditions that existed in a specific geographical area millions of years ago. As heritage resources that inform us of the history of a place, fossils are public property that the State is required to manage and conserve on behalf of all the citizens of South Africa. Fossils are therefore protected by the National Heritage Resources Act and are the property of the State. Ideally, a qualified person should be responsible for the recovery of fossils noticed during construction/mining to ensure that all relevant contextual information is recorded.

Heritage Authorities often rely on workmen and foremen to report finds, and thereby contribute to our knowledge of South Africa's past and contribute to its conservation for future generations.

Training

Workmen and foremen need to be trained in the procedure to follow in instances of accidental discovery of fossil material, in a similar way to the Health and Safety protocol. A brief introduction to the process to follow in the event of possible accidental discovery of fossils should be conducted by the designated Environmental Control Officer (ECO) for the project, or the foreman or site agent in the absence of the ECO It is recommended that copies of the attached poster and procedure are printed out and displayed at the site office so that workmen may familiarise themselves with them and are thereby prepared in the event that accidental discovery of fossil material takes place.

Actions to be taken

One person in the staff must be identified and appointed as responsible for the implementation of the attached protocol in instances of accidental fossil discovery and must report to the ECO or site agent. If the ECO or site agent is not present on site, then the responsible person on site should follow the protocol correctly in order to not jeopardize the conservation and well-being of the fossil material. Once a workman notices possible fossil material, he/she should report this to the ECO or site agent.

Procedure to follow if it is likely that the material identified is a fossil:

- The ECO or site agent must ensure that all work ceases immediately in the vicinity of the area where the fossil or fossils have been found;
- The ECO or site agent must inform SAHRA of the find immediately. This information must include photographs of the findings and GPS co-ordinates;
- The ECO or site agent must compile a Preliminary Report and fill in the attached Fossil Discoveries: Preliminary Record Form within 24 hours without removing the fossil from its original position. The Preliminary Report records basic information about the find including:
- The date
- A description of the discovery
- A description of the fossil and its context (e.g. position and depth of find)
- Where and how the find has been stored
- Photographs to accompany the preliminary report (the more the better):

- A scale must be used
- Photos of location from several angles
- Photos of vertical section should be provided
- Digital images of hole showing vertical section (side);
- Digital images of fossil or fossils.

Upon receipt of this Preliminary Report, SAHRA will inform the ECO or site agent whether or not a rescue excavation or rescue collection by a palaeontologist is necessary.

- Exposed finds must be stabilised where they are unstable and the site capped, e.g. with a plastic sheet or sandbags. This protection should allow for the later excavation of the finds with due scientific care and diligence. SAHRA can advise on the most appropriate method for stabilisation.
- If the find cannot be stabilised, the fossil may be collected with extreme care by the ECO or the site agent and put aside and protected until SAHRA advises on further action. Finds collected in this way must be safely and securely stored in tissue paper and an appropriate box. Care must be taken to remove all the fossil material and any breakage of fossil material must be avoided at all costs.

No work may continue in the vicinity of the find until SAHRA has indicated, in writing, that it is appropriate to proceed.

FOSSIL DISCOVERIES: PRELIMINARY RECORDING FORM		
Name of project:		
Name of fossil location:		
Date of discovery:		
Description of situation in which the fossil was found:		
Description of context in which the fossil was found:		
Description and condition of fossil identified:		
GPS coordinates:	Lat:	Long:
If no co-ordinates available then please describe the location:		
Time of discovery:		
Depth of find in hole		
Photographs (tick as appropriate and indicate number of the photograph)	Digital image of vertical section (side)	
	Fossil from different angles	
	Wider context of the find	
Wider context of the find. Temporary storage (where it is located and how it is conserved)		
Person identifying the fossil Name:		
Contact:		
Recorder Name:		
Contact:		
Photographer Name:		
Contact:		

CTS Heritage
34 Harries Street, Plumstead
Tel: +27 (0)87 073 5739 **Email:** info@ctsheritage.com **Web:** www.ctsheritage.com

Appendix 6 Specialist assessment: Visual, Aesthetic and Scenic Resources

VISUAL IMPACT
SPECIALIST ASSESSMENT

BASIC ASSESSMENT FOR THE PROPOSED SQUARE KILOMETRE ARRAY (SKA) FIBRE OPTIC CABLE BETWEEN BEAUFORT WEST AND CARNARVON

Report prepared for:	*Report prepared by:*
CSIR – Environmental Management Services P O Box 320 Stellenbosch 7599 South Africa	Quinton Lawson and Bernard Oberholzer PO Box 471 Stanford 7210 Western Cape

Version: Draft, v2

8th March 2021

Executive Summary

The proposed underground fibre optic cable would have little or no visual implications, and therefore only the above-ground sections of the route were assessed. The proposed route of the cable generally follows the R381 through the Molteno Pass and a number of smaller passes and *poorts*. These sections of the route have scenic value, and it is mainly users of the R381 that would potentially be affected by the proposed cable. Farmsteads in the area are too far away to be significantly affected.

Because the poles for the cables are relatively low, (7,5 and 9,0m), compared to the existing 22kV Eskom powerline (about 12,0m), visibility of the proposed cable infrastructure is not expected to be generally significant, although where poles are located on the skyline, visibility would become more significant and the scenic quality of the area could be affected.

Where the cable infrastructure is located immediately adjacent to the R381 road, the visual impact on users of the road, and on the rural or wilderness experience of the area, would become significant. In addition, where the cable route creates a different corridor to that of the existing 22kV powerline, further fragmentation of the scenic landscape can be expected.

Recommended mitigations include the following:

- combining the SKA cable and Eskom powerline corridors where possible, except where the existing powerline follows a visually intrusive route;
- placing the cable in a trench in those sections where the potential exists.avoiding visually exposed ridgelines and locating the SKA cable in the lower lying areas or valleys, where feasible (understood to not necessarily be technically implementable);
- observing a visual buffer along the R381 and minimising crossing of the road by the cable as far as possible (understood to not necessarily be technically implementable);

Since the mitigation options are limited by the technical requirements of the cable design and routing, the visual impact significance of the proposed SKA cable would remain <u>moderate</u> during its operational lifespan.

The potential cumulative visual impact for the proposed SKA cable, in combination with the existing Eskom powerline and telephone line would be <u>moderate,</u> but could be reduced to <u>low</u> if the above mitigations are implemented.

A summary of the overall visual impact significance (post mitigation) is given below:

Phase	**Overall Impact Significance**
Construction	Low
Operational	Moderate
Decommissioning	Very Low
Nature of Impact	**Overall Impact Significance**
Cumulative - Construction	Low
Cumulative - Operational	Moderate
Cumulative - Decommissioning	Very low

No fatal flaws from a visual perspective are expected as a result of the proposed cable infrastructure. However, the Molteno Pass, which ascends the great escarpment, has both scenic and heritage significance, and it is important that the recommended mitigations are implemented where possible. Provided a heritage permit is issued, the application could also be authorised from a visual perspective.

Contents

Maps

List of Abbreviations

BA	Basic Assessment
DEFF	Department of Environment, Forestry and Fisheries
EA	Environmental Assessment
EAP	Environmental Assessment Practitioner
EMPr	Environmental Management Programme
kV	Kilovolt
PoP	Point of Presence
SKA	Square Kilometre Array
VIA	Visual Impact Assessment

This report serves as the Visual Specialist Assessment (VIA) that was prepared as part of the Basic Assessment (BA) for the proposed installation of a fibre optic cable between Beaufort West and Carnarvon to complete a connection between the Square Kilometre Array (SKA) radio telescope to a data processing facility in Cape Town.

1. Introduction

1.1. Scope, Purpose and Objectives of this Specialist Report

The intention of the VIA is to assist in identifying the most suitable route for the proposed fibre optic cable, with the focus on the three above ground sections of the route, namely the Molteno Pass Section, the Mid Section (Blounek Pass) and the North Section, (Rosenberg Pass) as indicated on Maps 1 and 2. The position taken is that it is only these above-ground sections that have potential visual implications.

Given the minimal visual effect of 7,5m poles along the route, the visual specialists determined that only a 'Level 2' visual assessment was required, which involves the following (Oberholzer, 2005):

Site visit and identification of visual issues;
Description of the proposed project and the receiving environment;
Establishment of view catchment area and receptors;
Indication of potential visual impacts, and recommended mitigation measures.

1.2. Details of Specialists

This specialist assessment has been undertaken by:

Quinton Lawson, Architect, SACAP reg. no. 3686, and
Bernard Oberholzer, Landscape Architect, SACLAP reg. no. 87018.

Both specialists have more than 20 years of experience in visual assessments.
A curriculum vitae is included in Appendix A of this specialist assessment.
A signed specialist statement of independence is included in Appendix B.

1.3. Terms of Reference

The Terms of Reference for the visual specialist study include the following:

- A description of the regional and local features,
- A field survey to determine visually sensitive areas and receptors,
- Visual sensitivity mapping,
- Assessment of potential visual impacts on the landscape, and their significance,
- Identification of relevant legislation and legal requirements; and
- Recommendation of possible visual mitigation measures.

2. Approach and Methodology

The methodology involved a number of standard procedures as described below:

- A baseline survey of existing scenic resources and visual characteristics of the study area, including desktop work and field observations.
- A photographic survey of the proposed route of the fibre optic cable.
- Mapping of view corridors, important viewpoints and receptors.
- Mapping of distance radii from the proposed cable route to determine potential visibility.
- Mapping of viewsheds of the proposed overhead cable route to determine zones of visual influence.
- Construction of photomontages panoramic photographs taken in the field, plus digital terrain modelling and 3D modeling of the proposed cable route.

- Consideration of land uses, topographic features, vegetation cover and general intactness of the landscape.
- Determination of potential impacts based on the criteria and methodology provided by the EAP (Appendix D).

Field work was previously was carried out by the specialists in 2020 and additional photographs were taken by the CSIR on 17 November 2020. The season was not a consideration, nor had any effect on carrying out a visual assessment. Clear visibility was required for the photographic survey.

2.1. Information Sources

Base data used in the visual assessment is listed in Table 1 below. Although some of the information has not been updated for a few years, the quality of the data was considered adequate for the purpose of this assessment.

Table 1: Information Sources

Data / Information	Source	Date	Type	Description
Project description data and photos	CSIR	Feb. 2021		Construction method statement
1:50000 Topographic, 1:250000 Topo-Cadastral series maps and datasets	Chief Directorate: National Geospatial Information		Spatial	Topographic information
1 arcSEC 30m DEM Data	Shuttle Radar Topography Mission (SRTM)	2014	Spatial	Digital elevation model
Satellite Imagery	Google Earth	2021	Spatial	Aerial photography
Geographic information	Google Maps and Open Street Map (OSM)	2020	Spatial	Geographic information
South Africa Protected Areas Database (SAPAD)	DEFF	2020 Q3	Spatial	Location of protected areas
National Freshwater Ecosystem Priority Areas (NFEPA)	SANBI	2015	Spatial	River and Wetland Datasets
Electricity Grid Infrastructure (EGI)	ESKOM	2018	Spatial	Infrastructure dataset

2.2. Assumptions, Knowledge Gaps and Limitations

Based on the information provided, only a generalised routing of the overhead optic fibre cable is available. In a project of this nature, where the pylons are fairly small (7,5 and 9,0m), but the route is fairly long in a visually sensitive mountain pass environment, then micro-siting of the overhead cable will become important.

Secondly, it is understood that current design and route alignment is based on accessibility (i.e. as close to the road as possible to ensure construction and maintenance is technically possible) and to minimise tension and wind strain to the cabling. Therefore, recommendation measures that require significant re-routing is not considered technically implementable.

The only other cable infrastructure in the study corridor is the 22 kilovolt (kV) Eskom overhead powerline and a separate telephone line which would need to be considered in the cumulative visual impact assessment.

2.3. Consultation Processes Undertaken

No dedicated consultation has taken place for this visual assessment to date and it is anticipated that any visual issues will be identified in the Public Participation Process, and that these will be addressed in the final BAR.

3. Description of Project Aspects relevant to Visual and Scenic Resources

The proposed fibre optic cable installation will start in Beaufort West and terminate at the existing Carnarvon SKA internet Point of Presence (PoP) site, via Loxton where a 3m x 6m container for regeneration of signal will be established. The total length of the cable is about 185km (CSIR et al, 2020).

The underground cable would generally be installed in trenches at least 1m from the fence of adjacent private land within the road reserves, mainly being the road reserve of the R381 Route.

Some sections, i.e. the North Section, the Mid Section and the Molteno Pass Section would be unfeasible to trench because of the rugged topography and substrate, and therefore the cabling would be installed overhead on poles in these sections. The distances for the 3 separate overhead sections are as follows:

North Section (Rosenberg Pass): 750m
Mid Section (Blounek Pass): 4,73km
South Section (Molteno Pass and Ouberg): 15,14km

Wooden poles with a total length of 9m would be buried 1.5m deep, resulting in a total above-ground height of about 7.5m. At the start and end of the overhead sections, 9m high hollow concrete poles would be used. (See Maps 3 to 6). As a comparison, the existing 22kV Eskom powerline poles are about 12m in height.

A combination of two techniques would be used to dig holes for the poles:

a) A drill mounted on the back of a truck for those areas that are accessible; and
b) A hand-held drill in areas which are inaccessible to the drill-mounted truck.

Example of the existing 22kV Eskom powerline and adjacent telephone line

4. Visual Baseline Description of the Study Area

A brief description of the landscape and scenic features of the grid corridor are given below, and in the accompanying photographs.

Landscape setting

The proposed SKA cable would follow the R381, the most significant, and visually sensitive part of the route being the 15 km long Molteno Pass Section - a mix of tar and gravel that ascends 647m to the plateau at 1574m.

Molteno Pass was laid out by Thomas Bain and completed in 1881, and was named after the first Prime Minister of the Cape, Sir JC Molteno. The pass therefore has both scenic and historical significance.

The Karoo National Park, north of Beaufort West, lies adjacent to the Molteno Pass, adding to the visual and scenic significance of the area.

The Mid Section (Blounek Pass) and North Section (Rosenberg Pass) are considerably shorter and include a number of smaller passes and *poorts* through which the proposed overhead cable would pass.

Existing visual intrusions

Existing intrusions along the route of the proposed SKA overhead cable include the R381 Road, which required a number of cut and fill embankments in the steeper sections. The only other significant visual intrusion is that of the 22kV Eskom powerline and a smaller telephone line which thread their way through the passes and *poorts*, sometimes crossing small ridges on the skyline, but generally following the R381 in the flatter areas. Little effort was made to avoid visual intrusion on scenic resources in the original routing of the powerline.

The 22kV Eskom powerline crosses the R381 Route twice over a short distance in the scenic Blounek Pass

Geology and landforms

The landscape in this part of the Great Karoo has been eroded over time, the once deeply buried Beaufort Group mudstones and sandstones and the dolerite intrusions having been exposed to form the present-day Karoo landscape.

The Nuweveld escarpment is characterised by horizontal sills of erosion-resistant dolerite forming steep cliffs, boulder-strewn slopes, and flat-topped *koppies,* as well as the Nuweveld mountain range, that constitute the scenic resources along the proposed SKA cable route.

The plateau areas consist of more even topography with easily weathered mudstone, and occasional narrow ledges of harder sandstone.

Vegetation cover

The vegetation of the Upper Karoo Bioregion is a response to the geology and relatively low rainfall, which occurs mainly in summer. Snow is sometimes experienced in winter on the Nuweveld Mountains.

The Eastern Upper Karoo vegetation type covers a vast area on the plateau above the escarpment, and consists largely of dwarf shrubland, along with grasses and succulent shrubs in places. (Mucina and Rutherford, 2006).

The Upper Karoo Hardeveld vegetation type covers smaller areas, occurring on the dolerite crests and steep slopes, often among large boulders. It consists of a grassy dwarf Karoo shrubland.

The sparse, stunted vegetation of the area provides little in the way of visual screening. However the farmsteads tend to be surrounded by gums, pines and/or poplars, which would mitigate potential visual effects of the SKA overhead cable.

Land use

There are a number of farmsteads along the route, as well as tourist facilities, such as Ko-Ka Tsara Bush Camp in the Molteno Pass area. The farms in the area have mainly merino sheep, as well as dorper sheep and game.

The Karoo National Park adjoins the southern section of the proposed grid route in the vicinity of the Molteno Pass. Much of the proposed SKA cable would lie within the 'Viewshed Protection Area' of the National Park, (see Map 1).

Sense of place

The Molteno Pass, completed in 1881 by the renowned pass builder, Thomas Bain, is one of South Africa's first mountain passes, and forms an important gateway to the plateau and Great Karoo to the north.

The flat-topped dolerite hills and Nuweveld mountains, forming the escarpment, are characteristic features of the Great Karoo in an otherwise fairly featureless, parched landscape, an area noted mainly for its empty, uncluttered landscapes.

Isolated farmsteads form green oases in the semi-arid landscape, sheltered from the heat by poplars and other exotic trees.

Picturesque R381 Route winding between dolerite formations. Pylons on the far skyline.

5. Environmental Sensitivity

5.1 Sensitivities identified by the National Web-Based Environmental Screening Tool

As no specific assessment protocol has been prescribed, the required level of assessment is based on Appendix 6 of the Environmental Impact Assessment Regulations promulgated under sections 24(5) and 44 of the National Environmental Management Act, 1998 (Act No. 107 of 1998), where a specialist assessment is required.

Visual and landscape sensitivity mapping is indirectly represented on the web-based environmental screening tool under the Archaeological and Cultural Heritage theme, with the following sensitivities assigned:

- Within protected area – High;
- Within 1 km of a protected area – High;
- Important mountain pass – High; and
- Mountain or ridge – Medium.

Given the specific nature of the proposed fibre optic cable, more detailed verified viewshed mapping (Maps 7 to 10), and visual sensitivity mapping (Table 3; Maps 11 to 14), were considered necessary, and included in this assessment.

5.2 Visual Sensitivity Analysis and Verification

Sensitive Scenic Features and Receptors

Sensitive topographic features include the Nuweveld Mountains, which form part of the escarpment, a major scenic feature of this part of the Karoo.

The Gamka River, flowing through the Nuweveld Mountain, adjacent to the Molteno Pass (R381 Route), is the main water feature, forming scenic gorges in places. The Sak River, which also rises in the Nuweveld Mountains, flows north, and is crossed by the R381 Route and proposed SKA cable in places.

The Karoo National Park, adjacent to the R381 Route, which includes a 'Viewshed Protection Area' (SANParks, 2017), has wilderness and scenic value in addition to its biological conservation role, serving as an important visitor / tourist destination. Visual significance is increased by its protection status.

Private nature reserves and guest farms in the area, which include the Ko-Ka Tsara Bush Camp, are important for the local tourism economy, and tend to be sensitive to loss or degradation of scenic quality. These are some distance from the proposed SKA cable, and would not be affected.

Farmsteads bordering on the proposed SKA cable are also generally some distance from the proposed cable route. In addition, the farmsteads are mostly screened by trees. (See Table 1).

The R381 Route, particularly the Molteno Pass, and a number of smaller passes and *poorts*, have high scenic value in places and are therefore visually sensitive for users of the Route. (See Table 1).

Cultural and heritage sites form part of the heritage study (CTS Heritage, 2021), but could have visual implications.

Visual Sensitivity Buffers

Areas to be avoided (including buffers) have been identified, including areas not suitable for construction or operation of the proposed project.

A four-tier sensitivity table and map of the study area, which indicate very high, high, medium and low sensitivities as well as recommended buffers, are given below. The proposed SKA cable facility has been superimposed on the visual sensitivity maps, (see Table 3 and attached Maps 11 to 14).

The recommended buffers are based on those used previously for powerlines, but have been adapted for the smaller 7,5 and 9,0m SKA overhead fibre optic cable.

Table 2: Distances between receptors and the proposed fibre optic cable

Receptor	Location	Coordinates		Distance to SKA Fibre OHL	Visibility
R1	Rosedene Farmstead	32.03214S	22.44057E	1 653m	Marginal visibility
R2	Renosterfontein farmstead	32.16946S	22.54122E	496m	Marginal visibility
R3	Farm B101A	32.18819S	22.55154E	110m	High visibility
R4	KNP Staff Quarters	32.20367S	22.56129E	38m	High visibility
R5	Ko-KaTsara Bush Camp	32.25510S	22.57424E	448m	Marginal visibility

High visibility: Prominent feature within the observer's viewframe 0 - 100m
Moderate visibility: Noticeable feature as part of the wider landscape 100 – 250m
Marginal visibility: Partially noticeable as a minor element in the landscape 250m – 1km

Table 3: Visual Sensitivity Mapping Categories for the SKA Fibre Optic Overhead Cable

Scenic Resources	Very high visual sensitivity	High visual sensitivity	Medium visual sensitivity	Low visual sensitivity
Topographic features, ridges, peaks, scarps	Feature	within 50m	100m	-
Geological features / outcrops	Feature	within 25m	50m	-
Steep slopes	-	Slopes > 1:4	Slopes > 1:10	-
Scenic water features (rivers, large dams)	within 50m	within 100m	150m	-
Protected Landscapes / Sensitive Receptors				
National Parks (Karoo NP)	Feature	100m	150m	-
Nature Reserves	Feature	within 100m	within 150m	-
Guest farms	Feature	within 100m	within 150m	-
Farmsteads	within 50m	within 100m	within 150m	-
Scenic poorts / passes R381[1]	-	within 50m	within 100m	-
Arterial route R381[1]	-	within 25m	within 50m	-
Main district road[1]	-	within 25m	within 50m	-

[1] Except where road crossings are required.

5.3 Sensitivity Analysis Summary Statement

Visual and landscape sensitivity mapping is indirectly represented on the web-based environmental screening tool under the Archaeological and Cultural Heritage theme, and assigned Medium to High sensitivity. For the purpose of this study, the scale of the fibre optic project was taken into consideration to develop verified visual and scenic resource sensitivity analysis and mapping, which ranges from Medium to Very High.

6. Issues, Risks and Impacts

The potential visual impacts include the following:

Construction Phase

- Visual effect of spoil heaps from underground cable trenches in the R381 road reserve.
- Potential dust and noise caused by excavation works.

Operational Phase

- Visual intrusion of overhead cables in the landscape, particularly when visible on the skyline, and on the scenic Molteno Pass and other smaller passes and *poorts.*
- Visual clutter of poles where cable is routed close to the R381 Road.

Decommissioning Phase

- Potential visual effect of abandoned poles and cables, if not removed after decommissioning.

Cumulative Impacts

- Potential cumulative visual impact of an additional cable corridor, when seen together with the existing 22kV powerline, particularly where these occur on the opposite sides of the R381 Route.

The visual effects of the proposed SKA cable can be seen in Figures 1 and 2, the cable becoming prominent on the skyline where it crosses ridgelines.

6.1 Summary of Issues identified during the Public Consultation Phase

No comments have been received to date from the public participation process. This section will therefore be updated once the information is available.

7. Impact Assessment

7.1 Potential Impacts during the Construction Phase

Where the proposed cable is located underground, or where holes are excavated for poles, there could be potential visual impacts relating to spoil heaps from trenches, mainly along the R381 road reserve. There would also be potential dust and noise caused by excavation works. These impacts would however only affect users of the R381, be fairly localised and of very short term duration.

Table 3: Impact Summary - Construction Phase

Construction phase impacts	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
CONSTRUCTION PHASE						
Visual effect of spoil heaps from underground cable trenches in the R381 road reserve. Potential dust and noise caused by excavation works.	Status	Negative	Very low risk	Adherence to construction method statement and EMPr.	Very low risk	High
	Spatial Extent	Site specific				
	Duration	Short term				
	Consequence	Slight				
	Probability	Likely				
	Reversibility	High				
	Irreplaceability	Low				

7.2 Potential Impacts during the Operational Phase

There would be potential visual intrusion of overhead cables in the scenic landscape, particularly when visible on the skyline, and on the scenic Molteno Pass as well as other smaller passes and *poorts.* In addition, there would be potential visual clutter of poles where the cable is routed close to the R381 Road.

Table 4: Impact Summary - Operational Phase

Operations phase impacts	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
OPERATIONAL PHASE						
Visual intrusion of overhead cables in the landscape, particularly when visible on the skyline, and on the scenic Molteno Pass and other smaller passes and poorts. Visual clutter of poles where cable is routed close to the R381 Road.	Status	Negative	Moderate risk	Locate poles in same corridor as existing powerline where possible. Place cable in underground trench where feasible. Locate poles in low-lying areas or valleys and avoid ridgelines where possible (understood to not necessarily be technically implementable). Implement 50m buffer from R381 where possible (understood to not necessarily be technically implementable).	Moderate risk	High
	Spatial Extent	Local				
	Duration	Long term				
	Consequence	Substantial				
	Probability	Likely				
	Reversibility	High				
	Irreplaceability	Low				

7.3 Potential Impacts during the Decommissioning Phase

There could be on-going potential visual impact of abandoned poles and cables, if these are not removed after decommissioning. However, mitigation is feasible if the infrastructure is removed and the site rehabilitated, in which case scenic resources would be restored.

Table 5: Impact Summary - Decommissioning Phase

Decommissioning phase impacts	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
DECOMMISSIONING PHASE						
Potential visual effect of abandoned poles and cables, if not removed after decommissioning.	Status	Negative	Moderate risk	Poles and cables to be removed after decommissioning. Affected area to be rehabilitated as per vegetation specialist specifications.	Very low risk	High
	Spatial Extent	Local				
	Duration	Long term				
	Consequence	Substantial				
	Probability	Likely				
	Reversibility	High				
	Irreplaceability	Low				

7.4 Cumulative Impacts

There would be potential cumulative visual impacts resulting from of an additional cable corridor, when seen together with the existing 22kV powerline and telephone line, particularly where these create a new corridor, such as when they are on opposite sides of the R381 Route.

Table 6: Impact Summary - Cumulative Impacts

Cumulative impacts	Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
CONSTRUCTION PHASE						
	Status	Negative	Very low risk	Adherence to construction method statement and EMPr.	Very low risk	High
	Spatial Extent	Site specific				
	Duration	Short term				
	Consequence	Slight				
	Probability	Likely				
	Reversibility	High				
	Irreplaceability	Low				
OPERATIONAL PHASE						
	Status	Negative	Moderate risk	SKA cables to share corridors of existing powerline and telephone line where possible, and avoid ridgelines / skylines.	Moderate risk	High
	Spatial Extent	Local				
	Duration	Long term				
	Consequence	Substantial				
	Probability	Likely				
	Reversibility	High				
	Irreplaceability	Low				
DECOMMISSIONING PHASE						
	Status	Negative	Moderate risk	Poles and cables to be removed after decommissioning. Affected area to be rehabilitated as per vegetation specialist specifications.	Very low risk	High
	Spatial Extent	Local				
	Duration	Long term				
	Consequence	Substantial				
	Probability	Likely				
	Reversibility	High				
	Irreplaceability	Low				

7.5 Impact Assessment Summary

Table 7: Overall Impact Significance (Post Mitigation)

Phase	**Overall Impact Significance**
Construction	Low
Operational	Moderate
Decommissioning	Very Low
Nature of Impact	**Overall Impact Significance**
Cumulative - Construction	Low
Cumulative - Operational	Moderate
Cumulative - Decommissioning	Very low

Alternatives

An alternative route for the SKA cable was considered at the early screening stage, but was screened out and only the preferred route, based on environmental, engineering and technical aspects, was taken forward to the Basic Assessment Stage.

No-go Alternative

In the no-go alternative, the SKA fibre optic cable along the proposed route would not be realised and therefore no additional visual intrusion on the rural landscape and scenic resources would occur. The visual significance would therefore be neutral, with neither impacts nor benefits occurring.

Findings

Given the fairly small footprint of the proposed underground and overhead fibre optic cable, the limited viewshed and the localised visual effects in a remote area, the visual impact significance was found to be **moderate risk** after mitigation in the long term during the operational stage. The implementable mitigation options are limited by the technical requirements of the cable design and routing. Risk would be very low after the cable is decommissioned, provided the infrastructure is removed and the site rehabilitated.

The potential cumulative visual impacts, when combined with the existing 22kV Eskom powerline and the telephone line could result in additional visual clutter in the landscape. It would therefore be important for the proposed fibre optic cable to share the same corridor with the powerline and telephone lines, where possible, (except where these are in visually intrusive areas), to avoid a proliferation of corridors.

8. Legislative and Permit Requirements

The National Environmental Management Act (Act No. 107 of 1998). (NEMA) and the (NEMA EIA Regulations (2014, as amended) apply as the proposed cable infrastructure a listed activity, a Basic Assessment (BA) being required. The need for a visual assessment has been identified.

The National Heritage Resources Act (Act No. 25 of 1999) (NHRA), and associated provincial regulations, provide legislative protection for natural, cultural and scenic resources, as well as for heritage sites within the study area. This report deals with visual considerations, including scenic resources, which form part of the National Estate. The Visual Assessment would therefore form part of the Heritage Assessment in terms of obtaining the relevant permits.

Other than the above legislation, there are no specific policies or guidelines for visual and scenic resources for the Western Cape and Northern Cape. The Guideline for Involving Visual and Aesthetic

Specialists in EIA Processes, by the Provincial Government of the Western Cape, was used as a general guide.

9. Environmental Management Programme Inputs

Planning and Design Phase

Ensure that the visual sensitivity mapping is used to inform the routing of the overhead cable alignment where possible, as well as the siting of any construction camps and material stockpiles, which should be located in visually unobtrusive positions in the landscape, away from public roads.

Construction Phase Monitoring:

Implement dust suppression and litter control measures, as well as rehabilitation of excavations to minimise their visual effect on the surroundings. Ensure regular reporting to an environmental management team by the Environmental Control Officer (ECO) during the construction phase.

Operation Phase Monitoring:

No particular monitoring is required during the operational phase.

Decommissioning Phase Monitoring:

Ensure that procedures for the removal of poles and cables during the decommissioning phase are implemented, including recycling of materials and rehabilitation of the site to a visually acceptable standard as prescribed in a rehabilitation plan, and signed off by the delegated authority.

10. Final Specialist Statement and Authorisation Recommendation

10.1 Statement and Reasoned Opinion

As the underground fibre optic cable would have little or no visual implications, only the above-ground sections of the route were assessed. The route of the cable generally follows the R381 through the Molteno Pass and a number of smaller passes and *poorts*. These sections of the route have scenic value, and it is mainly users of the R381 Route that would potentially be affected by the proposed cable. Farmsteads in the area are too far away to be significantly affected.

Because the poles for the cables are relatively low, (7,5 and 9,0m), compared to the existing 22kV Eskom powerline (about 12,0m), visibility of the proposed cable infrastructure is not expected to be generally significant, except where it is in the road reserve. However, if the poles are located on ridgelines, where they break the skyline, visibility would become more significant and the scenic quality of the area affected. For this reason, the cable route should ideally follow the lower lying areas or valleys, i.e. the lower side of the road, where possible within the constraints of engineering feasibility.

Based on the engineering constraints a visual buffer is not practical and the scenic quality of the view from the road could be affected. Crossing of the road by the cable should also be minimised as far as possible.

Where the cable route creates a different corridor to that of the existing 22kV powerline, as often occurs in the current proposal, further fragmentation of the scenic landscape can be expected. One of the visual mitigations therefore is to combine the corridors as far as possible, except where the existing powerline follows a visually intrusive route.

A further mitigation would be to place the cable in a trench in the road reserve for those sections where the topography is more even and the potential exists, such as between the 6 and 8 km mark, and the 11 and 12 km mark (Maps 5 and 6), if technically feasible.

Where these mitigations cannot be implemented for practical engineering feasibility reasons, the visual impact significance of the proposed SKA cable would remain moderate during its operational lifespan.

As the visual landscape could be restored after decommissioning, the visual significance would reduce to very low post mitigation.

The potential cumulative visual impact for the proposed SKA cable, in combination with the existing Eskom powerline and telephone line would be moderate, but would only reduce to low if the above mitigations are implemented.

10.2 EA Condition Recommendations

No fatal flaws from a visual perspective are expected as a result of the proposed cable infrastructure. However, the Molteno Pass, which ascends the great escarpment, has both scenic and heritage significance, and it is important that the recommended mitigations are implemented where possible. Provided a heritage permit is issued, the application could be authorised from a visual perspective.

11. References

CSIR. May 2020. Environmental Screening Study for Prposed Square Kilometre Array Fibre Optic cable from Beaufort West to Carnarvon.

CSIR. Nov. 2020. Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon: Construction Method Statement.

CTS Heritage. 2021. Heritage Impact Assessment: Basic Assessment for the proposed Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon.

Mucina, L. and Rutherford, M.C. (eds) 2006.The Vegetation of South Africa, Lesotho and Swaziland. *Strelizia* 19. SANBI, Pretoria.

Oberholzer, B. 2005. Guideline for Involving Visual and Aesthetic Specialists in EIA Processes: Edition 1 CSIR Report No. ENV-S-C 2005 053 F. Provincial Government of the Western Cape, Department of Environmental Affairs and Development Planning.

SANParks. 2017. Karoo National Park, Park Management Plan for the period 2017 – 2027.

Appendix A - Specialist Expertise

Quinton Lawson Architect (qarc)

Qualifications:
Bachelor of Architecture (Univ. of Natal 1977)

Professional registration/membership:
Professional member of the SA Council for the Architectural Profession (SACAP), reg. no. 3686.
Member of the Cape Institute for Architects and SA Institute of Architects.
B-BBEE Status: Level 4.

Quinton has practiced as a professional architect since 1978, specialising in architectural and urban design, environmental design and computer visualisation.

He was one of the founding partners of Meirelles Lawson Architects formed in 1988, initially specialising in economic and sustainable housing. He was a senior partner at MLB Architecture and Urban Design, with specialist expertise in visual modelling and design solutions.

In the past he has been a visiting lecturer at UCT teaching a post-graduate course on Computer Techniques in Landscape Architecture, including visualisation and visual assessment techniques.

Together with BOLA, Quinton has been involved in numerous visual impact assessments over a number of years, and previously served on the Impact Assessment Review Committee of Heritage Western Cape.

Bernard Oberholzer Landscape Architect + Environmental Planner (BOLA)

Qualifications:
Bachelor of Architecture (UCT 1970), Master of Landscape Architecture (U. of Pennsylvania 1975)

Professional registration/membership:
Professional member of the SA Council for the Landscape Architectural Profession (SACLAP), reg. no. 87018.
Fellow of the Institute of Landscape Architects of South Africa.
B-BBEE Status: Level 4.

Bernard has 40 years of experience as a professional landscape architect, specialising in, environmental planning, coastal planning, urban landscape design and visual assessments.

He is currently an independent consultant, and was for 7 years the Convenor of the Master of Landscape Architecture Programme at UCT.

He has presented papers on *Visual and Aesthetic Assessment Techniques*, and provides specialist services as a reviewer of visual impact studies prepared by other firms.

He is the author of *Guideline for Involving Visual and Aesthetic Specialists in EIA Processes,* prepared with the CSIR for the Dept. of Environmental and Development Planning, Provincial Government of the Western Cape, 2005.

Bernard has been involved in numerous land use suitability studies and visual assessments for a wide range of projects, and serves as a member of the Stanford Heritage Committee.

Bernard and Quinton were joint authors of the visual specialist chapters for the National Wind and Solar SEA and National Electricity Grid Infrastructure SEA, with the CSIR, for the Department of Environmental Affairs.

Appendix B - Specialist Statement of Independence

We, Quinton Lawson and Bernard Oberholzer, declare that –

- act as the independent specialist in this application;
- will 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;
- declare that there are no circumstances that may compromise my objectivity in performing such work;
- 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;
- will comply with the Act, Regulations and all other applicable legislation;
- have no, and will not engage in, conflicting interests in the undertaking of the activity;
- 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;
- all the particulars furnished by me in this form are true and correct; and
- 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: qarc and bola

Date: 18 February 2021

Appendix C: Site Sensitivity Verification

Prior to commencing with the specialist assessment in accordance with Appendix 6 of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) Environmental Impact Assessment (EIA) Regulations of 2014, a site sensitivity verification was undertaken in order to confirm the current land use and environmental sensitivity of the proposed project area as identified by the National Web-Based Environmental Screening Tool (Screening Tool).

The details of the site sensitivity verification are noted below:

Date of Site Visit	17 November 2020
Specialist Name	Quinton Lawson and Bernard Oberholzer
Professional Registration Number	SACAP 3686, SACLAP 87018
Specialist Affiliation / Company	qarc and bola

The site sensitivity verification was undertaken using the following means:

(a) desk top analysis, using satellite imagery;
(b) preliminary on-site inspection; and
(c) a range of other available / relevant information included in Section 2.1 of this Report.

A screening report was generated by the CSIR (15/4/2020) using the DEFF screening tool. Visual and landscape sensitivity mapping is indirectly represented on the web-based environmental screening tool under the Archaeological and Cultural Heritage theme, with the following sensitivities assigned:

- Within protected area – High;
- Within 1 km of a protected area – High;
- Important mountain pass – High; and
- Mountain or ridge – Medium.

Fine-scale visual sensitivity mapping at the project scale is included in this Visual Impact Assessment, including viewshed mapping. This mapping provides the detail that is required, given the nature of the project. Refer to Table 3 in the main VIA report.

Appendix D: Impact Assessment Methodology

The impact assessment includes:

- *the nature, significance and consequences of the impact and risk;*
- *the extent and duration of the impact and risk;*
- *the probability of the impact and risk occurring;*
- *the degree to which impacts and risks can be mitigated;*
- *the degree to which the impacts and risks can be reversed; and*
- *the degree to which the impacts and risks can cause loss of irreplaceable resources.*

As per the DEFFT Guideline 5: Assessment of Alternatives and Impacts, the following methodology is applied to the prediction and assessment of impacts and risks. Potential impacts and risks have been rated in terms of the direct, indirect and cumulative:

- *Direct impacts are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.*
- *Indirect impacts of an activity are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken or which occur at a different place as a result of the activity.*
- *Cumulative impacts are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.*

The impact assessment methodology includes the following aspects:

- *Nature of impact/risk - The type of effect that a proposed activity will have on the environment.*

- *Status - Whether the impact/risk on the overall environment will be:*
    - *Positive - environment overall will benefit from the impact/risk;*
    - *Negative - environment overall will be adversely affected by the impact/risk; or*
    - *Neutral - environment overall not be affected.*

- *Spatial extent – The size of the area that will be affected by the impact/risk:*
    - *Site specific;*
    - *Local (<10 km from site);*
    - *Regional (<100 km of site);*
    - *National; or*
    - *International (e.g. Greenhouse Gas emissions or migrant birds).*

- *Duration – The timeframe during which the impact/risk will be experienced:*
    - *Very short term (instantaneous);*
    - *Short term (less than 1 year);*
    - *Medium term (1 to 10 years);*
    - *Long term (the impact will cease after the operational life of the activity (i.e. the impact or risk will occur for the project duration)); or*
    - *Permanent (mitigation will not occur in such a way or in such a time span that the impact can be considered transient (i.e. the impact will occur beyond the project decommissioning)).*

- *Consequence – The anticipated consequence of the risk/impact:*
    - *Extreme (extreme alteration of natural systems, patterns or processes, i.e. where environmental functions and processes are altered such that they permanently cease);*
    - *Severe (severe alteration of natural systems, patterns or processes, i.e. where environmental functions and processes are altered such that they temporarily or permanently cease);*
    - *Substantial (substantial alteration of natural systems, patterns or processes, i.e. where environmental functions and processes are altered such that they temporarily or permanently cease);*

- *Moderate (notable alteration of natural systems, patterns or processes, i.e. where the environment continues to function but in a modified manner); or*
- *Slight (negligible alteration of natural systems, patterns or processes, i.e. where no natural systems/environmental functions, patterns, or processes are affected).*

- *Reversibility of the Impacts - the extent to which the impacts/risks are reversible assuming that the project has reached the end of its life cycle (decommissioning phase):*
    - *High reversibility of impacts (impact is highly reversible at end of project life i.e. this is the most favourable assessment for the environment);*
    - *Moderate reversibility of impacts;*
    - *Low reversibility of impacts; or*
    - *Impacts are non-reversible (impact is permanent, i.e. this is the least favourable assessment for the environment).*

- *Irreplaceability of Receiving Environment/Resource Loss caused by impacts/risks – the degree to which the impact causes irreplaceable loss of resources assuming that the project has reached the end of its life cycle (decommissioning phase):*
    - *High irreplaceability of resources (project will destroy unique resources that cannot be replaced, i.e. this is the least favourable assessment for the environment);*
    - *Moderate irreplaceability of resources;*
    - *Low irreplaceability of resources; or*
    - *Resources are replaceable (the affected resource is easy to replace/rehabilitate, i.e. this is the most favourable assessment for the environment).*

Using the criteria above, the impacts have been further assessed in terms of the following:

- *Probability – The probability of the impact/risk occurring:*
    - *Extremely unlikely (little to no chance of occurring);*
    - *Very unlikely (<30% chance of occurring);*
    - *Unlikely (30-50% chance of occurring)*
    - *Likely (51 – 90% chance of occurring); or*
    - *Very Likely (>90% chance of occurring regardless of prevention measures).*

To determine the significance of the identified impact/risk, the consequence is multiplied by probability (qualitatively as shown in Figure 1).

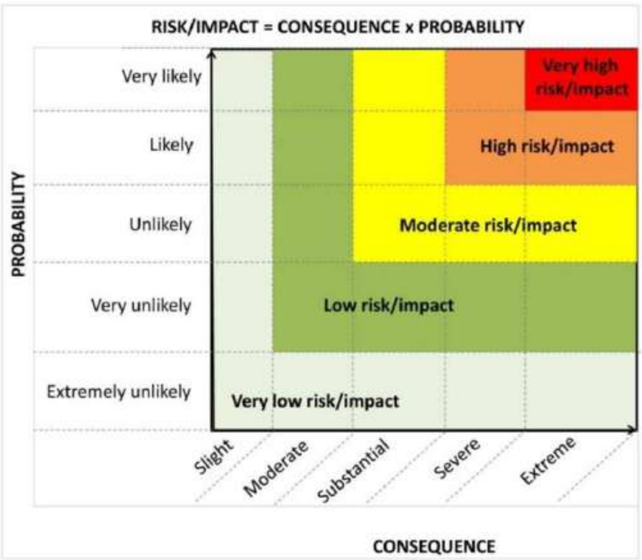


Figure 1. Guide to assessing risk/impact significance as a result of consequence and probability.

- *Significance – Will the impact cause a notable alteration of the environment?*

- *Very low (the risk/impact may result in very minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);*
- *Low (the risk/impact may result in minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);*
- *Moderate (the risk/impact will result in moderate alteration of the environment and can be reduced or avoided by implementing the appropriate mitigation measures, and will only have an influence on the decision-making if not mitigated);*
- *High (the risk/impact will result in major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making); and*
- *Very high (the risk/impact will result in very major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making (i.e. the project cannot be authorised unless major changes to the engineering design are carried out to reduce the significance rating)).*

With the implementation of mitigation measures, the residual impacts/risks are ranked as follows in terms of significance:

- *Very low = 5;*
- *Low = 4;*
- *Moderate = 3;*
- *High = 2; and*
- *Very high = 1.*

Confidence – The degree of confidence in predictions based on available information and specialist knowledge:
- *Low;*
- *Medium; or*
- *High.*

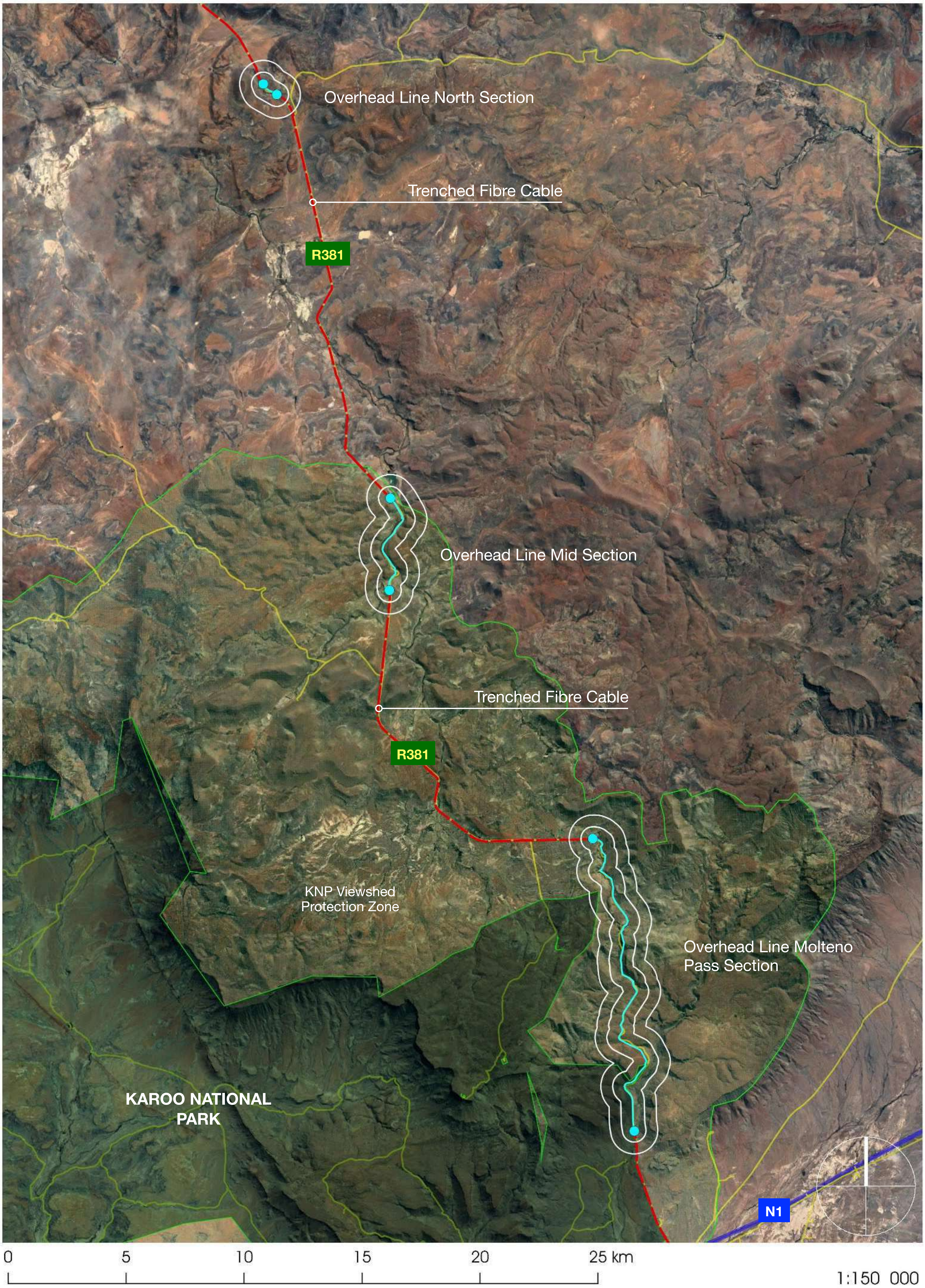
Appendix E: Compliance with the Appendix 6 of the 2014 EIA Regulations (as amended)

Requirements of Appendix 6 (Specialist Reports) of Government Notice R326 (Environmental Impact Assessment (EIA) Regulations of 2014, as amended)	***Section where this has been addressed in the Specialist Report***
1. (1) A specialist report prepared in terms of these Regulations must contain - *a) details of -* *i. the specialist who prepared the report; and* *ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;*	Section 1.2 and Appendix A
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix B
c) an indication of the scope of, and the purpose for which, the report was prepared;	Sections 1.1 and 1.3
(cA) an indication of the quality and age of base data used for the specialist report;	Section 2.1
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Sections 6 and 7
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 2
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 2
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Sections 6 and 7
g) an identification of any areas to be avoided, including buffers;	Maps 11 to 14
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Maps 11 to 14
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 2.2
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 10
k) any mitigation measures for inclusion in the EMPr;	Section 7
l) any conditions for inclusion in the environmental authorisation;	Section 10
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 9
n) a reasoned opinion- *i. whether the proposed activity, activities or portions thereof should be authorised;* *(iA) regarding the acceptability of the proposed activity or activities; and* *ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;*	Section 10
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Refer to EAP
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Refer to EAP

Requirements of Appendix 6 (Specialist Reports) of Government Notice R326 (Environmental Impact Assessment (EIA) Regulations of 2014, as amended)	***Section where this has been addressed in the Specialist Report***
q) any other information requested by the competent authority.	None
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	"General requirements for undertaking an initial site sensitivity verification where no specific assessment protocol has been identified (GN 320, 20 March 2020)" applies – see below.
General requirements for undertaking an initial site sensitivity verification where no specific assessment protocol has been identified (GN 320, 20 March 2020)	**Section 5 and Appendix C**
1. Site sensitivity verification and minimum report content requirements Prior to commencing with a specialist assessment, the current use of the land and the environmental sensitivity of the site under consideration identified by the national web based environmental screening tool (screening tool), where determined, must be confirmed by undertaking a site sensitivity verification. *(1.1) The site sensitivity verification must be undertaken by an environmental assessment practitioner or a specialist.*	Appendix C
(1.2) The site sensitivity verification must be undertaken through the use of: *a) a desk top analysis, using satellite imagery;* *b) a preliminary on -site inspection; and* *c) any other available and relevant information*	Appendix C
(1.3) The outcome of the site sensitivity verification must be recorded in the form of a report that- *a) confirms or disputes the current use of the land and the environmental sensitivity as identified by the screening tool, such as new developments or infrastructure, the change in vegetation cover or status* *b) contains a motivation and evidence (e.g. photographs) of either the verified or different use of the land and environmental sensitivity; and* *c) is submitted together with the relevant assessment report prepared in accordance with the requirements of the Environmental Impact Assessment Regulations1 (EIA Regulations).*	Appendix C

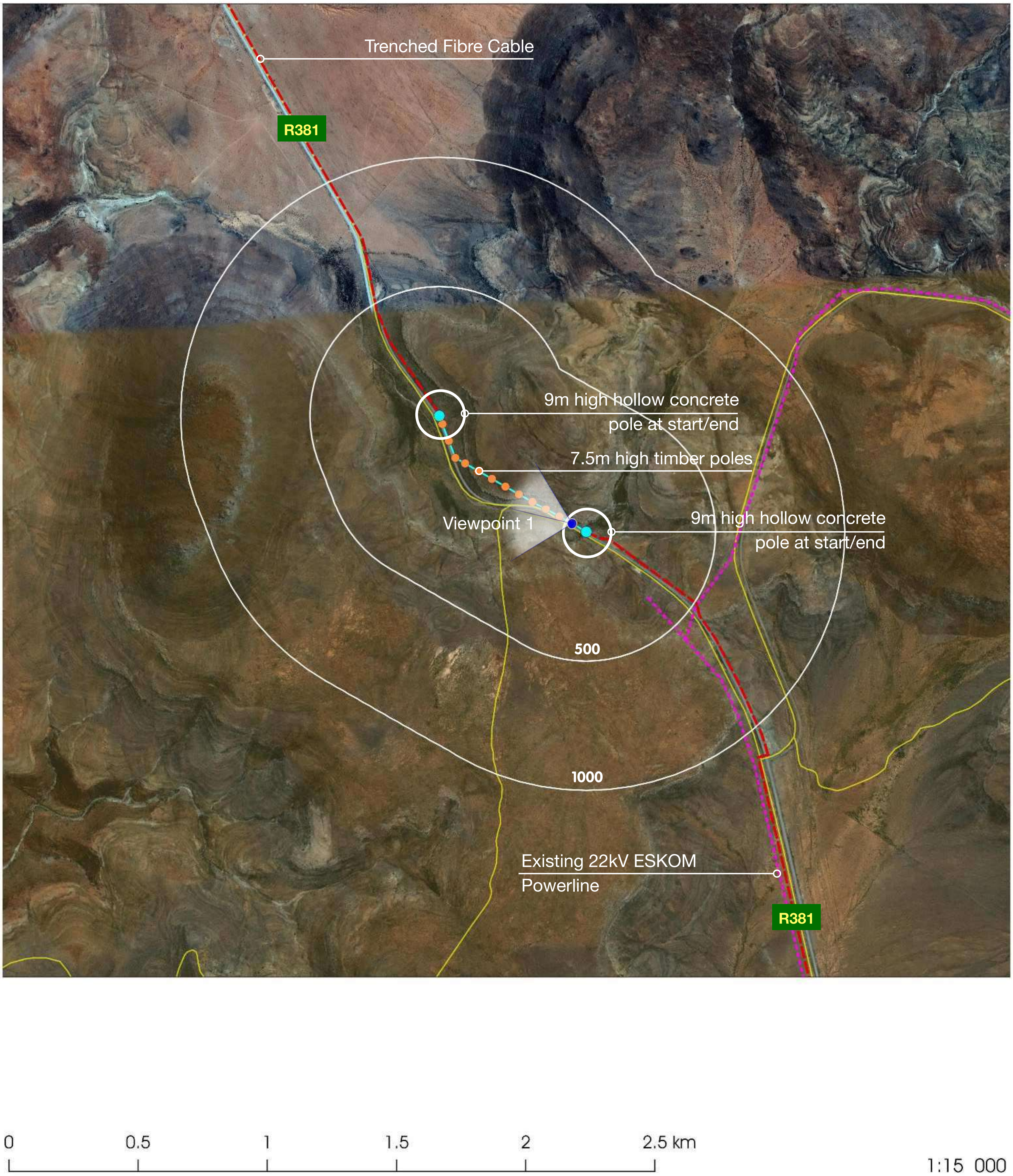
Base map : Google Earth 2021

map 1 : SKA Fibre Overhead Lines • Carnarvon to Beaufort West



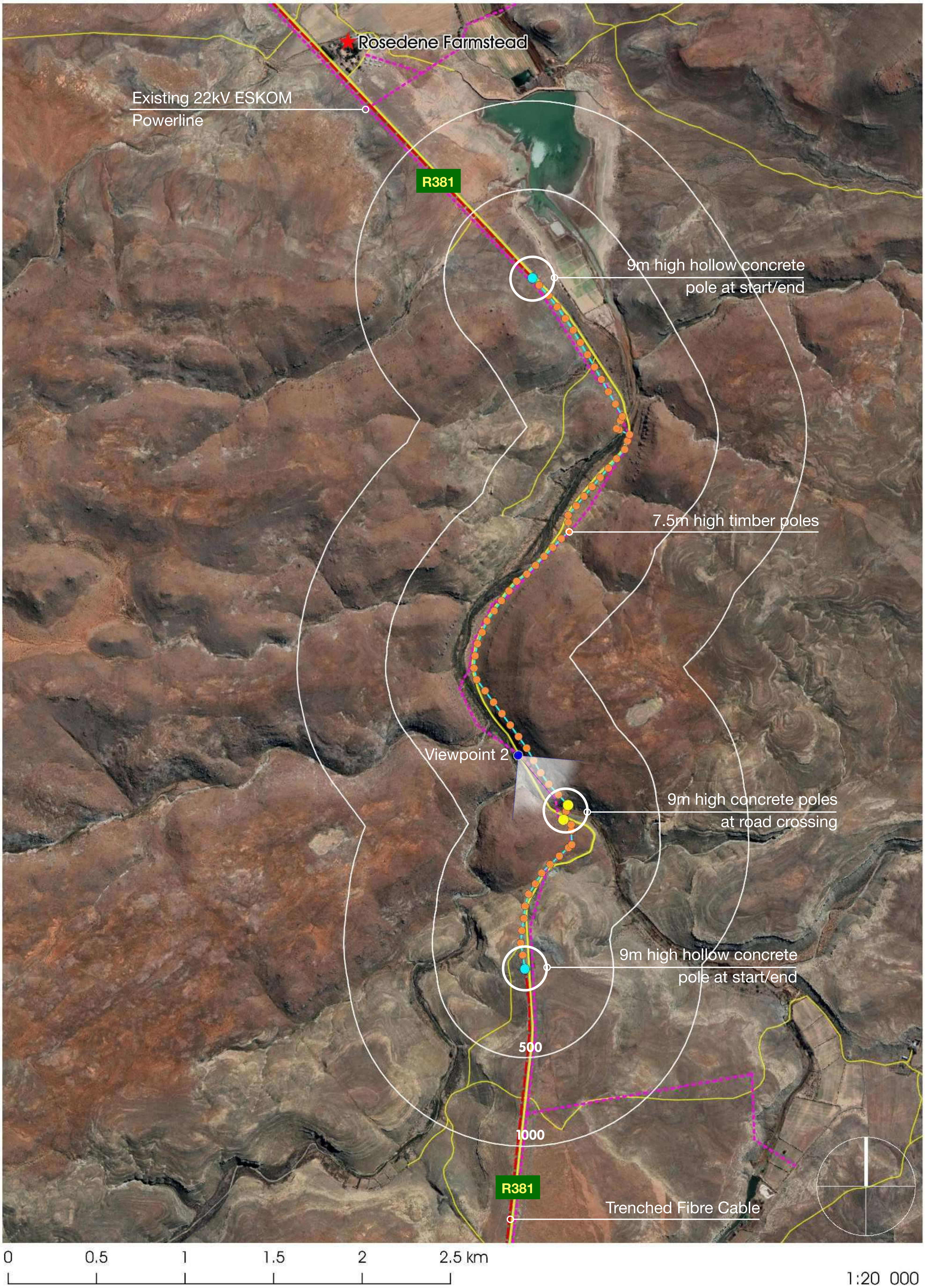
Base map : Google Earth 2021

map 2 : SKA Fibre Overhead Lines



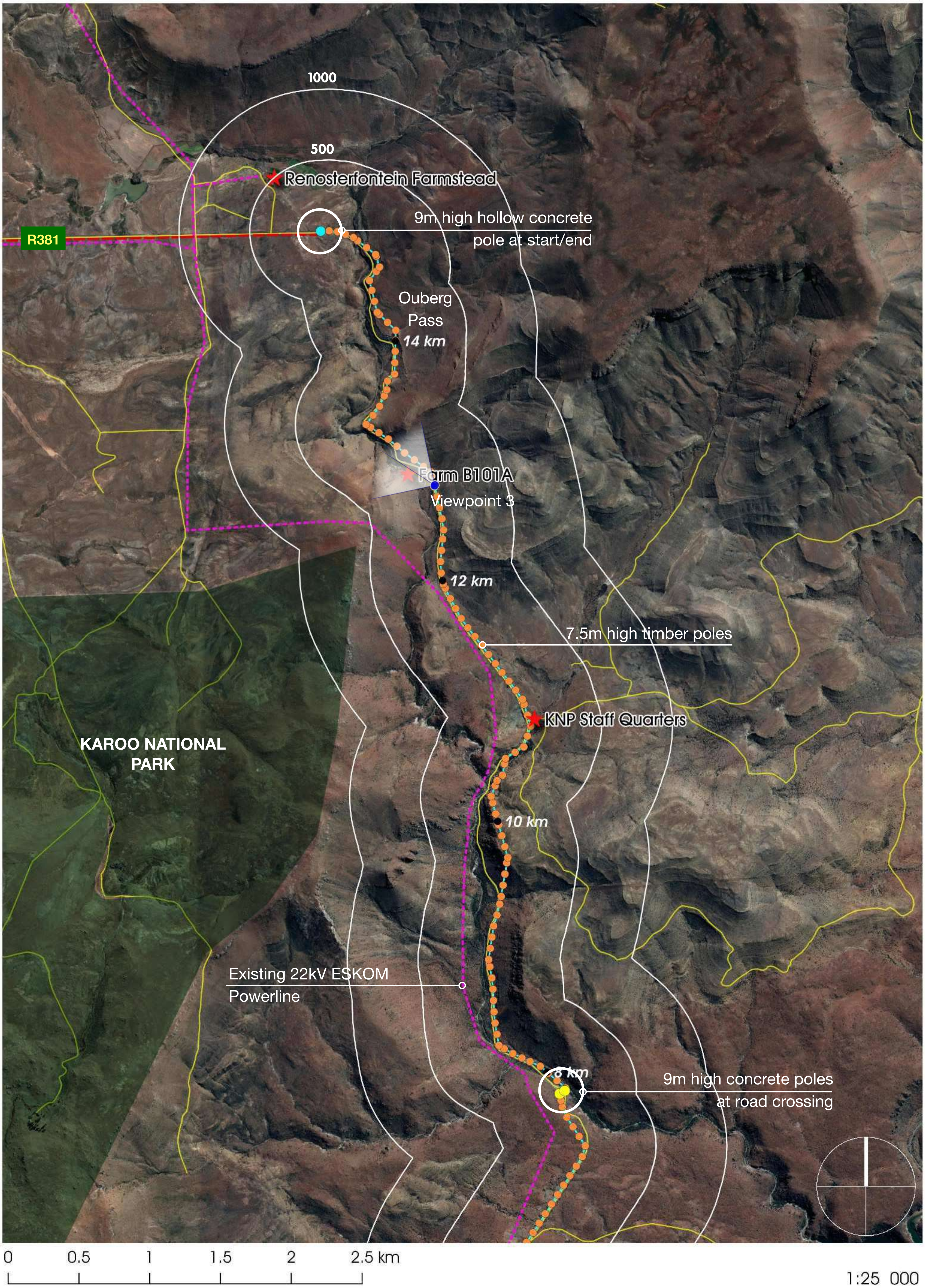
Base map : Google Earth 2021

map 3 : SKA Fibre OHL : North Section



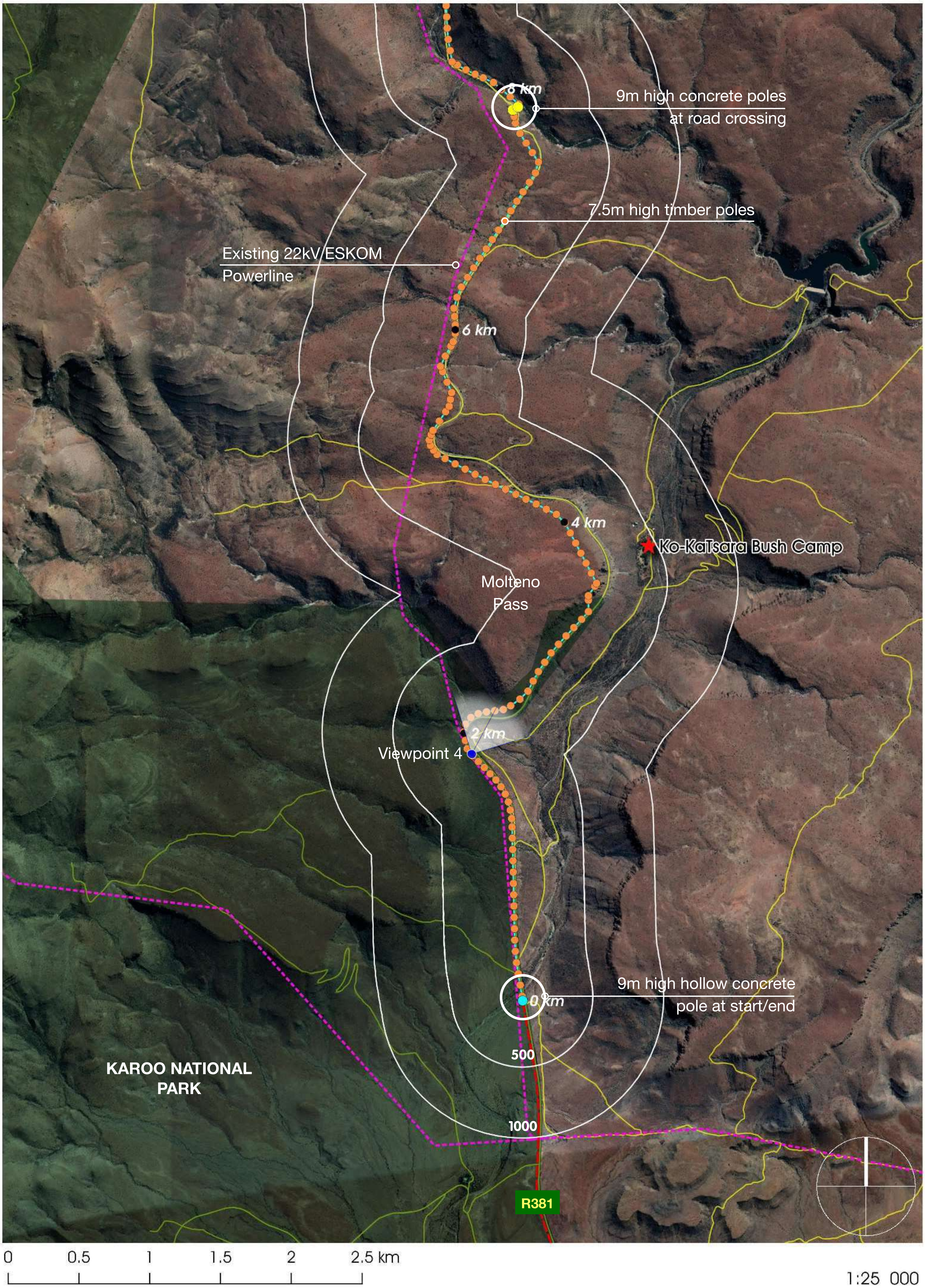
Base map : Google Earth 2021

map 4 : SKA Fibre OHL : MID Section



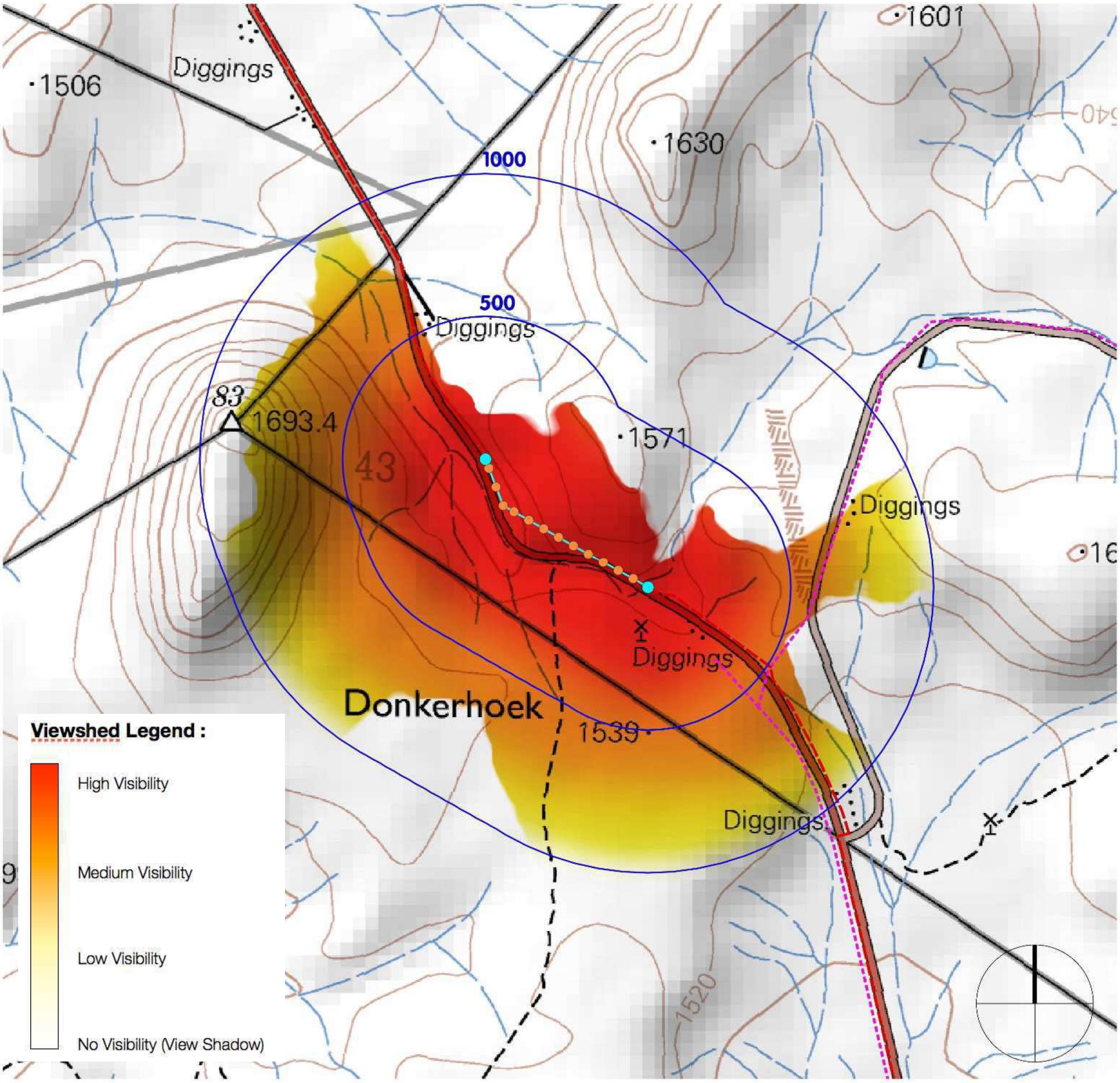
Base map : Google Earth 2021

map 5 : SKA Fibre OHL : Molteno Pass North Section



Base map : Google Earth 2021

map 6 : SKA Fibre OHL : Molteno Pass South Section

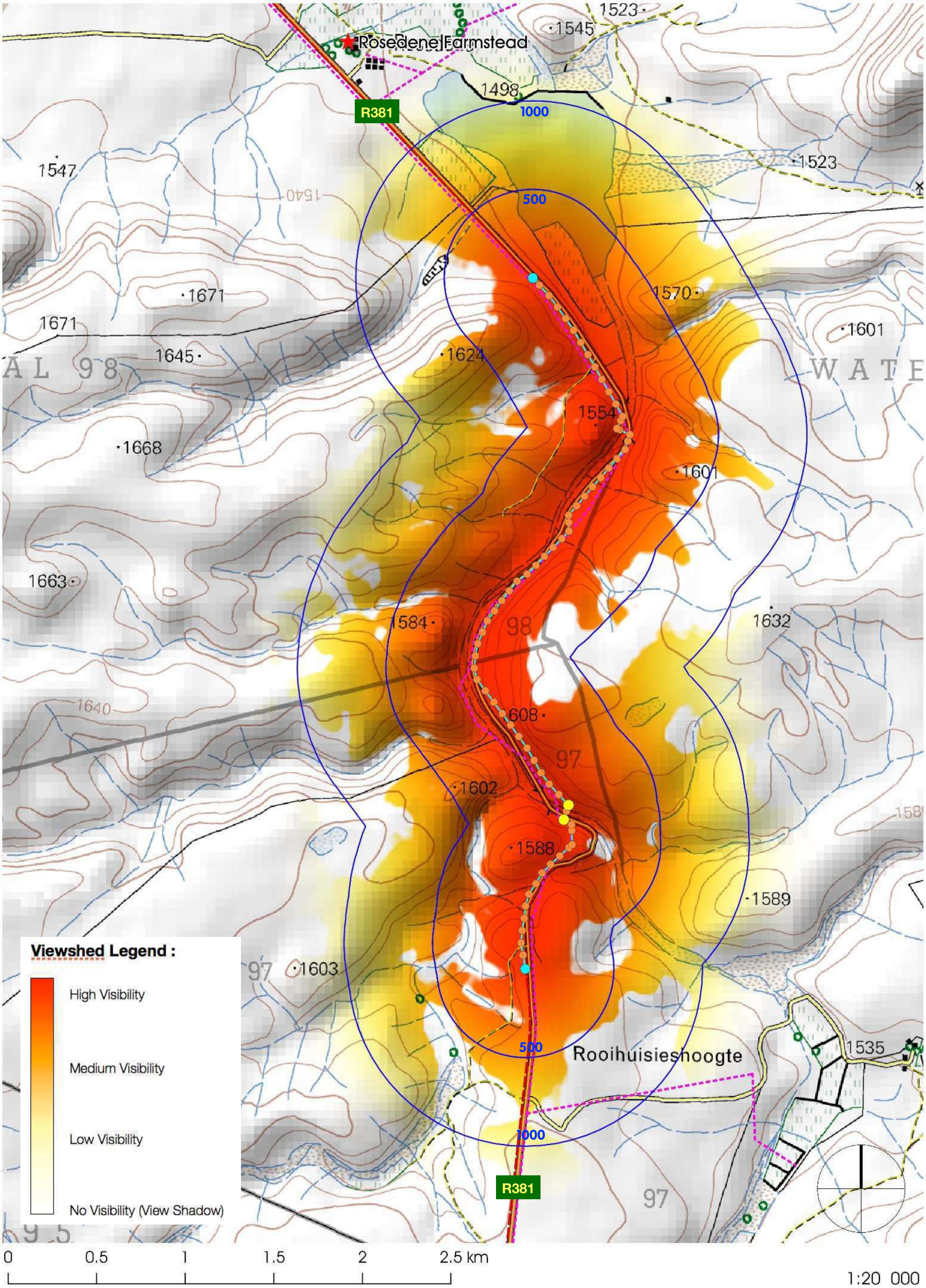


0 0.5 1 1.5 2 2.5 km

1:15 000

Base map : NGI 1:50K Topographic Series : 3122 CD Dunedin

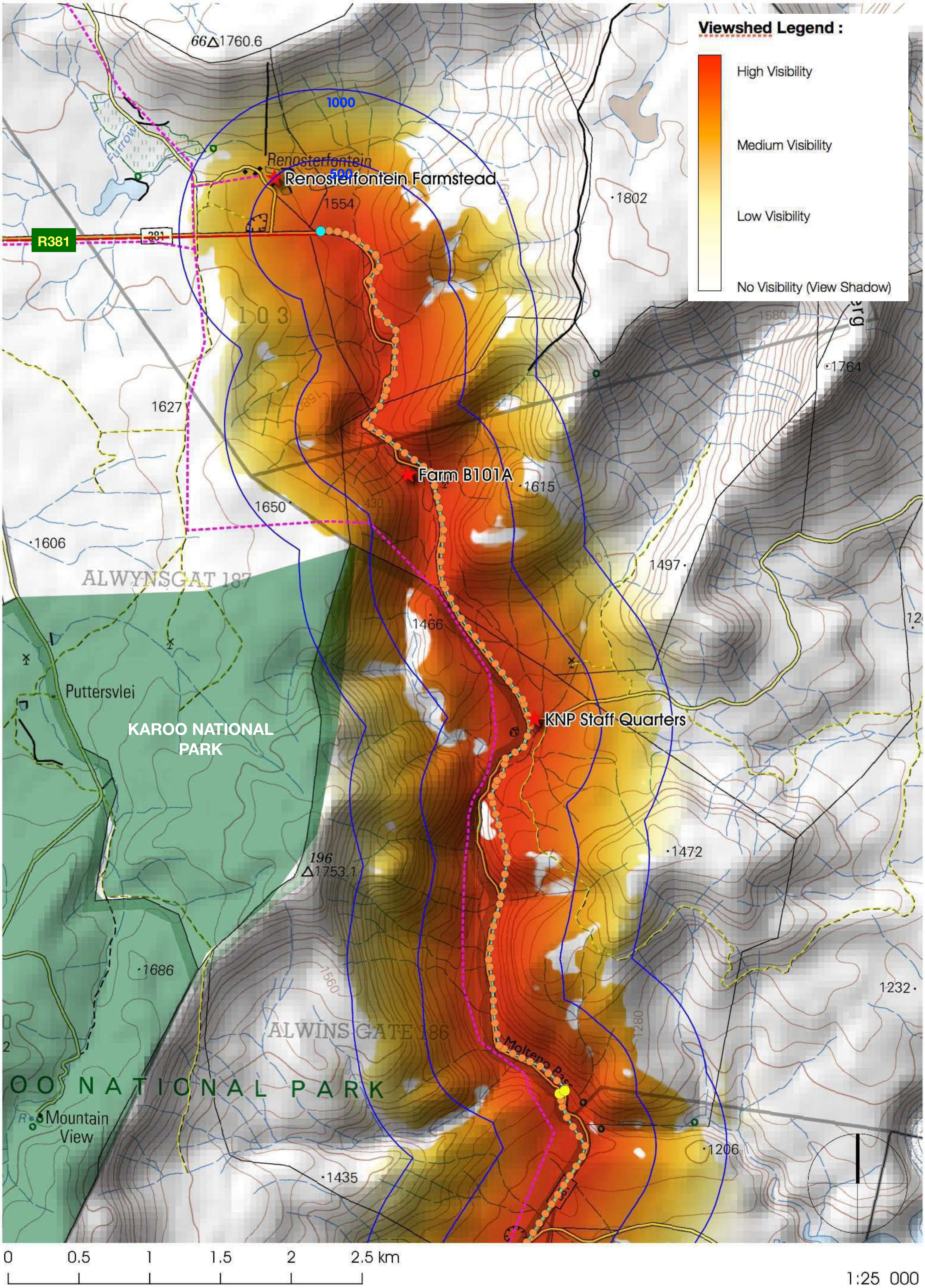
map 7 : SKA Fibre OHL : North Section Viewshed



1:20 000

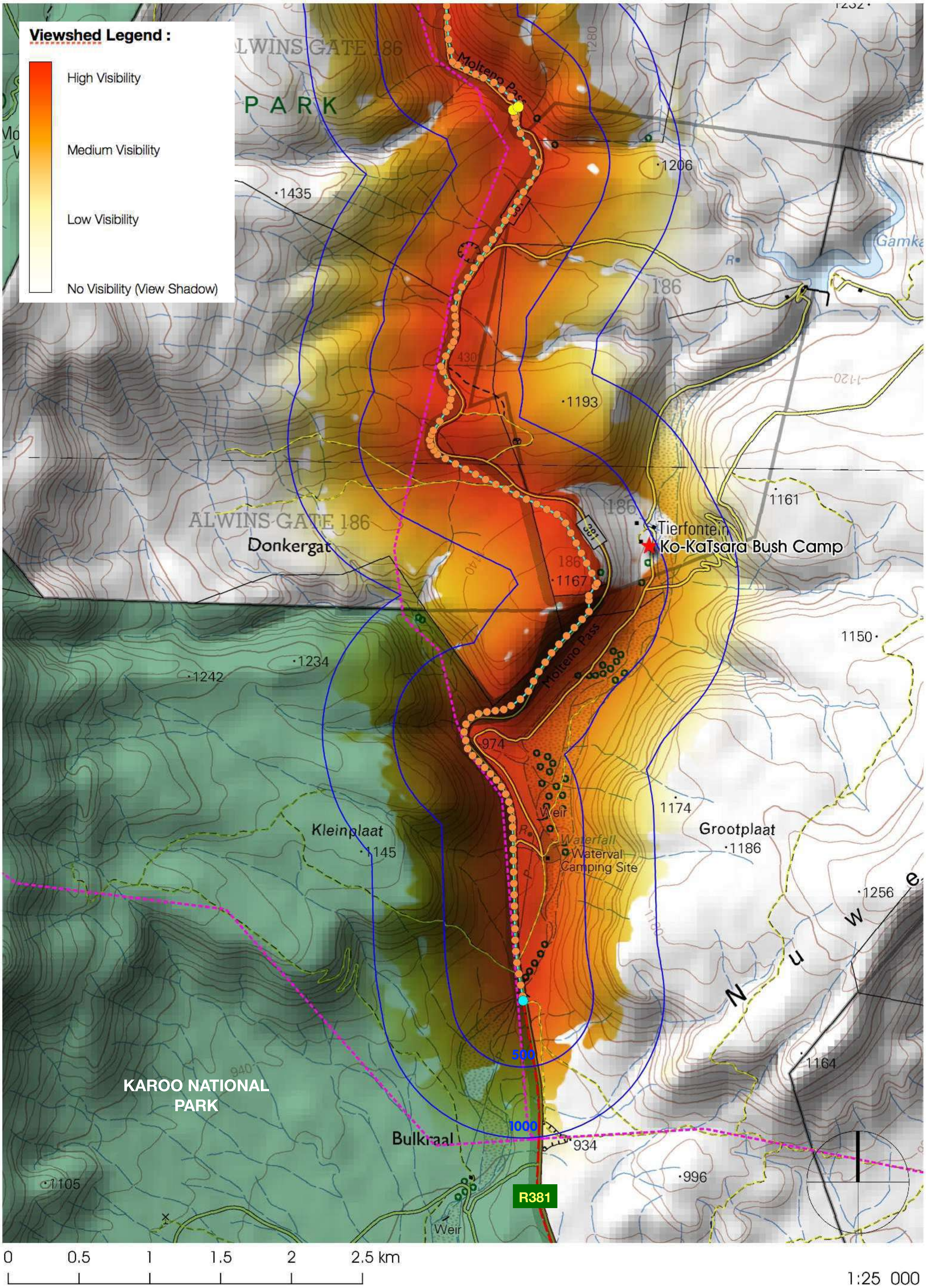
Base map : NGI 1:50K Topographic Series : 3222 AB Rosedene

map 8 : SKA Fibre OHL : Mid Section Viewshed



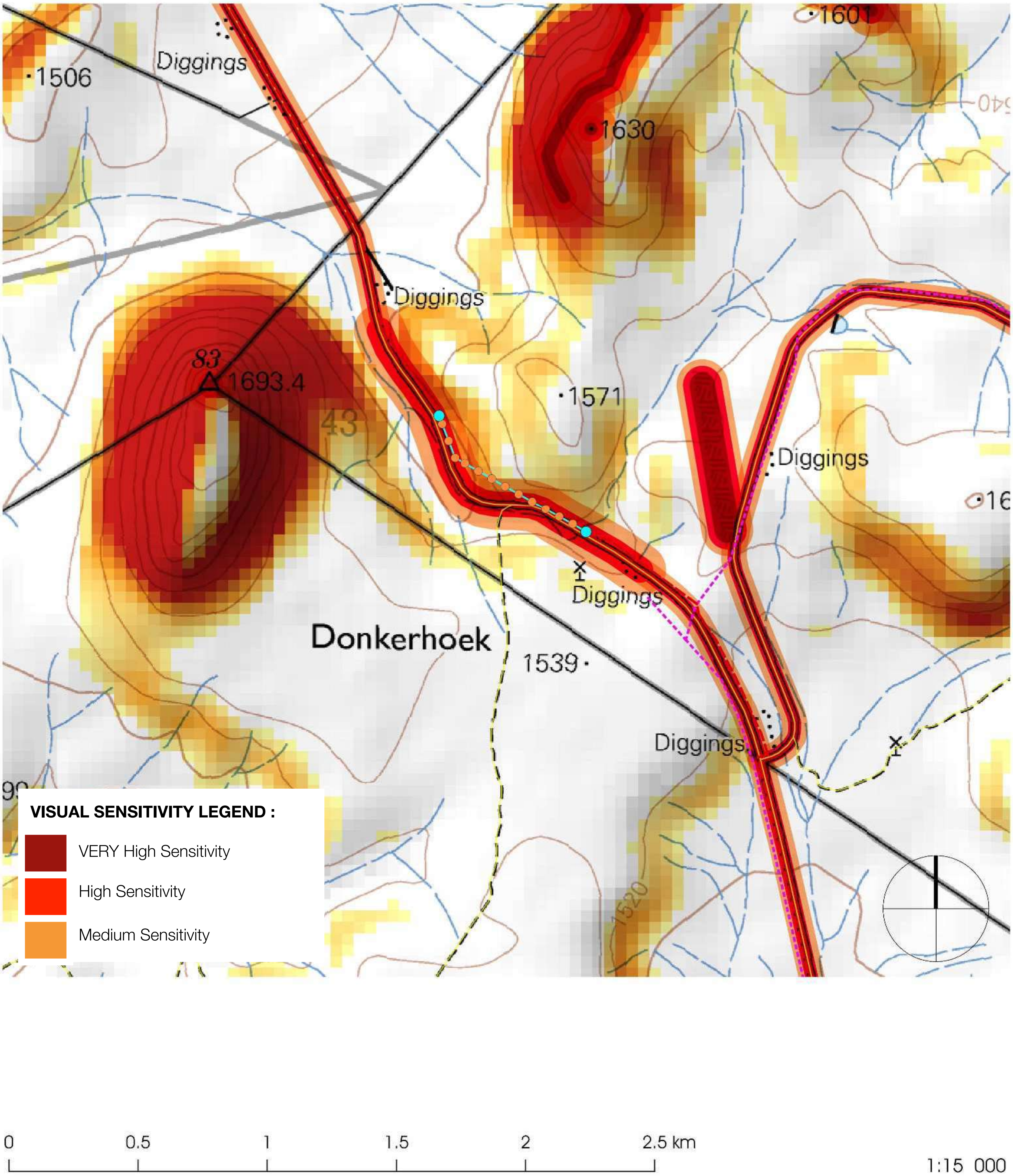
Base map : NGI 1:50K Topographic Series : 3222 BA Kuilspoort

map 9 : SKA Fibre OHL : Molteno Pass North Section Viewshed



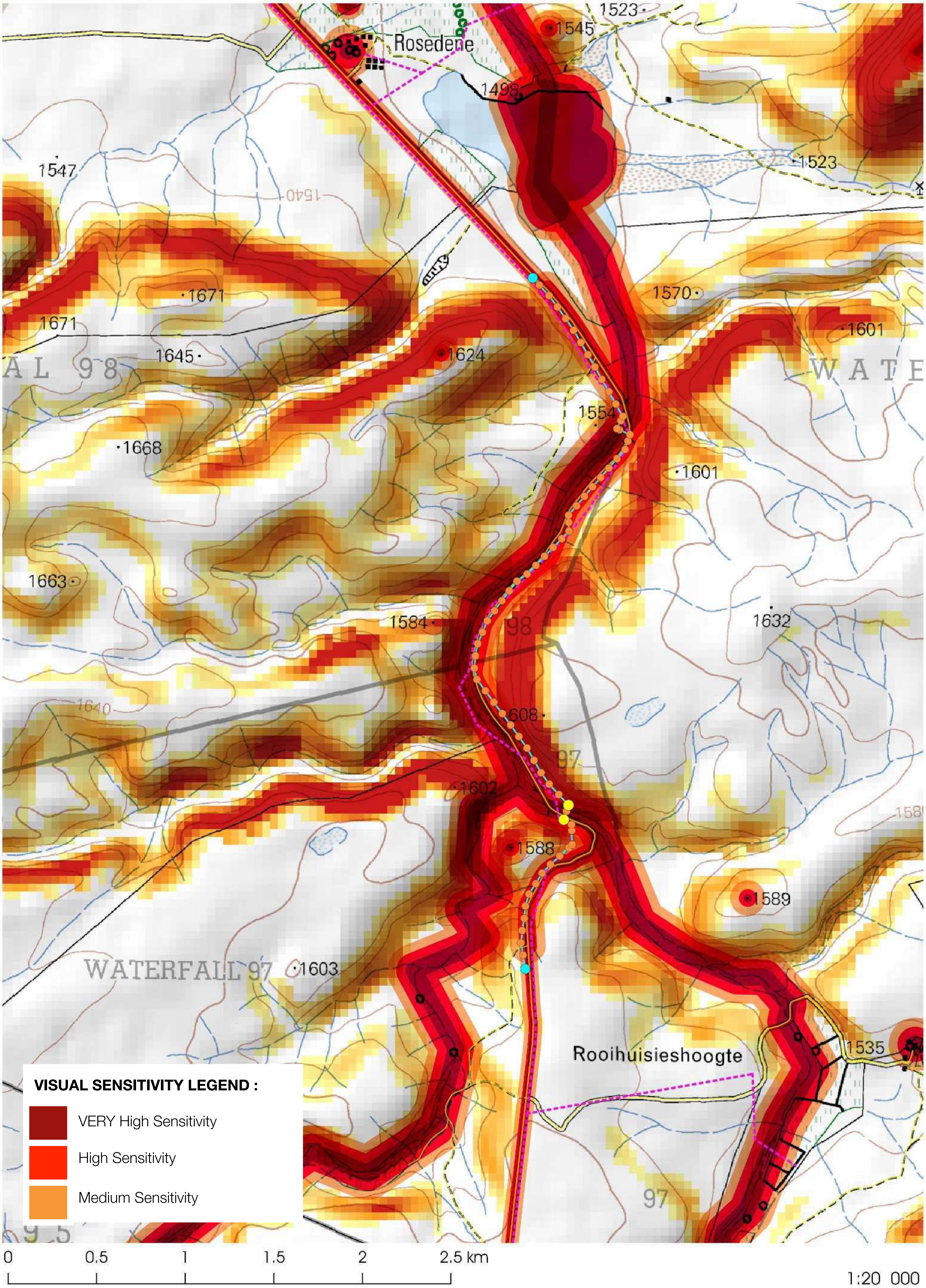
Base map : NGI 1:50K Topographic Series : 3222 BA Kuilspoort, 3222 BC Beaufort West

map 10 : SKA Fibre OHL : Molteno Pass South Section Viewshed



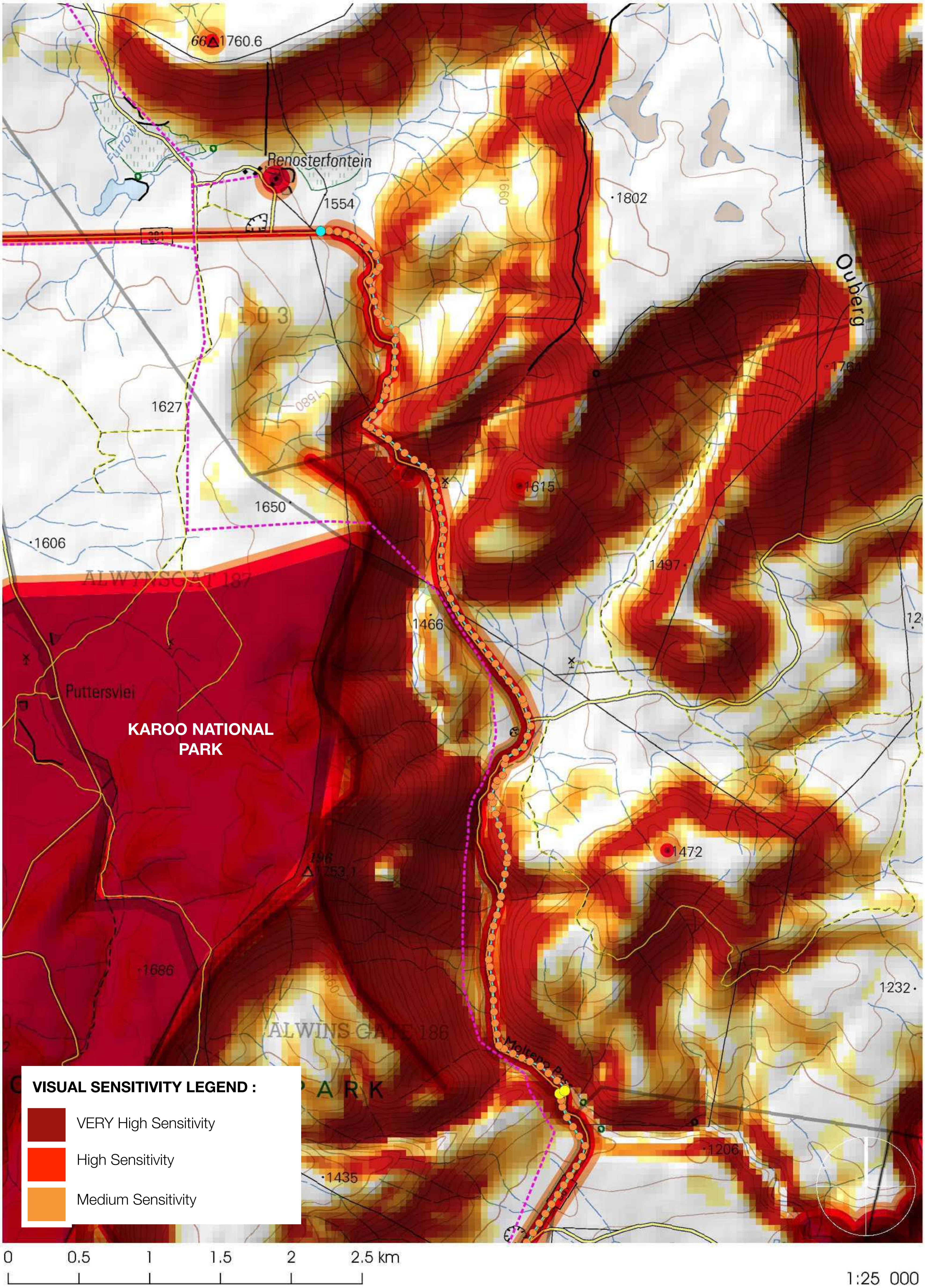
Base map : NGI 1:50K Topographic Series : 3122 CD Dunedin

map 11 : SKA Fibre OHL : North Section Visual Sensitivity



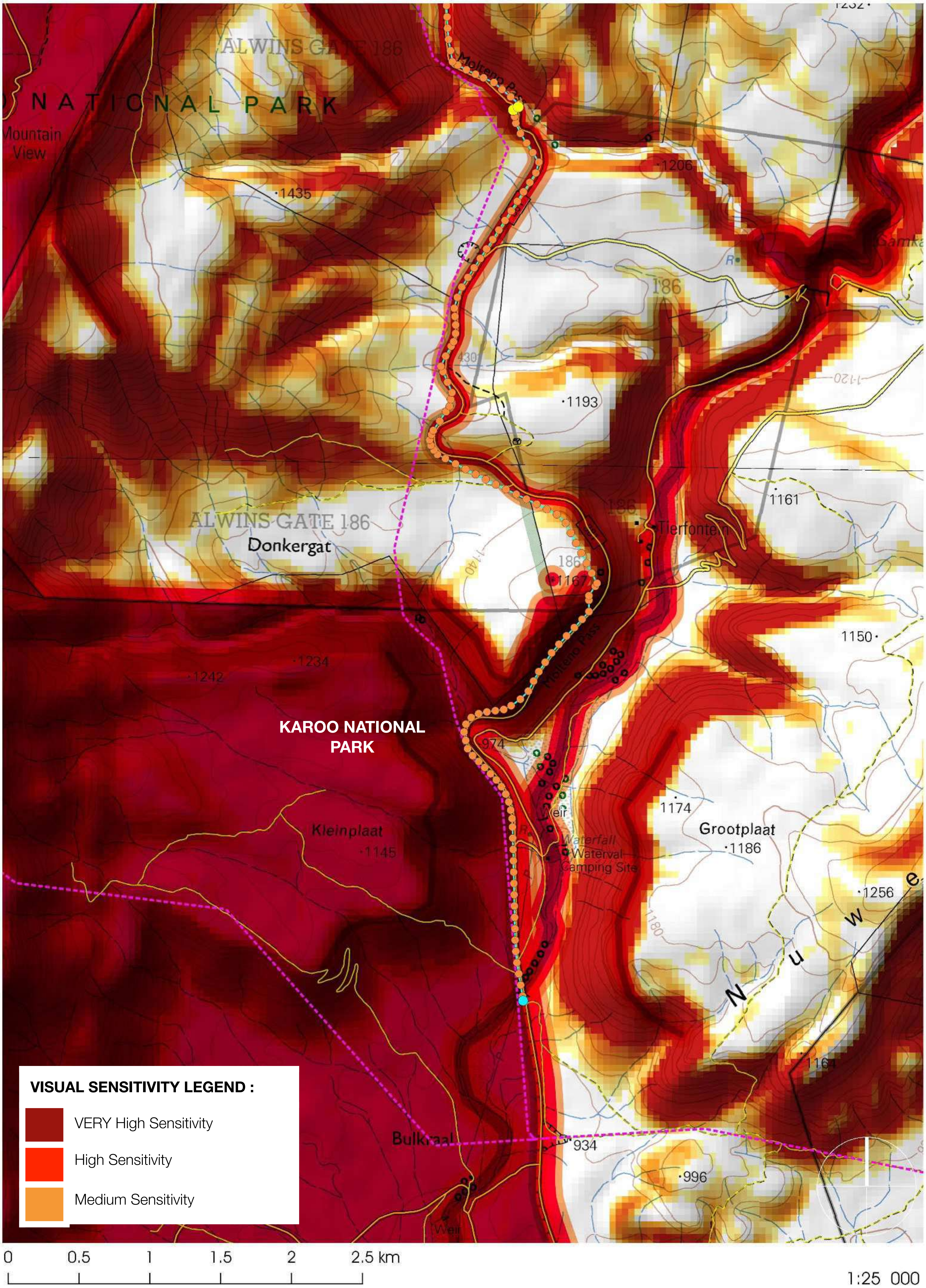
Base map : NGI 1:50K Topographic Series : 3222 AB Rosedene

map 12 : SKA Fibre OHL : Mid Section Visual Sensitivity



Base map : NGI 1:50K Topographic Series : 3222 BA Kuilspoort

map 13 : SKA Fibre OHL : Molteno Pass North Section Visual Sensitivity



Base map : NGI 1:50K Topographic Series : 3222 BA Kuilspoort, 3222 BC Beaufort West

map 14 : SKA Fibre OHL : Molteno Pass South Section Visual Sensitivity

Viewpoint 1 *: looking North-West from Southern entrance to Donkerhoek Poort* *Location 31.88993ºS 22.39773ºE Distance 13m*

Viewpoint 2 *: looking South in Sakrivier Poort* *Location 32.06964ºS 22.45248ºE Distance 30m*

figure 1 : SKA Fibre Overhead Lines • Photomontages

Viewpoint 3 *: looking North-West from start of Ouberg Pass* *Location 32.18873ºS 22.55324ºE Distance 33m*

Viewpoint 4 *: looking North-East in Molteno Pass* *Location 32.26771ºS 22.56081ºE Distance 121m*

figure 2 : SKA Fibre Overhead Lines • Photomontages

Appendix 7 Detailed fibre optic route coordinates

The spatial extent of the proposed Fibre Optic Project, for which EA is being sought, is defined as follows:

- Underground sections (total of approximately 162 km): within a 30 m wide corridor around the centre line of the roads (i.e. the road reserve) where the cabling will be installed underground.
- Overhead sections, outside of the road reserve (total of approximately 21 km): a 30 m wide corridor around the engineering Low Level Design (LLD) route (latest technically feasible engineering design at the time of writing this report).

Thus, 30 m around the coordinates provided below:

Point id	Latitude (decimal degrees)	Longitude (decimal degrees	Latitude (degrees minutes seconds)	Longitude (degrees minutes seconds)
UNDERGROUND IN ROAD RESERVE OF THE R381, FROM START IN BEAUFORT WEST TO MOLTENO PASS SECTION.				
1-UDG-BW start	-32.3504	22.57657	32° 21' 01.45296160" S	022° 34' 35.66783960" E
2-UDG	-32.3506	22.58036	32° 21' 02.00291034" S	022° 34' 49.30938015" E
3-UDG	-32.3463	22.58088	32° 20' 46.75101817" S	022° 34' 51.16497783" E
4-UDG	-32.3423	22.58164	32° 20' 32.20080011" S	022° 34' 53.89356026" E
5-UDG	-32.3411	22.58146	32° 20' 27.82345066" S	022° 34' 53.27059703" E
6-UDG	-32.3358	22.5812	32° 20' 09.02991886" S	022° 34' 52.30598450" E
7-UDG	-32.3323	22.5849	32° 19' 56.37408241" S	022° 35' 05.63729855" E
8-UDG	-32.3282	22.58261	32° 19' 41.59805606" S	022° 34' 57.38818967" E
9-UDG	-32.3239	22.5796	32° 19' 25.97040761" S	022° 34' 46.55034939" E
10-UDG	-32.3195	22.57661	32° 19' 10.28562641" S	022° 34' 35.80027383" E
11-UDG	-32.3147	22.57442	32° 18' 53.00473608" S	022° 34' 27.90072979" E
12-UDG	-32.3099	22.57231	32° 18' 35.55831511" S	022° 34' 20.33035145" E
13-UDG	-32.305	22.57023	32° 18' 18.08243493" S	022° 34' 12.82925048" E
14-UDG	-32.3002	22.56813	32° 18' 00.63823782" S	022° 34' 05.25374631" E
15-UDG	-32.2952	22.56669	32° 17' 42.56787540" S	022° 34' 00.07618073" E
16-UDG	-32.2899	22.56664	32° 17' 23.58132606" S	022° 33' 59.91103601" E
17-UDG	-32.2847	22.56559	32° 17' 04.95096006" S	022° 33' 56.12302521" E
OVERHEAD – MOLTENO PASS, WITHIN THE ROAD RESERVE OF THE R381 (WHERE POSSIBLE) AND OUTSIDE ROAD RESERVE ON THE FOLLOWING PROPERTIES: • **Erf 3545 of the Beaufort West region [C00900010000354500000] (Karoo National Park).** • **Erf 1707 of the Beaufort West Region [C00900010000170700000] (Karoo National Park).** • **Portion 9 of the Farm Alwins Gate 186 [C00900000000018600009] (Karoo National Park).** • **Portion 1 of the farm Matjes Valie 103 [C00900000000010300001].**				
18-OVH-Molteno	-32.2842	22.5653	32° 17' 03.02461154" S	022° 33' 55.06331864" E
19-OVH-Molteno	-32.2842	22.56547	32° 17' 02.94091091" S	022° 33' 55.69023963" E
20-OVH-Molteno	-32.2791	22.56458	32° 16' 44.86673690" S	022° 33' 52.47386231" E
21-OVH-Molteno	-32.2739	22.56434	32° 16' 25.86727471" S	022° 33' 51.63368839" E
22-OVH-Molteno	-32.2693	22.56212	32° 16' 09.60720586" S	022° 33' 43.62430146" E
23-OVH-Molteno	-32.2658	22.56241	32° 15' 56.91674841" S	022° 33' 44.68485862" E
24-OVH-Molteno	-32.2628	22.5664	32° 15' 46.12713425" S	022° 33' 59.03698334" E
25-OVH-Molteno	-32.2589	22.56979	32° 15' 32.120457984" S	022° 34' 11.25605872" E
26-OVH-Molteno	-32.2544	22.5684	32° 15' 15.88049089" S	022° 34' 06.24983823" E
27-OVH-Molteno	-32.2518	22.56396	32° 15' 06.53495032" S	022° 33' 50.26720424" E
28-OVH-Molteno	-32.2498	22.55908	32° 14' 59.29453256" S	022° 33' 32.68276468" E
29-OVH-Molteno	-32.2485	22.55767	32° 14' 54.75479842" S	022° 33' 27.61200097" E
30-OVH-Molteno	-32.2457	22.55926	32° 14' 44.63517952" S	022° 33' 33.32014439" E
31-OVH-Molteno	-32.2439	22.55843	32° 14' 37.86907444" S	022° 33' 30.35991510" E
32-OVH-Molteno	-32.2409	22.55947	32° 14' 27.37904234" S	022° 33' 34.10617670" E
33-OVH-Molteno	-32.2364	22.56172	32° 14' 10.91420258" S	022° 33' 42.18368623" E
34-OVH-Molteno	-32.2321	22.56486	32° 13' 55.62767268" S	022° 33' 53.49730025" E
35-OVH-Molteno	-32.2308	22.56556	32° 13' 50.76480016" S	022° 33' 56.00879929" E
36-OVH-Molteno	-32.2276	22.56362	32° 13' 39.44424042" S	022° 33' 49.04269495" E
37-OVH-Molteno	-32.2271	22.56402	32° 13' 37.54869755" S	022° 33' 50.48492730" E

Point id	Latitude (decimal degrees)	Longitude (decimal degrees	Latitude (degrees minutes seconds)	Longitude (degrees minutes seconds)
38-OVH-Molteno	-32.225	22.56008	32° 13' 29.93194058" S	022° 33' 36.27590531" E
39-OVH-Molteno	-32.2245	22.55898	32° 13' 28.11873609" S	022° 33' 32.31102377" E
40-OVH-Molteno	-32.2205	22.55841	32° 13' 13.63151249" S	022° 33' 30.26510066" E
41-OVH-Molteno	-32.2153	22.55892	32° 12' 55.06325500" S	022° 33' 32.10214917" E
42-OVH-Molteno	-32.2125	22.55944	32° 12' 44.99693502" S	022° 33' 33.97245183" E
43-OVH-Molteno	-32.2102	22.55864	32° 12' 36.69345999" S	022° 33' 31.12071380" E
44-OVH-Molteno	-32.2076	22.55855	32° 12' 27.37344249" S	022° 33' 30.76582087" E
45-OVH-Molteno	-32.2057	22.55995	32° 12' 20.69664442" S	022° 33' 35.82888543" E
46-OVH-Molteno	-32.204	22.56098	32° 12' 14.34451938" S	022° 33' 39.51655209" E
47-OVH-Molteno	-32.2014	22.55943	32° 12' 04.97355553" S	022° 33' 33.94223362" E
48-OVH-Molteno	-32.1975	22.55586	32° 11' 50.96367062" S	022° 33' 21.08404688" E
49-OVH-Molteno	-32.1927	22.55417	32° 11' 33.72825731" S	022° 33' 15.01530504" E
50-OVH-Molteno	-32.1878	22.55289	32° 11' 15.97959434" S	022° 33' 10.39982093" E
51-OVH-Molteno	-32.185	22.54837	32° 11' 06.14186426" S	022° 32' 54.14588165" E
52-OVH-Molteno	-32.1805	22.55045	32° 10' 49.76619757" S	022° 33' 01.60524662" E
53-OVH-Molteno	-32.176	22.54848	32° 10' 33.50493050" S	022° 32' 54.53489054" E
54-OVH-Molteno	-32.1742	22.54889	32° 10' 27.21284468" S	022° 32' 56.01735196" E
55-OVH-Molteno	-32.1729	22.54465	32° 10' 22.28736431" S	022° 32' 40.74561608" E
56-OVH-Molteno	-32.1728	22.54605	32° 10' 22.10238336" S	022° 32' 45.76840434" E
57-OVH-Molteno	-32.1728	22.54465	32° 10' 22.03944820" S	022° 32' 40.73755132" E
UNDERGROUND IN ROAD RESERVE OF THE R381, BETWEEN MOLTENO PASS AND BLOUNEK PASS.				
58-UDG	-32.174	22.49533	32° 10' 26.50896770" S	022° 29' 43.18997724" E
59-UDG	-32.174	22.50059	32° 10' 26.36480976" S	022° 30' 02.12227075" E
60-UDG	-32.1739	22.50587	32° 10' 25.98436834" S	022° 30' 21.13613473" E
61-UDG	-32.1738	22.51115	32° 10' 25.63830791" S	022° 30' 40.15110880" E
62-UDG	-32.1737	22.51644	32° 10' 25.29224749" S	022° 30' 59.16608287" E
63-UDG	-32.1735	22.52172	32° 10' 24.75217055" S	022° 31' 18.17639578" E
64-UDG	-32.1734	22.527	32° 10' 24.18470587" S	022° 31' 37.18605072" E
65-UDG	-32.1732	22.53228	32° 10' 23.61724119" S	022° 31' 56.19570565" E
66-UDG	-32.1731	22.53756	32° 10' 23.04977651" S	022° 32' 15.20536058" E
67-UDG	-32.1729	22.54284	32° 10' 22.48231183" S	022° 32' 34.21501551" E
68-UDG	-32.1722	22.4904	32° 10' 20.01252918" S	022° 29' 25.42527857" E
69-UDG	-32.1695	22.48588	32° 10' 10.12559911" S	022° 29' 09.18227708" E
70-UDG	-32.1667	22.48142	32° 09' 59.96307621" S	022° 28' 53.10707490" E
71-UDG	-32.1638	22.47697	32° 09' 49.69433102" S	022° 28' 37.10253807" E
72-UDG	-32.1597	22.47408	32° 09' 34.79032501" S	022° 28' 26.69724524" E
73-UDG	-32.1545	22.47486	32° 09' 16.09874887" S	022° 28' 29.50125539" E
74-UDG	-32.1496	22.4743	32° 08' 58.46074171" S	022° 28' 27.46810353" E
75-UDG	-32.1464	22.47005	32° 08' 47.16121122" S	022° 28' 12.18808510" E
76-UDG	-32.1434	22.46575	32° 08' 36.14379040" S	022° 27' 56.68641177" E
77-UDG	-32.1403	22.46145	32° 08' 25.08199260" S	022° 27' 41.21625901" E
78-UDG	-32.1372	22.45715	32° 08' 14.02019480" S	022° 27' 25.74610626" E
79-UDG	-32.1341	22.45286	32° 08' 02.90856513" S	022° 27' 10.31351223" E
80-UDG	-32.1305	22.44907	32° 07' 49.93381940" S	022° 26' 56.65746504" E
81-UDG	-32.1255	22.44771	32° 07' 31.97351659" S	022° 26' 51.74989800" E
82-UDG	-32.1203	22.44817	32° 07' 13.07161652" S	022° 26' 53.40093283" E
83-UDG	-32.1151	22.4489	32° 06' 54.23958726" S	022° 26' 56.03148128" E
84-UDG	-32.1098	22.44952	32° 06' 35.35442613" S	022° 26' 58.26243802" E
85-UDG	-32.1046	22.44992	32° 06' 16.39242052" S	022° 26' 59.72234901" E
86-UDG	-32.0993	22.45033	32° 05' 57.43041491" S	022° 27' 01.18226000" E
87-UDG	-32.0941	22.45109	32° 05' 38.63470458" S	022° 27' 03.91464293" E
88-UDG	-32.0888	22.45188	32° 05' 19.84473475" S	022° 27' 06.75862951" E
89-UDG	-32.0836	22.45243	32° 05' 00.93120476" S	022° 27' 08.75045788" E
OVERHEAD – BLOUNEK PASS, WITHIN THE ROAD RESERVE OF THE R381 (WHERE POSSIBLE) AND OUTSIDE ROAD RESERVE ON THE FOLLOWING PROPERTIES: • **Remainder of the Farm Waterval 97 [C00900000000009700000].** • **Remainder of the Farm Middle Kraal 98 [C00900000000009800000].**				
90-OVH-Blounek	-32.0789	22.45238	32° 04' 44.06088094" S	022° 27' 08.55324082" E
91-OVH-Blounek	-32.0788	22.45181	32° 04' 43.83273014" S	022° 27' 06.51615552" E
92-OVH-Blounek	-32.0756	22.45177	32° 04' 32.32599452" S	022° 27' 06.36196394" E
93-OVH-Blounek	-32.0715	22.45446	32° 04' 17.31505951" S	022° 27' 16.05668125" E
94-OVH-Blounek	-32.0675	22.45167	32° 04' 03.05074598" S	022° 27' 06.00487021" E

Point id	Latitude (decimal degrees)	Longitude (decimal degrees	Latitude (degrees minutes seconds)	Longitude (degrees minutes seconds)
95-OVH-Blounek	-32.0634	22.44853	32° 03' 48.18441178" S	022° 26' 54.71565692" E
96-OVH-Blounek	-32.059	22.45117	32° 03' 32.32431337" S	022° 27' 04.20324135" E
97-OVH-Blounek	-32.0565	22.45407	32° 03' 23.39639974" S	022° 27' 14.65199975" E
98-OVH-Blounek	-32.0552	22.45448	32° 03' 18.79242715" S	022° 27' 16.11355818" E
99-OVH-Blounek	-32.0514	22.45729	32° 03' 05.06415169" S	022° 27' 26.23028290" E
100-OVH-Blounek	-32.0506	22.45719	32° 03' 02.21457694" S	022° 27' 25.88224819" E
101-OVH-Blounek	-32.0472	22.45486	32° 02' 50.02197874" S	022° 27' 17.50749483" E
102-OVH-Blounek	-32.0436	22.4517	32° 02' 37.07520690" S	022° 27' 06.12362411" E
103-OVH-Blounek	-32.0435	22.45183	32° 02' 36.60534962" S	022° 27' 06.58795163" E
UNDERGROUND IN ROAD RESERVE THE R381, BETWEEN BLOUNEK PASS AND ROSEBERG PASS				
104-UDG	-32.043	22.45132	32° 02' 34.97866581" S	022° 27' 04.73919067" E
105-UDG	-32.0396	22.44735	32° 02' 22.41573224" S	022° 26' 50.46117621" E
106-UDG	-32.0361	22.44338	32° 02' 09.85279868" S	022° 26' 36.18316174" E
107-UDG	-32.0326	22.43942	32° 01' 57.26659454" S	022° 26' 21.92565808" E
108-UDG	-32.0292	22.43536	32° 01' 45.11242245" S	022° 26' 07.30385317" E
109-UDG	-32.0254	22.43177	32° 01' 31.41730185" S	022° 25' 54.37672358" E
110-UDG	-32.0204	22.43154	32° 01' 13.26544486" S	022° 25' 53.55522311" E
111-UDG	-32.0151	22.43183	32° 00' 54.27640897" S	022° 25' 54.60164743" E
112-UDG	-32.0099	22.43128	32° 00' 35.48044532" S	022° 25' 52.61930854" E
113-UDG	-32.0047	22.42998	32° 00' 17.05148990" S	022° 25' 47.93803996" E
114-UDG	-31.9998	22.42815	31° 59' 59.21047247" S	022° 25' 41.35245871" E
115-UDG	-31.9948	22.42644	31° 59' 41.24443165" S	022° 25' 35.16738856" E
116-UDG	-31.9897	22.42486	31° 59' 23.09605831" S	022° 25' 29.48208124" E
117-UDG	-31.9848	22.42311	31° 59' 05.16703554" S	022° 25' 23.20389022" E
118-UDG	-31.9801	22.42067	31° 58' 48.48433594" S	022° 25' 14.41515621" E
119-UDG	-31.9756	22.41801	31° 58' 32.09040449" S	022° 25' 04.81927657" E
120-UDG	-31.9708	22.42016	31° 58' 15.03547600" S	022° 25' 12.56504881" E
121-UDG	-31.9665	22.42314	31° 57' 59.33194808" S	022° 25' 23.29296603" E
122-UDG	-31.9616	22.42405	31° 57' 41.60421224" S	022° 25' 26.56892881" E
123-UDG	-31.9564	22.42278	31° 57' 23.13706351" S	022° 25' 22.02432603" E
124-UDG	-31.9513	22.42136	31° 57' 04.82381716" S	022° 25' 16.90269267" E
125-UDG	-31.9463	22.4199	31° 56' 46.54633389" S	022° 25' 11.64697179" E
126-UDG	-31.9412	22.41844	31° 56' 28.26885061" S	022° 25' 06.39125090" E
127-UDG	-31.9361	22.41697	31° 56' 09.99902496" S	022° 25' 01.10911151" E
128-UDG	-31.931	22.41549	31° 55' 51.74408523" S	022° 24' 55.77561617" E
129-UDG	-31.926	22.41401	31° 55' 33.48914551" S	022° 24' 50.44212083" E
130-UDG	-31.9209	22.41253	31° 55' 15.23420579" S	022° 24' 45.10862549" E
131-UDG	-31.9158	22.41105	31° 54' 56.97821857" S	022° 24' 39.77873219" E
132-UDG	-31.9108	22.40958	31° 54' 38.70996392" S	022° 24' 34.49102297" E
133-UDG	-31.9057	22.40813	31° 54' 20.42109010" S	022° 24' 29.27622082" E
134-UDG	-31.9006	22.40673	31° 54' 02.08936609" S	022° 24' 24.21293220" E
135-UDG	-31.8957	22.40486	31° 53' 44.37634641" S	022° 24' 17.48318820" E
136-UDG	-31.8917	22.4015	31° 53' 30.14325760" S	022° 24' 05.38204191" E
OVERHEAD – ROSEBERG PASS, IN THE ROAD RESERVE OF THE R381				
137-OVH-Roseberg	-31.8901	22.3984	31° 53' 24.44750265" S	022° 23' 54.25716000" E
138-OVH-Roseberg	-31.89	22.39847	31° 53' 24.08273979" S	022° 23' 54.50761436" E
139-OVH-Roseberg	-31.8889	22.39583	31° 53' 20.08487329" S	022° 23' 44.98787511" E
140-OVH-Roseberg	-31.8876	22.39299	31° 53' 15.23988381" S	022° 23' 34.75990085" E
141-OVH-Roseberg	-31.8861	22.39228	31° 53' 10.02207126" S	022° 23' 32.21035846" E
UNDERGROUND IN ROAD RESERVE OF THE R381 and R63 FROM BLOUNEK PASS TO END AT SKA INTERNET POINT-OF-PRESENCE IN CARNARVON				
142-UDG	-31.8824	22.38974	31° 52' 56.47092650" S	022° 23' 23.07543987" E
143-UDG	-31.8776	22.38765	31° 52' 39.36168175" S	022° 23' 15.53916225" E
144-UDG	-31.8733	22.38464	31° 52' 23.72626681" S	022° 23' 04.71246541" E
145-UDG	-31.8689	22.38162	31° 52' 08.12657691" S	022° 22' 53.83468684" E
146-UDG	-31.8653	22.3778	31° 51' 55.06211346" S	022° 22' 40.09236068" E

Point id	Latitude (decimal degrees)	Longitude (decimal degrees	Latitude (degrees minutes seconds)	Longitude (degrees minutes seconds)
147-UDG	-31.8621	22.37358	31° 51' 43.65962182" S	022° 22' 24.89893883" E
148-UDG	-31.8592	22.36916	31° 51' 33.27861459" S	022° 22' 08.96395575" E
149-UDG	-31.8564	22.36473	31° 51' 22.90238152" S	022° 21' 53.02587665" E
150-UDG	-31.8533	22.3605	31° 51' 11.83120626" S	022° 21' 37.79789674" E
151-UDG	-31.8487	22.35804	31° 50' 55.22266161" S	022° 21' 28.95116482" E
152-UDG	-31.8443	22.35564	31° 50' 39.30615743" S	022° 21' 20.29065076" E
153-UDG	-31.839	22.35505	31° 50' 20.44978204" S	022° 21' 18.18512200" E
154-UDG	-31.8337	22.35478	31° 50' 01.45778628" S	022° 21' 17.21288749" E
155-UDG	-31.8285	22.35461	31° 49' 42.44963690" S	022° 21' 16.59705150" E
156-UDG	-31.8232	22.35482	31° 49' 23.48476861" S	022° 21' 17.36134272" E
157-UDG	-31.8183	22.35679	31° 49' 05.94876004" S	022° 21' 24.42975756" E
158-UDG	-31.8131	22.35772	31° 48' 47.27463854" S	022° 21' 27.79415783" E
159-UDG	-31.8079	22.35838	31° 48' 28.40327958" S	022° 21' 30.15229430" E
160-UDG	-31.8026	22.35903	31° 48' 09.53192061" S	022° 21' 32.51043077" E
161-UDG	-31.7974	22.35985	31° 47' 50.74964447" S	022° 21' 35.45130321" E
162-UDG	-31.7922	22.36065	31° 47' 31.96526923" S	022° 21' 38.33356872" E
163-UDG	-31.787	22.36114	31° 47' 13.03423569" S	022° 21' 40.11444009" E
164-UDG	-31.7817	22.36112	31° 46' 54.02513858" S	022° 21' 40.02377089" E
165-UDG	-31.7765	22.36008	31° 46' 35.38023221" S	022° 21' 36.27457585" E
166-UDG	-31.7713	22.35924	31° 46' 16.62159008" S	022° 21' 33.26549717" E
167-UDG	-31.766	22.35878	31° 45' 57.68696372" S	022° 21' 31.59851823" E
168-UDG	-31.7608	22.35898	31° 45' 38.86282655" S	022° 21' 32.32359699" E
169-UDG	-31.7562	22.36161	31° 45' 22.49469150" S	022° 21' 41.78469490" E
170-UDG	-31.7514	22.36326	31° 45' 04.90971205" S	022° 21' 47.75184246" E
171-UDG	-31.7462	22.36246	31° 44' 46.17133419" S	022° 21' 44.84925990" E
172-UDG	-31.741	22.36114	31° 44' 27.75277006" S	022° 21' 40.11159250" E
173-UDG	-31.7359	22.36022	31° 44' 09.09905041" S	022° 21' 36.79356325" E
174-UDG	-31.7306	22.36058	31° 43' 50.23784118" S	022° 21' 38.07514621" E
175-UDG	-31.7255	22.36176	31° 43' 31.70426005" S	022° 21' 42.34074901" E
176-UDG	-31.7203	22.36295	31° 43' 13.17067892" S	022° 21' 46.60635181" E
177-UDG	-31.7151	22.36374	31° 42' 54.39251445" S	022° 21' 49.46905747" E
178-UDG	-31.7099	22.36309	31° 42' 35.58033011" S	022° 21' 47.11813821" E
179-UDG	-31.7047	22.36193	31° 42' 17.03045024" S	022° 21' 42.93411862" E
180-UDG	-31.6996	22.36068	31° 41' 58.54957462" S	022° 21' 38.44643681" E
181-UDG	-31.6944	22.35968	31° 41' 39.89801838" S	022° 21' 34.84496393" E
182-UDG	-31.6892	22.35892	31° 41' 21.07502822" S	022° 21' 32.12760524" E
183-UDG	-31.684	22.3582	31° 41' 02.23795995" S	022° 21' 29.52741793" E
184-UDG	-31.679	22.35954	31° 40' 44.27403580" S	022° 21' 34.34174495" E
185-UDG	-31.6743	22.35748	31° 40' 27.31693392" S	022° 21' 26.94314803" E
186-UDG	-31.669	22.3566	31° 40' 08.56883461" S	022° 21' 23.77171162" E
187-UDG	-31.6638	22.35577	31° 39' 49.78835712" S	022° 21' 20.77460270" E
188-UDG	-31.6586	22.35494	31° 39' 31.00787962" S	022° 21' 17.77749378" E
189-UDG	-31.6534	22.35406	31° 39' 12.25306772" S	022° 21' 14.62590920" E
190-UDG	-31.6482	22.35316	31° 38' 53.51242963" S	022° 21' 11.38901554" E
191-UDG	-31.6429	22.35272	31° 38' 34.60009087" S	022° 21' 09.78246861" E
192-UDG	-31.6377	22.35276	31° 38' 15.58345796" S	022° 21' 09.92077456" E
193-UDG	-31.6324	22.35289	31° 37' 56.57836550" S	022° 21' 10.39938069" E
194-UDG	-31.6271	22.35331	31° 37' 37.62065343" S	022° 21' 11.91402586" E
195-UDG	-31.6219	22.35374	31° 37' 18.66648679" S	022° 21' 13.47109363" E
196-UDG	-31.6166	22.3542	31° 36' 59.72035408" S	022° 21' 15.12428801" E
197-UDG	-31.6113	22.35466	31° 36' 40.77422092" S	022° 21' 16.77747728" E
198-UDG	-31.6061	22.35507	31° 36' 21.81380650" S	022° 21' 18.25258918" E
199-UDG	-31.6008	22.35482	31° 36' 02.85840454" S	022° 21' 17.33697163" E
200-UDG	-31.5956	22.35399	31° 35' 44.11403017" S	022° 21' 14.38010108" E
201-UDG	-31.5905	22.35268	31° 35' 25.69475395" S	022° 21' 09.64566046" E
202-UDG	-31.5853	22.35186	31° 35' 06.98076670" S	022° 21' 06.70139124" E
203-UDG	-31.58	22.35185	31° 34' 47.96266218" S	022° 21' 06.67497875" E
204-UDG	-31.5747	22.35188	31° 34' 28.94512558" S	022° 21' 06.75348989" E
205-UDG	-31.5694	22.35194	31° 34' 09.92842125" S	022° 21' 06.98576827" E
206-UDG	-31.5641	22.35201	31° 33' 50.91171692" S	022° 21' 07.21804666" E
207-UDG	-31.5589	22.35198	31° 33' 31.89598223" S	022° 21' 07.13922242" E
208-UDG	-31.5539	22.3502	31° 33' 14.09022134" S	022° 21' 00.70967943" E
209-UDG	-31.5491	22.34813	31° 32' 56.59324890" S	022° 20' 53.25912233" E
210-UDG	-31.5451	22.34482	31° 32' 42.18408900" S	022° 20' 41.36771932" E
211-UDG	-31.5416	22.34079	31° 32' 29.90677809" S	022° 20' 26.84390374" E

Point id	Latitude (decimal degrees)	Longitude (decimal degrees	Latitude (degrees minutes seconds)	Longitude (degrees minutes seconds)
212-UDG	-31.5376	22.33855	31° 32' 15.18599810" S	022° 20' 18.76270703" E
213-UDG	-31.5336	22.34095	31° 32' 01.02636733" S	022° 20' 27.40409588" E
214-UDG	-31.5288	22.3389	31° 31' 43.64139366" S	022° 20' 20.03314672" E
215-UDG	-31.5236	22.33826	31° 31' 24.82669074" S	022° 20' 17.74644258" E
216-UDG	-31.5184	22.33937	31° 31' 06.33442511" S	022° 20' 21.74894321" E
217-UDG	-31.5134	22.34095	31° 30' 48.18459677" S	022° 20' 27.42901239" E
218-UDG	-31.5083	22.34255	31° 30' 30.05708445" S	022° 20' 33.18073334" E
219-UDG	-31.5033	22.34414	31° 30' 11.91670591" S	022° 20' 38.89173451" E
220-UDG	-31.4983	22.34572	31° 29' 53.77710823" S	022° 20' 44.60520781" E
221-UDG	-31.4932	22.34732	31° 29' 35.64908394" S	022° 20' 50.35531495" E
222-UDG	-31.4882	22.3489	31° 29' 17.50311548" S	022° 20' 56.04764737" E
223-UDG	-31.4833	22.35086	31° 28' 59.88035701" S	022° 21' 03.10532933" E
224-UDG	-31.4795	22.35082	31° 28' 46.16558783" S	022° 21' 02.93429580" E
225-UDG	-31.4766	22.34843	31° 28' 35.87547501" S	022° 20' 54.33788947" E
226-UDG	-31.4721	22.34945	31° 28' 19.61496839" S	022° 20' 58.01198897" E
227-UDG	-31.4683	22.34582	31° 28' 05.81138237" S	022° 20' 44.93619143" E
228-UDG	-31.4644	22.34225	31° 27' 51.77131300" S	022° 20' 32.10789888" E
229-UDG	-31.4605	22.33868	31° 27' 37.75139661" S	022° 20' 19.25757043" E
230-UDG	-31.4566	22.33511	31° 27' 23.73148022" S	022° 20' 06.40724198" E
231-UDG	-31.4527	22.33154	31° 27' 09.71156384" S	022° 19' 53.55691353" E
232-UDG	-31.4475	22.3307	31° 26' 51.07845246" S	022° 19' 50.52956042" E
233-UDG	-31.4423	22.32999	31° 26' 32.23651219" S	022° 19' 47.94687114" E
234-UDG	-31.4371	22.32927	31° 26' 13.39457193" S	022° 19' 45.36418187" E
235-UDG	-31.4318	22.32855	31° 25' 54.55263166" S	022° 19' 42.78149259" E
236-UDG	-31.4266	22.32783	31° 25' 35.71069140" S	022° 19' 40.19880332" E
237-UDG	-31.4222	22.32528	31° 25' 19.76846764" S	022° 19' 31.01295163" E
238-UDG	-31.4181	22.32191	31° 25' 05.11718243" S	022° 19' 18.88740676" E
239-UDG	-31.414	22.31854	31° 24' 50.46589721" S	022° 19' 06.76186190" E
240-UDG	-31.4099	22.31518	31° 24' 35.81461199" S	022° 18' 54.63631704" E
241-UDG	-31.4059	22.31181	31° 24' 21.16332677" S	022° 18' 42.51077217" E
242-UDG	-31.4018	22.30844	31° 24' 06.51204155" S	022° 18' 30.38522731" E
243-UDG	-31.3973	22.30574	31° 23' 50.33446327" S	022° 18' 20.65166623" E
244-UDG	-31.3924	22.30388	31° 23' 32.52641946" S	022° 18' 13.97649254" E
245-UDG	-31.3874	22.30202	31° 23' 14.72570777" S	022° 18' 07.28155342" E
246-UDG	-31.3824	22.30051	31° 22' 56.53588028" S	022° 18' 01.82859339" E
247-UDG	-31.3773	22.29907	31° 22' 38.27437136" S	022° 17' 56.64534735" E
248-UDG	-31.3725	22.29691	31° 22' 20.92100764" S	022° 17' 48.86475601" E
249-UDG	-31.3676	22.29509	31° 22' 03.19087596" S	022° 17' 42.33046289" E
250-UDG	-31.3625	22.2965	31° 21' 44.96956797" S	022° 17' 47.39172909" E
251-UDG	-31.3575	22.29822	31° 21' 26.98670265" S	022° 17' 53.57985420" E
252-UDG	-31.3525	22.29994	31° 21' 09.01226491" S	022° 17' 59.79293801" E
253-UDG	-31.3474	22.30095	31° 20' 50.64468240" S	022° 18' 03.42578465" E
254-UDG	-31.3423	22.30142	31° 20' 32.42208792" S	022° 18' 05.12826680" E
255-UDG	-31.3378	22.30415	31° 20' 16.13787014" S	022° 18' 14.95207992" E
256-UDG	-31.3333	22.30689	31° 19' 59.87395133" S	022° 18' 24.80917920" E
257-UDG	-31.3295	22.31051	31° 19' 46.08634001" S	022° 18' 37.82686868" E
258-UDG	-31.3258	22.31432	31° 19' 32.93362419" S	022° 18' 51.56096198" E
259-UDG	-31.3214	22.31712	31° 19' 16.96398680" S	022° 19' 01.63356500" E
260-UDG	-31.3162	22.31791	31° 18' 58.25605219" S	022° 19' 04.48910506" E
261-UDG	-31.3109	22.3182	31° 18' 39.26678624" S	022° 19' 05.53555478" E
262-UDG	-31.3057	22.31764	31° 18' 20.50216715" S	022° 19' 03.50789071" E
263-UDG	-31.3011	22.31502	31° 18' 04.13998958" S	022° 18' 54.07568467" E
264-UDG	-31.297	22.31178	31° 17' 49.12961408" S	022° 18' 42.39765576" E
265-UDG	-31.2928	22.30853	31° 17' 34.13948908" S	022° 18' 30.69360239" E
266-UDG	-31.2884	22.30562	31° 17' 18.30259507" S	022° 18' 20.22955184" E
267-UDG	-31.2838	22.30302	31° 17' 01.74917817" S	022° 18' 10.86614739" E
268-UDG	-31.2792	22.30042	31° 16' 45.19068172" S	022° 18' 01.51172802" E
269-UDG	-31.2746	22.29783	31° 16' 28.62085277" S	022° 17' 52.17739541" E
270-UDG	-31.27	22.29524	31° 16' 12.04627661" S	022° 17' 42.85149559" E
271-UDG	-31.2654	22.29264	31° 15' 55.48804027" S	022° 17' 33.49683579" E
272-UDG	-31.2608	22.29005	31° 15' 38.91744442" S	022° 17' 24.16387195" E
273-UDG	-31.2562	22.28745	31° 15' 22.34619417" S	022° 17' 14.83211297" E
274-UDG	-31.2516	22.28486	31° 15' 05.77779625" S	022° 17' 05.49528827" E
275-UDG	-31.247	22.28227	31° 14' 49.20519634" S	022° 16' 56.16593172" E
276-UDG	-31.2427	22.27925	31° 14' 33.64010945" S	022° 16' 45.29360935" E

Point id	Latitude (decimal degrees)	Longitude (decimal degrees	Latitude (degrees minutes seconds)	Longitude (degrees minutes seconds)
277-UDG	-31.2388	22.27562	31° 14' 19.80931253" S	022° 16' 32.24551680" E
278-UDG	-31.235	22.27195	31° 14' 06.15927012" S	022° 16' 19.00304615" E
279-UDG	-31.2312	22.26828	31° 13' 52.46603314" S	022° 16' 05.80515969" E
280-UDG	-31.2274	22.26461	31° 13' 38.77224854" S	022° 15' 52.60783950" E
281-UDG	-31.2236	22.26095	31° 13' 25.07846394" S	022° 15' 39.41051931" E
282-UDG	-31.2198	22.25728	31° 13' 11.39451581" S	022° 15' 26.20302308" E
283-UDG	-31.216	22.2536	31° 12' 57.74020304" S	022° 15' 12.96486839" E
284-UDG	-31.2122	22.24993	31° 12' 44.07895470" S	022° 14' 59.73390359" E
285-UDG	-31.2084	22.24626	31° 12' 30.39807657" S	022° 14' 46.52342268" E
286-UDG	-31.2046	22.24267	31° 12' 16.43288977" S	022° 14' 33.62550063" E
287-UDG	-31.2006	22.23921	31° 12' 02.07062093" S	022° 14' 21.15897624" E
288-UDG	-31.1965	22.2359	31° 11' 47.27717299" S	022° 14' 09.24355457" E
289-UDG	-31.1921	22.23286	31° 11' 31.72143909" S	022° 13' 58.30243307" E
290-UDG	-31.1878	22.22982	31° 11' 16.16570519" S	022° 13' 47.36131157" E
291-UDG	-31.1835	22.22678	31° 11' 00.60997129" S	022° 13' 36.42019008" E
292-UDG	-31.1792	22.22374	31° 10' 45.05423738" S	022° 13' 25.47906858" E
293-UDG	-31.1749	22.2207	31° 10' 29.49850348" S	022° 13' 14.53794709" E
294-UDG	-31.1705	22.21767	31° 10' 13.94276958" S	022° 13' 03.59682559" E
295-UDG	-31.1662	22.21463	31° 09' 58.38703568" S	022° 12' 52.65570409" E
296-UDG	-31.1619	22.21159	31° 09' 42.83130178" S	022° 12' 41.71458260" E
297-UDG	-31.1574	22.20879	31° 09' 26.77359888" S	022° 12' 31.63718498" E
298-UDG	-31.1526	22.2066	31° 09' 09.46659466" S	022° 12' 23.75850545" E
299-UDG	-31.1478	22.2045	31° 08' 52.01856199" S	022° 12' 16.19179198" E
300-UDG	-31.1429	22.2024	31° 08' 34.57052932" S	022° 12' 08.62507851" E
301-UDG	-31.1381	22.20029	31° 08' 17.12249665" S	022° 12' 01.05836504" E
302-UDG	-31.1332	22.19819	31° 07' 59.67437389" S	022° 11' 53.49185932" E
303-UDG	-31.1284	22.19609	31° 07' 42.23168764" S	022° 11' 45.91291243" E
304-UDG	-31.1236	22.19396	31° 07' 24.82395936" S	022° 11' 38.25393125" E
305-UDG	-31.1188	22.19177	31° 07' 07.53737976" S	022° 11' 30.37235710" E
306-UDG	-31.1143	22.18886	31° 06' 51.65413613" S	022° 11' 19.91235860" E
307-UDG	-31.1099	22.18596	31° 06' 35.77089250" S	022° 11' 09.45236010" E
308-UDG	-31.1055	22.18305	31° 06' 19.88764887" S	022° 10' 58.99236159" E
309-UDG	-31.1011	22.18015	31° 06' 04.00403803" S	022° 10' 48.53292074" E
310-UDG	-31.0967	22.17724	31° 05' 48.12024886" S	022° 10' 38.07375067" E
311-UDG	-31.0923	22.17433	31° 05' 32.26378918" S	022° 10' 27.57320497" E
312-UDG	-31.0879	22.17141	31° 05' 16.40980949" S	022° 10' 17.06890466" E
313-UDG	-31.0835	22.16849	31° 05' 00.55582980" S	022° 10' 06.56460436" E
314-UDG	-31.0789	22.16586	31° 04' 44.07578599" S	022° 09' 57.07858627" E
315-UDG	-31.0743	22.16324	31° 04' 27.54639955" S	022° 09' 47.67282312" E
316-UDG	-31.0697	22.16063	31° 04' 11.01701311" S	022° 09' 38.26705996" E
317-UDG	-31.0651	22.15802	31° 03' 54.48762666" S	022° 09' 28.86129680" E
318-UDG	-31.0605	22.15541	31° 03' 37.95580669" S	022° 09' 19.45981564" E
319-UDG	-31.0559	22.1528	31° 03' 21.41102977" S	022° 09' 10.08116503" E
320-UDG	-31.0513	22.1502	31° 03' 04.85915588" S	022° 09' 00.71503573" E
321-UDG	-31.0468	22.14759	31° 02' 48.31135775" S	022° 08' 51.34170262" E
322-UDG	-31.0422	22.14499	31° 02' 31.76355961" S	022° 08' 41.96836950" E
323-UDG	-31.0376	22.14239	31° 02' 15.21576148" S	022° 08' 32.59503639" E
324-UDG	-31.033	22.13978	31° 01' 58.66757029" S	022° 08' 23.22239723" E
325-UDG	-31.0284	22.13718	31° 01' 42.11906211" S	022° 08' 13.85031775" E
326-UDG	-31.0238	22.13458	31° 01' 25.57055393" S	022° 08' 04.47823827" E
327-UDG	-31.0191	22.13213	31° 01' 08.74839480" S	022° 07' 55.68185144" E
328-UDG	-31.0142	22.13024	31° 00' 51.00238652" S	022° 07' 48.85001507" E
329-UDG	-31.0091	22.12862	31° 00' 32.90035029" S	022° 07' 43.01861033" E
330-UDG	-31.004	22.12736	31° 00' 14.48443880" S	022° 07' 38.47815137" E
331-UDG	-30.9988	22.12666	30° 59' 55.63095041" S	022° 07' 35.98115869" E
332-UDG	-30.9935	22.12597	30° 59' 36.77746202" S	022° 07' 33.48416601" E
333-UDG	-30.9883	22.12531	30° 59' 17.90594799" S	022° 07' 31.12857231" E
334-UDG	-30.9831	22.12467	30° 58' 59.02899284" S	022° 07' 28.81566050" E
335-UDG	-30.9778	22.124	30° 58' 40.16796531" S	022° 07' 26.39980483" E
336-UDG	-30.9726	22.12462	30° 58' 21.31409517" S	022° 07' 28.64356368" E
337-UDG	-30.9711	22.13233	30° 58' 16.08057945" S	022° 07' 56.38180468" E
338-UDG	-30.9697	22.12509	30° 58' 10.89765852" S	022° 07' 30.30814425" E
339-UDG	-30.9696	22.13739	30° 58' 10.45448580" S	022° 08' 14.59243035" E
340-UDG	-30.9692	22.13267	30° 58' 09.24492008" S	022° 07' 57.60840063" E
341-UDG-CNV end	-30.9699	22.14119	30° 58' 11.78892624" S	022° 08' 28.29445774" E

Appendix 8 Hydraulic Fluid Safety Data Sheet

Safety Data Sheet

SECTION 1 PRODUCT AND COMPANY IDENTIFICATION

Clarity Hydraulic Oil AW 32, 46, 68, 100

Product Use: Hydraulic Oil
Product Number(s): 219612, 230340, 230341, 230342, 255702, 278022, 278023, 278024
Synonyms: Clarity Hydraulic Oil AW 32 ISOCLEAN Certified; Clarity Hydraulic Oil AW 46 ISOCLEAN Certified; Clarity Hydraulic Oil AW 68 ISOCLEAN Certified
Company Identification
Chevron Products Company
a division of Chevron U.S.A. Inc.
6001 Bollinger Canyon Rd.
San Ramon, CA 94583
United States of America
www.chevronlubricants.com

Transportation Emergency Response
CHEMTREC: (800) 424-9300 or (703) 527-3887
Health Emergency
Chevron Emergency & Information Center: Located in the USA. International collect calls accepted. (800) 231-0623 or (510) 231-0623
Product Information
email : lubemsds@chevron.com
Product Information: 1 (800) 582-3835, LUBETEK@chevron.com

SECTION 2 HAZARDS IDENTIFICATION

CLASSIFICATION: Not classified as hazardous according to 29 CFR 1910.1200 (2012).

HAZARDS NOT OTHERWISE CLASSIFIED: Not Applicable

SECTION 3 COMPOSITION/ INFORMATION ON INGREDIENTS

COMPONENTS	CAS NUMBER	AMOUNT
Highly refined mineral oil (C15 - C50)	Mixture	70 - 99 %weight

SECTION 4 FIRST AID MEASURES

Description of first aid measures
Eye: No specific first aid measures are required. As a precaution, remove contact lenses, if worn, and flush eyes with water.
Skin: No specific first aid measures are required. As a precaution, remove clothing and shoes if contaminated. To remove the material from skin, use soap and water. Discard contaminated clothing and shoes or thoroughly clean before reuse.

Revision Number: 16
Revision Date: July 13, 2020

1 of 7

Clarity Hydraulic Oil AW 32, 46, 68, 100
SDS : 6691

Ingestion: No specific first aid measures are required. Do not induce vomiting. As a precaution, get medical advice.
Inhalation: No specific first aid measures are required. If exposed to excessive levels of material in the air, move the exposed person to fresh air. Get medical attention if coughing or respiratory discomfort occurs.

Most important symptoms and effects, both acute and delayed
IMMEDIATE HEALTH EFFECTS
Eye: Not expected to cause prolonged or significant eye irritation.
Skin: High-Pressure Equipment Information: Accidental high-velocity injection under the skin of materials of this type may result in serious injury. Seek medical attention at once should an accident like this occur. The initial wound at the injection site may not appear to be serious at first; but, if left untreated, could result in disfigurement or amputation of the affected part.
Contact with the skin is not expected to cause prolonged or significant irritation. Contact with the skin is not expected to cause an allergic skin response. Not expected to be harmful to internal organs if absorbed through the skin.
Ingestion: Not expected to be harmful if swallowed.
Inhalation: Not expected to be harmful if inhaled. Contains a petroleum-based mineral oil. May cause respiratory irritation or other pulmonary effects following prolonged or repeated inhalation of oil mist at airborne levels above the recommended mineral oil mist exposure limit. Symptoms of respiratory irritation may include coughing and difficulty breathing.

DELAYED OR OTHER HEALTH EFFECTS: Not classified

Indication of any immediate medical attention and special treatment needed
Note to Physicians: In an accident involving high-pressure equipment, this product may be injected under the skin. Such an accident may result in a small, sometimes bloodless, puncture wound. However, because of its driving force, material injected into a fingertip can be deposited into the palm of the hand. Within 24 hours, there is usually a great deal of swelling, discoloration, and intense throbbing pain. Immediate treatment at a surgical emergency center is recommended.

SECTION 5 FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA: Use water fog, foam, dry chemical or carbon dioxide (CO_2) to extinguish flames.
Unusual Fire Hazards: Leaks/ruptures in high pressure system using materials of this type can create a fire hazard when in the vicinity of ignition sources (eg. open flame, pilot lights, sparks, or electric arcs).

PROTECTION OF FIRE FIGHTERS:
Fire Fighting Instructions: This material will burn although it is not easily ignited. See Section 7 for proper handling and storage. For fires involving this material, do not enter any enclosed or confined fire space without proper protective equipment, including self-contained breathing apparatus.
Combustion Products: Highly dependent on combustion conditions. A complex mixture of airborne solids, liquids, and gases including carbon monoxide, carbon dioxide, and unidentified organic compounds will be evolved when this material undergoes combustion.

SECTION 6 ACCIDENTAL RELEASE MEASURES

Protective Measures: Eliminate all sources of ignition in vicinity of spilled material.
Spill Management: Stop the source of the release if you can do it without risk. Contain release to prevent further contamination of soil, surface water or groundwater. Clean up spill as soon as possible, observing precautions in Exposure Controls/Personal Protection. Use appropriate techniques such as applying non-combustible absorbent materials or pumping. Where feasible and appropriate, remove contaminated soil. Place contaminated materials in disposable containers and dispose of in a manner

consistent with applicable regulations.
Reporting: Report spills to local authorities and/or the U.S. Coast Guard's National Response Center at (800) 424-8802 as appropriate or required.

SECTION 7 HANDLING AND STORAGE

General Handling Information: Avoid contaminating soil or releasing this material into sewage and drainage systems and bodies of water.
Precautionary Measures: DO NOT USE IN HIGH PRESSURE SYSTEMS in the vicinity of flames, sparks and hot surfaces. Use only in well ventilated areas. Keep container closed.
Static Hazard: Electrostatic charge may accumulate and create a hazardous condition when handling this material. To minimize this hazard, bonding and grounding may be necessary but may not, by themselves, be sufficient. Review all operations which have the potential of generating and accumulating an electrostatic charge and/or a flammable atmosphere (including tank and container filling, splash filling, tank cleaning, sampling, gauging, switch loading, filtering, mixing, agitation, and vacuum truck operations) and use appropriate mitigating procedures.
Container Warnings: Container is not designed to contain pressure. Do not use pressure to empty container or it may rupture with explosive force. Empty containers retain product residue (solid, liquid, and/or vapor) and can be dangerous. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose such containers to heat, flame, sparks, static electricity, or other sources of ignition. They may explode and cause injury or death. Empty containers should be completely drained, properly closed, and promptly returned to a drum reconditioner or disposed of properly.

SECTION 8 EXPOSURE CONTROLS/PERSONAL PROTECTION

GENERAL CONSIDERATIONS:
Consider the potential hazards of this material (see Section 2), applicable exposure limits, job activities, and other substances in the work place when designing engineering controls and selecting personal protective equipment. If engineering controls or work practices are not adequate to prevent exposure to harmful levels of this material, the personal protective equipment listed below is recommended. The user should read and understand all instructions and limitations supplied with the equipment since protection is usually provided for a limited time or under certain circumstances.

ENGINEERING CONTROLS:
Use in a well-ventilated area.

PERSONAL PROTECTIVE EQUIPMENT
Eye/Face Protection: No special eye protection is normally required. Where splashing is possible, wear safety glasses with side shields as a good safety practice.
Skin Protection: No special protective clothing is normally required. Where splashing is possible, select protective clothing depending on operations conducted, physical requirements and other substances in the workplace. Suggested materials for protective gloves include: 4H (PE/EVAL), Nitrile Rubber, Silver Shield, Viton.
Respiratory Protection: No respiratory protection is normally required.
If user operations generate an oil mist, determine if airborne concentrations are below the occupational exposure limit for mineral oil mist. If not, wear an approved respirator that provides adequate protection from the measured concentrations of this material. For air-purifying respirators use a particulate cartridge.
Use a positive pressure air-supplying respirator in circumstances where air-purifying respirators may not provide adequate protection.

Occupational Exposure Limits:

Component	Agency	Form	TWA	STEL	Ceiling	Notation
Highly refined mineral oil	ACGIH	--	5 mg/m3	10 mg/m3	--	--

(C15 - C50)						
Highly refined mineral oil (C15 - C50)	OSHA Z-1	--	5 mg/m3	--	--	--

Consult local authorities for appropriate values.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Attention: the data below are typical values and do not constitute a specification.

Color: Colorless to yellow
Physical State: Liquid
Odor: Petroleum odor
Odor Threshold: No data available
pH: Not Applicable
Vapor Pressure: No data available
Vapor Density (Air = 1): No data available
Initial Boiling Point: No data available
Solubility: Soluble in hydrocarbons; insoluble in water
Freezing Point: Not Applicable
Melting Point: No data available
Density: 0.8618 kg/l - 0.8694 kg/l @ 15°C (59°F) (Typical)
Viscosity: 32 mm2/s - 110 mm2/s @ 40°C (104°F) (Minimum)
Evaporation Rate: No data available
Decomposition temperature: No data available
Octanol/Water Partition Coefficient: No data available

FLAMMABLE PROPERTIES:
Flammability (solid, gas): Not Applicable

Flashpoint: (Cleveland Open Cup) 190 °C (374 °F) (Minimum)
Autoignition: No data available
Flammability (Explosive) Limits (% by volume in air): Lower: Not Applicable Upper: Not Applicable

SECTION 10 STABILITY AND REACTIVITY

Reactivity: May react with strong acids or strong oxidizing agents, such as chlorates, nitrates, peroxides, etc.
Chemical Stability: This material is considered stable under normal ambient and anticipated storage and handling conditions of temperature and pressure.
Incompatibility With Other Materials: Not applicable
Hazardous Decomposition Products: None known (None expected)
Hazardous Polymerization: Hazardous polymerization will not occur.

SECTION 11 TOXICOLOGICAL INFORMATION

Information on toxicological effects
Serious Eye Damage/Irritation: The eye irritation hazard is based on evaluation of data for product components.

Skin Corrosion/Irritation: The skin irritation hazard is based on evaluation of data for product components.

Skin Sensitization: The skin sensitization hazard is based on evaluation of data for product components.

Acute Dermal Toxicity: The acute dermal toxicity hazard is based on evaluation of data for product components.

Acute Oral Toxicity: The acute oral toxicity hazard is based on evaluation of data for product components.

Acute Inhalation Toxicity: The acute inhalation toxicity hazard is based on evaluation of data for product components.
Acute Toxicity Estimate: Not Determined

Germ Cell Mutagenicity: The hazard evaluation is based on data for components or a similar material.

Carcinogenicity: The hazard evaluation is based on data for components or a similar material.

Reproductive Toxicity: The hazard evaluation is based on data for components or a similar material.

Specific Target Organ Toxicity - Single Exposure: The hazard evaluation is based on data for components or a similar material.

Specific Target Organ Toxicity - Repeated Exposure: The hazard evaluation is based on data for components or a similar material.

ADDITIONAL TOXICOLOGY INFORMATION:
This product contains petroleum base oils which may be refined by various processes including severe solvent extraction, severe hydrocracking, or severe hydrotreating. None of the oils requires a cancer warning under the OSHA Hazard Communication Standard (29 CFR 1910.1200). These oils have not been listed in the National Toxicology Program (NTP) Annual Report nor have they been classified by the International Agency for Research on Cancer (IARC) as; carcinogenic to humans (Group 1), probably carcinogenic to humans (Group 2A), or possibly carcinogenic to humans (Group 2B).
These oils have not been classified by the American Conference of Governmental Industrial Hygienists (ACGIH) as: confirmed human carcinogen (A1), suspected human carcinogen (A2), or confirmed animal carcinogen with unknown relevance to humans (A3).

SECTION 12 ECOLOGICAL INFORMATION

ECOTOXICITY
This material is not expected to be harmful to aquatic organisms.
The product has not been tested. The statement has been derived from the properties of the individual components.

MOBILITY
No data available.

PERSISTENCE AND DEGRADABILITY
This material is not expected to be readily biodegradable. The biodegradability of this material is based on an evaluation of data for the components or a similar material.
The product has not been tested. The statement has been derived from the properties of the individual components.

POTENTIAL TO BIOACCUMULATE
Bioconcentration Factor: No data available.
Octanol/Water Partition Coefficient: No data available

SECTION 13 DISPOSAL CONSIDERATIONS

Use material for its intended purpose or recycle if possible. Oil collection services are available for used oil recycling or disposal. Place contaminated materials in containers and dispose of in a manner consistent with applicable regulations. Contact your sales representative or local environmental or health authorities for approved disposal or recycling methods.

SECTION 14 TRANSPORT INFORMATION

The description shown may not apply to all shipping situations. Consult 49CFR, or appropriate Dangerous Goods Regulations, for additional description requirements (e.g., technical name) and mode-specific or quantity-specific shipping requirements.

DOT Shipping Description: NOT REGULATED AS HAZARDOUS MATERIAL UNDER 49 CFR

IMO/IMDG Shipping Description: NOT REGULATED AS DANGEROUS GOODS FOR TRANSPORT UNDER THE IMDG CODE

ICAO/IATA Shipping Description: NOT REGULATED AS DANGEROUS GOODS FOR TRANSPORT UNDER ICAO

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC code:
Not applicable

SECTION 15 REGULATORY INFORMATION

EPCRA 311/312 CATEGORIES: Not applicable

REGULATORY LISTS SEARCHED:

01-1=IARC Group 1	03=EPCRA 313
01-2A=IARC Group 2A	04=CA Proposition 65
01-2B=IARC Group 2B	05=MA RTK
02=NTP Carcinogen	06=NJ RTK
	07=PA RTK

No components of this material were found on the regulatory lists above.

CHEMICAL INVENTORIES:
All components comply with the following chemical inventory requirements: AICS (Australia), DSL (Canada), EINECS (European Union), ENCS (Japan), IECSC (China), KECI (Korea), NZIoC (New Zealand), PICCS (Philippines), TCSI (Taiwan), TSCA (United States).

NEW JERSEY RTK CLASSIFICATION:
Under the New Jersey Right-to-Know Act L. 1983 Chapter 315 N.J.S.A. 34:5A-1 et. seq., the product is to be identified as follows: PETROLEUM OIL (Hydraulic oil)

SECTION 16 OTHER INFORMATION

NFPA RATINGS: Health: 0 Flammability: 1 Reactivity: 0

HMIS RATINGS: Health: 0 Flammability: 1 Reactivity: 0
(0-Least, 1-Slight, 2-Moderate, 3-High, 4-Extreme, PPE:- Personal Protection Equipment Index

recommendation, *- Chronic Effect Indicator). These values are obtained using the guidelines or published evaluations prepared by the National Fire Protection Association (NFPA) or the National Paint and Coating Association (for HMIS ratings).

REVISION STATEMENT: SECTION 01 - Product Code(s) information was modified.
SECTION 08 - Occupational Exposure Limit Table information was modified.
SECTION 09 - Physical/Chemical Properties information was modified.
SECTION 15 - Chemical Inventories information was deleted.
SECTION 15 - Chemical Inventories information was modified.
SECTION 15 - SARA 311 EPCRA Score information was added.
SECTION 15 - SARA 311 Score information was deleted.

Revision Date: July 13, 2020

ABBREVIATIONS THAT MAY HAVE BEEN USED IN THIS DOCUMENT:

TLV - Threshold Limit Value	TWA - Time Weighted Average
STEL - Short-term Exposure Limit	PEL - Permissible Exposure Limit
GHS - Globally Harmonized System	CAS - Chemical Abstract Service Number
ACGIH - American Conference of Governmental Industrial Hygienists	IMO/IMDG - International Maritime Dangerous Goods Code
API - American Petroleum Institute	SDS - Safety Data Sheet
HMIS - Hazardous Materials Information System	NFPA - National Fire Protection Association (USA)
DOT - Department of Transportation (USA)	NTP - National Toxicology Program (USA)
IARC - International Agency for Research on Cancer	OSHA - Occupational Safety and Health Administration
NCEL - New Chemical Exposure Limit	EPA - Environmental Protection Agency
SCBA - Self-Contained Breathing Apparatus	

Prepared according to the 29 CFR 1910.1200 (2012) by Chevron Energy Technology Company, 6001 Bollinger Canyon Road, San Ramon, CA 94583.

The above information is based on the data of which we are aware and is believed to be correct as of the date hereof. Since this information may be applied under conditions beyond our control and with which we may be unfamiliar and since data made available subsequent to the date hereof may suggest modifications of the information, we do not assume any responsibility for the results of its use. This information is furnished upon condition that the person receiving it shall make his own determination of the suitability of the material for his particular purpose.

Appendix 9 Environmental Screening Study (May 2020)

Final
11 May 2020

Environmental Screening Study

for the proposed Square Kilometre Array (SKA) fibre optic cable from Beaufort West to Carnarvon

CSIR
our future through science

Prepared by: Council for Scientific and Industrial Research (CSIR)
Environmental Management Services

Authors: Luanita Snyman-van der Walt (Pr. Sci. Nat)
Paul Lochner (Pr. EAP)
Lizande Kellerman (Pr. Sci. Nat)

Prepared for: South African Research Network (SANReN)

SUMMARY

This Environmental Screening Study (ESS) reviews available geographic information and legislative requirements to determine the need for the proposed Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon to:

- obtain an Environmental Authorisation in terms of the National Environmental Management Act (No. 107 of 1998) Environmental Impact Assessment Regulations (2014, as amended in 2017), or obtain exclusion from Environmental Authorisation as part of the SKA Phase 1 environmental management instrument (Government Gazette 42323, Notice 436;)
- obtain a Water Use License in terms of the National Water Act (No. 36 of 1998); and
- conduct a Heritage Impact Assessment and obtain approval from the South African Heritage Resources Agency in terms of the National Heritage Act (No. 25 of 1999).

The baseline environmental description (§3) provides an overview of the ecosystems, species and heritage features that could potentially be impacted by the proposed development. Notably, the proposed route will traverse several Critical Biodiversity Areas and will have to make twenty-one river crossings. Some of these riverine / riparian ecosystems are the habitat of "Critically Endangered" Riverine rabbits. These findings are consistent with the "Screening Tool Report" generated for the proposed fibre optic cable route (Appendix A).

The results of legislative screening (§4) indicate that:

- The SKA Phase 1 Integrated Environmental Management Plan and Exclusion from Environmental Authorisation does not apply since the proposed fibre optic cable is not situated within the SKA Phase 1 geographical area;
- A **Basic Assessment** procedure is required to obtain Environmental Authorisation for the proposed fibre optic route. This requirement is triggered by Listing Notice 3, Activity 12 of the Environmental Impact Assessment Regulations[1];
- A Water Use License Application is required to obtain a **Water Use License** for river crossings. This requirement is triggered by Section 21(c) and (i) of the National Water Act[2]; and
- A **Heritage Impact Assessment** is required for comment and / or approval by the South African Heritage Resources Agency). This requirement is triggered in terms of Section 38(1)(a) of the National Heritage Act[3], and can be conducted as part of the Basic Assessment.

These outcomes have been confirmed with the relevant Authorities.

Finally, this report concludes with a recommended way forward to obtaining the required Environmental Authorisation, Water Use License and Heritage Approval (§5).

[1] "The clearance of an area of 300 square metres or more of indigenous vegetation…within critical biodiversity areas identified in bioregional plans".
[2] "Impeding or diverting the flow of water in a watercourse; Altering the bed, banks, course or characteristics of a watercourse".
[3] "The construction of a road, wall, powerline, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length"

Contents

List of Tables

List of Figures

Abbreviations and acronyms

AVN	African Very Long Baseline Interferometry
BA	Basic Assessment
CBA	Critical Biodiversity Area
CR	Critically Endangered (ecosystem / species threat status)
DEA&DP	Department of Environmental Affairs and Development Planning (Western Cape)
DEFF	Department of Environment, Forestry and Fisheries
DENC	Department of Nature Conservation (Northern Cape)
DWDM	Dense Wavelength Division Multiplexing
E	Ephemeral (river)
EA	Environmental Authorisation
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
EN	Endangered (ecosystem / species threat status)
ESA	Ecological Support Area
ESS	Environmental Screening Study
FEPA	Freshwater Ecosystem Priority Area
GA	General Authorisation
GG	Government Gazette
GIS	Geographic Information System
HartRAO	Hartebeesthoek Radio Astronomy Observatory
HDD	Horizontal Directional Drilling
HIA	Heritage Impact Assessment
IEMP	Integrated Environmental Management Plan
LC	Least Concern (ecosystem / species threat status)
LN	Listing Notice
LT	Least Threatened (ecosystem / species threat status)
NC	Northern Cape
NEMA	National Environmental Management Act (No. 107 of 1998)
NHA	National Heritage Act (No. 25 of 1999)
NRF	National Research Foundation
NWA	National Water Act (No. 36 of 1998)
ONA	Other Natural Area
P	Perennial (river)
PA	Protected Area
PoP	Point of Presence
SAHRA	South African Heritage Resources Agency
SARAO	South African Radio Astronomy Observatory
SKA	Square Kilometre Array
VU	Vulnerable (ecosystem / species threat status)
WC	Western Cape
WUL	Water Use License
WULA	Water Use License Application

1. Introduction

This Environmental Screening Study (ESS) reviews available geographic information and legislative requirements to determine the need for the proposed Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon to:

- be granted exclusion from obtaining Environmental Authorisation (EA) under the ambit of the Phase 1 SKA Environmental Management Instrument and Exclusion (Government Gazette (GG) 42323, Notice 436, enacted under the National Environmental Management Act (No. 107 of 1998) (NEMA));
- obtain an EA in terms of the NEMA Environmental Impact Assessment (EIA) Regulations (2014, as amended in 2017);
- obtain a Water Use License (WUL) in terms of the National Water Act (No. 36 of 1998) (NWA); and
- conduct a Heritage Impact Assessment (HIA) and obtain approval from the South African Heritage Resources Agency (SAHRA) in terms of the National Heritage Act (No. 25 of 1999) (NHA).

2. Project description[4]

The South African Radio Astronomy Observatory (SARAO) spearheads South Africa's activities in the SKA Radio Telescope, commonly known as the SKA, in engineering, science and construction. SARAO is a National Facility, managed by the National Research Foundation, which incorporates radio astronomy instruments and programmes such as the MeerKAT and KAT-7 telescopes in the Karoo, the Hartebeesthoek Radio Astronomy Observatory (HartRAO) in Gauteng, the African Very Long Baseline Interferometry (AVN) programme in nine African countries, as well as the associated human capital development and commercialisation endeavours.

Connectivity is required between the SKA core site in the Northern Cape and a data processing facility in Cape Town to transport the science data for the SKA project and its precursor, MeerKAT. Access to dark fibre is required to transport this data due to the expected data throughputs for the SKA project.

SARAO has built an overhead fibre route between Carnarvon and the SKA core site. Additionally, SANReN has procured access to fibre between Beaufort West area and Cape Town. A fibre optic cable connection must, therefore, be built between Carnarvon and Beaufort West.

[4] CSIR, 2019:6.

Two potential routes for the SKA fibre optic cable were considered (see Section 2.1). The details of the preferred and selected SKA fibre route (Route A) is as follows:

1. The fibre route starts from Beaufort West Transnet building to Loxton where a 3 m x 6 m container for regeneration of signal then to Carnarvon SKA Point of Presence[5] (PoP) site.
2. The fibre duct and cable will be laid in a 1 m deep and 300 mm wide trench and be buried by backfilling and compacting the trench.
3. The full fibre route will be installed within road reserves and 1 m from the fence of the private land.
4. 155 km will be underground and 25 km will be overhead due to it not being technically or financially feasible to trench on the Molteno Pass section.
5. There are several streams / river and associated wetlands to cross. Rivers will be crossed using directional drilling 2 m below riverbed starting 32 m away from river banks.
6. There is only one river with solid bedrock (the Brak river near Loxton) where directional drilling is not technically or financially feasible. Here the fibre cable will be attached to the existing road bridge.

The proposed SKA fibre optic cable starts in Beaufort West, Western Cape (WC) Province, via Loxton, and terminates in Carnarvon, Northern Cape (NC) Province (Figure 1). The route crosses three local municipalities, namely the Beaufort West Local Municipality (WC), Ubuntu Local Municipality (NC) and the Kareeberg Local Municipality (NC).

Using Geographic Information Systems (GIS) the total construction footprint of the proposed SKA fibre route was calculated (Table 1). The calculated footprints were subsequently also used to identify coinciding conservation planning units (see Section 3.3) and determine spatial thresholds that would trigger the need for an EIA or Basic Assessment (BA) process to acquire EA (see Section 4.2).

[5] Location where networking equipment may be accessed.

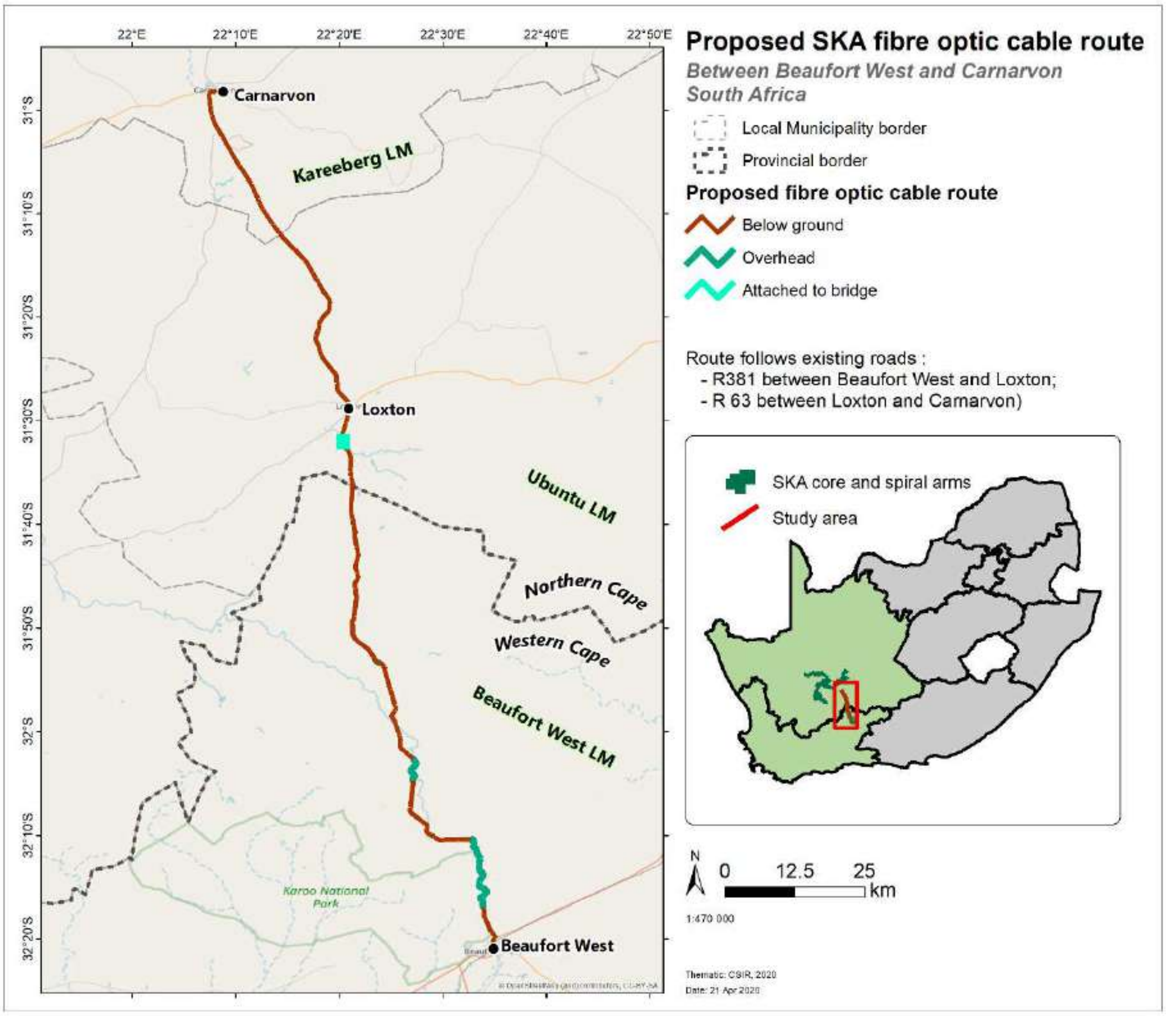


Figure 1: The proposed SKA fibre optic cable route starts in Beaufort West, follows the existing R 381 and R 63 roads via Loxton to Carnarvon.

Table 1: Construction footprints of the proposed SKA fibre optic cable from Beaufort West to Carnarvon.

Fibre optic route section type	Length (m)	Length (km)	Footprint (m^2) *[length x 0.3 m]*
Beaufort West to Loxton			
Trench	92 005.69	92.01	27 601.71
Overhead	20 621.15	20.62	6 186.34
Fence line	2 760.82	2.76	828.25
Concrete encasement	947.13	0.95	284.14
HDD	818.84	0.82	245.65
Attached to bridge	57.54	0.06	17.26
Loxton to Carnarvon			
Trench	65 057.94	65.06	19 517.38
Concrete encasement	1 373.22	1.37	411.97
HDD	347.51	0.35	104.25
Existing sleeve	8.65	0.01	2.59
Total	**183 998.49**	**184.00**	**55 199.55**
HDD: Horizontal Directional Drilling			

2.1 Consideration of alternatives

Two alternative routes for the proposed fibre optic cable routes for the Beaufort West-to-Carnarvon section to complete the SKA-Cape Town connection were considered (Table 2; Figure 2).

Table 2: Summary of the specifications for the two alternative fibre optic cable routes.

Specification	Fibre optic cable route alternatives	
	Option A (Beaufort West – Loxton – Carnarvon)*	**Option B (Beaufort West – Leeu Gamka – Fraserburg – Loxton – Carnarvon)**
Length	184 km	354 km
Total footprint *[length x 0.3 m]*	10.9 ha	19.3 ha
River crossings (SANBI, 2018)	21	37
Total footprint in Critical Biodiversity Areas (CapeNature, 2017; DENC, 2016) *[CBA1 & CBA2]*	57 617 m^2	83 783 m^2
CBA: Critical Biodiversity Area		

* *Preferred from an environmental, engineering and technical perspective.*

Option A (Beaufort West – Loxton – Carnarvon) is the most direct and shortest route between the Beaufort West area and Carnarvon and is therefore preferred from an environmental, engineering and technical perspective. Option A is considerably shorter than Option B (-170 km) and is therefore the preferred option by SARAO. Having a shorter link between end points leads to potentially higher transfer speeds per wavelength on the Dense Wavelength Division Multiplexing (DWDM) system[6] and lower latency. The rate and volume of data that will be transferred from the SKA via the fibre optic cable require high transfer speed and low latency. This is partly achieved through establishing a shortest and most direct route for the fibre optic cable. The shorter length of Option A also results in lower engineering and environmental costs as it has fewer river crossings and a smaller cumulative construction footprint (including in Critical Biodiversity Areas). The longer Option B route would also require the establishment

[6] Technology that combines data signals from different sources so they can share a single optical fiber pair while maintaining complete separation of the data streams.

of an additional repeater station[7], which would require the establishment of another facility (site, container, etc.), extra equipment, electricity supply, cooling system and security. Furthermore, Option B would also require SANReN to redesign the DWDM system that has already been deployed by adding a new add-drop site in Leeu Gamka.

Route Option A (Beaufort West – Loxton – Carnarvon) is thus taken forward and further considered in this ESS and any other future subsequent environmental assessment required.

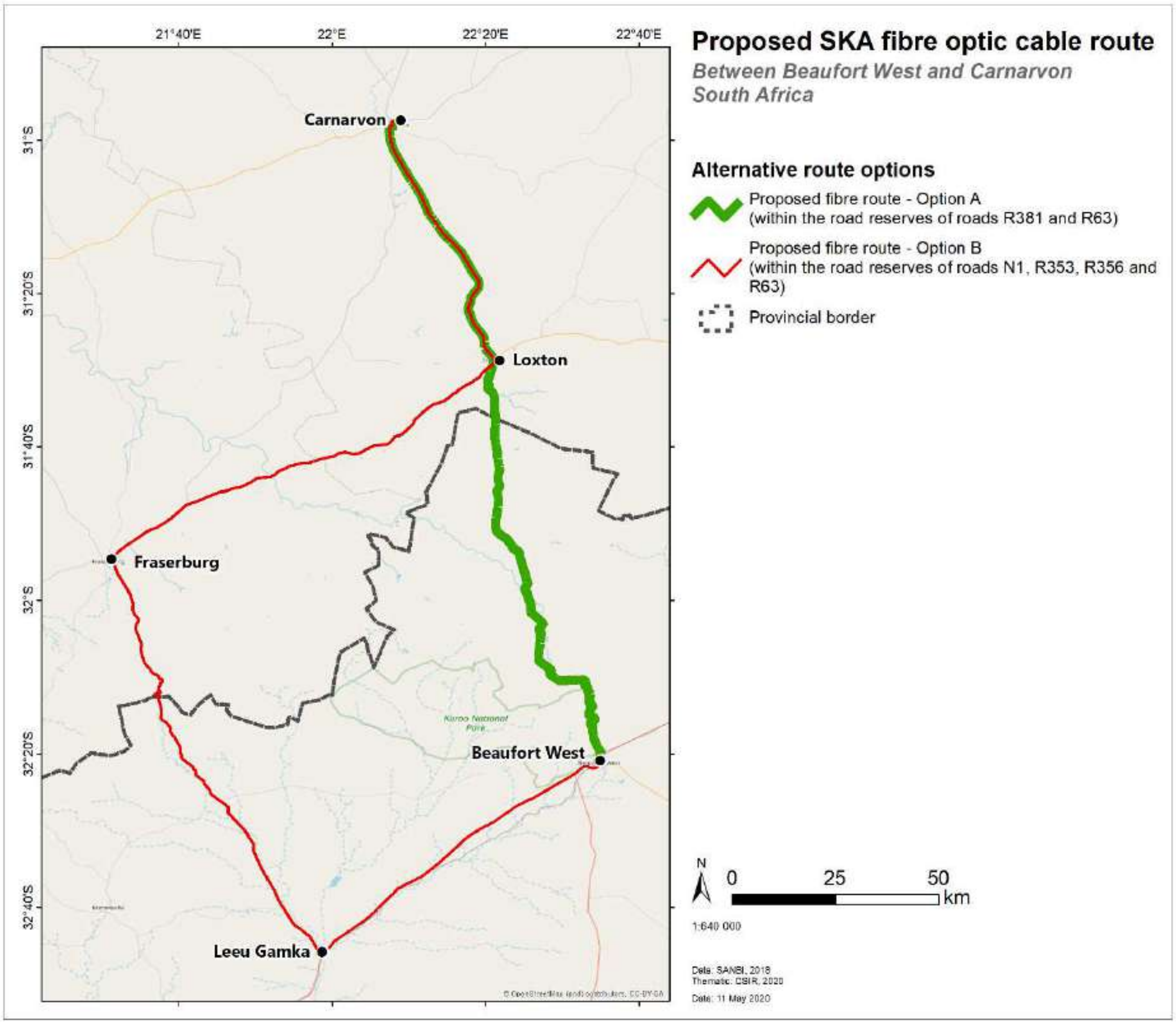


Figure 2: Two alternative routes for the proposed fibre optic cable between the Beaufort West area and Carnarvon were considered.

[7] System used to regenerate and extend the reach of a DWDM system and correct any signal distortion.

3. Baseline environmental description

3.1 Terrestrial ecology

Flora

The proposed SKA fibre optic cable route spans several vegetation types in the Nama Karoo biome, the most prominent of which is the Eastern Upper Karoo. Azonal vegetation – Southern Karoo Riviere – is present in the vicinity of Beaufort West (Table 3, Figure 3). The ecosystem threat status of these vegetation types are listed as "Least Concern" (LC) (SANBI, 2018). Two sensitive plant species may be present along the proposed route, one of which is the Tree Rice-bush (*Cliffortia arborea*) ("Vulnerable" (VU)) (Whitehouse & Raimondo, 2007), the other is only identified as "Sensitive species 704" (see Appendix A, pg. 21).

Table 3: Vegetation types traversed by the proposed SKA fibre optic cable.

<table>
<tr><th>Vegetation type</th><th>Biome</th><th>Bioregion</th><th>Ecosystem threat status</th><th>Protection level</th></tr>
<tr><td>Southern Karoo Riviere</td><td>Azonal Vegetation</td><td>Inland Saline Vegetation</td><td>LC</td><td>PP</td></tr>
<tr><td>Gamka Karoo</td><td rowspan="5">Nama-Karoo</td><td>Lower Karoo Bioregion</td><td>LC</td><td>PP</td></tr>
<tr><td>Eastern Upper Karoo</td><td rowspan="4">Upper Karoo Bioregion</td><td>LC</td><td>PP</td></tr>
<tr><td>Northern Upper Karoo</td><td>LC</td><td>NP</td></tr>
<tr><td>Upper Karoo Hardeveld</td><td>LC</td><td>PP</td></tr>
<tr><td>Western Upper Karoo</td><td>LC</td><td>NP</td></tr>
<tr><td colspan="5">LC: Least Concern; PP: Poorly Protected; NP: Not Protected</td></tr>
</table>

Fauna

The "Critically Endangered" (CR) Riverine rabbit (*Bunolagus monticularis*) occurs within the region (Collins et al., 2019; Appendix A, pg. 16). The habitat of Riverine rabbit, as the name suggests, is typically riparian scrub. As such, care must be taken where the fibre optic cable crosses rivers to identify and minimise impacts to potential burrows, and limit construction in these areas during the breeding season (August to May (Duthie, 1989)). Southern Mountain Reedbuck (*Redunca fulvorufula fulvorufula*), listed as "Endangered" (EN) (Child et al., 2016) can also be found within the region where the fibre optic cable is proposed (Appendix A, pg. 16).

The Karoo dwarf tortoise (*Chersobius boulengeri*) (EN) is an endemic reptile which occurs within the region (Hofmeyer et al., 2018; Appendix A, pg. 16). This species, along with the other described in this section, would be at risk to falling into and getting stuck in open trenches during the construction phase of establishing the fibre optic cable.

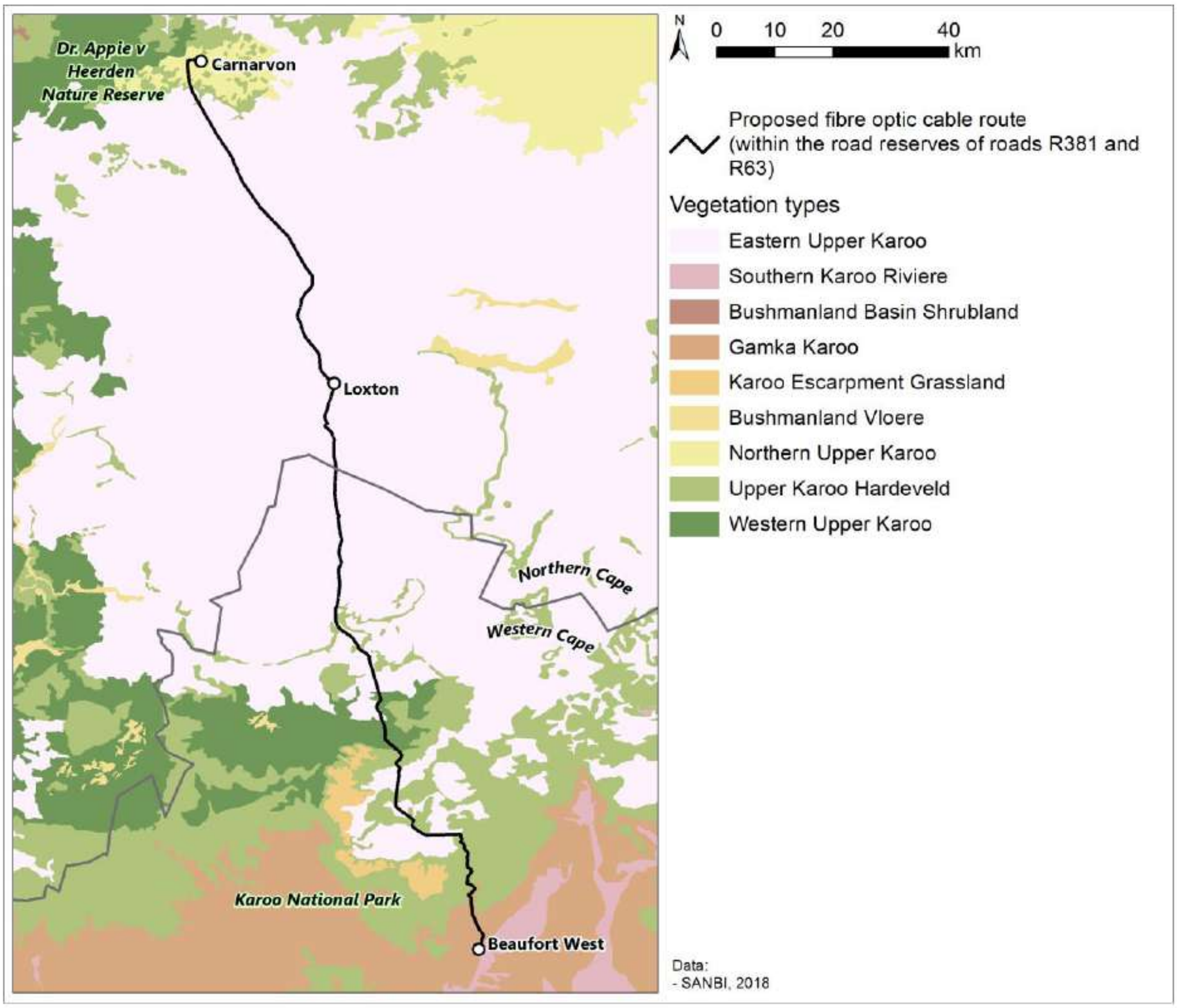


Figure 3: Vegetation types traversed by the proposed SKA fibre optic cable is mainly within the Nama Karoo biome.

Avifauna

Black harrier (*Circus maurus*) (EN) (Birdlife International, 2017) and Verraux's eagle (*Aquila verreauxii*) (LC) (Birdlife International, 2016) are known to be present within the region that the fibre optic cable is proposed (see Appendix A, pg.16). Sections of the proposed cabling, buried at a depth of 1 m, do not pose any risk to birds. Overhead sections of the cabling across the Molteno pass, at a height of 7.5 m, may be frequented by larger birds as perches, but doesn't pose an electrocution risk.

3.2 Aquatic ecology

Water Management Areas and catchments

The proposed fibre optic cable is situated in seven quaternary catchments in the Gourits and Lower Orange Water Management Areas (Figure 4).

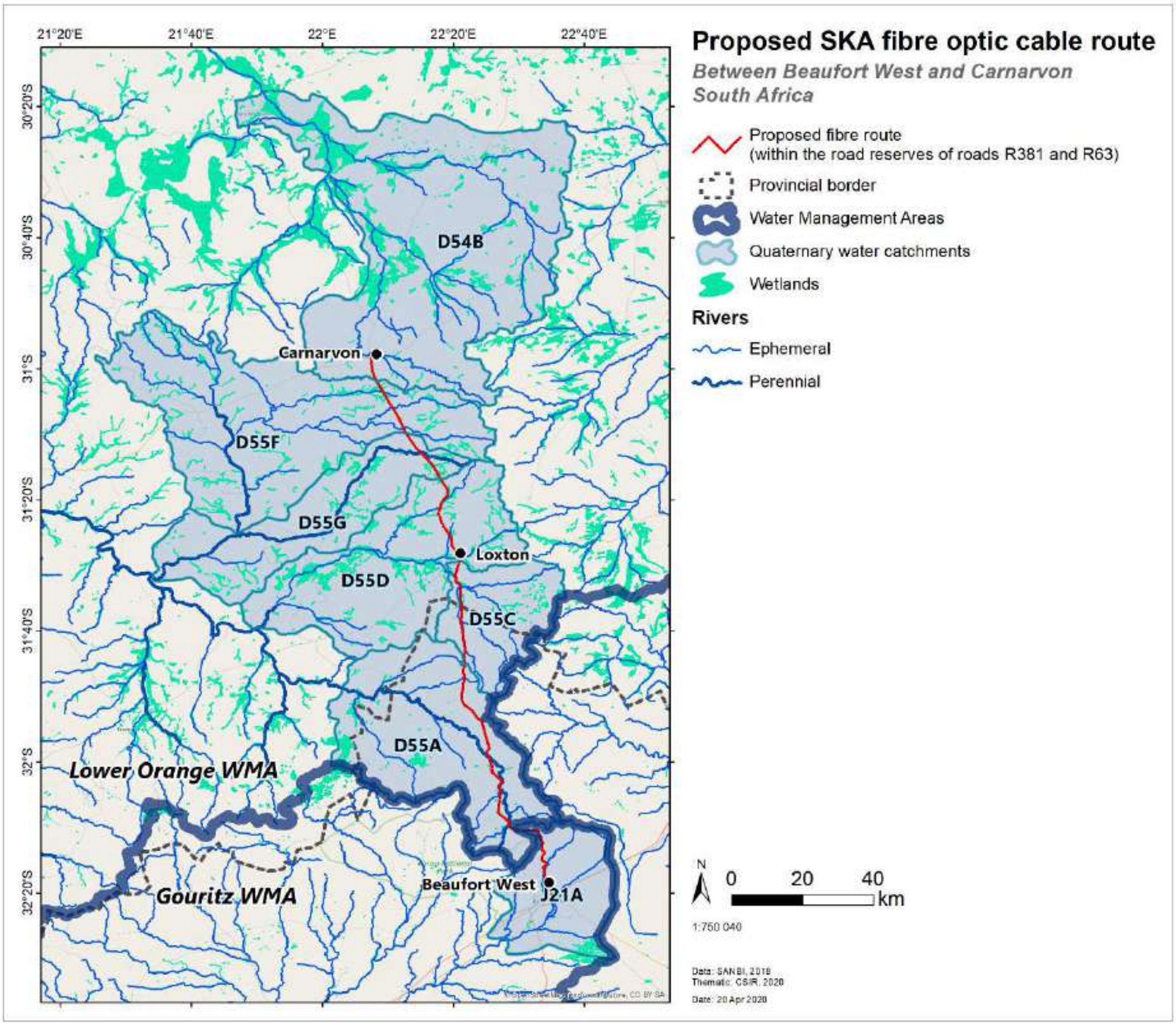


Figure 4: Water management areas and quaternary catchments traversed by the proposed SKA fibre optic cable.

Aquatic ecosystems (rivers and wetlands)

The proposed route makes 21 crossings over 16 different rivers (see Table 4) and several wetlands (mostly associated with the rivers) in the region (Figure 5). The majority of rivers in the Karoo region is ephemeral, with Gansvlei and Sak being the only perennial rivers. Some sections of the rivers are characterised as being Endangered (EN) (SANBI, 2018) (refer to Figure 6).

Table 4: Rivers that will have to be crossed by the proposed SKA fibre optic cable.

Fibre optic route section type	Rivers (SANBI, 2018)			Location	
	Name	Flow	Ecosystem threat status	Latitude	Longitude
Beaufort West to Loxton Section					
HDD	Gamka	E	LT	32° 21' 1.487" S	22° 34' 48.714" E
HDD	Slangfontein	E	LT	31° 38' 30.572" S	22° 21' 8.788" E
HDD	Slangfontein	E	EN	31° 33' 23.048" S	22° 21' 3.411" E
Overhead	Gamka	E	LT	32° 17' 0.397" S	22° 33' 54.534" E
Overhead	Sak	P	LT	32° 4' 15.212" S	22° 27' 14.772" E
Overhead	Sak	P	EN	32° 3' 4.805" S	22° 27' 25.553" E
Attached to bridge	Brak	E	EN	31° 32' 11.737" S	22° 20' 22.433" E
Trench	Sak	P	LT	32° 9' 42.927" S	22° 28' 27.878" E
Trench	Sak	P	EN	31° 59' 8.794" S	22° 25' 23.540" E
Trench	Unnamed 1	E	LT	31° 38' 58.918" S	22° 21' 11.368" E
Trench	Unnamed 2	E	LT	31° 28' 57.735" S	22° 21' 3.598" E
Trench	Unnamed 3	E	LT	31° 40' 35.321" S	22° 21' 28.617" E
Trench	Unnamed 4	E	LT	31° 41' 7.198" S	22° 21' 29.143" E
Trench	Unnamed 5	E	LT	31° 47' 7.354" S	22° 21' 39.110" E
Loxton to Carnarvon Section					
Concrete encasement	Unnamed 6	E	LT	31° 25' 12.441" S	22° 19' 24.296" E
HDD	Alarmleegte	E	EN	31° 5' 49.087" S	22° 10' 38.113" E
HDD	Soutpoort	E	EN	31° 20' 55.530" S	22° 18' 3.110" E
Trench	Brak	E	EN	31° 9' 5.903" S	22° 12' 21.755" E
Trench	Gansvlei	P	EN	31° 12' 46.116" S	22° 15' 0.825" E
Trench	Reitzvilleleegte	E	LT	31° 3' 35.736" S	22° 9' 17.793" E
Trench	Unnamed 7	E	LT	31° 25' 12.441" S	22° 19' 24.296" E
E: Ephemeral; P: Perennial; EN: Endangered; LT: Least Threatened					

[Note: the potential crossing methodology of some of the fibre optic cable route sections, based on spatial data, are indicated as "trench". This could be attributed to spatial inaccuracies. The presence of rivers / river crossings and confirmation of appropriate crossing methodologies will be determined at the EIA phase.]

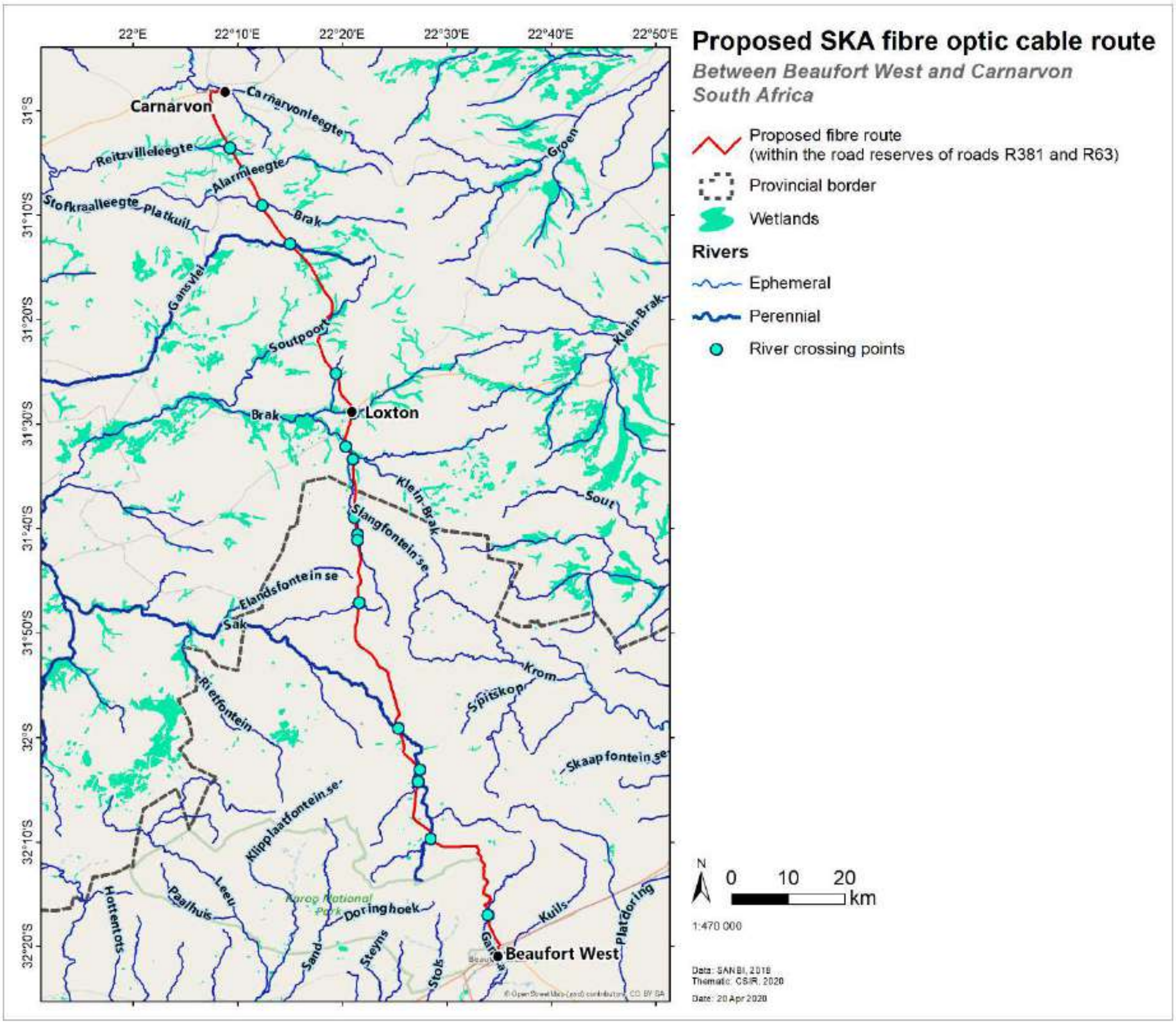


Figure 5: Rivers and wetlands in the project area proposed for the SKA fibre optic cable route from Beaufort West to Carnarvon.
[Note: smaller wetlands may not be visible at the scale of this map]

In addition to some of the rivers in the proposed project area being listed as EN, several water catchments are classified as Freshwater Ecosystem Priority Areas (FEPAs) – strategic priority areas for conserving freshwater ecosystems and supporting sustainable use of water resources – and Upstream Management Areas (Driver et al., 2011) (Figure 6).

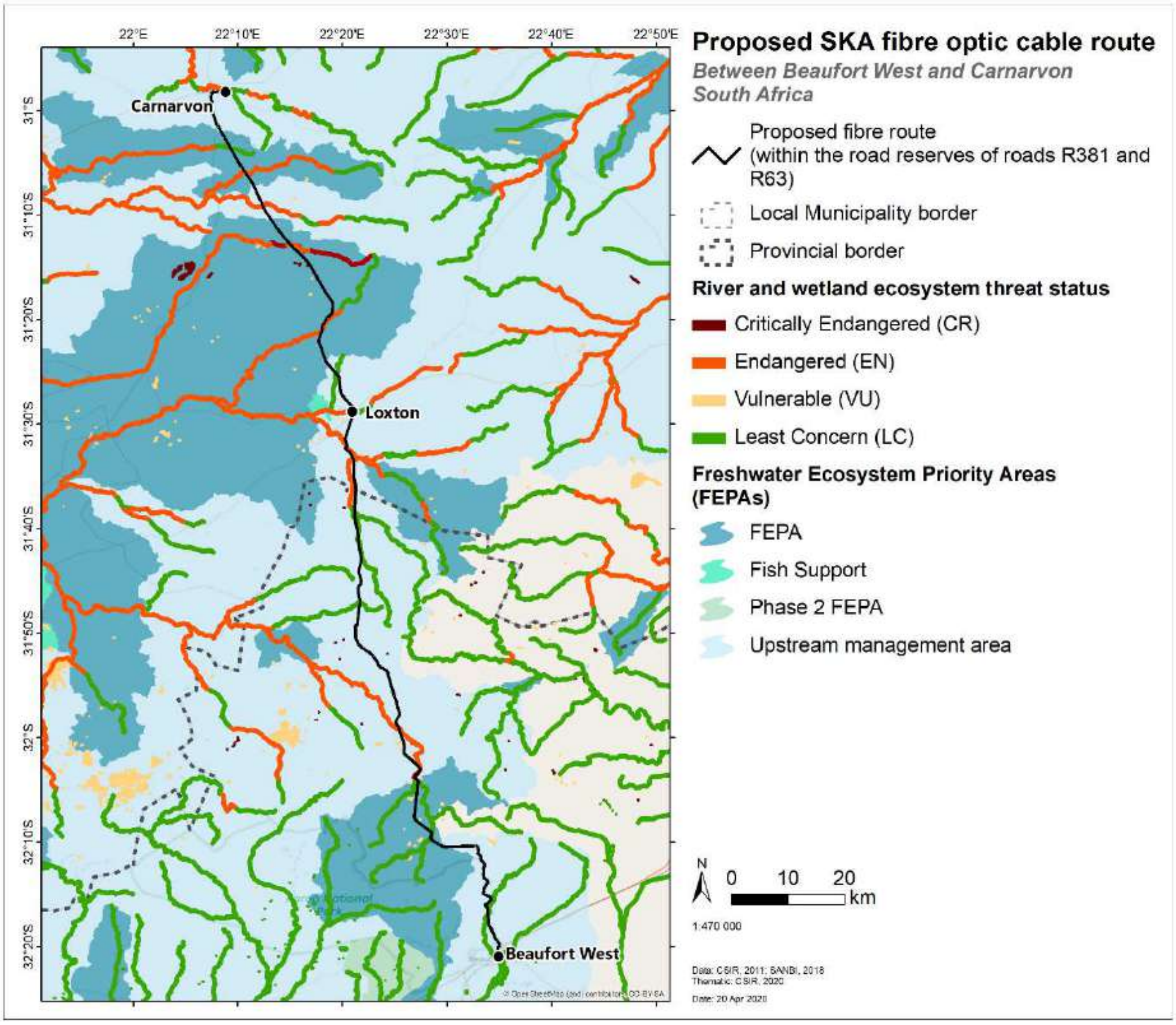


Figure 6: River ecosystem threat and freshwater priority areas in the project area proposed for the SKA fibre optic cable route from Beaufort West to Carnarvon.
[Note: smaller wetlands may not be visible at the scale of this map]

3.3 Conservation planning

Provincial biodiversity spatial plans or conservation plans is a tool for determining biodiversity priority areas and land use guidance for development planning, environmental assessment and regulation, and natural resource management (CapeNature, 2017). Although proposed within the road reserves of the R381 and R63, the proposed SKA fibre optic route traverses through the Karoo National Park and crosses multiple Critical Diversity Areas (CBAs) and Ecological Support Areas (ESAs) within the Western and Northern Cape Provinces (Figure 7).

The cumulative construction phase footprint (length x 0.3 m) within each of the different conservation planning units were calculated using GIS tools (Table 5). The results indicate an exceedance of the threshold stipulated in Listing Notice 3 Activity 12, entailing the need for an EA – see Table 7 in Section 4.2.

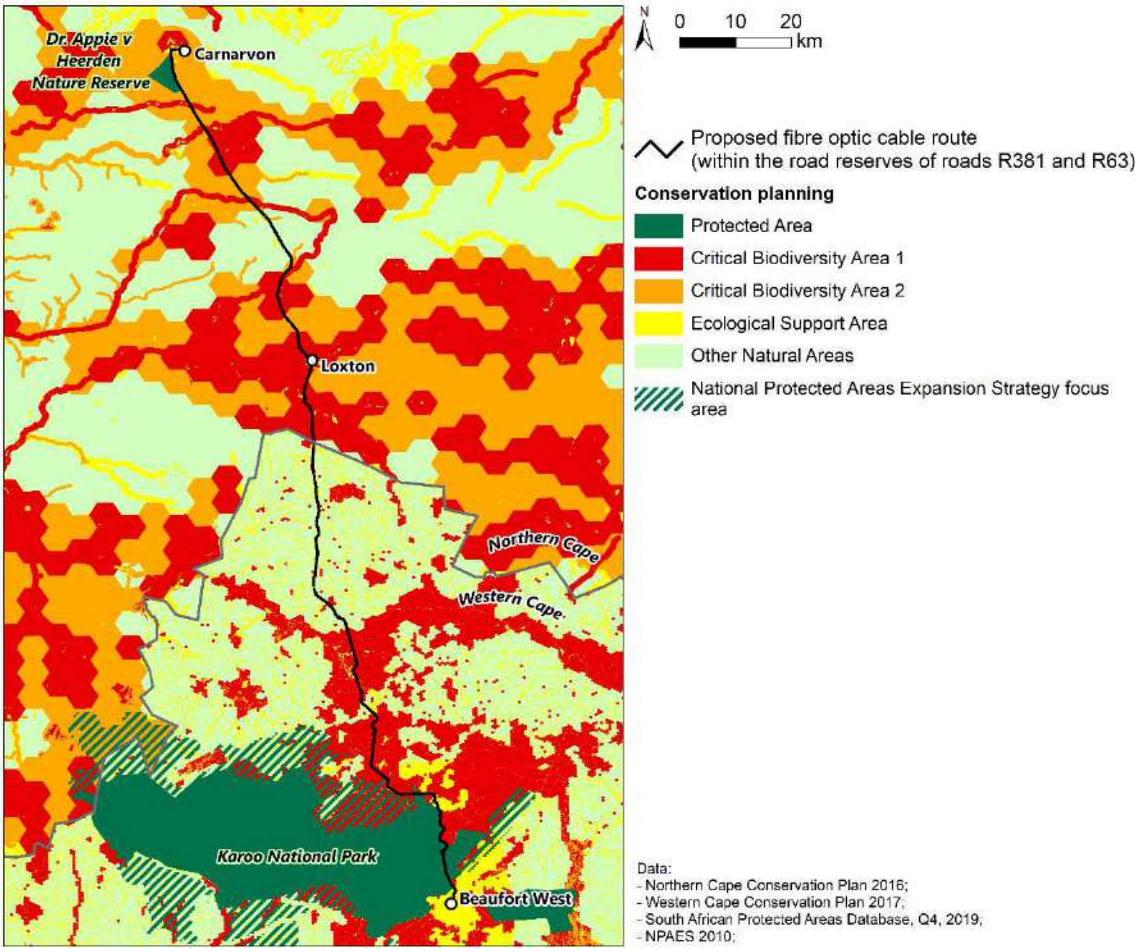


Figure 7: Protected areas and conservation planning in the project area proposed for the SKA fibre optic cable route from Beaufort West to Carnarvon.

Table 5: Construction footprints of the proposed SKA fibre optic cable within Conservation Planning Units.

Conservation Planning Category	Footprint (m^2)
Western Cape (CapeNature, 2017)	
CBA1	19 703.87*
CBA2	110.29
ESA1	5 110.23
ESA2	2 475.61
ONA	15 310.64
PA	6 983.24
Northern Cape (DENC, 2016)	
CBA1	24 844.94*
CBA2	12 958.06
ESA	197.58
ONA	5 436.86
PA	2 573.38
CBA: Critical Biodiversity Area; ESA: Ecological Support Area; ONA: Other Natural Area; PA: Protected Area	

** The construction footprints exceed the threshold stipulated in Listing Notice 3 Activity 12, entailing the need for an EA – refer to Table 7 in Section 4.2.*

3.4 Heritage and palaeontology

Recorded heritage features in the proposed project area are mainly buildings, cemeteries and trees concentrated within the towns of Beaufort West and Carnarvon (SAHRA, 2018).

The regional palaeontological (fossil) sensitivity of the project area proposed for the SKA fibre optic cable route is predominantly Very High (Figure 8), which entails the requirement for a desktop palaeontology assessment and field investigation if necessary (Table 6). One palaeontology find exists within proximity of road R381 between Beaufort West and Loxton (SAHRA, 2018).

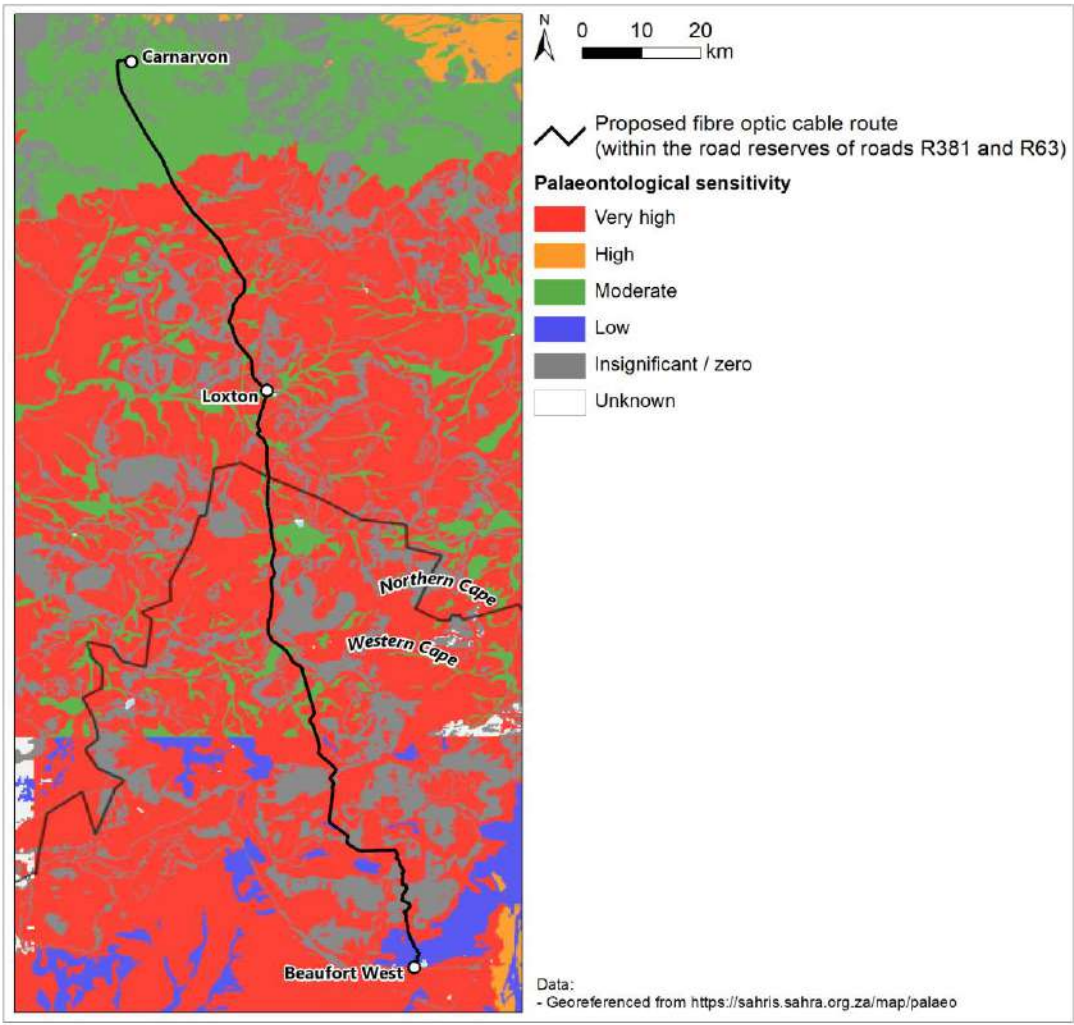


Figure 8: Palaeontological sensitivity of the proposed project area (SAHRA, 2020).

Table 6: Recommended investigation required for each palaeontology sensitivity class (SAHRA, 2020).

Palaeontology sensitivity class	Required action
High	Desktop study is required and based on the outcome of the desktop study, a field assessment is likely.
Moderate	Desktop study is required.
Low	No palaeontological studies are required however a protocol for finds is required.
Insignificant / zero	No palaeontological studies are required.
Unknown	These areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

3.5 Agriculture

The proposed SKA fibre optic cable will be constructed within the road reserve – i.e. between the road surface and the fence line of any adjacent property – where no agriculture is practiced or likely to be practiced in the future. As such, the proposed fibre optic cable poses negligible risk to agricultural resources. However, aspects such as the control of erosion and invasive alien plants, which could have secondary consequences for agricultural resources, will have to be implemented and monitored during all project phases (construction, operations/maintenance, decommissioning).

4. Legislative screening

This section considers the relevant legislation that outlines:

- The applicability of the Phase 1 SKA Environmental Management Instrument and Exclusion (GG 42323: 436) (Section 4.1);

and / or the need for:

- Environmental Authorisation in terms of the NEMA (107/1998) EIA Regulations 2014, as amended in 2017 (Section 4.2; Table 7); and
- Water Use License in terms of the NWA (36/1998) (Section 4.3); and
- HIA and / or approval in terms of the NHA (25/1999) (Section 4.4).

4.1 SKA Environmental Management Instrument and Exclusion

In March 2019, the Minister of Environmental Affairs adopted an environmental management instrument and exclusion for Phase 1 of the SKA from obtaining EA. The environmental management instrument is an Integrated Environmental Management Plan (IEMP) (NRF

SARAO, 2018) which was developed on the basis of an extensive Strategic Environmental Assessment (SEA) process (CSIR, 2016).

The IEMP and EA exclusion applies to:

- development activities related to the SKA, as contemplated in the IEMP, where the National Research Foundation (NRF) is the applicant for EA;
- the geographical area which was assessed in the SEA and contemplated in the IEMP (Figure 9).

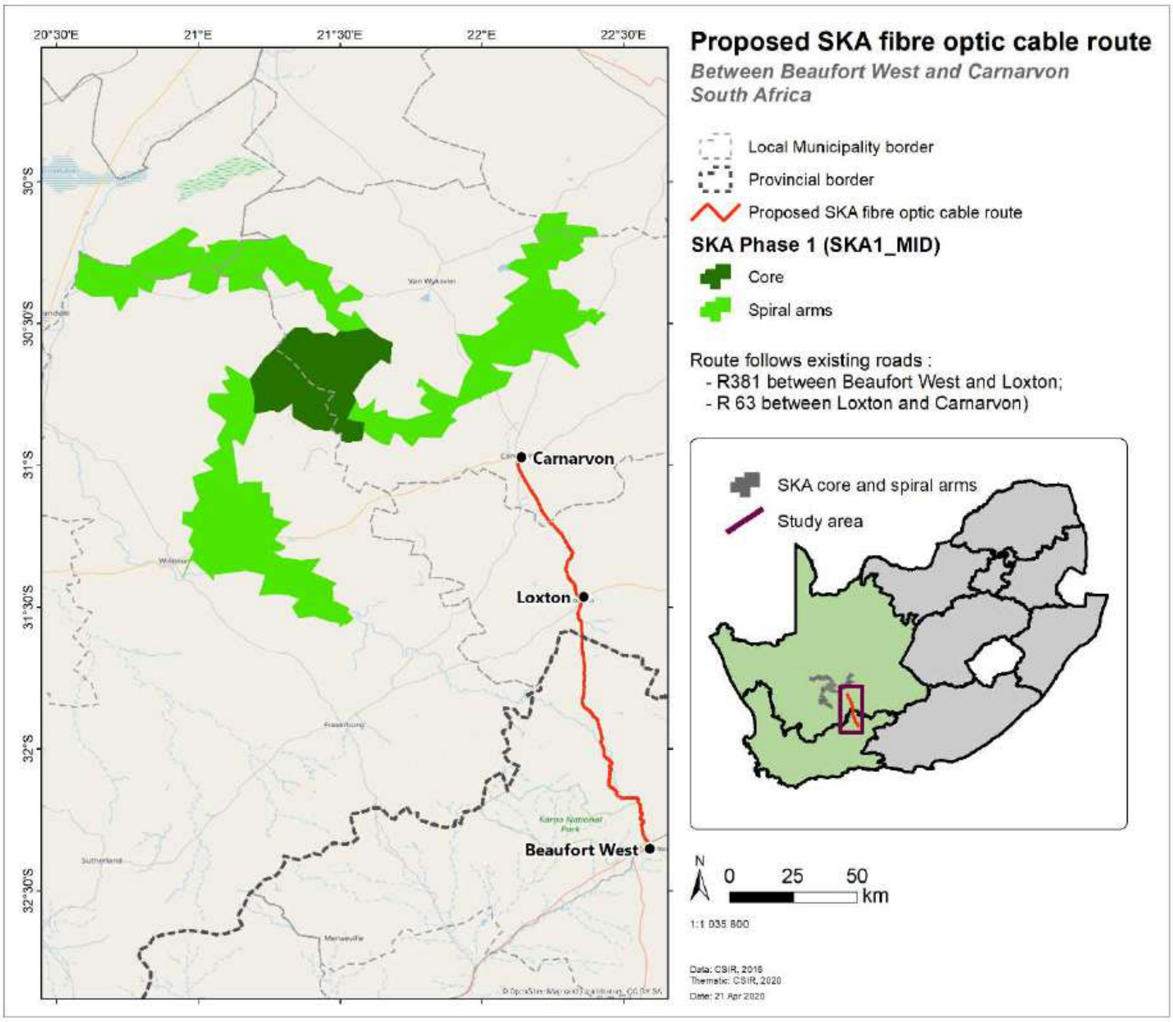


Figure 9: The proposed SKA fibre optic cable between Beaufort West and Carnarvon in relation to the SKA1_MID area to which the IEMP and EA exclusion apply.

Outcome

The proposed SKA fibre optic cable route between Beaufort West and Carnarvon is located outside of the SKA1_MID area to which the IEMP and EA exclusion applies (GG 42323: 436), and is therefore <u>not eligible for exclusion from obtaining EA.</u>

4.2 Environmental Authorisation

Key to Table 7 -- *LN1: Basic Assessment required | LN2: Full Scoping and EIA required | LN3: BA required.*

-- *Yellow highlights indicate potentially relevant Listed Activities.*

-- *Red box / border indicates triggered Listed Activities.*

Table 7: Listed Activities (NEMA EIA Regulations 2014, as amended in 2017) which require an Environmental Authorisation.

Listed Activity	Comment
LN 1 Activity 12 The development of— (i) dams or weirs, where the dam or weir, including infrastructure and water surface area, exceeds 100 square metres; or (ii) infrastructure or structures with a physical footprint of 100 square metres or more; where such development occurs— (a) within a watercourse; (b) in front of a development setback; or (c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse; — excluding— (aa) the development of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour; (bb) where such development activities are related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies; (cc) activities listed in activity 14 in Listing Notice 2 of 2014 or activity 14 in Listing Notice 3 of 2014, in which case that activity applies; (dd) where such development occurs within an urban area; or (ee) where such development occurs within existing roads, or road reserves or railway line reserves; or	**Outcome:** LN 1 (12) does not apply since the full fibre route will be installed within road reserves and 1 m from the fence of the private land.

Listed Activity	Comment
(ff) the development of temporary infrastructure or structures where such infrastructure or structures will be removed within 6 weeks of the commencement of development and where indigenous vegetation will not be cleared.	
LN 1 Activity 27 The clearance of an area of 1 hectares or more, but less than 20 hectares of indigenous vegetation, except where such clearance of indigenous vegetation is required for— (i) the undertaking of a linear activity; or (ii) maintenance purposes undertaken in accordance with a maintenance management plan.	**Outcome:** LN 1 (27) does not apply since linear activities are exempted here.
LN2 – No applicable activities identified	
LN 3 Activity 3 The development of masts or towers of any material or type used for telecommunication broadcasting or radio transmission purposes where the mast or tower— (a) is to be placed on a site not previously used for this purpose; and (b) will exceed 15 metres in height— but excluding attachments to existing buildings and masts **g. Northern Cape** i. In an estuary; ii. Outside urban areas: (aa) A protected area identified in terms of NEMPAA, excluding conservancies; (bb) National Protected Area Expansion Strategy Focus areas; *(see Table 7)* (cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; (dd) Sites or areas identified in terms of an international convention; (ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; *(see Fig 1)*	**Outcome:** LN 3 (3) does not apply since the total pole height is 9 m, buried 1.5 m deep, with a resultant above-ground height of 7.5 m

Listed Activity	Comment
(ff) Core areas in biosphere reserves; (gg) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core areas of a biosphere reserve; *((see Table 7)*, or (hh) Areas seawards of the development setback line or within 1 kilometre from the high-water mark of the sea if no such development setback line is determined; or iii. Inside urban areas: (aa) Areas zoned for use as public open space; or (bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority or zoned for a conservation purpose. **i. Western Cape** i. All areas outside urban areas; ii. Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority, or zoned for a conservation purpose, within urban areas; or iii. Areas zoned for use as public open space or equivalent zoning within urban areas.	
LN 3 Activity 12 The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan. **g. Northern Cape** i. Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004; ii. Within critical biodiversity areas identified in bioregional plans; *(see Figure 7)* iii. Within the littoral active zone or 100 metres inland from high water mark of the sea or an estuary, whichever distance is the greater, excluding where such removal will occur behind the development setback line on erven in urban areas; or	**Outcome:** LN 3 (12) does apply since the total construction footprint of the of the proposed fibre optic cable within CBAs in the Northern Cape (37 803 m^2) and Western Cape (19 9814 m^2) Provinces exceed the 300 m^2 clearance threshold. **Environmental Assessment procedure required:** Basic Assessment.

Listed Activity	Comment
iv. On land, where, at the time of the coming into effect of this Notice or thereafter such land was zoned open space, conservation or had an equivalent zoning. **i. Western Cape** i. Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004; ii. Within critical biodiversity areas identified in bioregional plans; *(see Figure 7)* iii. Within the littoral active zone or 100 metres inland from high water mark of the sea or an estuarine functional zone, whichever distance is the greater, excluding where such removal will occur behind the development setback line on erven in urban areas; iv. On land, where, at the time of the coming into effect of this Notice or thereafter such land was zoned open space, conservation or had an equivalent zoning; or v. On land designated for protection or conservation purposes in an Environmental Management Framework adopted in the prescribed.	

Outcome

The proposed SKA fibre optic cable between Beaufort West and Carnarvon triggers Listing Notice 3, Activity 12 of the NEMA EIA Regulations due to the construction phase cumulative footprint in CBAs (refer to Table 5). Resultantly, a BA process will have to be undertaken to obtain EA.

4.3 Water Use License

The following activities require a Water Use Licence (WUL), in terms of Section 21 of the National Water Act:

21. For the purposes of this Act. water use includes— a) taking water from a water resource; b) storing water; c) impeding or diverting the flow of water in a watercourse; d) engaging in a stream flow reduction activity contemplated in section 36; e) engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1): f) discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit; g) disposing of waste in a manner which may detrimentally impact on a water resource; h) disposing in any manner of water which contains waste from. or which has been heated in any industrial or power generation process; i) altering the bed, banks, course or characteristics of a watercourse; j) removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and k) using water for recreational purposes.
Yellow highlights indicate potentially relevant "water uses".

Outcome

The activities associated with the proposed SKA fibre optic cable installation between Beaufort West and Carnarvon are considered section 21(c) and (i) water uses in terms of the NWA and as such will require an application for water use authorisation.

The proposed project will most probably qualify for an application for a General Authorisation (GA) in terms of section 6(2) of GNR 509 of 2016 stating that "*All State Owned Companies (SOCs) and other institutions specified in Appendix D2 of the Notice, having lawful access to that property or land, may on that property use water in terms of section 21(c) or (i) of the NWA under each of the relevant SOCs and other institutions*"; however, due to the nature of the activities (i.e. river/stream and wetland crossings) the GA in terms of section 3(b) of the Notice may not apply to the use of water in terms of section 21(c) or (i) of the NWA within the regulated area of a watercourse (i.e. 500 m) where the Risk Class is Medium or High as determined by the Risk Matrix. This means a Risk Matrix, as prescribed in Appendix A of the Notice, is to be compiled to ascertain whether the Risk Class is Low and a GA is applicable, or if an application for a Water Use License (WUL) will be required should the Risk Class be confirmed as Medium or High. Depending on the outcome of the Risk matrix, an application for a GA or a WUL will be required to obtain water use authorisation. The Risk Matric can be undertaken as part of the BA process.

4.4 Heritage Impact Assessment and approval

The NHA under Section 38 states:

38.

(1) Subject to the provisions of subsections (7), (8) and (9), any person who intends to undertake a development categorised as—
  a) the construction of a road, wall, powerline, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;
  b) the construction of a bridge or similar structure exceeding 50 m in length;
  c) any development or other activity which will change the character of a site—
    (i) exceeding 5 000 m^2 in extent; or
    (ii) involving three or more existing erven or subdivisions thereof; or
    (iii) involving three or more erven or divisions thereof which have been consolidated within the past five years; or
    (iv) the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;
  d) the re-zoning of a site exceeding 10 000 m^2 in extent; or
  e) any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority,

must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development.

(2) The responsible heritage resources authority must, within 14 days of receipt of a notification in terms of subsection (1)—
  a) if there is reason to believe that heritage resources will be affected by such development, notify the person who intends to undertake the development to submit an impact assessment report. Such report must be compiled at the cost of the person proposing the development, by a person or persons approved by the responsible heritage resources authority with relevant qualifications and experience and professional standing in heritage resources management; or
  b) notify the person concerned that this section does not apply.

Yellow highlights indicate potentially relevant activities requiring HIA / approval.

Outcome

The activities associated with the proposed SKA fibre optic cable between Beaufort West and Carnarvon is categorised as a Section 38(1)(a) development type in terms of the NHA. This requires an HIA (which can be conducted as part of the BA) and comment / approval from the SAHRA.

5. Conclusion and recommendations

5.1 Environmental Authorisation

The cumulative construction footprint of the proposed SKA fibre optic cable in CBA's triggers Listing Notice 3, Activity 12, which stipulates the requirement for a BA process to obtain EA in terms of the NEMA EIA Regulations. Since the proposed cable route spans two provinces, the National Department of Environmental Affairs, Forestry and Fisheries are the Competent Authority for the EA Application.

The following specialist assessments are recommended as part of the BA:

- Heritage (see Section 5.3)
- Palaeontology (desktop)
- Aquatic ecology and hydrology
- Terrestrial ecology (incl. fauna and flora species)

The applicability and relevance of following specialist studies, outlined as requirements in the Screening Tool Report[8] (Appendix A, pg 13-14), need to be considered and determined:

- Landscape / Visual; and
- Socio-economic.

The BA process (incl. specialist assessments) culminates in the development of an EMPr. Based on the results on the ESS, the EMPr should focus on and address, *inter alia*, the following aspects:

- Management of dug trenches during construction to minimise the entrapment of animals;
- Timing of construction activities to avoid the breeding season of specifically the Riverine Rabbit, which is generally August to May;
- Ensuring that the burrows and / or nests of fauna and avifauna that may be present within the road reserve are not adversely affected during construction;
- Runoff and erosion control; and
- Invasive alien plant control.

[8] The use of the National Screening Tool (https://screening.environment.gov.za/) is mandatory for planning development that require EA, and the Report generated by the Tool must be submitted together with an EA application. The Screening Tool specifies which specialist studies must be undertaken in the EIA, and provides protocols that guide the manner in which the specialist assessments must be undertaken. It is the responsibility of the Environmental Assessment Practitioner undertaking the EIA to confirm identified specialist assessment and to motivate in the assessment report, the reason for not including any of the identified specialist studies.

5.2 Water Use License

Due to the proposed SKA fibre optic cable having to cross rivers and wetlands, an application for water use authorisation is required in terms of section 21(c) and (i) of the NWA. In terms of section 6(2) of GNR 509 of 2016, the project most probably qualifies for GA; but first, a Risk Matrix must be compiled to determine the Risk Class associated with the intended water use activities. This can be conducted as part of the BA process. Should the Risk Class be confirmed as Low, the project will qualify for a GA; but should the Risk Class be confirmed as Medium or High, an application for a Water Use License will be required.

5.3 Heritage Impact Assessment and approval

A HIA (desktop palaeontology study) is required in terms of the NHA. The HIA and consultation with SAHRA for comment / approval must be conducted as part of the BA process.

6. References

BirdLife International 2016. *Aquila verreauxii*. The IUCN Red List of Threatened Species 2016: e.T22696067A95221980. [https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22696067A95221980.en]. Downloaded on 16 April 2020.

BirdLife International 2017. *Circus maurus*. The IUCN Red List of Threatened Species 2017: e.T22695379A118433168. [https://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T22695379A118433168.en]. Downloaded on 16 April 2020.

Cape Nature. 2017. Western Cape Biodiversity Spatial Plan. Spatial data. Available at [https://bgis.sanbi.org/Projects/Detail/194].

Child MF, Roxburgh L, Do Linh San E, Raimondo D, Davies-Mostert HT, editors. The 2016 Red List of Mammals of South Africa, Swaziland and Lesotho. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa. Available at [https://www.ewt.org.za/wp-content/uploads/2019/02/27.-Mountain-Reedbuck-Redunca-fulvorufula_EN.pdf].

Collins, K., Bragg, C. & Birss, C. 2019. *Bunolagus monticularis*. *The IUCN Red List of Threatened Species* 2019: e.T3326A45176532. [https://dx.doi.org/10.2305/IUCN.UK.2019-1.RLTS.T3326A45176532.en]. Downloaded on 16 April 2020.

CSIR (Council for Scientific and Industrial Research). 2016. Strategic Environmental Assessment for the South African mid-frequency array of SKA Phase 1. CSIR Report Number: CSIR/02100/EMS/ER/2016/15240/B. Available at [https://egis.environment.gov.za/SKAphase1].

CSIR. 2019. Technical Requirements -SARAO Underground Fibre Installation Technical Requirements: Beaufort West to Carnarvon (180km) Link. RFP No. 3259/08/02/2019.

DENC (Department of Nature Conservation). 2016. Northern Cape Critical Biodiversity Areas. Spatial data. Available at [https://bgis.sanbi.org/Projects/Detail/203].

Driver, A., Nel., J.L., Snaddon, K., Murray, K., Roux, D.J., Hill, L., Swartz, E.R., Manuel, J. & Funke, N. 2011. Implementation Manual for Freshwater Ecosystem Priority Areas. WRC Report. Final Draft. June 2011.

Duthie, A.G. 1989. The ecology of the Riverine rabbit *Bunolagus monticularis.* MSc Thesis. University of Pretoria. Available at [http://hdl.handle.net/2263/32387].

NRF SARAO (National Research Foundation, South African Radio Astronomy Observatory). 2018. Integrated Environmental Management Plan (IEMP) for SKA Phase 1 mid-frequency array (SKA1_MID) in South Africa. Version 2 - prepared by Gaea Enviro (Pty) Ltd. Available at [https://egis.environment.gov.za/SKAphase1].

SAHRA (South African Heritage Resources Agency). 2018. Heritage resources database, All sites, End 2018.

SAHRA. 2020. PalaeoSensitivity Map. [https://sahris.sahra.org.za/map/palaeo]. Accessed on 20 April 2020.

SANBI (South African National Biodiversity Institute). 2018. National Biodiversity Assessment. Spatial Data. Available at [https://bgis.sanbi.org/Projects/Detail/221].

Whitehouse, C.M. & Raimondo, D. 2007. Cliffortia arborea Marloth. National Assessment: Red List of South African Plants version 2017.1. [http://redlist.sanbi.org/species.php?species=3455-11]. Accessed on 17 April 2020.

7. Appendix A: DEA Screening Tool Report

Appendix 10 Terrestrial ecology specialist assessment proof of appointment (September 2020)

our future through science

Supplier:
EKOTRUST CC
7 ST GEORGE STREET
SOMERSET WEST, WESTERN CAPE
7130
South Africa

Deliver To:
LUANITA SNYMAN-VAN DER WALT (LvdWalt1@csir.co.za)
CSIR - Jan Celliers Str
Stellenbosch, WP 7599
South Africa
0218882490

Invoice To:
CSIR Accounts Payables Office
P.O. Box 395
Pretoria, 0001
South Africa
(012) 841 2477

Standard CSIR: Purchase Order 1000753151

Order No.	1000753151
Revision	0
Order Date	11-SEP-2020 10:50:07
Revision Date	
Supplier No.	MAAA0070982
Vat Registration No.	4470114283

CSIR Strategic Procurement Unit:
CSIR Pretoria - Building 10
Meiring Naude Road, Brummeria
Pretoria, 0001
South Africa
(012) 841 2400

Special Instructions:

Please reflect the CSIR's Order number on all invoices.

Line	Item Details	Quantity	UOM	Unit Price excl VAT	Line Total excl VAT
1	Terrestrial Biodiversity and Ecology Impact Assessmentfor SKA fibre optic cable between Beaufort West and Carnarvon (EEMS035.11214.06000.060SE.RUN)	1	Each	[redacted]	[redacted]
				Order Total:	[redacted]

- This order is subject to the CSIR's General Conditions of Purchase as well as - where applicable - the terms and conditions of any existing Service Level Agreement with the CSIR.
- By responding to this order by delivering the goods and/or rendering the services as identified above, you will therefore be deemed to have accepted and agreed to such conditions.
- In the event of any conflict between the provisions of this document and the attached General Conditions of Purchase, the provisions of this document shall prevail.

Appendix 11 National Web-based Screening Tool Report

SCREENING REPORT FOR AN ENVIRONMENTAL AUTHORIZATION OR FOR A PART TWO AMENDMENT OF AN ENVIRONMENTAL AUTHORISATION AS REQUIRED BY THE 2014 EIA REGULATIONS – PROPOSED SITE ENVIRONMENTAL SENSITIVITY

EIA Reference number: --

Project name: SKA fibre optic cable

Project title: Square Kilometre Array

Date screening report generated: 15/04/2020 11:51:23

Applicant: SKA / SANReN

Compiler: CSIR

Compiler signature: .... Luanita Snyman- van der Walt

Table of Contents

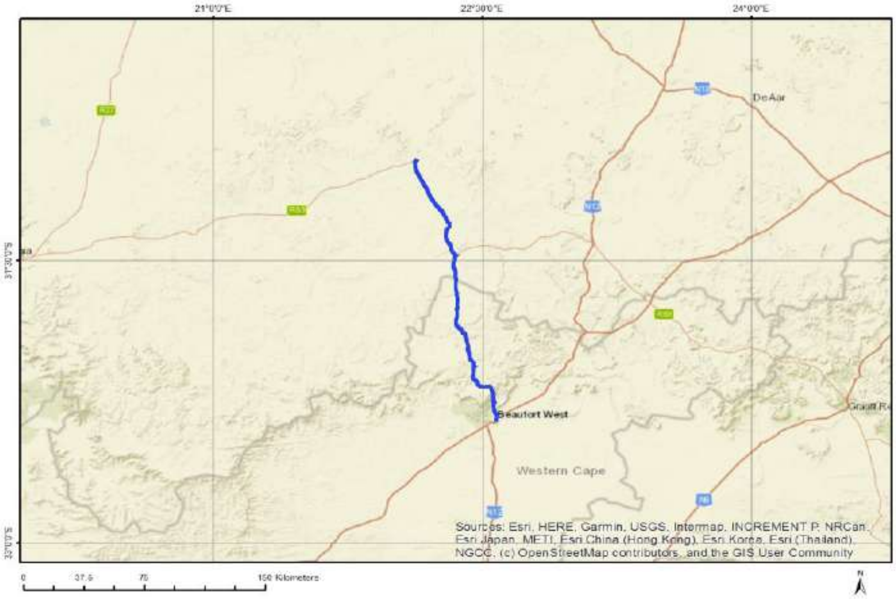
Proposed Project Location

Orientation map 1: General location

General Orientation: SKA fibre optic cable

Disclaimer applies
15/04/2020

Map of proposed site and relevant area(s)



Cadastral details of the proposed site

Property details:

No	Farm Name	Farm/ Erf No	Portion	Latitude	Longitude	Property Type
1	BEAUFORT WEST	2	0	32°20'59.28S	22°34'51.58E	Erven
2	BEAUFORT WEST	4	0	32°21'7.01S	22°34'36.81E	Erven
3	CARNARVON	13	0	30°58'8.32S	22°7'59.88E	Erven
4	BEAUFORT WEST	34	0	32°21'7.19S	22°34'45.56E	Erven
5	BEAUFORT WEST	4	0	32°21'18.79S	22°34'29.6E	Erven
6	BEAUFORT WEST	7	0	32°20'13.59S	22°34'51.54E	Erven
7	BEAUFORT WEST	41	0	32°20'57.14S	22°34'46.22E	Erven
8	CARNARVON	3	0	30°58'8.81S	22°8'2.79E	Erven
9	BEAUFORT WEST	7	0	32°20'14.1S	22°34'49.84E	Erven
10	CARNARVON	12	0	30°58'10.14S	22°7'59.57E	Erven
11	CARNARVON	23	0	30°58'10.67S	22°7'56.2E	Erven
12	BEAUFORT WEST	36	0	32°20'57.4S	22°34'48.71E	Erven
13	LOXTON	38	0	31°28'34S	22°20'56.27E	Erven
14	LOXTON	71	0	31°28'43.19S	22°20'57.96E	Erven
15	LOXTON	75	0	31°28'43.78S	22°20'59.75E	Erven
16	BEAUFORT WEST	86	0	32°20'33.37S	22°34'48.6E	Erven
17	LOXTON	90	0	31°28'46.27S	22°21'7.31E	Erven
18	BEAUFORT WEST	98	0	32°20'36.52S	22°34'48.03E	Erven
19	CARNARVON	19	0	30°58'8.19S	22°7'58.83E	Erven
20	CARNARVON	25	0	30°58'7.92S	22°7'56.7E	Erven
21	LOXTON	91	0	31°28'46.55S	22°21'8.15E	Erven
22	BEAUFORT WEST	101	0	32°20'37.58S	22°34'48.18E	Erven
23	BEAUFORT WEST	88	0	32°20'34.27S	22°34'48.1E	Erven
24	CARNARVON	1	0	30°58'11.43S	22°8'2.6E	Erven
25	BEAUFORT WEST	40	0	32°21'1.41S	22°34'45.03E	Erven
26	CARNARVON	18	0	30°58'9.99S	22°7'58.52E	Erven
27	CARNARVON	24	0	30°58'9.77S	22°7'56.35E	Erven
28	BEAUFORT WEST	39	0	32°21'0.21S	22°34'51.82E	Erven
29	LOXTON	57	0	31°28'37.82S	22°20'54.51E	Erven

30	LOXTON	70	0	31°28'43.02S	22°20'56.95E	Erven
31	LOXTON	74	0	31°28'43.49S	22°20'58.85E	Erven
32	BEAUFORT WEST	94	0	32°20'35.76S	22°34'48.94E	Erven
33	BEAUFORT WEST	96	0	32°20'36.4S	22°34'48.88E	Erven
34	LOXTON	62	0	31°28'41.5S	22°20'52.85E	Erven
35	LOXTON	66	0	31°28'42.09S	22°20'54.62E	Erven
36	LOXTON	67	0	31°28'42.38S	22°20'55.52E	Erven
37	BEAUFORT WEST	85	0	32°20'33.48S	22°34'47.6E	Erven
38	LOXTON	86	0	31°28'45.69S	22°21'5.54E	Erven
39	LOXTON	87	0	31°28'45.99S	22°21'6.43E	Erven
40	BEAUFORT WEST	95	0	32°20'36.22S	22°34'49.15E	Erven
41	BEAUFORT WEST	103	0	32°20'38.15S	22°34'49.28E	Erven
42	BEAUFORT WEST	104	0	32°20'38.23S	22°34'48.49E	Erven
43	BEAUFORT WEST	109	0	32°20'39.97S	22°34'48.77E	Erven
44	BEAUFORT WEST	131	0	32°20'43.75S	22°34'49.29E	Erven
45	LOXTON	56	0	31°28'36.31S	22°20'55.17E	Erven
46	LOXTON	82	0	31°28'44.88S	22°21'3.08E	Erven
47	LOXTON	83	0	31°28'45.18S	22°21'3.98E	Erven
48	BEAUFORT WEST	87	0	32°20'34.2S	22°34'48.72E	Erven
49	BEAUFORT WEST	123	0	32°20'42.73S	22°34'49.15E	Erven
50	LOXTON	61	0	31°28'39.98S	22°20'53.53E	Erven
51	LOXTON	63	0	31°28'41.8S	22°20'53.73E	Erven
52	BEAUFORT WEST	77	0	32°21'14.14S	22°35'4.86E	Erven
53	BEAUFORT WEST	102	0	32°20'37.49S	22°34'49.19E	Erven
54	BEAUFORT WEST	158	0	32°20'47.44S	22°34'50.27E	Erven
55	BEAUFORT WEST	111	0	32°20'39.45S	22°34'49.73E	Erven
56	BEAUFORT WEST	157	0	32°20'47.25S	22°34'50.86E	Erven
57	CARNARVON	317	0	30°58'8.89S	22°8'3.25E	Erven
58	CARNARVON	328	0	30°58'11.16S	22°7'45.88E	Erven
59	LOXTON	330	0	31°28'52.85S	22°21'3.65E	Erven
60	BEAUFORT WEST	349	0	32°20'57.93S	22°34'55.31E	Erven
61	BEAUFORT WEST	97	0	32°20'36.63S	22°34'49.06E	Erven
62	BEAUFORT WEST	110	0	32°20'39.77S	22°34'49.43E	Erven
63	BEAUFORT WEST	156	0	32°20'47.26S	22°34'50.07E	Erven
64	BEAUFORT WEST	129	0	32°20'43.65S	22°34'50.3E	Erven
65	BEAUFORT WEST	130	0	32°20'43.46S	22°34'49.76E	Erven
66	BEAUFORT WEST	194	0	32°20'49.1S	22°34'50.73E	Erven
67	BEAUFORT WEST	203	0	32°20'53.06S	22°34'51.1E	Erven
68	BEAUFORT WEST	219	0	32°21'0.59S	22°34'52.85E	Erven
69	BEAUFORT WEST	226	0	32°21'2.6S	22°34'51.57E	Erven
70	CARNARVON	282	0	30°58'7.49S	22°8'13.49E	Erven
71	CARNARVON	329	0	30°58'11.46S	22°7'47.33E	Erven
72	LOXTON	348	0	31°28'50.54S	22°21'9.74E	Erven
73	CARNARVON	354	0	30°58'10.53S	22°8'2.74E	Erven
74	CARNARVON	222	0	30°58'9.95S	22°7'37.16E	Erven
75	BEAUFORT WEST	224	0	32°21'1.18S	22°34'50.45E	Erven
76	LOXTON	227	0	31°28'27.5S	22°20'59.19E	Erven
77	BEAUFORT WEST	228	0	32°21'2.52S	22°34'52.33E	Erven
78	BEAUFORT WEST	220	0	32°21'0.97S	22°34'52.59E	Erven
79	BEAUFORT WEST	221	0	32°21'1.02S	22°34'51.89E	Erven
80	BEAUFORT WEST	222	0	32°21'1.08S	22°34'51.38E	Erven
81	CARNARVON	302	0	30°58'7.09S	22°8'10.26E	Erven
82	BEAUFORT WEST	195	0	32°20'49.5S	22°34'51.17E	Erven
83	CARNARVON	223	0	30°58'10.73S	22°7'35.95E	Erven
84	LOXTON	226	0	31°28'28.26S	22°20'58.85E	Erven
85	BEAUFORT WEST	227	0	32°21'2.56S	22°34'51.97E	Erven
86	LOXTON	240	0	31°28'27.19S	22°20'56.91E	Erven
87	LOXTON	249	0	31°28'32.14S	22°20'53.67E	Erven
88	BEAUFORT WEST	155	0	32°20'46.89S	22°34'49.37E	Erven
89	BEAUFORT WEST	201	0	32°20'52.4S	22°34'50.99E	Erven

90	BEAUFORT WEST	204	0	32°20'53.7S	22°34'51.19E	Erven
91	CARNARVON	221	0	30°58'10.86S	22°7'37.02E	Erven
92	CARNARVON	327	0	30°58'10.98S	22°7'44.39E	Erven
93	LOXTON	346	0	31°28'59.63S	22°21'5.87E	Erven
94	LOXTON	359	0	31°28'31.4S	22°19'12.17E	Erven
95	BEAUFORT WEST	359	0	32°20'50.96S	22°34'52.57E	Erven
96	CARNARVON	312	0	30°58'18.24S	22°8'21.94E	Erven
97	LOXTON	320	0	31°28'43.6S	22°20'48.58E	Erven
98	LOXTON	347	0	31°28'53.06S	22°21'8.47E	Erven
99	CARNARVON	353	0	31°0'9.92S	22°7'33.56E	Erven
100	LOXTON	385	0	31°28'32.22S	22°20'56.57E	Erven
101	BEAUFORT WEST	426	0	32°20'40.36S	22°34'51.09E	Erven
102	LOXTON	328	0	31°28'48.64S	22°20'58.71E	Erven
103	BEAUFORT WEST	342	0	32°20'59.75S	22°34'55.64E	Erven
104	BEAUFORT WEST	350	0	32°20'58.13S	22°34'53.3E	Erven
105	BEAUFORT WEST	358	0	32°20'51.55S	22°34'52.51E	Erven
106	CARNARVON	656	0	30°58'11.54S	22°8'15.11E	Erven
107	BEAUFORT WEST	360	0	32°20'50.59S	22°34'52.5E	Erven
108	BEAUFORT WEST	367	0	32°20'50.13S	22°34'52.45E	Erven
109	LOXTON	371	0	31°28'49.85S	22°21'7.22E	Erven
110	LOXTON	379	0	31°28'27.35S	22°20'58.74E	Erven
111	LOXTON	380	0	31°28'28.11S	22°20'58.41E	Erven
112	BEAUFORT WEST	438	0	32°20'34.05S	22°34'50.2E	Erven
113	BEAUFORT WEST	124	0	32°20'42.61S	22°34'49.65E	Erven
114	LOXTON	155	0	31°28'32.36S	22°20'57.01E	Erven
115	LOXTON	250	0	31°28'36.13S	22°20'51.88E	Erven
116	LOXTON	261	0	31°28'39.89S	22°20'50.15E	Erven
117	CARNARVON	896	0	30°58'9.89S	22°7'32.9E	Erven
118	BEAUFORT WEST	947	0	32°20'52.87S	22°34'52.9E	Erven
119	CARNARVON	1046	0	30°58'13.02S	22°7'32.38E	Erven
120	CARNARVON	278	0	30°58'9.9S	22°8'19.86E	Erven
121	CARNARVON	330	0	30°58'11.85S	22°7'50.08E	Erven
122	LOXTON	331	0	31°29'2.13S	22°20'59.6E	Erven
123	LOXTON	376	0	31°29'2.98S	22°21'2.15E	Erven
124	LOXTON	377	0	31°29'2.72S	22°21'1.37E	Erven
125	LOXTON	387	0	31°28'32.95S	22°20'55.39E	Erven
126	BEAUFORT WEST	427	0	32°20'39.55S	22°34'50.97E	Erven
127	BEAUFORT WEST	440	0	32°20'33.12S	22°34'51.09E	Erven
128	CARNARVON	446	0	30°58'10.84S	22°7'58.11E	Erven
129	LOXTON	369	0	31°28'46.69S	22°21'8.6E	Erven
130	BEAUFORT WEST	370	0	32°20'48.9S	22°34'52.28E	Erven
131	LOXTON	378	0	31°28'27.48S	22°20'57.8E	Erven
132	LOXTON	382	0	31°28'29.95S	22°20'56.74E	Erven
133	BEAUFORT WEST	229	0	32°21'2.48S	22°34'52.82E	Erven
134	BEAUFORT WEST	216	0	32°20'59.18S	22°34'52.3E	Erven
135	LOXTON	383	0	31°28'29.64S	22°20'57.71E	Erven
136	LOXTON	386	0	31°28'33.83S	22°20'55.89E	Erven
137	CARNARVON	433	0	30°58'10.25S	22°8'17.76E	Erven
138	BEAUFORT WEST	437	0	32°20'35.67S	22°34'50.36E	Erven
139	CARNARVON	499	0	30°58'12.57S	22°7'49.26E	Erven
140	BEAUFORT WEST	648	0	32°20'52.4S	22°34'52.82E	Erven
141	CARNARVON	657	0	30°58'11.94S	22°8'16.2E	Erven
142	CARNARVON	841	0	30°58'21.45S	22°7'30.07E	Erven
143	CARNARVON	850	0	30°58'24.12S	22°7'29.86E	Erven
144	CARNARVON	862	0	30°58'13.54S	22°7'55.67E	Erven
145	CARNARVON	865	0	30°58'14.57S	22°7'53.92E	Erven
146	CARNARVON	871	0	30°58'11.88S	22°7'45.75E	Erven
147	CARNARVON	888	0	30°58'8.84S	22°8'3.87E	Erven
148	CARNARVON	890	0	30°58'11.96S	22°8'28.72E	Erven
149	CARNARVON	1023	0	30°58'23.95S	22°7'26.79E	Erven

150	CARNARVON	1059	0	30°58'13.21S	22°8'18.15E	Erven
151	BEAUFORT WEST	218	0	32°21'0.09S	22°34'52.68E	Erven
152	LOXTON	224	0	31°28'30.55S	22°20'57.82E	Erven
153	LOXTON	233	0	31°28'27.45S	22°20'53.73E	Erven
154	LOXTON	241	0	31°28'29.47S	22°20'55.89E	Erven
155	CARNARVON	2016	0	30°58'8.06S	22°8'1.96E	Erven
156	BEAUFORT WEST	2037	0	32°20'32.86S	22°34'55.88E	Erven
157	BEAUFORT WEST	2037	0	32°20'33.01S	22°34'55.9E	Erven
158	BEAUFORT WEST	5290	0	32°17'27.08S	22°34'31.85E	Erven
159	BEAUFORT WEST	223	0	32°21'1.16S	22°34'50.82E	Erven
160	LOXTON	225	0	31°28'29.79S	22°20'58.16E	Erven
161	CARNARVON	274	0	30°58'10.73S	22°8'22.05E	Erven
162	CARNARVON	286	0	30°58'7.22S	22°8'12.13E	Erven
163	CARNARVON	326	0	30°58'10.4S	22°7'39.59E	Erven
164	LOXTON	332	0	31°29'3.57S	22°21'3.94E	Erven
165	CARNARVON	644	0	30°58'13.24S	22°7'52.43E	Erven
166	CARNARVON	646	0	30°58'13S	22°7'51.03E	Erven
167	BEAUFORT WEST	7583	0	32°21'0.21S	22°34'52.13E	Erven
168	CARNARVON	645	0	30°58'13.25S	22°7'51.55E	Erven
169	BEAUFORT WEST	1480	0	32°20'42.5S	22°34'50.13E	Erven
170	BEAUFORT WEST	1707	0	32°15'37S	22°34'3.73E	Erven
171	BEAUFORT WEST	345	0	32°20'58.9S	22°34'55.24E	Erven
172	CARNARVON	353	0	30°55'33.17S	22°9'51.9E	Erven
173	LOXTON	372	0	31°28'50S	22°21'8.05E	Erven
174	LOXTON	375	0	31°28'59.46S	22°21'3.74E	Erven
175	LOXTON	384	0	31°28'30.41S	22°20'57.38E	Erven
176	BEAUFORT WEST	400	0	32°20'43.5S	22°34'51.78E	Erven
177	BEAUFORT WEST	428	0	32°20'37.95S	22°34'50.68E	Erven
178	CARNARVON	658	0	30°58'12.35S	22°8'17.29E	Erven
179	LOXTON	321	0	31°28'45.09S	22°20'52.68E	Erven
180	LOXTON	329	0	31°28'49.28S	22°21'5.32E	Erven
181	BEAUFORT WEST	339	0	32°21'2.19S	22°34'54.65E	Erven
182	BEAUFORT WEST	368	0	32°20'49.78S	22°34'52.39E	Erven
183	BEAUFORT WEST	416	0	32°20'41.15S	22°34'51.2E	Erven
184	BEAUFORT WEST	432	0	32°20'37.18S	22°34'50.57E	Erven
185	BEAUFORT WEST	439	0	32°20'33.23S	22°34'50.09E	Erven
186	LOXTON	531	0	31°28'44.44S	22°21'1.75E	Erven
187	CARNARVON	1021	0	30°58'18.71S	22°7'31.49E	Erven
188	LOXTON	373	0	31°28'52.91S	22°21'6.69E	Erven
189	LOXTON	374	0	31°28'53.03S	22°21'5.74E	Erven
190	LOXTON	381	0	31°28'28.81S	22°20'57.25E	Erven
191	BEAUFORT WEST	399	0	32°20'43.56S	22°34'51.28E	Erven
192	CARNARVON	660	0	30°58'13.18S	22°8'19.47E	Erven
193	CARNARVON	824	0	30°58'17.81S	22°7'30.89E	Erven
194	CARNARVON	826	0	30°58'16.17S	22°7'31.15E	Erven
195	CARNARVON	864	0	30°58'15.2S	22°7'55.3E	Erven
196	CARNARVON	828	0	30°58'14.57S	22°7'31.4E	Erven
197	CARNARVON	829	0	30°58'13.75S	22°7'31.54E	Erven
198	CARNARVON	822	0	30°58'19.6S	22°7'30.35E	Erven
199	CARNARVON	827	0	30°58'15.37S	22°7'31.28E	Erven
200	BEAUFORT WEST	997	0	32°20'48.14S	22°34'50.73E	Erven
201	CARNARVON	643	0	30°58'12.79S	22°7'50.11E	Erven
202	CARNARVON	661	0	30°58'13.59S	22°8'20.56E	Erven
203	BEAUFORT WEST	8422	0	32°20'40.96S	22°34'49.19E	Erven
204	BEAUFORT WEST	8422	0	32°20'41.32S	22°34'49.17E	Erven
205	BEAUFORT WEST	8449	0	32°20'47.29S	22°34'52.02E	Erven
206	CARNARVON	1187	0	30°58'10.87S	22°8'1.61E	Erven
207	CARNARVON	1201	0	30°58'12.49S	22°7'54.77E	Erven
208	CARNARVON	1034	0	30°58'7.77S	22°8'14.32E	Erven
209	CARNARVON	1069	0	30°58'17.08S	22°7'31.75E	Erven

210	CARNARVON	1186	0	30°58'22.89S	22°7'30.08E	Erven
211	BEAUFORT WEST	1320	0	32°20'47.79S	22°34'50.31E	Erven
212	BEAUFORT WEST	1478	0	32°21'0.12S	22°34'46.5E	Erven
213	CARNARVON	849	0	30°58'25.2S	22°7'29.33E	Erven
214	BEAUFORT WEST	949	0	32°21'1.12S	22°34'51.03E	Erven
215	BEAUFORT WEST	946	0	32°20'53.44S	22°34'52.95E	Erven
216	CARNARVON	1018	0	30°58'10.7S	22°7'41.31E	Erven
217	CARNARVON	1033	0	30°58'14.34S	22°7'54.89E	Erven
218	CARNARVON	1964	0	30°58'8.26S	22°8'15.54E	Erven
219	BEAUFORT WEST	1975	0	32°20'55.41S	22°34'53.2E	Erven
220	BEAUFORT WEST	3555	0	32°20'50.2S	22°34'50.88E	Erven
221	BEAUFORT WEST	5369	0	32°20'44.9S	22°34'51.71E	Erven
222	BEAUFORT WEST	5865	0	32°20'42.35S	22°34'52.87E	Erven
223	BEAUFORT WEST	5971	0	32°21'1.05S	22°34'34.64E	Erven
224	BEAUFORT WEST	5991	0	32°20'59.07S	22°34'39.05E	Erven
225	BEAUFORT WEST	5997	0	32°20'59.62S	22°34'40.32E	Erven
226	BEAUFORT WEST	1200	0	32°21'2.89S	22°34'50.69E	Erven
227	BEAUFORT WEST	5272	0	32°20'45.27S	22°34'49.72E	Erven
228	BEAUFORT WEST	5279	0	32°20'58.32S	22°34'51.35E	Erven
229	BEAUFORT WEST	6268	0	32°20'35.84S	22°34'48.16E	Erven
230	BEAUFORT WEST	7396	0	32°20'59.47S	22°34'50.81E	Erven
231	BEAUFORT WEST	7598	0	32°20'43.08S	22°34'50.03E	Erven
232	BEAUFORT WEST	8334	0	32°20'43.94S	22°34'49.82E	Erven
233	BEAUFORT WEST	8435	0	32°20'56.25S	22°34'53.27E	Erven
234	BEAUFORT WEST	8448	0	32°20'46.12S	22°34'51.91E	Erven
235	BEAUFORT WEST	5994	0	32°21'0.2S	22°34'36.74E	Erven
236	BEAUFORT WEST	2800	0	32°20'33.02S	22°34'52.09E	Erven
237	BEAUFORT WEST	3545	0	32°18'0.4S	22°32'43.78E	Erven
238	BEAUFORT WEST	5371	0	32°20'22.65S	22°34'49.33E	Erven
239	BEAUFORT WEST	8597	0	32°20'32.05S	22°34'53.94E	Erven
240	CARNARVON	2017	0	30°58'12.54S	22°7'55.76E	Erven
241	BEAUFORT WEST	5995	0	32°21'0.46S	22°34'36.19E	Erven
242	CARNARVON	1640	0	30°58'10.88S	22°7'42.74E	Erven
243	BEAUFORT WEST	1969	0	32°20'54.21S	22°34'53.17E	Erven
244	BEAUFORT WEST	2630	0	32°20'56.14S	22°34'55.04E	Erven
245	BEAUFORT WEST	3462	0	32°20'51.56S	22°34'50.71E	Erven
246	BEAUFORT WEST	8605	0	32°20'13.34S	22°34'51.55E	Erven
247	BEAUFORT WEST	10247	0	32°20'21.19S	22°34'52.47E	Erven
248	BEAUFORT WEST	5887	0	32°21'2.64S	22°34'51.21E	Erven
249	BEAUFORT WEST	5937	0	32°20'45.4S	22°34'50.47E	Erven
250	BEAUFORT WEST	5992	0	32°20'59.43S	22°34'38.3E	Erven
251	BEAUFORT WEST	7391	0	32°20'31.76S	22°34'52.19E	Erven
252	BEAUFORT WEST	5866	0	32°20'32.91S	22°34'53.09E	Erven
253	BEAUFORT WEST	5892	0	32°20'48.27S	22°34'49.99E	Erven
254	BEAUFORT WEST	5990	0	32°20'58.83S	22°34'39.54E	Erven
255	BEAUFORT WEST	5993	0	32°20'59.86S	22°34'37.44E	Erven
256	BEAUFORT WEST	8403	0	32°20'36.43S	22°34'50.46E	Erven
257	BEAUFORT WEST	6897	0	32°20'59.5S	22°34'53.57E	Erven
258	BEAUFORT WEST	5989	0	32°20'58.62S	22°34'39.97E	Erven
259	BEAUFORT WEST	5996	0	32°21'0.71S	22°34'35.67E	Erven
260	BEAUFORT WEST	7587	0	32°21'0.78S	22°34'54.68E	Erven
261	BEAUFORT WEST	8604	0	32°20'26.18S	22°34'53.09E	Erven
262	BEAUFORT WEST	11202	0	32°20'40.66S	22°34'49.42E	Erven
263		21	0	31°49'15.84S	22°22'43.59E	Farm
264		40	0	31°52'19.05S	22°19'58.32E	Farm
265		42	0	31°55'5.28S	22°22'33.3E	Farm
266	WATERVAL	101	0	32°2'42.02S	22°29'20.27E	Farm
267	MATJES VALIE	103	0	32°7'31.73S	22°32'54.12E	Farm
268	QUAGGA FONTEIN	82	0	31°58'3.26S	22°25'18.47E	Farm
269	DUIKERFONTEIN	5	0	31°38'1.02S	22°19'41.52E	Farm

15/04/2020

270	ALWINS GATE	186	0	32°14'29.4S	22°34'27.32E	Farm
271	UITSPAN BERG	142	0	31°25'17.28S	22°20'2.18E	Farm
272	LAKEN VALLEY	145	0	31°35'23.48S	22°27'16.29E	Farm
273		187	0	32°11'33.42S	22°31'53.14E	Farm
274	GROOTVLEI	193	0	32°11'15.29S	22°27'13.63E	Farm
275	VRYE LAAGTE	530	0	31°6'22.66S	22°6'56.66E	Farm
276		43	0	31°52'16.6S	22°26'14.66E	Farm
277	WATERFALL	97	0	32°4'45.04S	22°26'17E	Farm
278	JACKALL`S DANCE	143	0	31°32'21.02S	22°20'50.79E	Farm
279	MURANDA	144	0	31°34'52.79S	22°20'26.97E	Farm
280		570	0	31°22'49.45S	22°17'48.24E	Farm
281	WELTEVREDEN	571	0	31°20'13.66S	22°18'1.37E	Farm
282	RONDOM	540	0	31°16'57.62S	22°15'21.9E	Farm
283		185	0	32°21'40.99S	22°36'18.66E	Farm
284	ADJ LAP FONTEIN	41	0	31°53'33.57S	22°21'6.31E	Farm
285	WITTE HART	96	0	32°7'2.08S	22°28'19.17E	Farm
286	ALWINS GATE	186	0	32°14'11.25S	22°32'44.59E	Farm
287		582	0	31°18'36.58S	22°18'25.22E	Farm
288		6	0	31°40'28.87S	22°24'36.78E	Farm
289	MIDDLE KRAAL	98	0	32°2'35.68S	22°25'12.22E	Farm
290		185	0	32°20'19.54S	22°34'12.54E	Farm
291	BLAAUW KRANTZ	485	0	31°2'47.78S	22°13'59.88E	Farm
292		7	0	31°42'9.25S	22°24'18.26E	Farm
293	KLIPBANKS FONTEIN	533	0	31°7'23.28S	22°8'29.39E	Farm
294		185	0	32°21'26.76S	22°34'50.27E	Farm
295		437	0	32°10'30.02S	22°37'12.92E	Farm
296		18	0	31°44'53.99S	22°24'36.26E	Farm
297		437	0	32°14'34.64S	22°33'37.08E	Farm
298	NIEUWE UITVLUGT	539	0	31°13'52.02S	22°18'3.29E	Farm
299		7	1	31°41'53.31S	22°21'53.42E	Farm Portion
300	WATERVAL	101	0	32°2'42.42S	22°28'50.15E	Farm Portion
301		42	0	31°55'5.28S	22°22'33.3E	Farm Portion
302	MIDDLE KRAAL	98	0	32°2'35.68S	22°25'12.22E	Farm Portion
303	DUIKERFONTEIN	5	1	31°38'53.48S	22°20'54.3E	Farm Portion
304	MATJES VALIE	103	1	32°10'15.61S	22°32'39.6E	Farm Portion
305	LAKEN VALLEY	145	3	31°36'26.19S	22°24'26.56E	Farm Portion
306	ALWINS GATE	186	6	32°14'56.2S	22°34'24.32E	Farm Portion
307		185	0	32°20'27.75S	22°34'50.04E	Farm Portion
308		43	0	31°52'16.6S	22°26'14.66E	Farm Portion
309		187	0	32°10'57.56S	22°31'37.19E	Farm Portion
310	GROOTVLEI	193	0	32°11'15.29S	22°27'13.63E	Farm Portion
311	DUIKERFONTEIN	5	3	31°38'18.82S	22°19'53.1E	Farm Portion
312		6	1	31°40'37.3S	22°20'41.18E	Farm Portion
313		18	2	31°42'37.84S	22°21'23.62E	Farm Portion
314		21	0	31°49'58.68S	22°22'31.92E	Farm Portion
315		21	1	31°47'18.12S	22°23'15.68E	Farm Portion
316	ADJ LAP FONTEIN	41	0	31°53'33.57S	22°21'6.31E	Farm Portion
317		430	0	32°14'38.97S	22°33'36E	Farm Portion
318	KLIPBANKS FONTEIN	533	0	31°7'23.28S	22°8'29.39E	Farm Portion
319	JACKALL`S DANCE	143	0	31°32'22.65S	22°21'10.64E	Farm Portion
320		185	16	32°19'49.85S	22°35'25.68E	Farm Portion
321		185	0	32°21'44.83S	22°36'18.28E	Farm Portion
322		570	2	31°21'58.76S	22°19'34.14E	Farm Portion
323		582	0	31°17'52.27S	22°19'49.39E	Farm Portion
324	DUIKERFONTEIN	5	0	31°37'5.28S	22°20'12.42E	Farm Portion
325		18	0	31°45'0.77S	22°24'35.32E	Farm Portion
326	MURANDA	144	0	31°34'52.79S	22°20'26.97E	Farm Portion
327		185	0	32°21'28.57S	22°36'16.52E	Farm Portion

328	VRYE LAAGTE	530	0	31°6'22.66S	22°6'56.66E	Farm Portion
329	NIEUWE UITVLUGT	539	6	31°13'53.06S	22°15'45.14E	Farm Portion
330		185	0	32°20'21.58S	22°34'12.69E	Farm Portion
331		437	0	32°14'36.02S	22°33'36.54E	Farm Portion
332		437	0	32°10'26.5S	22°37'13.49E	Farm Portion
333	BLAAUW KRANTZ	485	29	31°4'48.59S	22°10'36.45E	Farm Portion
334	RONDOM	540	0	31°17'8.94S	22°16'21.52E	Farm Portion
335		430	0	32°10'45.49S	22°37'1.52E	Farm Portion
336	BLAAUW KRANTZ	485	13	31°3'35.69S	22°9'13.75E	Farm Portion
337		570	1	31°23'27.47S	22°16'28.85E	Farm Portion
338	WITTE HART	96	0	32°7'2.08S	22°28'19.17E	Farm Portion
339	WATERFALL	97	0	32°4'39.81S	22°25'57.83E	Farm Portion
340		40	1	31°52'18.93S	22°19'58.98E	Farm Portion
341	QUAGGA FONTEIN	82	0	31°58'3.26S	22°25'18.47E	Farm Portion
342	WATERFALL	97	2	32°5'5.64S	22°27'32.61E	Farm Portion
343	UITSPAN BERG	142	0	31°25'17.28S	22°20'2.18E	Farm Portion
344		185	0	32°21'23.29S	22°34'49.76E	Farm Portion
345	ALWINS GATE	186	9	32°14'5.85S	22°32'43.28E	Farm Portion
346		185	0	32°20'22.89S	22°34'12.64E	Farm Portion
347	ALWINS GATE	186	2	32°13'59S	22°34'32.49E	Farm Portion
348	BLAAUW KRANTZ	485	3	31°9'23.43S	22°12'15.63E	Farm Portion
349	BLAAUW KRANTZ	485	16	31°7'8.45S	22°11'50.48E	Farm Portion
350	BLAAUW KRANTZ	485	4	31°11'31.2S	22°12'44.7E	Farm Portion
351	BLAAUW KRANTZ	485	33	31°2'35.15S	22°8'55.61E	Farm Portion
352	WELTEVREDEN	571	1	31°20'12.95S	22°18'1.8E	Farm Portion
353	NIEUWE UITVLUGT	539	0	31°12'57.61S	22°16'22.32E	Farm Portion
354	NIEUWE UITVLUGT	539	3	31°15'10.59S	22°16'28.57E	Farm Portion

Development footprint[1] vertices:
No development footprint(s) specified.

Wind and Solar developments with an approved Environmental Authorisation or applications under consideration within 30 km of the proposed area

No	EIA Reference No	Classification	Status of application	Distance from proposed area (km)
1	12/12/20/2133	Solar PV	Approved	4.1
2	14/12/16/3/3/2/773	Solar PV	Approved	4.4
3	12/12/20/2286	Solar PV	Approved	2.3
4	14/12/16/3/3/2/772	Solar PV	Approved	4.4
5	14/12/16/3/3/2/774	Solar PV	Approved	4.4

Environmental Management Frameworks relevant to the application

No intersections with EMF areas found.

[1] "development footprint", means the area within the site on which the development will take place and incudes all ancillary developments for example roads, power lines, boundary walls, paving etc. which require vegetation clearance or which will be disturbed and for which the application has been submitted.

Environmental screening results and assessment outcomes

The following sections contain a summary of any development incentives, restrictions, exclusions or prohibitions that apply to the proposed development site as well as the most environmental sensitive features on the site based on the site sensitivity screening results for the application classification that was selected. The application classification selected for this report is:
Any activities within or close to a watercourse|Any activities within or close to a watercourse.

Relevant development incentives, restrictions, exclusions or prohibitions

The following development incentives, restrictions, exclusions or prohibitions and their implications that apply to this site are indicated below.

Incentive, restriction or prohibition	Implication
Strategic Transmission Corridor-Central corridor	https://screening.environment.gov.za/ScreeningDownloads/DevelopmentZones/GNR_350_of_13_April_2017.pdf
South African Protected Areas	https://screening.environment.gov.za/ScreeningDownloads/DevelopmentZones/SAPAD_OR_2019_Q4_Metadata.pdf

Map indicating proposed development footprint within applicable development incentive, restriction, exclusion or prohibition zones

Project Location: SKA fibre optic cable

Proposed Development Area Environmental Sensitivity

The following summary of the development site environmental sensitivities is identified. Only the highest environmental sensitivity is indicated. The footprint environmental sensitivities for the proposed development footprint as identified, are indicative only and must be verified on site by a suitably qualified person before the specialist assessments identified below can be confirmed.

Theme	Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
Agriculture Theme		X		
Animal Species Theme		X		

Aquatic Biodiversity Theme	X			
Archaeological and Cultural Heritage Theme		X		
Civil Aviation Theme		X		
Paleontology Theme		X		
Plant Species Theme			X	
Defence Theme				X
Terrestrial Biodiversity Theme	X			

Specialist assessments identified

Based on the selected classification, and the environmental sensitivities of the proposed development footprint, the following list of specialist assessments have been identified for inclusion in the assessment report. It is the responsibility of the EAP to confirm this list and to motivate in the assessment report, the reason for not including any of the identified specialist study including the provision of photographic evidence of the site situation.

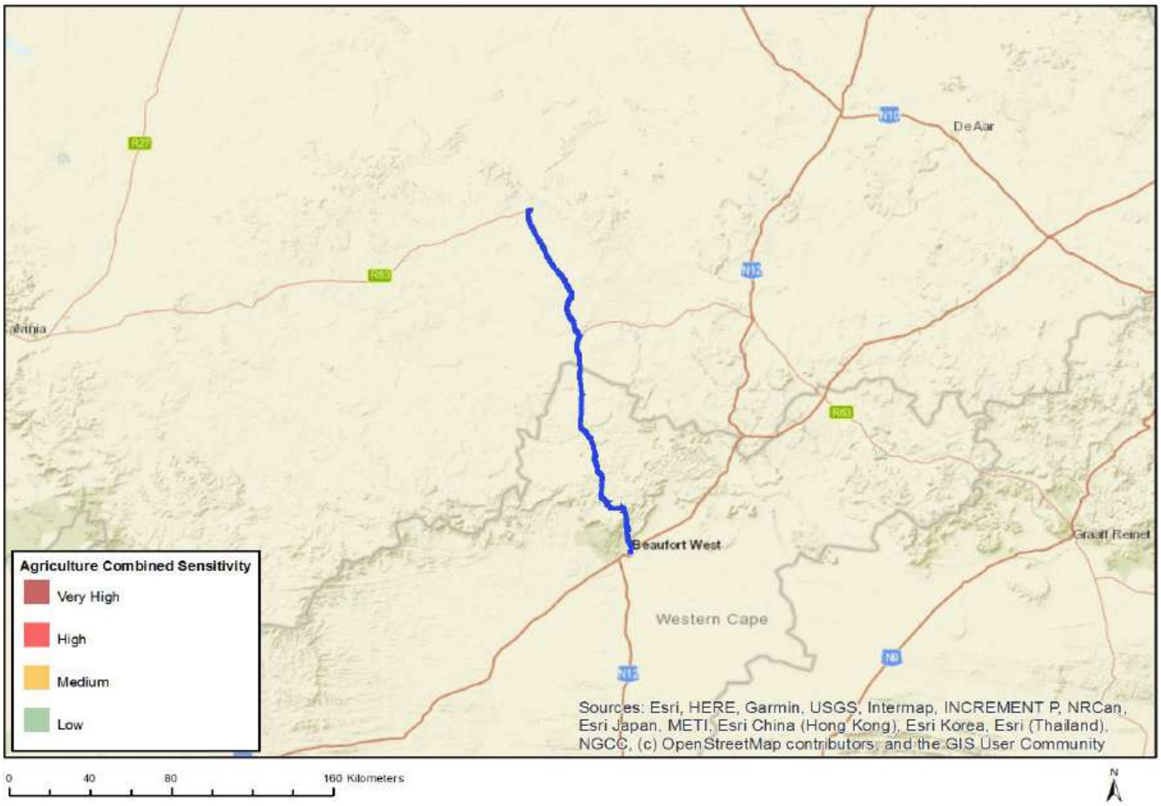
No	Specialist assessment	Assessment Protocol
1	Landscape/Visual Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/DraftGazetted_General_Requirement_Assessment_Protocols.pdf
2	Archaeological and Cultural Heritage Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/DraftGazetted_General_Requirement_Assessment_Protocols.pdf
3	Palaeontology Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/DraftGazetted_General_Requirement_Assessment_Protocols.pdf
4	Terrestrial Biodiversity Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/DraftGazetted_Terrestrial_Biodiversity_Assessment_Protocols.pdf
5	Aquatic Biodiversity Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/DraftGazetted_Aquatic_Biodiversity_Assessment.pdf
6	Hydrology Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/DraftGazetted_General_Requirement_Assessment_Protocols.pdf
7	Socio-Economi	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols

	c Assessment	/DraftGazetted_General_Requirement_Assessment_Protocols.pdf
8	Plant Species Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/DraftGazetted_General_Requirement_Assessment_Protocols.pdf
9	Animal Species Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/DraftGazetted_General_Requirement_Assessment_Protocols.pdf

Results of the environmental sensitivity of the proposed area.

The following section represents the results of the screening for environmental sensitivity of the proposed site for relevant environmental themes associated with the project classification. It is the duty of the EAP to ensure that the environmental themes provided by the screening tool are comprehensive and complete for the project. Refer to the disclaimer.

MAP OF RELATIVE AGRICULTURE THEME SENSITIVITY

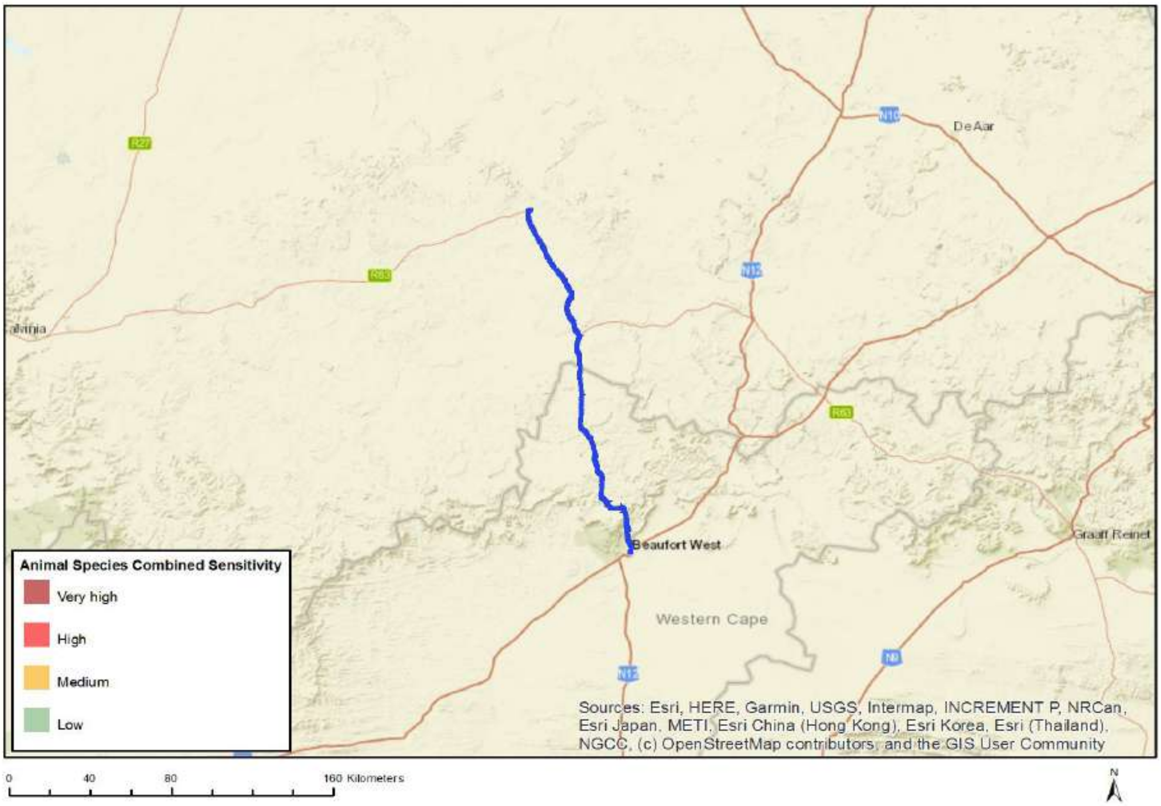


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Annual Crop Cultivation / Planted Pastures Rotation;Land capability;01. Very low/02. Very low/03. Low-Very low/04. Low-Very low/05. Low
High	Annual Crop Cultivation / Planted Pastures Rotation;Land capability;06. Low-Moderate/07. Low-Moderate/08. Moderate
Low	Land capability;01. Very low/02. Very low/03. Low-Very low/04. Low-Very low/05. Low
Medium	Land capability;06. Low-Moderate/07. Low-Moderate/08. Moderate

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY

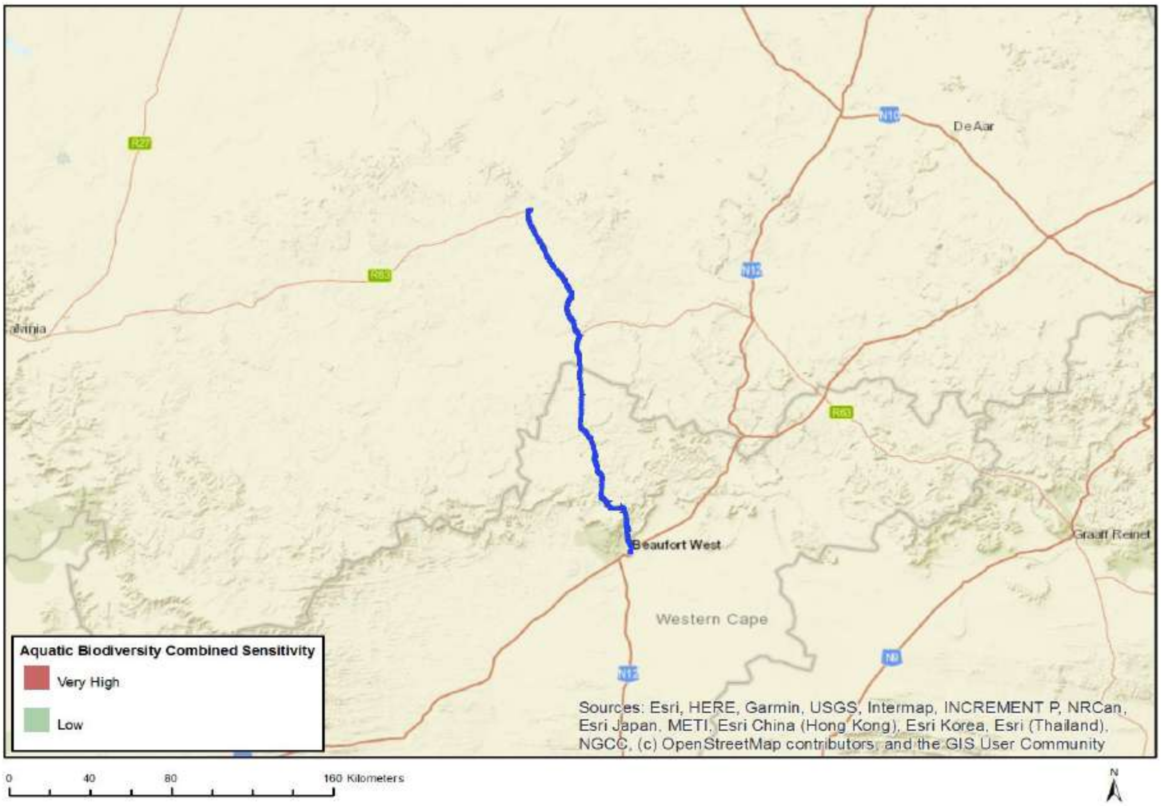


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Aves-Aquila verreauxii
High	Aves-Circus maurus
High	Mammalia-Bunolagus monticularis
High	Mammalia-Redunca fulvorufula fulvorufula
Low	Low sensitivity
Medium	Mammalia-Bunolagus monticularis
Medium	Reptilia-Chersobius boulengeri

MAP OF RELATIVE AQUATIC BIODIVERSITY THEME SENSITIVITY

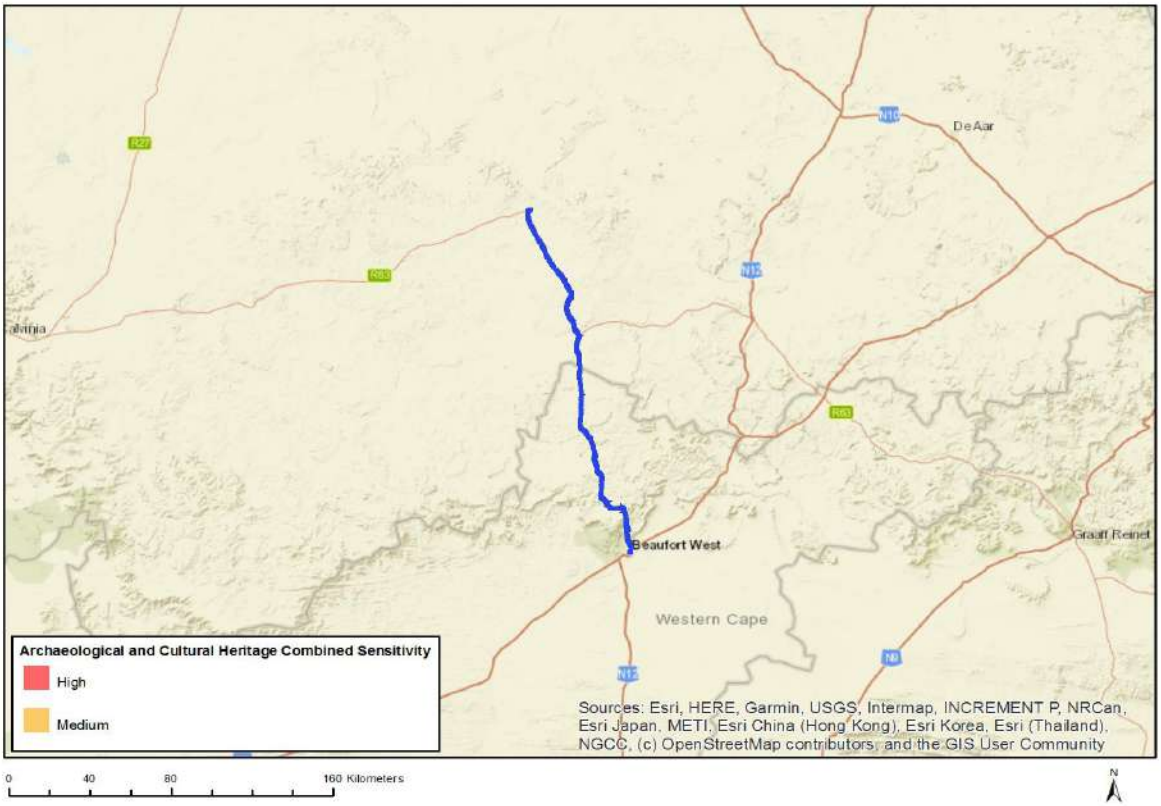


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity
Very High	Aquatic CBAs
Very High	Rivers
Very High	Wetlands and Estuaries
Very High	Freshwater ecosystem priority area quinary catchments

MAP OF RELATIVE ARCHAEOLOGICAL AND CULTURAL HERITAGE THEME SENSITIVITY

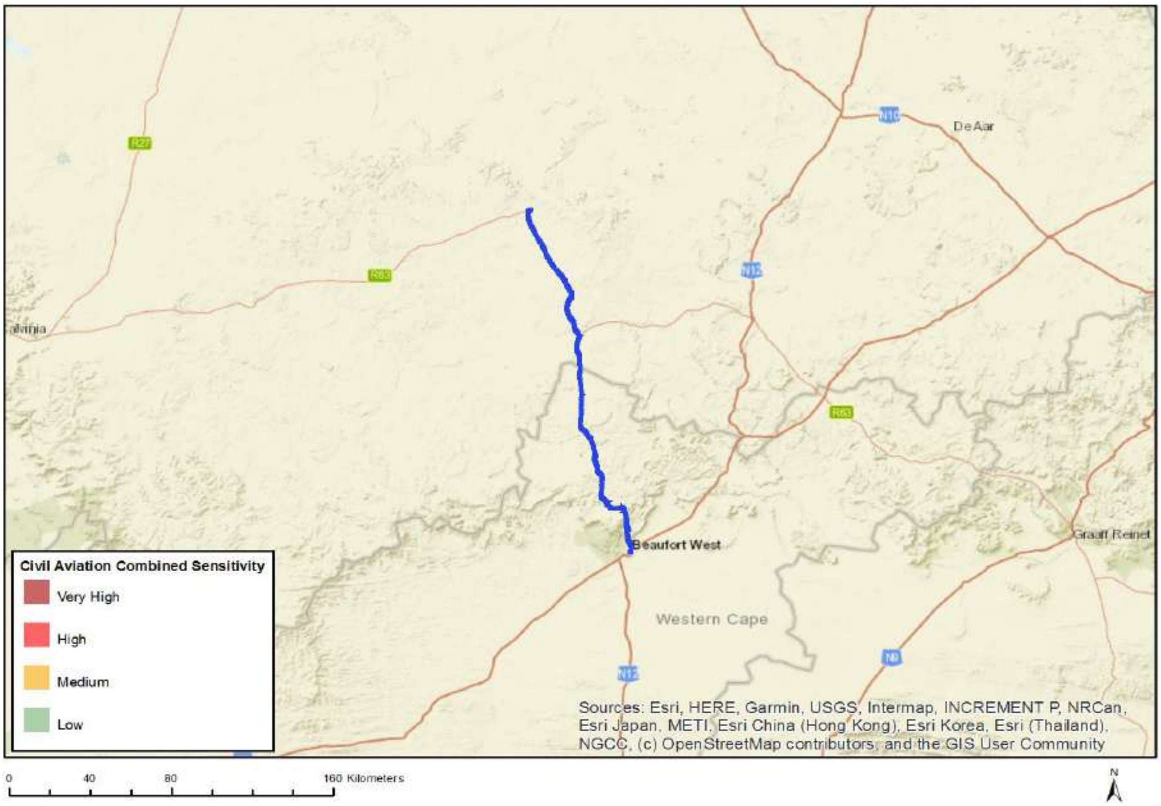


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Important mountain pass
High	Within 500 m of an important river
High	Within 500 m of an important wetland
High	Within 500 m of a heritage site
High	Within protected area
High	Within 1 km of a protected area
High	Within 500 m of a provincial heritage site
Medium	Mountain or ridge

MAP OF RELATIVE CIVIL AVIATION THEME SENSITIVITY

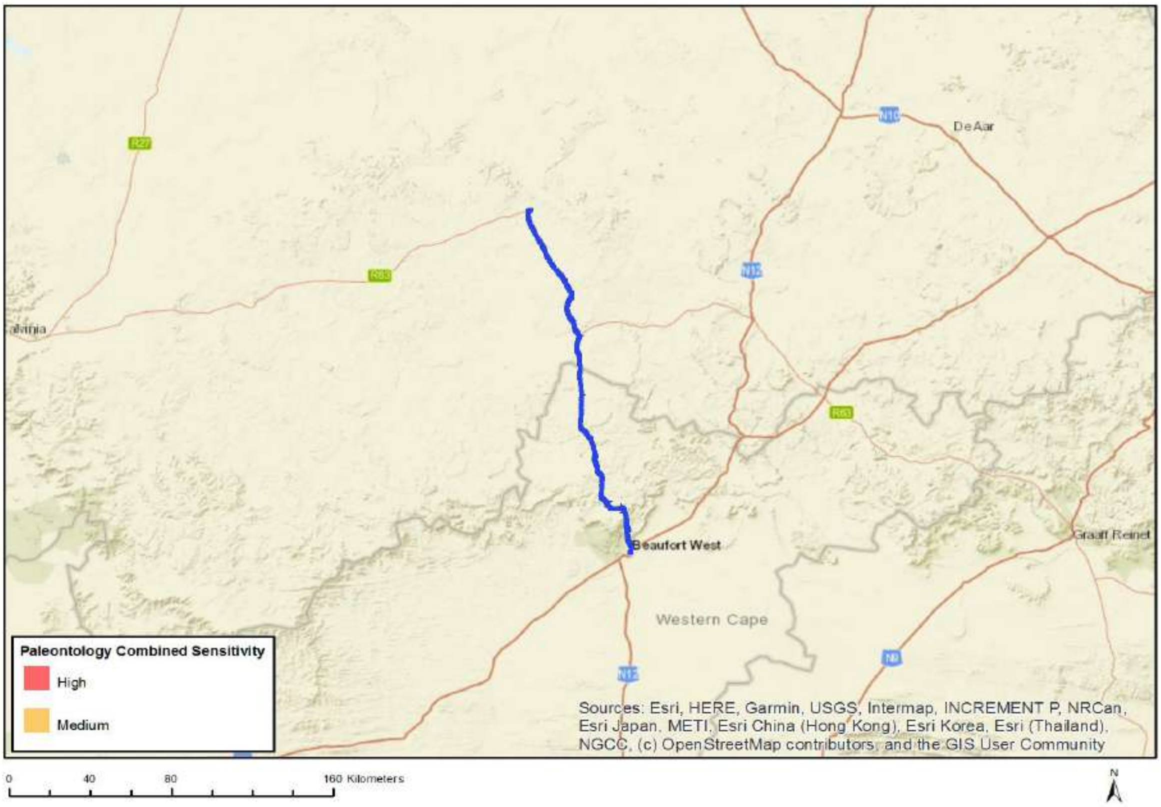


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Within 8 km of other civil aviation aerodrome
High	Dangerous and restricted airspace as demarcated
Low	Low sensitivity
Medium	Within 5 km of an air traffic control or navigation site
Medium	Between 8 and 15 km of other civil aviation aerodrome

MAP OF RELATIVE PALEONTOLOGY THEME SENSITIVITY

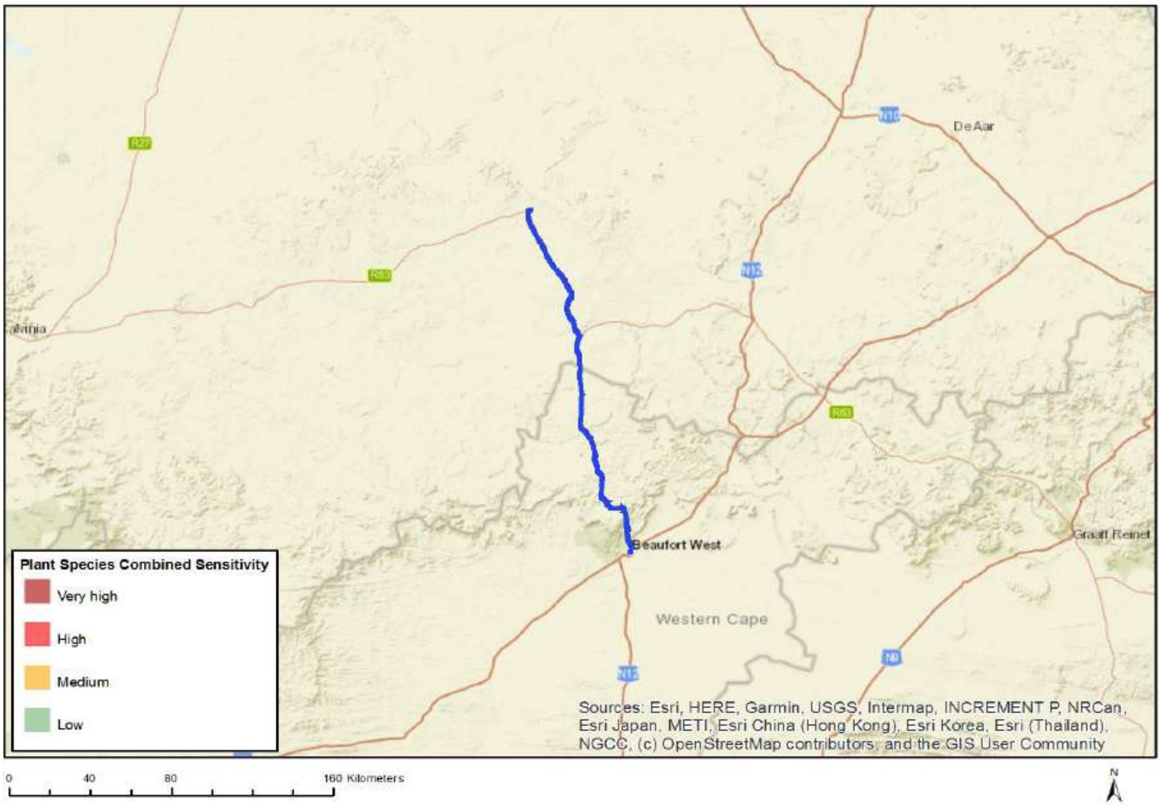


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Rock units with a high paleontological sensitivity
Medium	Rock units with a medium paleontological sensitivity

MAP OF RELATIVE PLANT SPECIES THEME SENSITIVITY

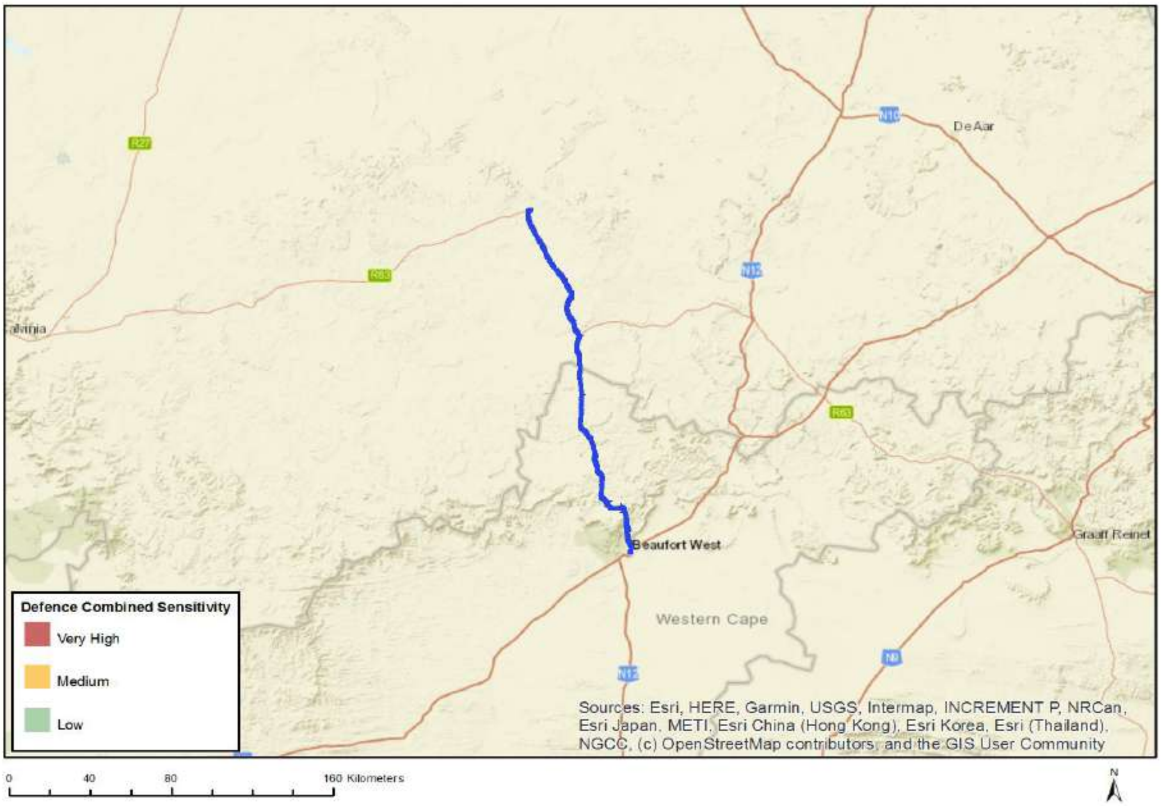


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity
Medium	Cliffortia arborea
Medium	Sensitive species 704

MAP OF RELATIVE DEFENCE THEME SENSITIVITY

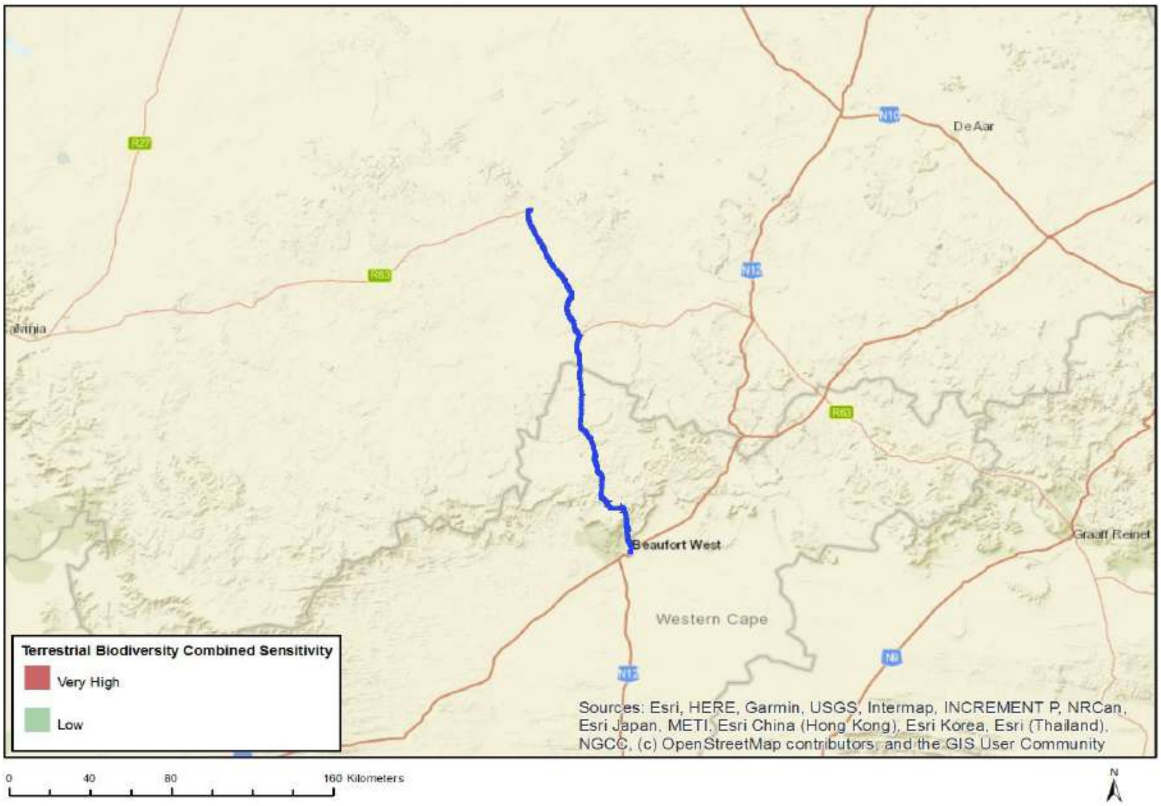


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity

MAP OF RELATIVE TERRESTRIAL BIODIVERSITY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity
Very High	Ecological Support Area 2
Very High	Ecological Support Area 1
Very High	Critical Biodiversity Area 2
Very High	Critical Biodiversity Area 1
Very High	Ecological Support Area
Very High	Focus Areas for land-based protected areas expansion
Very High	Freshwater ecosystem priority area quinary catchments
Very High	Karoo National Park
Very High	Dr Appie van Heerden Nature Reserve

Appendix 12 Letter confirming peer review of documents (to date, as at draft Basic Assessment Report)

Project Reference: 720.03046.00005

File Ref. SLR Letter Peer Review Declaration

28th July 2021

CSIR Environmental Management Services

ATTENTION: TO WHO IT MAY CONCERN

Dear Sir/Madam,

PEER REVIEW OF BASIC ASSESSMENT FOR THE PROPOSED SQUARE KILOMETRE ARRAY (SKA) FIBRE OPTIC CABLE BETWEEN BEAUFORT WEST AND CARNARVON

I (Edward Perry) can attest that I acted as an independent peer review environmental assessment practitioner for this project. I have the necessary knowledge and experience to undertake this review being a registered Environmental Assessment Practitioner with the Environmental Assessment Practitioner Association of South Africa. I undertook a review of the following documents providing comments to CSIR Environmental Management Services that, where applicable, were incorporated into the documents that are required to be submitted as part of this application.

- Public Participation Process Plan.
- Pre-application meeting 2 presentation.
- Pre-app meeting 2 notes.
- Draft Basic Assessment Report.
- Draft Environmental Management Programme.
- Newspaper advertisement.
- Site notice.
- Letter 1 notification to Interested and Affected Parties.
- EA application.

I can declare that I do not have any vested interest in the proposed activity beyond being paid a reasonable fee for the work undertaken.

Yours faithfully

Edward Perry

Appendix 13 NEM:PAA Section 50 (5) approval for activities in the Karoo National Park

South African National Research Network (SANReN)
Council for Scientific and Industrial Research (CSIR)
NextGen Enterprises and Institutions Cluster
PO Box 395
Pretoria
0001
South Africa

Attention: Mr. Zuki Makalima
CC: Mr. Mlungisi Majola
Ms. Luanita Snyman-van der Walt

APPROVAL IN TERMS OF SECTION 50 (5) OF THE NATIONAL ENVIRONMENTAL MANAGEMENT: PROTECTED AREAS ACT (ACT NO. 57 OF 2003, AS AMENDED) FOR THE INSTALLATION OF OVERHEAD FIBRE OPTIC CABLES IN THE KAROO NATIONAL PARK, FOR THE PURPOSES OF THE SQUARE KILOMETRE ARRAY (SKA) RADIO-TELESCOPE

The South African National Research Network (SANReN), hosted and implemented by the Council for Scientific and Industrial Research (CSIR) is tasked with constructing fibre optic cable between Beaufort West and Carnarvon (via Loxton). The purpose of the fibre optic cable is to connect the South African Radio Astronomy Observatory (SARAO) core site hosting the Square Kilometre Array (SKA) and MeerKAT telescopes to transport radio astronomy measurements to the SARAO Science Data Processor (SDP) that will be located in Cape Town.

The fibre optic cable will follow the Ni, R381 and R63 roads between Beaufort West and Carnarvon. Where the cabling needs to traverse difficult terrain, for example the Molteno Pass on the eastern side of the Karoo National Park ("the Park"), it would need to be installed overhead within the Park on a combination of timber and concrete poles between 7.5 and 9 m high at intervals of 20 - 80m. SANParks acknowledges that the SANReN fibre route to be constructed for SARAO would encroach the identified properties, which have been declared as part of the Park, where it is not possible to remain within the road reserves:

- Erf 3545 of the Beaufort West region [C00900010000354500000];
- Erf 1707 of the Beaufort West Region [C00900010000170700000]; and
- Portion 9 of the Farm Alwins Gate 186 [C00900000000018600009].

Section 50 (5) of the National Environmental Management: Protected Areas Act (Act no. 57 of 2003, as amended) (NEM:PAA) stipulates:

No development, construction or farming may be permitted in a national park, nature reserve or world heritage site without the prior written approval of the management authority.

Furthermore, Section 19 of the NEM:PAA regulations for the proper administration of special nature reserves, national parks and world heritage sites (Government Notice R1061 in Government Gazette 28181, dated 28 October 2005) stipulates:

(1) No development contemplated in section 50 (5) of the Act shall be implemented—

(a) in any area other than an area specifically designated for such development in a management plan; and

(b) before a management authority has indicated in writing the nature and extent of the strategic or environmental impact assessment required for the development.

(2) No commercial activity or activity contemplated in section 50 of the Act, which requires an environmental impact assessment to be undertaken, either in terms of subregulation (1)(b) or under any other law, may be implemented before a management authority has approved, with or without conditions, the environmental impact assessment before it is submitted to the relevant authority for approval.

SANParks confirms that it is the management authority of the Karoo National Park. Approximately 4.7 km of the overhead cabling is proposed within the Park in order to traverse the difficult terrain in the Molteno Pass section. The proposed fibre optic cabling will follow the same corridor as the abandoned Telkom telephone line (adjacent to the Eskom power line). The proposed SKA fibre optic cable is a remote zone, in an existing footprint used for linear infrastructure. SANParks has no objection to the proposed fibre optic cable footprint in the Park.

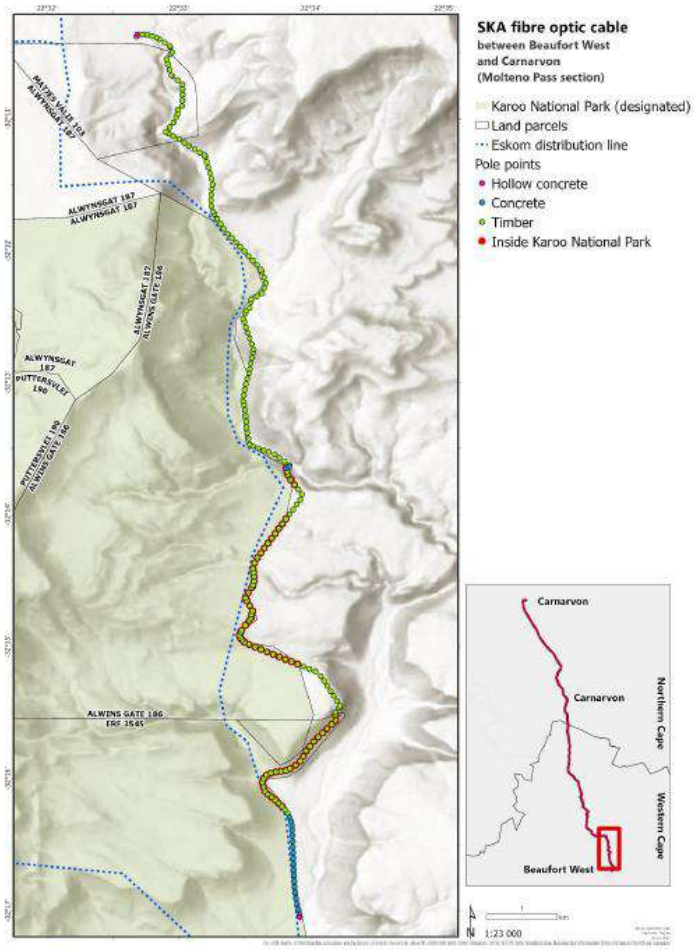


Figure 2: Proposed pole placement for overhead installation of the SKA fibre optic cable in the Molteno Pass section within the Karoo National Park and its Viewshed Protection buffer zone.

SANParks understands that Environmental Authorisation (EA) is also required for the proposed fibre optic cable development. The Environmental Impact Assessment (EIA) process (Basic Assessment (BA)) be conducted in accordance the requirements of the National Environmental Management Act (NEMA) EIA Regulations in this regard, and Park Management must be included in the Public Participation Process going forward. A Water Use License (WUL) is also required for the proposed fibre optic cable project.

We hereby grant approval in terms of Section 50 (5) of the NEM:PAA and wayleave for CSIR to proceed with the fibre installation within the Karoo National Park (after EA has been obtained).

We further recognize that SANReN is a non-profit initiative for the benefit of South African research, education and innovation communities, and thus waive any payment for the granting of the wayleave.

We trust that the CSIR and all construction, operations and maintenance contractors will:

- To the best of its abilities, endeavour to avoid any possible damage to Park property or services through the installation of the fibre optic cable. CSIR will minimize any inconvenience and also repair any damage that may be caused during the installation.
- Endeavor to arrange for access to the property at mutually agreeable times and to minimize any disruption.
- Ensure that all construction, operations and maintenance activities will be carried out in accordance to the EA (if granted) and associated Environmental Management Programme for the proposed fibre optic cable development.

Yours sincerely

Mr Property Mokoena
Managing Executive - Parks Division
South African National Parks

Date: 2 August 2021

CC: Andre Riley
Nico van der Walt
Kristal Maze
Marinda van Graan
Maretha Alant

Appendix 14 EAP curricula vitae and declaration of interest

Luanita Snyman-van der Walt (EAP) – details, declaration of interest and undertaking

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE ENVIRONMENTAL ASSESSMENT PRACTITIONER, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

Square Kilometre Array fibre optic cable between Beaufort West and Carnarvon.

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

LsvdW

1. ENVIRONMENTAL ASSESSMENT PRACTITIONER (EAP) INFORMATION

Company of Environmental Assessment Practitioner:	**Council for Scientific and Industrial Research (CSIR) Environmental Management Services (EMS)**			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	2	Percentage Procurement recognition	125 %
EAP name:	**Luanita Snyman-van der Walt**			
EAP Qualifications:	**MSc Environmental Science; PgD Geographic Information Science**			
Professional affiliation/registration:	**South African Council for Natural Scientific Professions (SACNASP) Pr. Sci. Nat. Environmental Science (400128/16)**			
Physical address:	**CSIR, 11 Jan Celliers Street, Stellenbosch, 7600**			
Postal address:	**PO Box 320, Stellenbosch**			
Postal code:	**7599**	Cell:	**072 182 9718**	
Telephone:	**021 888 2490**	Fax:	**021 888 2490**	
E-mail:	**Lvdwalt1@csir.co.za**			

The appointed EAP must meet the requirements of Regulation 13 of GN R982 of 04 December 2014, as amended.

2. DECLARATION BY THE EAP

I, ______Luanita Snyman-van der Walt_________, declare that –

- I act as the independent environmental assessment practitioner in this application;
- I have expertise in conducting environmental impact assessments, 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 will 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;
- I will take into account, to the extent possible, the matters listed in Regulation 13 of the Regulations when preparing the application and any report relating to the application;
- 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, unless access to that information is protected by law, in which case it will be indicated that such information exists and will be provided to the Competent Authority;
- I will perform all obligations as expected from an environmental assessment practitioner in terms of the Regulations; and
- I am aware of what constitutes an offence in terms of Regulation 48 and that a person convicted of an offence in terms of Regulation 48(1) is liable to the penalties as contemplated in Section 49B of the Act.

LSvdW

Disclosure of Vested Interest (delete whichever is not applicable)

- I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Regulations;

- ~~I have a vested interest in the proposed activity proceeding, such vested interest being:~~

Signature of the Environmental Assessment Practitioner

Council for Scientific and Industrial Research (CSIR)

Name of Company:

21 July 2021

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, Luanita Snyman-van der Walt, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Environmental Assessment Practitioner

Council for Scientific and Industrial Research (CSIR)

Name of Company

21 July 2021

Date

Signature of the Commissioner of Oaths

21.07.2021

Date

JURGENS STEPHANUS TERBLANCHE
Adendorff Attorneys Inc.
Commissioner of Oaths
Practising Attorney (RSA)
3rd Floor, Tygervalley Chambers 4
27 Willie van Schoor Drive
Tyger Valley, Cape Town

JURGENS STEPHANUS TERBLANCHE
Adendorff Attorneys Inc.
Commissioner of Oaths
Practising Attorney (RSA)
3rd Floor, Tygervalley Chambers 4
27 Willie van Schoor Drive
Tyger Valley, Cape Town

Luanita Snyman-van der Walt (EAP) – curriculum vitae

LUANITA SNYMAN-VAN DER WALT

MSc Environmental Science (NWU)
PgD Geographic Information Science (VU)

Tel : +27 21 888 2490
Email: LvdWalt1@csir.co.za

Full Name: Snyman-Van der Walt, Luanita
Professional Registration: Pr.Sci.Nat Environmental Science – Reg No: 400128/16
Nationality: South Africa
Marital Status: Married
Current employer: CSIR Environmental Management Services
Position in Firm: Senior Environmental Scientist and Assessment Practitioner
Specialisation and Research interest: Environmental Assessment and Management; Strategic Environmental Assessment; Geographic Information Systems; Geodesign; Science-society-policy interface; Systems-thinking; Terrestrial, landscape & Urban Ecology.

BIOSKETCH

Luanita holds an MSc in Environmental Science and PgD in Geographic Information Science. She is an environmental scientist and assessment practitioner registered as a Professional Natural Scientist with the South African Council for Natural Scientific Professions (Reg. no. 400128/16). She has 7 years' experience in strategic environmental assessment, management, and planning, with a focus on Geographic Information System (GIS) analyses for environmental assessment and decision-making on sustainable development.

She is trained and has technical expertise in environmental science (terrestrial- and urban ecology) and geographic information science, and has managed, coordinated, designed and provided technical input to multiple Strategic Environmental Assessments (SEAs), Environmental Impact Assessments (EIAs) and Risk and Resilience Assessments, and Environmental Screening Studies (ESSs) in South Africa, as well as Environmental and Social Impact Assessments (ESIAs) in Namibia and Cameroon.

PROJECT TRACK RECORD

Completion	Description	Role	Client
In progress	Basic Assessment for the Proposed Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon,	Environmental Assessment Practitioner; Project manager; Technical GIS analysis and mapping; Report writing	South African National Research Network
March 2021	Environmental and Social Impact Assessment for exploration/appraisal drilling, Matanda Block, Onshore Douala Basin, Cameroon	Project manager; Technical GIS analysis and mapping; Report review	Gaz du Cameroun
March 2021	Environmental and social screening: Feasibility study for a desalination plant and water carriage system to secure water supply to central coast, Windhoek and en-route users.	Project manager; Technical GIS analysis and mapping; Environmental Sensitivity Analysis	Namwater

Completion	Description	Role	Client
May 2020	Environmental Screening Study for the Proposed Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon,	Project manager; Technical GIS analysis and mapping; Report writing	South African National Research Network
November 2019	Strategic Environmental Assessment for the Saldanha Bay Municipality (Phase 1)	Technical GIS analysis and mapping, Biodiversity and Ecology assessment	Western Cape Department of Environmental Affairs and Development Planning.
September 2019	Environmental Screening Study for a proposed 100 – 150 megalitre/day desalination plant for the City of Cape Town: Pre-feasibility study for terrestrial project components	Technical GIS and mapping, Environmental Sensitivity Analysis	City of Cape Town
October 2019	Strategic Environmental Assessment for Gas Pipeline Corridors and Electricity Grid Expansion.	Integrating Author and Editor: Biodiversity and Ecology	Department of Environmental Affairs
October 2019	Strategic Environmental Assessment Aquaculture Development in South Africa	Project member – Technical GIS and mapping	Department of Environmental Affairs
August 2019	Sustainable Development Goal Lab on “Africa’s first Decision-Theatres”.	Project manager	Future Earth
December 2018	Substantive amendment to the Environmental Authorisation of the Edison PV solar development.	Project manager and Environmental Assessment Practitioner.	29 Solar
October 2018	Environmental Screening Study: Stand Number 159. Diepkloof, Gauteng, Proposed for a Comprehensive Integrated Transport Customer Service Centre.	Project manager, author, Technical GIS and mapping	CSIR Built Environment
March 2018	Scoping and Environmental Impact Assessment for the proposed development of the Kap Vley Wind Energy Facility near Kleinzee in the Northern Cape	Specialist study: Aquatic Ecology	juwi Renewable Energies
March 2018	Scoping and Environmental Impact Assessment for the proposed development of a 100 MW Solar Photovoltaic Facility near Kenhardt in the Northern Cape Province	Specialist study: Visual Impact Assessment	juwi Renewable Energies
September 2017	Sustainable Development Goal Lab on “Mainstreaming resilience into climate change adaptation and disaster risk planning.”	Project leader	Future Earth; Stockholm Resilience Centre; University of Tokyo (funders)
June 2017	Strategic Environmental Assessment for the development of Shale Gas in South Africa	Project officer	Department of Environmental Affairs
December 2017	Guidance for Resilience in the Anthropocene: Investments for development (GRAID) – African Cities.	Project member: Sustainability assessment guideline	Stockholm Resilience Centre (funder)
January 2017	**Environmental and Social Impact Assessment for the Floating Liquid Natural Gas project near Kribi, Cameroon.**	**Project member – Technical GIS and mapping, ecology inputs**	**Golar**
October 2016	Environmental Screening Study for the Giyani Waste Oil Boiler, Limpopo: Environmental management plan for the Hi-Hanyile essential oil distillery	Project manager	CSIR Enterprise Creation for Development

Completion	Description	Role	Client
September 2016	Scoping and Environmental Impact Assessment for 5 x 100 MW Solar PV facilities near Dealesville, Free State.	Project manager and Environmental Assessment Practitioner	29 Solar
June 2016	**Environmental and Social Impact Assessment for the Bomono Early Field Development Project, Cameroon.**	**Project member - Technical GIS and mapping, ecology inputs**	**EurOil**
May 2016	Scoping and Environmental Impact Assessment for the proposed Development of a 7 x 75 MW Solar Photovoltaic Facilities near Kenhardt, Northern Cape	Project member - Technical GIS and mapping	Mulilo
April 2016	Scoping and Environmental Impact Assessment for the Proposed Development 3 x 75 MW Solar Photovoltaic Facilities near Kenhardt, Northern Cape	Project member - Technical GIS and mapping	Scatec
April 2016	Strategic Environmental Assessment for identification of electricity grid infrastructure development corridors in South Africa	Project member - Technical GIS and mapping	Department of Environmental Affairs
February 2016	Environmental Impact Assessment for the development of 12 Solar PV projects near Dealesville, Free State.	Project member - Technical GIS and mapping, ecology inputs, stakeholder engagement	Mainstream Renewable Energy
September 2015	Environmental Screening Study for the Proposed Vaayu Energy SA Wind Energy Facility near Wesley, Eastern Cape	Project leader	Vaayu Energy
February 2015	Environmental Screening Study for Biochar- and Composting facilities in the Umzimvubu Catchment	Project member - Technical GIS and mapping & ecology inputs	Department of Environmental Affairs
March 2015	Strategic Environmental Assessment for identification of renewable energy zones for wind and solar PV projects in South Africa	Project member - Technical GIS and mapping	Department of Environmental Affairs
November 2014	Rapid environmental screening study for WASA wind monitoring masts (11-15) in the eastern cape, Kwazulu-Natal and Free State provinces, South Africa	Project member - Technical GIS and mapping	CSIR Built Environment
August 2014	Environmental Screening Study for the importation of Liquid Natural Gas into the Western Cape	Project member - Technical GIS and mapping, ecology inputs	Western Cape Government
March 2014	Environmental Screening Study for a Proposed LNG Terminal at Saldanha and associated pipeline infrastructures to Atlantis and Mossel Bay, Western Cape	Project member - Technical GIS and mapping, ecology inputs	PetroSA

PAST EMPLOYMENT RECORD

2015 – 2018 Junior Environmental Scientist and Assessment Practitioner, Council for Scientific and Industrial Research – Environmental Management Services (EMS), Implementation Unit (IU) - Stellenbosch.

2014 - 2015 Environmental Scientist and Assessment Practitioner (Intern). Council for Scientific and Industrial Research – Environmental Management Services (EMS), Implementation Unit (IU) - Stellenbosch.

QUALIFICATIONS

2017 - current	MSc. Geographic Information Science	Vrije Universiteit, Amsterdam, Netherlands (UNIGIS)
2019	PgD. GISc *(Cum Laude)*	Vrije Universiteit, Amsterdam, Netherlands (UNIGIS)
2018	PgC. GISc *(Cum Laude)*	Vrije Universiteit, Amsterdam, Netherlands (UNIGIS)
2013	MSc. Environmental Science *(Cum Laude)*	North West University, Potchefstroom, South Africa
2010	BSc. Hons. Environmental Science	North West University, Potchefstroom, South Africa
2009	BSc. Botany- Zoology-Tourism	North West University, Potchefstroom, South Africa

SOFTWARE SKILLS

- Esri Arcmap
- Microsoft Office (Word, Excel, Powerpoint, Visio, Project)
- Google Earth
- Vensim PLE
- QGIS

PEER REVIEWED PUBLICATIONS

Snyman-van der Walt, L., Schreiner, G., Laurie, S., Audouin, M., Lochner, P., Marivate, R., Pasquini, L., Davison, A., Hadingham, T. and Cameron, R., 2020. Pathways for Mainstreaming Resilience-Thinking into Climate Change Adaptation and Planning in the City of Cape Town. *In:* The Palgrave Handbook of Climate Resilient Societies, pp.1-22.

Schreiner, G.O., De Jager, M.J., Snyman-Van der Walt, L., Dludla, A., Lochner, P.A., Wright, J. G., Scholes, R.J., Atkinson, D., Hardcastle, P., Kotze, H., Esterhuyse, S. 2018. 'Evidence-based and participatory processes in support of shale gas policy development in South Africa'. *In:* Whitton, J., Cotton, M., Charnley-Parry, I.M. & Brasier, K. (*Eds.*) Governing Shale Gas: Development, Citizen Participation and Decision Making in the US, Canada, Australia and Europe. London, UK: Routledge.

Schreiner, G.O. & Snyman-van der Walt, L. 2018. Risk modelling of shale gas development scenarios in the central Karoo. *International Journal of Sustainable Development and Planning*, 13(2): 294-306.

Scholes, R.J., Schreiner, G.O. & Snyman-Van der Walt, L., 2017, 'Scientific assessments: Matching the process to the problem', *Bothalia,* 47(2), a2144. https://doi.org/10.4102/abc. v47i2.2144.

Scholes, R., Lochner, P., Schreiner, G., Snyman-Van der Walt, L. and de Jager, M. (eds.). 2016. Shale Gas Development in the Central Karoo: A Scientific Assessment of the Opportunities and Risks. CSIR/IU/021MH/EXP/2016/003/A, ISBN 978-0-7988-5631-7

Burns, M., Atkinson, D., Barker, O., Davis, C., Day, L., Dunlop, A., Esterhuyse, S., Hobbs, P., McLachlan, I., Neethling, H., Rossouw, N., Todd, S., Snyman-Van der Walt, L., Van Huyssteen, E., Adams, S., de Jager, M., Mowzer, Z. and Scholes, B. 2016. Scenarios and Activities. In Scholes, R., Lochner, P., Schreiner, G., Snyman-Van der Walt, L. and de Jager, M.(*Eds*.). 2016. Shale Gas Development in the Central Karoo: A Scientific Assessment of the Opportunities and Risks. CSIR/IU/021MH/EXP/2016/003/A, ISBN 978-0-7988-5631-7, Pretoria: CSIR.

Van Wilgen, B.W., Boshoff, N., Smit, I.P., Solano-Fernandez, S. & Van der Walt, L. 2016. A bibliometric analysis to illustrate the role of an embedded research capability in South African National Parks. *Scientometrics,* 107:185-212.

Van der Walt, L., Cilliers, S. S., Kellner, K., Du Toit, M.J., Tongway, D. 2014. To what extent does urbanisation affect fragmented grassland functioning? *Journal of Environmental Management*, 151, 517-530.

Van der Walt, L., Cilliers, S. S., Du Toit, M. J., & Kellner, K. 2014. Urban Ecosystems Conservation of fragmented grasslands as part of the urban green infrastructure : How important are species diversity, functional diversity and landscape functionality? *Urban Ecosystems*, 18(1): 87-113. DOI 10.1007/s11252–014–0393–9.

Van der Walt, L., Cilliers, S. S., Kellner, K., Tongway, D., & van Rensburg, L. 2012. Landscape functionality of plant communities in the Impala Platinum mining area, Rustenburg. *Journal of Environmental Management*, 113, 103–116. doi:10.1016/j.jenvman.2012.08.024. DOI: http://dx.doi.org/10.1016/j.jenvman.2014.11.034.

Breedt, J.A.D., Brewer, I., Coetzer, A., Van der Walt, L. & Cilliers, S.S., 2012. "Landskapsfunksionaliteit en plantdiversiteit in stedelike en landelike gefragmenteerde grasvelde in die Potchefstroom omgewing", *Suid-Afrikaanse Tydskrif vir Natuurwetenskap en Tegnologie* 31(1), Art. #279, 1 page. http://dx.doi. org/10.4102/satnt.v31i1.279.

Van der Walt, L., Cilliers, S.S., Kellner, K. 2011. Landscape function of plant communities in the Impala Platinum mining area, Rustenburg, South Africa. *South African Journal of Botany*. 77(2): 563.

CONFERENCES

Snyman-van der Walt, L. & Laurie, S. 2017. Sustainable Development Goals Lab: Mainstreaming resilience into climate change adaptation and disaster risk planning. 7th International Conference on Sustainability Science, Stockholm Sweden. 24 – 26 August 2017. TOdB: CSIR/IU/021MH/EXP/2017/0015/A

Snyman-van der Walt, L. 2017. Conference Presentation. GIS analysis and stakeholder input to identify strategic areas for aquaculture development: National Strategic Environmental Assessment for Aquaculture Development in South Africa; International Association for Impact Assessment - South Africa Conference, Worcester, 15 – 18 August 2017. TOdB Publication Number: CSIR/IU/021MH/EXP/2017/0010/A

Snyman-van der Walt, L. 2017. Key results of the South African shale gas scientific assessment: science for policy and responsible decision-making. Conference Presentation at 2017 2017 Southern African Systems Analysis Centre Capacity Development Programme. Stellenbosch, 12 July 2017. TOdB Publication Number: CSIR/IU/021MH/EXP/2017/0008/A.

Snyman-van der Walt, L. 2017. National Strategic Environmental Assessment for aquaculture development in South Africa: GIS analysis for identifying optimal areas for marine and freshwater aquaculture development presentation at World Aquaculture Conference, Cape Town, 26-30 June 201, TOdB Publication Number: CSIR/IU/021MH/EXP/2017/0006/A.

Schreiner, G.O. & Snyman-van der Walt, L. 2017. Modelling social-ecological risks of shale gas development in the Central Karoo: key results of the South African shale gas scientific assessment. CSIR document number: CSIR/IU/021MH/EXP/2017/0005/A. Oral presentation at the American Association of Petroleum Geologists workshop on exploration and development of unconventional hydrocarbons: understanding and mitigating geotechnical challenges through conventional wisdom, Cape Town, South Africa, 20 June 2017.

Schreiner, G.O, Snyman-Van der Walt, L., Fischer, D. & Cape, L. 2017. Scenarios-based risk model for shale gas scientific assessment. Conference proceedings from the International Association of Impact Assessment International Conference 2017, Montreal, Canada. 4-7 April 2017.

Van der Walt, L., Cilliers, S.S., Du Toit, M.J. & Kellner, K. 2013. Conservation of fragmented grasslands as part of the green infrastructure: how important are species diversity, functional diversity, and landscape functionality? Oral presentation at the First Congress of SURE (Society of Urban Ecology), Berlin, Germany, 25-27 July 2013.

Van der Walt, L., Cilliers, S.S., Kellner, K. & Du Toit, M.J. 2012. Landscape functionality and plant diversity in urban and rural grassland fragments in the Tlokwe Municipal area, North-West, South Africa. Poster presentation at the 38th Annual South African Association of Botanists (SAAB) Conference, Pretoria, South Africa, 15-18 January 2012.

Van der Walt, L., Cilliers, S.S. & Kellner, K. 2011. Landscape function of plant communities in the Impala Platinum mining area, Rustenburg, South Africa. Oral presentation at the 37th Annunal South African Association of Botanists (SAAB) Conference, Grahamstown, South Africa, 17-19 January 2011.

RELEVANT COURSES

2018	• GeoServices-4-Sustainability Summer School. Module: *Geo-Application Development* and Module: *Advanced Remote Sensing*, Eberswalde University for Sustainable Development, Germany.
2015	• Effective skills for dealing with challenging meetings, Conflict Dynamics (cc), CSIR Stellenbosch.
	• Foundation Level Course in Science Communication and Working with the Media, CSIR, Stellenbosch.
2014	• CiLLA Project Management 1 Course, CSIR Stellenbosch.
2012	• Transboundary Protection of Biodiversity, North West University Law Faculty (South Africa) and Justig Liebig University (Germany), NWU Potchefstroom.
2010	• Control of alien invasive species, Centre for Wildlife Management, University of Pretoria.

PROFESSIONAL AFFILIATIONS/REGISTRATIONS

2015-current	• South African Council for Natural Scientific Professions (SACNASP), Professional Natural Scientist (Reg. no. 400128/16).
2014-current	• International Association for Impact Assessment (IAIA) South Africa (Membership Number: 3584)
2014-2015	• South African Council for Natural Scientific Professions (SACNASP), Candidate Professional Natural Scientist (Reg. no. 100276/14).
2011-2012	• South African Association of Botanists (SAAB)

HONOURS AND AWARDS

2017	• CSIR Implementation Unit Excellence Awards: Collaboration Award – Team Shale Gas Strategic Environmental Assessment.
2016	• CSIR Excellence Awards: Collaboration Award finalist – Team Shale Gas Strategic Environmental Assessment.
2015	• CSIR Implementation Unit Excellence Awards: Human Capital Development Award – Team Special Needs & Skills Development. • Award: Best MSc Student in the Faculty of Natural Science, Potchefstroom Campus, North West University
2014	• Award: Best Masters Degree Student (S2A3 Bronze Medal) for Environmental Science and Technology, Potchefstroom Campus, North West University
2013	• Award: Mildred vd Merwe-Radloff Award for Best MSc Thesis – Botany, Potchefstroom Campus, North West University
2007-2013	• Golden Key International Academic Honours Association

LANGUAGE CAPABILITY

	Speaking	Reading	Writing
Afrikaans	Excellent	Excellent	Excellent
English	Excellent	Excellent	Excellent

Ed Perry (peer review EAP) – details, declaration of interest and undertaking

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE **PEER-REVIEW ENVIRONMENTAL ASSESSMENT PRACTITIONER**, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon.

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

Details of EAP, Declaration and Undertaking Under Oath

Page 1 of 3

1. PEER-REVIEW ENVIRONMENTAL ASSESSMENT PRACTITIONER (EAP) INFORMATION

Company of Environmental Assessment Practitioner:	**SLR CONSULTING SOUTH AFRICA**			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	**4**	Percentage Procurement recognition	**100%**
EAP name:	**Edward Perry**			
EAP Qualifications:	**MSc. Applied Hydrobiology; PgC Environmental Assessment**			
Professional affiliation/registration:	**Environmental Assessment Practitioners Association of South Africa (EAPASA) Pr. EAP (2019/1210)**			
Physical address:	**Suite 1 – Building D, Monte Circle, 178 Montecasine Boulevard, Fourways, Johannesburg, 2191**			
Postal address:	**PO Box, Cramerview 1596**			
Postal code:	**2060**		Cell:	**0798714798**
Telephone:	**011 467 0945**		Fax:	n/a
E-mail:	**EPerry@slrconsulting.co.za**			

The appointed EAP must meet the requirements of Regulation 13 of GN R982 of 04 December 2014, as amended.

2. DECLARATION BY THE PEER-REVIEW EAP

I, _Edward Perry________________________________, declare that –

- I act as the **independent peer-review environmental assessment practitioner** in this application;
- I have expertise in conducting environmental impact assessments, 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 will 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;
- I will take into account, to the extent possible, the matters listed in Regulation 13 of the Regulations when preparing the application and any report relating to the application;
- 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, unless access to that information is protected by law, in which case it will be indicated that such information exists and will be provided to the Competent Authority;
- I will perform all obligations as expected from a **peer-review environmental assessment practitioner** in terms of the Regulations; and
- I am aware of what constitutes an offence in terms of Regulation 48 and that a person convicted of an offence in terms of Regulation 48(1) is liable to the penalties as contemplated in Section 49B of the Act.

Disclosure of Vested Interest (delete whichever is not applicable)

- I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Regulations;

- ~~I have a vested interest in the proposed activity proceeding, such vested interest being:~~

Signature of the peer-review Environmental Assessment Practitioner

SLR Consulting (South Africa) (Pty) Ltd

Name of Company:

27 July 2021

Date

3. **UNDERTAKING UNDER OATH/ AFFIRMATION**

I, _Edward Perry_______________________________, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the peer-review Environmental Assessment Practitioner

SLR Consulting (South Africa) (Pty) Ltd

Name of Company

Date

28 July 2021

Signature of the Commissioner of Oaths

I HEREBY CERTIFY THAT THIS IS A TRUE COPY OF THE ORIGINAL DOCUMENT AND THAT THERE IS NO INDICATION THAT ALTERATIONS HAVE BEEN MADE THERETO BY AN UNAUTHORISED PERSON

28 JULY 2021

Date

COMMISSIONER OF OATHS

BRANCH MANAGER

S.A. POST OFFICE LTD

WESTVILLE 4 2021-07-28 3630

Details of EAP, Declaration and Undertaking Under Oath

Page 3 of 3

CURRICULUM VITAE

ED PERRY

OPERATIONS MANAGER

Environmental Management Planning & Approvals, South Africa

QUALIFICATIONS

Postgrad Cert.	2016	Postgraduate Certificate in Occupational Health and Safety, University of Cape Town
Postgrad Cert.	2012	Postgraduate Certificate in Envionmental Law, Centre for Environmental Management, Potchefstrom
Postgrad Cert.	2008	Postgrduate Certificate in Environmental Assessment, Oxford Brookes University
MSc	1994	MSc Applied Hydrobiology, Cardiff University
BSc (Hons)	1990	BSc (Hons) Environmental Science, Plymouth University

EXPERTISE

- Environmental and Social Impact Assessments
- EHSS Auditing
- Environmental Compliance
- Management Systems
- Due Diligence

Ed Perry joined SLR as the Operations Manager for the Environmental Management Planning and Approvals (EMPA) team in Africa (offices in South Africa, Namibia, and Ghana) in August 2019. He has worked in environmental consultancy for over twenty years for a wide range of public and private sector clients.

Ed is a registered Environmental Auditor with the Institute for Environmental Management and Assessment and a Lead Auditor with the International Cyanide Management Institute. Prior to moving to South Africa in 2011 Ed worked in the UK on a wide range of projects including EIAs and Integrated Pollution and Prevention Permits. This included permitting the first hazardous waste landfill in the UK under the new integrated permitting mechanism and undertaking a study for the European Commission on the implementation of the Landfill Directive in 15 European countries.

Since moving to South Africa, Ed has been involved with ESIAs and environmental authorisations throughout Africa. Ed has been Project Director / Partner in Charge of EIAs for a wide range of facilities including: New Mines and Extensions to Mines, Renewable Energy Facilities; Metal Extractive Industries; and Large Water Storage Schemes;.

Ed has also undertaken a wide range of environmental audits including; due diligence audits, EMPR audits, and over 20 international cyanide code audits of mines throughout Africa. These audits include assessing ESHIAs, RAPs and associated documentation against the requirements of the IFC Performance Standards. Ed is a registered Environmental Assessment Practitioner with the Environmental Assessment Practitioners Association of South Africa (EAPASA).

PROJECTS

A sample of Ed's project experience, summarised by sector, is provided below.

Mining

Lucara Diamonds – Karowe Diamond Mine, Botswana

Ed is part of the SLR team acting as the Independent Technical Expert (ITE) on behalf od the lender to assess a project to expand the mine. Ed undertook the environmental and social assessment against the requirements of the Equator Principles and the IFC Performance Standards.

Kefi Minerals – Tulu Kapi Gold Mine, Ethiopia	Ed is the Technical Reviewer for an Enviornmental and Social Due Diligence review of the ESHIA and associated documents against the requirements of the IFC Performance Standards, local legisation, and best practice. This includes liaison with the Environmental Assessment Practitioners producing the ESHIA and the Lender's representatives.
Swakop Uranium – Heap Leach Project, Namibia	Ed is the Technical Reviewer and Project Director for the heap leach project, undertaking screening and subsequent ESIA for the location of a new heap leach.
Nampower – Biomass Power Plant, Namibia	Ed is the Project Director for an ESIA as part of a financing arrangement with the European Development Bank for Nampower to construct a new Power Plant using biomass from encroaching b
West Wits Gold Mine – South Africa	Ed is the Technical Reviewer and Project Director for an ESIA for a new gold mine in South Africa including open cast and underground mining. The application for a mining right was successful with an Environmental Authorisation being issued. A Water Use Licence is currently being applied for.
Maamba Collieries Limited – Maamba Coal Mine, Zambia	Ed was the lead auditor leading the creation and implementation of an integrated management system in accordance with the requirements of the IFC performance standards, ISO 14001, ISO 9001, and OHSAS 18001.
Eramet - Senegal	Lead Auditor for a due diligence audit of a mineral sands mining operation. The operation was the subject of a possible joint venture. The environmental audit, which included 3 days on site, was to establish if what environmental risks were involved with the project, which was just about to enter the construction phase.
Continental Coal Limited – Penumbra, South Africa	Ed was the Lead Auditor undertaking review of EIA, EMP and site procedures against the requirements of the IFC Procedures.
Eurasian Natural Resources Corporation – Kakanda Mine, DRC	Ed was the Project Manager for the review of a Safety, Health, Environment and Community Management System for Kakanda Mine in the DRC.
Anglo-American – Polokwane Smelter, Polokwane	Ed was the Project Manager responsible for undertaking an external compliance audit for the Anglo-American Polokwane Smelter as stipulated in the slag stockpile permit for the Polokwane Metallurgical Complex. This included a review of the permit for the temporary stockpile of ash as part of the expansion of the Complex.
Ruighoek Mine, South Africa	Ed was the Project Manager for an ESIA associated with the expansion of this chromium mine in South Africa.
AngloGold Ashanti – Yatela, Sadiola, Siguri Gold Mines, Mali and Guinea	Ed was the Lead Auditor and Project Manager undertaking a re-certification audit against the requirements of the International Cyanide Code for three gold mines.
Freda Rebecca Gold Mine - Zimbabwe	Ed was the Lead Auditor and Project Manager for a gap audit to ascertain the status of the gold mine with regards to its ability to comply with the International Cyanide Code
Gold Fields Ghana – Tarkwa and Damang Gold Mines	Ed was the Lead Auditor and Project Manager undertaking a re-certification audit against the requirements of the International Cyanide Code for the two gold mines.

Goldfields, Harmony, AngloGold Ashanti – South Africa	Ed was the Lead Auditor and Project Manager undertaking a re-certification audit against the requirements of the International Cyanide Code for 5 gold mines for AngloGold Ashanti, 4 gold mines for Harmony, and a gold mine for Gold Fields.
Riversdale Capital – Zambeze Coal Mine, Zambia	Ed was the Technical Reviewer for an ESHIA for the development of the Zambeze Coal Mine on behalf of Riversdale Capital.
Confidential – proposed mine, South Africa	Ed was the Project Manager for an ESIA for a new proposed iron ore mine in South Africa. This application was withdrawn following baseline studies by specialist showing the existence of fatal flaws with regards to water use and location of the TSF.
	Industry
Dundee Precious Metals – Tsumeb Smelter, Namibia	Ed is the Project Director of an Agricultural Assessment to provide a consolidated management plan for improved agricultural land management, long term monitoring and mitigation of potential impacts.
Distell – South Africa	Ed was Project Manager for a number of projects for Distell in order to obtain various environmental authorisations for their brewing facilities including the one for the siting of a new waste water treatment works.
SPAR – South Africa	Ed was Project Manager for a number of energy projects undertaken for SPAR in South Africa including looking at Science Based Targets, Internal Carbon Pricing, and an ISO 50001 Energy Management System.
SCAW – South Africa.	Ed was the Project Manager for a range of Environmental Authorisations, including ESIAs, Air Emssions Licences, Water Use Licences and contaminated land assessments. These studies were undertaken for SCAW ata number of their smelter sites in Gauteng over a 5 year period.
Confidential – South Africa	Ed lead an EHS audit of a cable tie manufacturer using plastic extrusion as part of a due diligence project.
Pfizer – South Africa	Ed was the Project Manager and Lead Auditor for an EHS audit of the head offices of Pfizer in South Africa.
Sasol - Sasolburg	Ed was the Project Manager and Lead Auditor for International Cyanide Code recertification audit for the Sasol cyanide production facility at Sasolburg.
Sohar Aluminium - Oman	Ed was the Lead Auditor of Sohar Aluminium's environmental management system auditing the system against the requirements of ISO 14001 and benchmarking this facility against international requirements.
Confidential – KZN, South Africa	Lead Auditor for a due diligence audit of a white goods manufacturing company in Kwa-Zulu Natal.
Sasol – Secunda	Ed was the Lead Auditor for a third party audit of waste contractors operating on behalf of Sasol. The audit investigated compliance with South African environmental legislation and environmental best practice.
Confidential – South Africa, Kenya, UAE	Ed was the project manager for a due diligence audit of a packaging company's facilities in South Africa, Kenya and UAE.

	Infrastructure
Lesotho Highlands Development Agency - Lesotho	Ed took over as Project Manager undertaking an ESIA for the Polihali Reservoir and Western Access Road in Lesotho on behalf of the Lesotho Highlands Development Agency.
Freight Forwarders Group – Kenya and Tanzania	Ed was the Lead Auditor undertaking a re-certification audit against the requirements of the International Cyanide Code for the Freight Forwarders transportation group of companies.
Transnet Pipelines – South Africa	Ed was the Project Manager responsible for the creation and implementation of an Energy Management System for all of the pumps stations, workshops and offices for Transnet Pipelines, who pump crude oil and petroleum products from Durban to Johannesburg.
Interwaste – South Africa	Ed was the Technical Reviewer for the EIA for a new integrated waste management facility including a new landfill in South Africa against the requirments of NEMA and NEM:WA.
	Oil and Gas
Shell – South Africa	Ed was the Project Manager for various environmental authorisations in South Africa associated with the Shell GUESS program. This program related to the closure and clean up of Shell service stations.
Vopak – Richards Bay, South Africa	Ed was the Project Manager for an ESIA for a new terminal operated by Vopak at Richards Bay for the handling and storage of Liquid Petroleum Gas and Clean Petroleum Products.
Vopak – Durban, South Africa	Ed was the Project Manager for an ESIA for the expansion of the Vopak terminal at Durban Docks for the handling and storage of Liquid Petroleum Gas and Clean Petroleum Products.
Bidvest – Durban South Africa	Ed was the Project Manager for an ESIA for the expansion of the Bidvest terminal at Durban Docks for the handling and storage of Liquid Petroleum Gas and Clean Petroleum Products.
	Power
Nampower - Namibia	Ed is the Technical Reviewer for an ESIA for a biomass power plant that will use wood from encroacher bush in Namibia. This project is being funded by the European Investment Bank and it is therefore required to comply with the IFC Performance Standards.
Department for International Development – UK Government	The UK Department for International Development is providing support to medium sized renewable energy facilities (mainly hydroelectric power plants) in Uganda through the Global Energy Transfer Feed in Tariff programme (GET FiT). The project was to assess how local communities in the vicinity of these facilities could obtain power and how environmental and social safeguards for these types of facilities could be improved in the future. Ed was the lead environmental and social advisor undertaking a review of the environmental and social safeguards.
Confidential - Angola	Ed was Project Manager for a project undertaking a Strategic Environmental Assessment of locations for renewable energy facilities in Angola.
Confidential - Mozambique	Ed was the Project Manager for an ESIA to be submitted to the Mozambican authorities for the development of a unique renewable energy pilot facility.

MEMBERSHIPS

IEMA	Practitioner for the Institute of Environmental Management and Assessment
IEMA	Registered Environmental Auditor
EAPSA	Registered Environmental Assessment Practitioner

PUBLICATIONS

- The Role of Socio-Economic Factors, Seasonality and Geographic Differences on Household Waste Generation and Composition in the City of Tshwane. 2016 (Wastcon).
- EMS as a Tool for Integrated Business Risk Management. 2005 (various journals).
- Golder Associates EMS Roadmap. 2004 (CD ROM).
- Incentives to Encourage Recycling. 2002. Materials Recycling Week
- Recycle of Life. 2002. Government Business
- New Approaches to Management of Waste. 2002 (various journals)
- Minimise the Waste – Maximise the Message. 2001
- Guide to Waste Reduction on Construction Sites. 1999. Construction Confederation

Appendix 15 Public participation plan

Basic Assessment and Water Use License for the proposed Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon

Public Participation Plan

Prepared for:	**National Department of Environment, Forestry and Fisheries (DFFE)**
Applicant:	**Council for Scientific and Industrial Research (CSIR)** **South African National Research Network (SANReN)**
Contact person	**Mlungisi Majola** **PO Box 395, Pretoria, 0001** **Tel: +27 12 841 3555** **Email: mmajola1@csir.co.za**
Prepared by EAP:	**Council for Scientific and Industrial Research (CSIR)** **Environmental Management Services (EMS)**
Contact person:	**Luanita Snyman-van der Walt, *Pr. Sci. Nat. (400128/16)*** **PO Box 320, Stellenbosch, 7599** **Tel: +27 21 888 2490** **Fax: +27 21 888 2693** **Email: lvdwalt1@csir.co.za**
Reviewed by peer review EAP:	**SLR Consulting South Africa**
Contact person:	**Edward Perry** **PO Box 1596, Cramerview, 2060** **Tel: +27 11 467 0945** **Email: eperry@slrconsulting.com**

Version: Final, accepted by DFFE
Date: 12 May 2021

Contents

List of Figures

List of Tables

Summary

The South African National Research Network (SANReN) has been tasked with constructing a proposed 185 km fibre optic cable between Beaufort West and Carnarvon to complete the data connection between the Square Kilometre Array (SKA) radio telescope and the data processing facility in Cape Town. A Basic Assessment procedure is required to obtain Environmental Authorisation for the proposed fibre optic route. This requirement is triggered by Listing Notice 1, Activity 19, and Listing Notice 3, Activity 12 of the Environmental Impact Assessment Regulations. Furthermore, a Water Use License is required in terms of Section 2 (c) and (i) of the National Water Act.

This document serves as the Public Participation Plan required in GN 650 to document how the Public Participation Process (PPP) will be undertaken throughout the SKA fibre optic Basic Assessment (BA) and Water Use License Application (WULA) processes.

The following mechanisms are proposed to achieve the purpose of the PPP (see Section 4 of this plan):

- Adjacent landowner database collation and notification;
- Email notifications (hard copy letter notification where email address not available);
- SMS text notifications;
- Information sharing via broader social networks (e.g. farmer's associations);
- Newspaper advertisements;
- Site notices placed in Beaufort West, Loxton and Carnarvon;
- Hard copy non-technical BA Report summary placement in Beaufort West, Loxton and Carnarvon during the 30-day public commenting period;
- Digital full report access via CSIR website and other file-sharing platforms.
- Hard copy full report access on request from stakeholders.

The PPP for the proposed SKA fibre optic project will adhere to the requirements of Chapter 6 of the 2014 NEMA EIA Regulations (as amended).

All personal information collated for the purposes of the PPP for the proposed SKA fibre optic project will be collected, processed and safeguarded in accordance with the requirements of the Protection of Personal Information Act (No. 4 of 2013).

1. Introduction

The document presents the Public Participation Plan for an integrated Public Participation Process (PPP) as part of the Basic Assessment (BA) and Water Use License Application (WULA) for a proposed 184 km fibre optic cable installation between Beaufort West and Carnarvon to complete the data connection between the Square Kilometre Array (SKA) radio-telescope and the data processing facility in Cape Town.

2. Need for a Public Participation Plan

On 5 June 2020, the Minister of Forestry, Fisheries and the Environment issued Directions in terms of regulation 4 (10) of the Regulations issued by the Minister of Cooperative Governance and Traditional Affairs in terms of section 27(2) of the Disaster Management Act, 2002 (Act 57 of 2002). These Directions were published in Government Gazette 43412, GN 650 on 5 June 2020, regarding measures to address, prevent and combat the spread of COVID-19 relating to national environmental management permits and licences.

Regulation 5.1 of GN 650 states that Authorities responsible for the processing of applications contemplated in the EIA Regulations, will be receiving such applications from 5 June 2020 and will receive and process applications and issue decisions in the manner as set out in Annexure 2 of GN 650. Regulation 5.2 of GN 650 states that Annexure 3 includes additional requirements in respect of the provision, supporting or obtaining of services contemplated in Regulation 5.1.

Annexure 3 of GN 650 states that an Environmental Assessment Practitioner (EAP) must:

- Prepare a written public participation plan, containing proposals on how the identification of and consultation with all potential Interested and Affected Parties (I&APs) will be ensured in accordance with Regulation 41(2)(a) to (d) of the 2014 NEMA EIA Regulations (as amended) or proposed alternative reasonable methods as provided for in regulation 41(2)(e), for purposes of an application and submit such plan to the competent authority; and
- Request a meeting or pre-application discussion with the competent authority to determine the reasonable measures to be followed to identify potential I&APs and register IA&Ps for purposes of conducting public participation on the application requiring adherence to Chapter 6 of the 2014 NEMA EIA Regulations (as amended) as set out in the public participation plan and obtain agreement from the competent authority on the public participation plan.

GN 650 also states that for new applications, the public participation plan agreed with the competent authority must be annexed to the application form.

This document therefore serves as the Public Participation Plan required in GN 650 to document how the PPP will be undertaken throughout the SKA fibre optic BA and WULA Process. The Public Participation Plan will be discussed with the DEFF during the Pre-Application Meeting in order to facilitate the decision-making on the plan itself.

3. Project background

The South African Radio Astronomy Observatory (SARAO) spearheads South Africa's activities in the Square Kilometre Array (SKA) Radio Telescope in engineering, science and construction. SARAO is a National Facility, managed by the National Research Foundation, which incorporates radio astronomy instruments and programmes such as the MeerKAT and KAT-7 telescopes in the

Karoo, the Hartebeesthoek Radio Astronomy Observatory (HartRAO) in Gauteng, the African Very Long Baseline Interferometry (AVN) programme in nine African countries, as well as the associated human capital development and commercialisation endeavours.

Connectivity is required between the SKA core site in the Northern Cape and a data processing facility in Cape Town to transport the science data for the SKA project and its precursor, MeerKAT. Access to dark fibre is required to transport this data due to the expected data throughputs for the SKA project.

SARAO has already established a fibre optic connection between Carnarvon and the SKA core site.

Additionally, the South African National Research Network (SANReN – the Applicant) has procured access to fibre between Beaufort West area and Cape Town. A fibre optic cable connection must therefore be constructed between Beaufort West, in the Western Cape Provinces, and Carnarvon, in the Northern Cape Province (Figure 1). The Council for Scientific and Industrial Research (CSIR) Environmental Management Services (EMS) has been appointed as the EAP to undertake the necessary environmental assessments required together with an application for Environmental Authorisation (EA) for the proposed project.

The details of the preferred and selected SKA fibre route is as follows:

1. The fibre route starts from Beaufort West Transnet building, to Loxton where a 3 m x 6 m container for regeneration of signal will be established, and then to the existing Carnarvon SKA Point of Presence (PoP) site – a total of approximately 183 km.
2. The fibre duct and cable will be laid in a 1 m deep and 300 mm wide trench and be buried by backfilling and compacting the trench.
3. The fibre route will predominantly be installed within the road reserves of roads R381 and R63 (and other roads within the towns of Beaufort West, Loxton and Carnarvon), and at least 1 m from the fence of the private land.
4. 155 km will be underground and 25 km will be overhead due to it not being technically and financially feasible to trench on the Molteno Pass section and two other topographically complex sections north of the Molteno Pass.
    - Here, sections of the cabling may be installed outside the road reserve (i.e. following the most direct / technically feasible route).
    - The height of the aboveground poles vary between 7.5 m and 9 m.
5. There are several streams / river and associated wetlands to cross. Rivers will be crossed using directional drilling, 2 m below riverbed, and starting 32 m away from river banks.
    - An application for a Section 21 (c) and (i) Water Use License (in terms of the National Water Act) will also be undertaken, and subject to an integrated Public Participation Process (PPP) as part of the Basic Assessment.
6. There is one river with solid bedrock (the Brak river near Loxton) where directional drilling is not technically or financially feasible. Here the fibre cable will be attached to the existing road bridge.

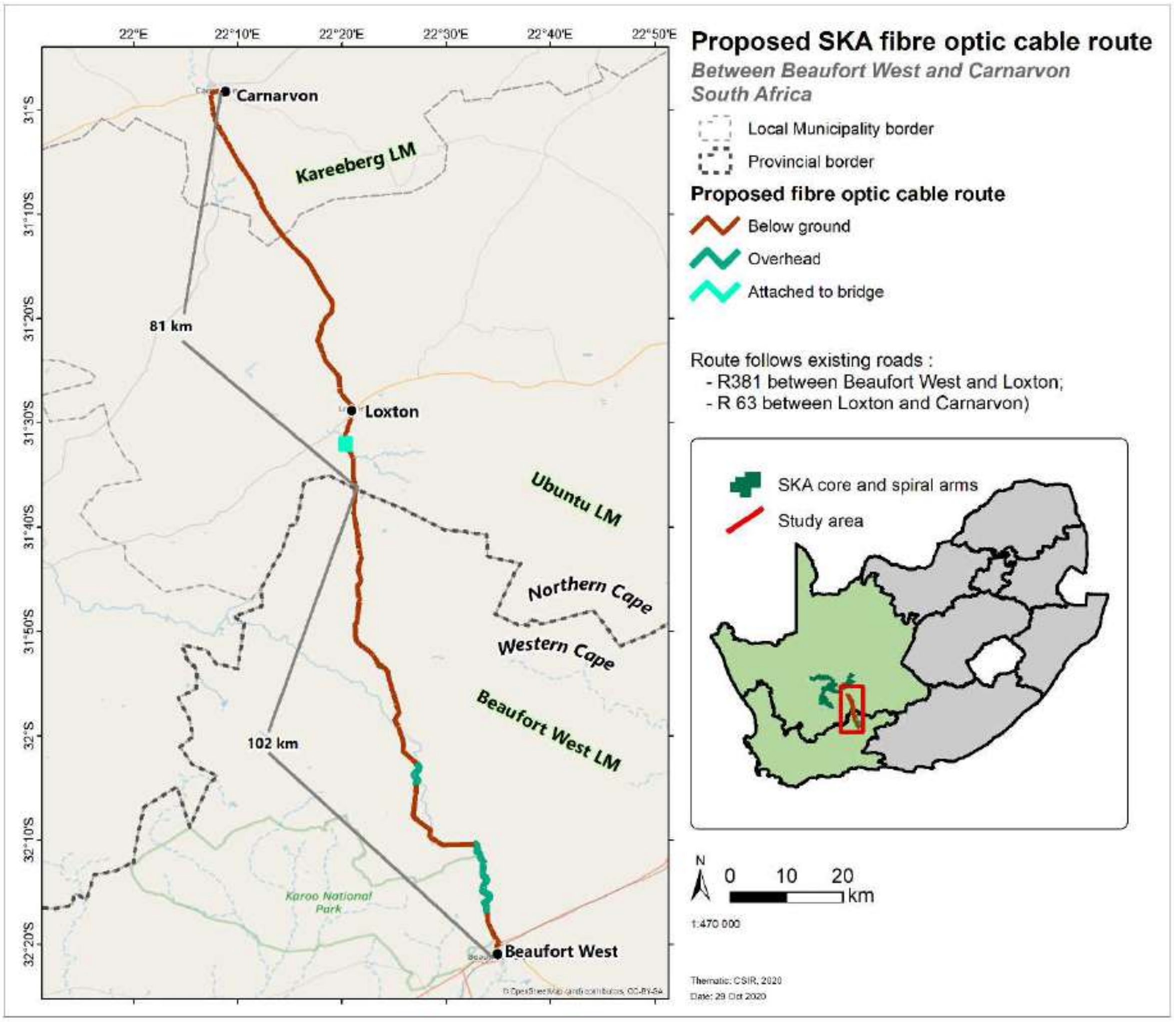


Figure 1: Proposed fibre optic cable route from Beaufort West, via Loxton, to Carnarvon.

The fibre optic cable will be placed in the reserves of the roads presented in Table 1. According to available cadastral data, approximately sixty (60) and thirty-eight (38) land portions are traversed by the proposed SKA fibre optic road reserve corridor (i.e. "neighbouring land portions") in the Western- and Northern Cape provinces, respectively (see Appendix A).

Table 1: The fibre optic cable is proposed in the road reserve of the following roads.

Road	Town
Park Avenue	Beaufort West
New Street	Beaufort West
Donkin Steet (N1 / N12)	Beaufort West
R381	Beaufort West to Loxton
Fraserburg Street	Loxton
Auret Street / R381	Loxton
R63	Loxton to Carnarvon
South Street	Carnarvon
Margaretha Prinsloo Street	Carnarvon
Biblioteek Street	Carnarvon
Zahn Street	Carnarvon
Van Riebeeck Street	Carnarvon
Stasieweg Street	Carnarvon

4. Proposed PPP plan and mechanisms

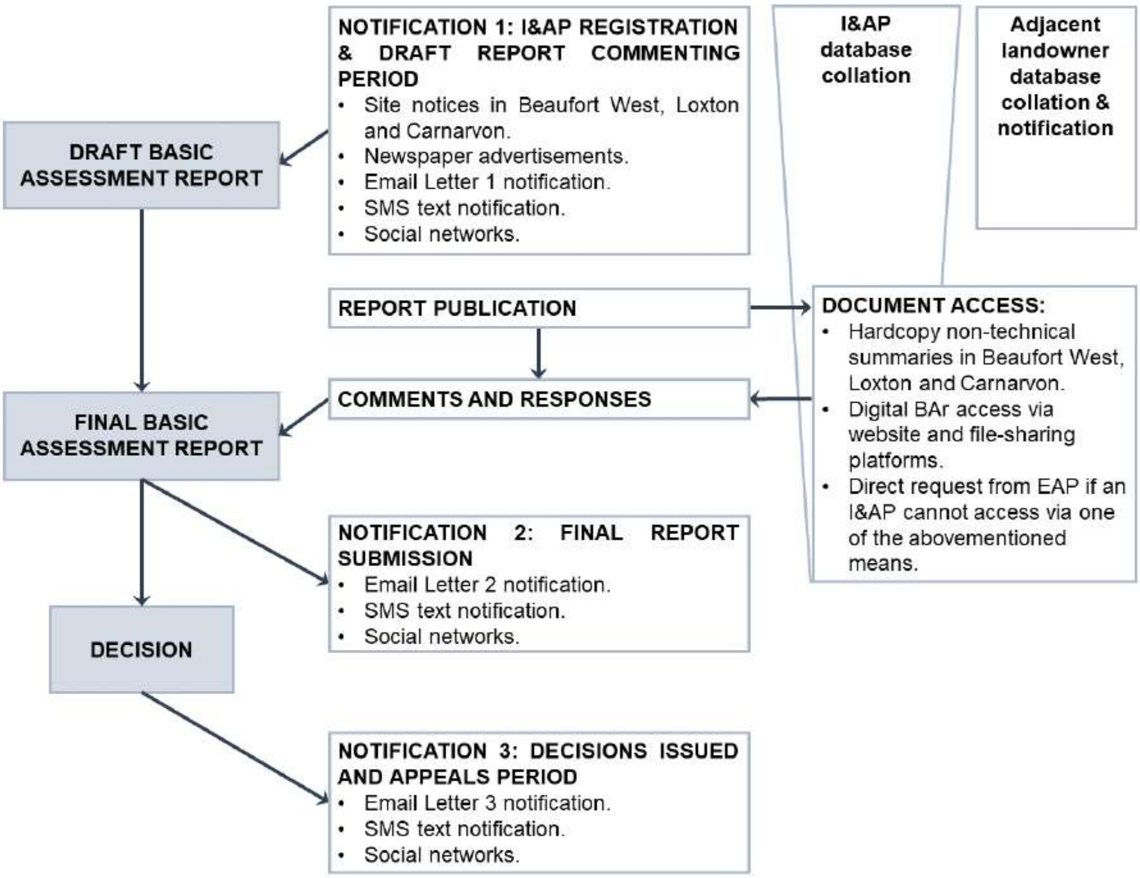


Figure 2: Summary of the Public Participation Process plan for the proposed Fibre Optic Project.

4.1 Interested and Affected Party Database and the Protection of Personal Information Act

The Protection of Personal Information Act (No. 4 of 2013) (POPIA) introduces minimum requirements for the processing of personal information and aims to promote the protection of personal information processed by public and private bodies. Enforcement of POPIA will commence on 01 July 2021.

The NEMA provides for PPP (" a process by which potential interested and affected parties are given opportunity to comment on, or raise issues relevant to, the application") to be conducted for any application for an environmental authorisation. In order to fulfil the aforementioned legal requirement, the EAP and / or appointed public engagement specialist must collect personal information (name and contact details (e.g. telephone number, email address, postal / street address)) of potential I&APs in order to notify them of the project details and opportunity to comment on the environmental impact assessment process and outputs[1]. I&APs provide their personal details on a voluntary basis, except where information is available publicly and can be sourced by the EAP indirectly (e.g. when an organisation is identified as a potential I&AP, and the organisation's email address is available from their website)[2].

[1] POPIA Section 11 (1) Personal information may only be processed if –
(c) processing complies with an obligation imposed by law on the responsible party.

[2] POPIA Section 12 (1) Personal information must be collected directly from the data subject, except as otherwise provided for in subsection (2)
(2) It is not necessary to comply with subsection (1) if –
(a) the information is contained in or derived from a public record or has deliberately been made public by the data subject.

I&APs will be made aware of the type of personal information that is sourced, the purpose of the data collection, how the data will be used and any other relevant information stipulated in Section 18 of the POPIA.

All personal information will be collected and processed in accordance with the requirements of the POPIA and will be safeguarded by the EAP and / or public engagement specialist. The collection of personal information for the purposes of PPP for the proposed SKA fibre optic project may thus be considered lawful in terms of the POPIA.

4.2 Adjacent landowner database collation and notification

- A public engagement specialist has been appointed to assist in collating a complete and verified adjacent landowner and occupier database for the proposed 183 km fibre optic route.
- The scope of work for the public engagement specialist includes:
  - Liaison with Authorities and Interested and Affected Parties (I&APs) in the project area of interest to obtain information required to develop a complete and verified adjacent land owners and / or occupiers, including, but not limited to:
    - Local and Provincial Government level within the Western Cape and Northern Cape Provinces
    - Local farmer associations, Agri Central Karoo, Agri Western Cape and Agri South Africa;
    - Legal representatives and trustees where farms are in trust, closed corporations or other entities;
    - Stakeholders on the ground; and,
    - Conservation bodies, water user associations, fire protection associations and safety and security groups.
  - Site Visits:
    - The team will visit each farm, commercial and residential property along the proposed SKA fibre optic route to contact the landowners and occupiers and collect, obtain and verify the interested and affected parties contact details.
  - Notification & Briefing:
    - The notification of the landowners, tenants and occupiers would be done through the site visits to each farm, telephone follow-up, local farmers WhatsApp, SMS network, farmers associations and the SFZA PPP drop bag method on farm entrances and at post office boxes.
    - Records / proof of delivery of the notification and briefing will be supplied.
  - Stakeholder Data Collection:
    - Stakeholder data collection would be done by reviewing existing databases, Cape Farm Mapper, The Deeds Office, Legal/Trust representatives, Conservation Agencies, Farmers Associations and Unions, Local and Provincial Government and the farm drop bag system (with photographic evidence of placement);
    - Data must be obtained for each property - e.g. rural farms, erven and street addresses (residential and commercial properties) in towns - at minimum as per the National cadastre.
  - Stakeholder Participation:
    - The stakeholders will be briefed and provided with an overview of the SKA fibre optic route as background information and the importance of their participation in the forthcoming impact assessment process.
  - Stakeholder Data Verification:
    - Stakeholder data will be verified via telephone and engaging with legal representatives and authorities.
  - Compilation of Verified Adjacent Landowner & Occupier Database:
    - The database will be constructed utilising the excel platform and focus on landowners, tenants, occupiers and other interest and affected parties of significance along the proposed SKA Fibre optic transmission route. This

would include parties who might have direct interest in the operations and maintenance of the transport corridors.

- Data on the adjacent land owners / occupiers / tenants will include, at minimum:
    - Name and Surname (required);
    - Surveyor General (SG) code and physical address (if SG code not obtainable) of the corresponding adjacent property (required);
    - Email address (if available, preferred);
    - Cell phone number (preferred);
    - Residential / Postal address (if available);
    - Land line telephone number (if available);
    - Any other means of communication used along the SKA Fibre optic route.
- The final Adjacent Landowner and Occupier Database must demonstrably be as complete and correct as possible.

4.3 Email notification and information sharing:

- Email letter 1 (Commencement of the BA Process): emailed to all I&APs in the database, where email addresses are available. Letter 1 will include information on the project and the availability of the Draft BA Reports.
- Non-technical Summaries of the Draft and Final BA Reports will be emailed to all I&APs in the database.
- Email letter 2 (Submission of Final BA Reports to DEFF) will be emailed to all I&APs in the database, where email addresses are available.
- Email Letter 3 (Release of Environmental Authorisation) will be emailed to all I&APs in the database, where email addresses are available. A copy of the Environmental Authorisation will be emailed with Letter 3.

4.4 SMS text notification:

- SMS texts will also be sent to all I&APs on the database, where cell phone numbers are provided / obtainable, to inform them of the proposed project and how to access the Draft and Final BA Reports.

4.5 Social networks:

- Communication will be made with key I&APs such as farmer's associations, and ward councillors / municipal managers to request that they send notifications of the project and report availability and executive summaries via their local social networks (such as WhatsApp groups, Neighbourhood Watch groups, other social media mechanisms etc.). This mechanism relies on the willingness of people to 'spread the word' on the project, and cannot be monitored in detail by the EAP.

4.6 Newspaper advertisements:

- In order to notify and inform the public of the proposed project, to invite I&APs to register on the project database, as well as to inform I&APs of the release of the Draft BA Report for comment, the BA Processes will be advertised in one local and one national newspaper (in English and Afrikaans) at the commencement of the 30-day comment period for the Draft BA Report.

4.7 Site notices:

- Notice boards will be placed at key roads along which the fibre optic cable will be installed in the towns of Beaufort West, Loxton and Carnarvon, as well as at well-known retail facilities / public spaces within these towns.

4.8 Document Access:

- Hardcopy non-technical summaries of the draft BAr will be placed at key locations in the towns of Beaufort West, Loxton and Carnarvon during the 30 day public commenting period.
- The Draft and Final BAr will be uploaded to a project website for I&APs to access it.
- As a supplementary mechanism, the Draft and Final BA Reports will also be uploaded to other alternative file sharing web-platforms such as Dropbox or Google Drive.
- In the event that an I&AP cannot access the report via the project website, via the alternative web-platforms such as Dropbox or Google Drive, and / or additional information is required (other than what is provided in the non-technical summary), the I&AP can contact the EAP, who will then make an electronic or hardcopy available via courier or post (where possible).

4.9 Compliance with Chapter 6 of the NEMA EIA Regulations

Chapter 6 of the 2014 NEMA EIA Regulations (as amended) contains the requirements for the Public Participation Process of projects requiring an Environmental Authorisation.

Table 2 provides a detailed description of the requirements of Chapter 6 of the 2014 NEMA EIA Regulations (as amended), as well as the proposed mechanisms that will be adopted to comply with the regulations during the National Lockdown.

Table 2: Proposed Mechanisms to Comply with Chapter 6 of the 2014 NEMA EIA Regulations (as amended).

Regulation	Proposed Mechanism to Comply
Activity on land owned by person other than proponent: Regulation 39: (1) If the proponent is not the owner or person in control of the land on which the activity is to be undertaken, the proponent must, before applying for an environmental authorisation in respect of such activity, obtain the written consent of the landowner or person in control of the land to undertake such activity on that land. (2) Subregulation (1) does not apply in respect of: (a) linear activities; (b) activities constituting, or activities directly related to prospecting or exploration of a mineral and petroleum resource or extraction and primary processing of a mineral or petroleum resource; and (c) strategic integrated projects as contemplated in the Infrastructure Development Act, 2014.	Land owner consent is not required from the owners of the property/ies (road reserves) on which the SKA fibre optic cable is proposed, as this constitutes a linear activity as per Regulation 39 (2) (a), and is related the SKA Strategic Infrastructure Project (SIP 19).
Purpose of Public Participation Regulation 40: (1) The public participation process to which the: (a) basic assessment report and EMPr, and where applicable the closure plan, submitted in terms of regulation 19; and (b) scoping report submitted in terms of regulation 21 and the environmental impact assessment report and EMPr submitted in terms of regulation 23; was subjected to must give all potential or registered interested and affected parties, including the competent authority, a period of at least 30 days to submit comments on each of the basic assessment report, EMPr, scoping report and environmental impact assessment report, and where applicable the closure plan, as well as the report contemplated in regulation 32, if such reports or plans are submitted at different times.	The Draft BA Report, Environmental Management Programme (EMPr) and WULA information will be compiled in compliance with Appendix 1 of the 2014 NEMA EIA Regulations (as amended). The reports and EMPrs will be released to all registered I&APs and stakeholders, including the National DEFF, for a 30-day comment period. The reports will also be made available to members of the public (i.e. potential I&APs) on a dedicated project webpage. Various mechanisms will be used to make the report available to the public, potential and registered I&APs, and stakeholders during the 30-day comment period. These mechanisms will be discussed below.
(2) The public participation process contemplated in this regulation must provide access to all information that reasonably has or may have the potential to influence any decision with regard to	The BA Process will be founded on a basis of ethics and will ensure that all registered and potential I&APs will have access to all information that has or may have the potential to influence any decision or comment made, unless such access to information is protected by law.

Regulation	Proposed Mechanism to Comply
an application unless access to that information is protected by law and must include consultation with: (a) the competent authority; (b) every State department that administers a law relating to a matter affecting the environment relevant to an application for an environmental authorisation; (c) all organs of state which have jurisdiction in respect of the activity to which the application relates; and (d) all potential, or, where relevant, registered interested and affected parties.	An initial database of I&APs (including key stakeholders and Organs of State) has been developed for the BA Processes (see Appendix B: Draft I&AP Database Summary) and will be expanded as new I&APs become evident and / or register their interest in the project. The I&AP database contains, as a minimum, the competent authority (DEFF); relevant state departments (e.g. Department of Environment, Nature and Conservation (DENC), Department of Human Settlements and Water and Sanitation (DHSWS); relevant organs of state (e.g. Beaufort West Local Municipality, Kareeberg Local Municipality, Ubuntu Local Municipality, Central Karoo District Municipality, Pixley ka Seme District Municipality, South African National Parks); as well as other I&APs as registration requests are received during the process.
(3) Potential or registered interested and affected parties, including the competent authority, may be provided with an opportunity to comment on reports and plans contemplated in subregulation (1) prior to submission of an application but must be provided with an opportunity to comment on such reports once an application has been submitted to the competent authority.	The Application for Environmental Authorisation will be submitted to the DEFF together with the Draft BA Report and EMPr. The 30-day comment period will commence on the day after the Applications and Draft BA Report have been sent to the DEFF for comment. Therefore, all registered I&APs and stakeholders, including the National DEFF, will be provided with an opportunity to comment on the reports once the Applications for EA have been submitted to the DEFF. The comment period will extend for a 30-day comment period. The BA Process will not include any pre-application reporting or comment periods.
<u>Public Participation Process</u> Regulation 41: (1) This regulation only applies in instances where adherence to the provisions of this regulation is specifically required.	Adherence to the provision of Regulation 41 of the 2014 NEMA EIA Regulations (as amended) is required as a BA Process is required for the proposed development.
(2) The person conducting a public participation process must take into account any relevant guidelines applicable to public participation as contemplated in section 24J of the Act and must give notice to all potential interested and affected parties of an application or proposed application which is subjected to public participation by: (a) fixing a notice board at a place conspicuous to and accessible by the public at the boundary, on the fence or along the corridor of: i. the site where the activity to which the application or proposed application relates is or is to be undertaken; and ii. any alternative site;	Relevant guidelines for Public Participation will be considered during the BA Processes. Notice will be given to all potential and registered I&APs of the proposed projects, which are subjected to public participation. Various mechanisms will be undertaken to provide such notice. Notice boards will be placed at key roads along which the fibre optic cable will be installed in the towns of Beaufort West, Loxton and Carnarvon, as well as at well-known retail facilities / public spaces within these towns. It is proposed that site notice boards be concentrated along the roads within the towns of Beaufort West, Loxton and Carnarvon. Placement of site notice boards along the fence lines of the road reserve in rural areas is not preferable since it may not be noticeable to people travelling on the R381 and R63 at between 80 – 120 km/h and could break free during windy conditions, thus contributing to litter. Site notice boards will be placed in English and Afrikaans. Proof of placement of such notice boards will be included in the Draft BA Reports.
(b) giving written notice, in any of the manners provided for in section 47D of the Act, to: i. the occupiers of the site and, if the proponent or applicant is not the owner or person in control of the site on which the activity is to be undertaken, the owner or person in	The owners / persons in control of the road reserves in which the proposed fibre optic cable will be installed, includes: • Northern Cape Roads and Public Works;

Regulation		Proposed Mechanism to Comply
	control of the site where the activity is or is to be undertaken and to any alternative site where the activity is to be undertaken;	• Western Cape Transport and Public Works Department; • South African National Roads Agency (SANRAL); • Beaufort West Municipality (Beaufort West); • Kareeberg Municipality (Carnarvon); and • Ubuntu Municipality (Loxton). Where overhead cabling is installed outside of the road reserve, the owners / persons in control of the land includes: • South African National Parks (SANParks) – Karoo National Park; and • Several private land owners. The aforementioned I&APs will be notified of pertinent information, progress and opportunity to participate throughout the BA and WULA processes.
ii.	owners, persons in control of, and occupiers of land adjacent to the site where the activity is or is to be undertaken and to any alternative site where the activity is to be undertaken;	An independent public engagement specialist has been appointed to assist in identifying land owners adjacent to the 183 km proposed fibre optic route. In order to build a complete and verified adjacent landowners database, the public engagement specialist will undertake site visits as required, and will also use this as an opportunity to notify adjacent landowners.
iii.	the municipal councillor of the ward in which the site and alternative site is situated and any organisation of ratepayers that represent the community in the area;	The municipal councillors and relevant ratepayers organisations (in addition to those identified in the Draft I&AP Database, Appendix B) will be identified and added to the database of I&APs. They will be sent Letter 1 via email to inform them of the proposed project and the release of the Draft BA Report for comment. Letter 1 will include the link to the project website and other web-platforms, which can be accessed to download the Draft BA Report. Executive Summaries will also be emailed to the municipal officials, who will also receive SMS texts about the release of the Draft BA Report (where cell phone numbers are obtainable / provided).

iv.	the municipality which has jurisdiction in the area;	The proposed SKA fibre optic cable route is situated in:
		Western Cape:
		• Central Karoo District Municipality
		  o Beaufort West Local Municipality
		Northern Cape:
		• Pixley ka Seme District Municipality
		  o Kareeberg Local Municipality
		  o Ubuntu Local Municipality
		These municipalities have jurisdiction of the area in which the proposed projects are to be undertaken. They will be sent Letter 1 via email to inform them of the proposed project and the release of the Draft BA Report for comment. Letter 1 will include the link to the project website and other web-platforms, which can be accessed to download the Draft BA Report. Executive Summaries will also be emailed to the municipal officials, who will also receive SMS texts about the release of the Draft BA Report (where cell phone numbers are obtainable / provided).
		
		During the National Lockdown, the provision of hard copy reports has been reduced in order to curb the spread of COVID-19. Many stakeholders, departments and organs of state, such as the National DEFF, are no longer requiring hard copies of reports. As such, hard copies of the Draft BA Reports

Regulation	Proposed Mechanism to Comply
	will not be provided to the municipalities. It is understood and expected that the municipal officials will have access to the project website or other web-platforms.
v. any organ of state having jurisdiction in respect of any aspect of the activity; and	Relevant Organs of State that have jurisdiction in respect of any aspect of the proposed project (in addition to those identified in the Draft I&AP Database, Appendix B) will be identified and added to the database of I&APs. They will be sent Letter 1 via email to inform them of the proposed project and the release of the Draft BA Report for comment. Letter 1 will include the link to the project website and other web-platforms, which can be accessed to download the Draft BA Report. Executive Summaries will also be emailed to the municipal officials, who will also receive SMS texts about the release of the Draft BA Report (where cell phone numbers are obtainable / provided). During the National Lockdown, the provision of hard copy reports has been reduced in order to curb the spread of COVID-19. Many stakeholders, departments and organs of state, such as the National DEFF, are no longer requiring hard copies of reports. As such, hard copies of the Draft BA Reports will not be provided to the organs of state. It is understood and expected that the relevant organs of state will have access to the project website or other web-platforms.
vi. any other party as required by the competent authority;	Other parties that are generally required by the DEFF (in addition to those identified in the Draft I&AP Database, Appendix B) will be identified and added to the database of I&APs. They will be sent Letter 1 via email to inform them of the proposed project and the release of the Draft BA Report for comment. Letter 1 will include the link to the project website and other web-platforms, which can be accessed to download the Draft BA Report. Executive Summaries will also be emailed to the I&APs, who will also receive SMS texts about the release of the Draft BA Report (where cell phone numbers are obtainable / provided). DEFF will also be communicated with during the pre-application meeting to confirm if any other parties need to be included on the database of I&APs.
(c) placing an advertisement in: i. one local newspaper; or ii. any official Gazette that is published specifically for the purpose of providing public notice of applications or other submissions made in terms of these Regulations;	In order to notify and inform the public of the proposed project, to invite I&APs to register on the project database, as well as to inform I&APs of the release of the Draft BA Reports for comment, the BA Process will be advertised in English and Afrikaans in two relevant local newspapers (one local and one national – see below) at the commencement of the 30-day comment period for the Draft BA Reports. The newspaper advertisement will also include the details of the project website, where information available on the project can be downloaded from. Proof of placement of the newspaper advertisements will be included in the Final BA Reports. The preliminarily identified local newspaper is Noordwester/Oewernuus. At this stage, there are no official Gazettes published specifically for the purpose of providing public notice of applications or other submissions made in terms of the 2014 NEMA EIA Regulations (as amended).
(d) placing an advertisement in at least one provincial newspaper or national newspaper, if the activity has or may have an impact that extends beyond the boundaries of the metropolitan or district municipality in which it is or will be undertaken: Provided that this paragraph need not be complied with if an advertisement has been placed in an official referred to in paragraph (c)(ii); and	In order to notify and inform the public of the proposed project, to invite I&APs to register on the project database, as well as to inform I&APs of the release of the Draft BA Reports for comment, the BA Process will be advertised in English and Afrikaans in two relevant local newspapers (one local and one national – see below) at the commencement of the 30-day comment period for the Draft BA Reports. The newspaper advertisement will also include the details of the project website, where

Regulation	Proposed Mechanism to Comply
	information available on the project can be downloaded from. Proof of placement of the newspaper advertisements will be included in the Final BA Reports. The preliminarily identified local newspaper is Sunday Times or City Press.
(e) using reasonable alternative methods, as agreed to by the competent authority, in those instances where a person is desirous of but unable to participate in the process due to: i. illiteracy; ii. disability; or iii. any other disadvantage.	If during the BA Processes, persons are identified as desiring but unable to participate due to illiteracy, disability or any other disadvantage, then the EAP can arrange focus-group meetings with the relevant persons via telephone, teleconference or other appropriate means as required. Holding a teleconference can allow the EAP to verbally explain the project to the relevant person. The teleconference will be undertaken at no cost to the relevant person.
(3) A notice, notice board or advertisement referred to in subregulation (2) must: (a) give details of the application or proposed application which is subjected to public participation; and (b) state: i. whether basic assessment or S&EIR procedures are being applied to the application; ii. the nature and location of the activity to which the application relates; iii. where further information on the application or proposed application can be obtained; and iv. the manner in which and the person to whom representations in respect of the application or proposed application may be made.	The notice boards to be placed and the newspaper advertisements to be published will fulfil the requirements of this regulation. Proof of placement of notice boards will be included in the Draft BA Report; and proof of placement of the newspaper advertisements will be included in the Final BA Report.
(4) A notice board referred to in subregulation (2) must: (a) be of a size of at least 60cm by 42cm; and (b) display the required information in lettering and in a format as may be determined by the competent authority.	The notice boards to be placed will fulfil the requirements of this regulation. Proof of placement of notice boards will be included in the Draft BA Report.
(5) Where public participation is conducted in terms of this regulation for an application or proposed application, subregulation (2)(a), (b), (c) and (d) need not be complied with again during the additional public participation process contemplated in regulations 19(1)(b) or 23(1)(b) or the public participation process contemplated in regulation 21(2)(d), on condition that: (a) such process has been preceded by a public participation process which included compliance with subregulation (2)(a), (b), (c) and (d); and (b) written notice is given to registered interested and affected parties regarding where the: i. revised basic assessment report or, EMPr or closure plan, as contemplated in regulation 19(1)(b); ii. revised environmental impact assessment report or EMPr as contemplated in regulation 23(1)(b); or iii. environmental impact assessment report and EMPr as contemplated in regulation 21(2)(d); may be obtained, the manner in which and the person to whom representations on these reports or plans may be made and the date on which such representations are due.	Note that this regulation does not apply at this stage because Regulation 19 (1) (b) does not apply. However, if for any reason revised a Draft BA Report need to be released in terms of Regulation (1) (b), this regulation will be complied with.
(6) When complying with this regulation, the person conducting the public participation process must ensure that: (a) information containing all relevant facts in respect of the application or proposed application is made available to potential interested and affected parties; and	The BA Process will be founded on a basis of ethics and will ensure that all registered and potential I&APs will have access to all information that has or may have the potential to influence any decision or comment made, unless such access to information is protected by law.

Regulation	Proposed Mechanism to Comply
(b) participation by potential or registered interested and affected parties is facilitated in such a manner that all potential or registered interested and affected parties are provided with a reasonable opportunity to comment on the application or proposed application.	The EAP conducting the PPP will ensure that information containing all relevant facts regarding the proposed projects is made available to I&APs. No information will be purposefully withheld. Participation by I&APs will be facilitated in a manner whereby all potential or registered I&APs are provided with a reasonable opportunity to comment on the Draft BA Reports.
(7) Where an environmental authorisation is required in terms of these Regulations and an authorisation, permit or licence is required in terms of a specific environmental management Act, the public participation process contemplated in this Chapter may be combined with any public participation processes prescribed in terms of a specific environmental management Act, on condition that all relevant authorities agree to such combination of processes.	The proposed SKA fibre optic cable between Beaufort West and Carnarvon includes various watercourse (rivers and associated wetland) crossings. The activities associated with the installation of the cabling constitute Section 21 (c) and (i) water uses in terms of the National Water Act. As such, it is proposed that the need for a WUL and relevant data pertaining to the WULA be subjected to PPP together with the BA Report. This will be discussed and confirmed with the DEFF and Regional Department of Water and Sanitation Offices during pre-application consultations.
<u>Register of Interested and Affected Parties</u> Regulation 42: (1) A proponent or applicant must ensure the opening and maintenance of a register of interested and affected parties and submit such a register to the competent authority, which register must contain the names, contact details and addresses of: (a) all persons who, as a consequence of the public participation process conducted in respect of that application, have submitted written comments or attended meetings with the proponent, applicant or EAP; (b) all persons who have requested the proponent or applicant, in writing, for their names to be placed on the register; and (c) all organs of state which have jurisdiction in respect of the activity to which the application relates.	An initial Draft I&AP Databse has been developed based on research, other project experience in the area, and interaction the Applicant. A detailed copy of the I&AP database will be included in the Draft BA Reports that will be released for a 30-day comment period to all I&APs, and it will also be included in the Final BA Reports that will be submitted to the DEFF for decision-making. The database will include the names and affiliations of the I&APs, as well as an indication of the interaction with I&APs, as well as all I&APs that have been added to the project database based on requests, submission of comments or based on research. The Final BA Report submitted to the DEFF for decision-making will also contain the contact details of I&APs in the database. The database will include the details of the following: • Land owners of the affected farm portions; • The municipal councillor of the ward in which the proposed projects will be undertaken; • The municipalities which has jurisdiction in the area; • Relevant Organs of State that have jurisdiction in respect of any aspect of the activity; and • Any other party as required by the competent authority. While I&APs will be encouraged to register their interest in the project from the start of the process, following the public announcements, the identification and registration of I&APs is ongoing for the duration of the BA.
<u>Registered interested and affected parties entitled to comment on reports and plans</u> Regulation 43: (1) A registered interested and affected party is entitled to comment, in writing, on all reports or plans submitted to such party during the public participation process contemplated in these Regulations and to bring to the attention of the proponent or applicant any issues which that party believes may be of significance to the consideration of the application, provided that the interested and affected	The Public Participation Process will fulfil the requirements of this regulation, using a combination of the mechanisms outlined in this plan.

Regulation	Proposed Mechanism to Comply
party discloses any direct business, financial, personal or other interest which that party may have in the approval or refusal of the application. (2) In order to give effect to section 24O of the Act, any State department that administers a law relating to a matter affecting the environment must be requested, subject to regulation 7(2), to comment within 30 days.	
Comments of interested and affected parties to be recorded in reports and plans Regulation 44: (1) The applicant must ensure that the comments of interested and affected parties are recorded in reports and plans and that such written comments, including responses to such comments and records of meetings, are attached to the reports and plans that are submitted to the competent authority in terms of these Regulations. (2) Where a person desires but is unable to access written comments as contemplated in subregulation (1) due to: (a) a lack of skills to read or write; (b) disability; or (c) any other disadvantage; reasonable alternative methods of recording comments must be provided for.	A key component of the BA Process is documenting and responding to the comments received from I&APs and the authorities during the 30-day comment period. Copies of all comments received during the review of the Draft BA Report will be included as an appendix to the Final BA Report. All comments received will be captured and responded to in a Comments and Response Report, which will be included as an appendix to the Final BA Report, which will be submitted to the DEFF. If during the BA Processes, persons are identified as desiring but unable to access written comments due to illiteracy, disability or any other disadvantage, then the EAP can arrange focus-group meetings with the relevant persons via telephone, teleconference or other appropriate means as required. Holding a teleconference can allow the EAP to verbally explain the project to the relevant person. The teleconference will be undertaken at no cost to the relevant person.

Appendix A: Land portions traversed by the proposed fibre optic cable road reserve corridor (adjacent land portions)

Western Cape: The roads followed by the proposed fibre optic cable traverses sixty (60) land portions in the Western Cape Province.

Name	Erf No	SG Code
Beaufort West Town Allotment	Parcel RE/40	C00900010000004000000
Beaufort West Town Allotment	Parcel RE/224	C00900010000022400000
Beaufort West Town Allotment	Parcel RE/223	C00900010000022300000
Beaufort West Town Allotment	Parcel RE/949	C00900010000094900000
Beaufort West Town Allotment	Parcel RE/222	C00900010000022200000
Beaufort West Town Allotment	Parcel RE/221	C00900010000022100000
Beaufort West Town Allotment	Parcel RE/220	C00900010000022000000
Beaufort West Town Allotment	Parcel RE/5996	C00900010000599600000
Beaufort West Town Allotment	Parcel RE/219	C00900010000021900000
Beaufort West Town Allotment	Parcel RE/5995	C00900010000599500000
Beaufort West Town Allotment	Parcel RE/7583	C00900010000758300000
Beaufort West Town Allotment	Parcel RE/5994	C00900010000599400000
Beaufort West Town Allotment	Parcel RE/1478	C00900010000147800000
Beaufort West Town Allotment	Parcel RE/5993	C00900010000599300000
Beaufort West Town Allotment	Parcel RE/5997	C00900010000599700000
Beaufort West Town Allotment	Parcel RE/7396	C00900010000739600000
Beaufort West Town Allotment	Parcel RE/5992	C00900010000599200000
Beaufort West Town Allotment	Parcel RE/216	C00900010000021600000
Beaufort West Town Allotment	Parcel RE/5991	C00900010000599100000
Beaufort West Town Allotment	Parcel RE/5279	C00900010000527900000
Beaufort West Town Allotment	Parcel RE/41	C00900010000004100000
Beaufort West Town Allotment	Parcel RE/204	C00900010000020400000
Beaufort West Town Allotment	Parcel RE/203	C00900010000020300000
Beaufort West Town Allotment	Parcel RE/36	C00900010000003600000
Beaufort West Town Allotment	Parcel RE/87	C00900010000008700000
Beaufort West Town Allotment	Parcel RE/86	C00900010000008600000
Beaufort West Town Allotment	Parcel RE/7391	C00900010000739100000
Farm 185	Parcel RE/185	C00900000000018500000
Beaufort West Town Allotment	Parcel RE/7	C00900010000000700000
Farm 185	Parcel 16/185	C00900000000018500016
Beaufort West Town Allotment	Parcel RE/185	C0090001
Beaufort West Town Allotment	Parcel RE/3545	C0090001
Beaufort West Town Allotment	Parcel RE/1707	C00900010000170700000
Alwins Gate	Parcel 6/186	C00900000000018600006
Alwins Gate	Parcel RE/186	C00900000000018600000
Farm 185	Parcel 9/186	C00900000000018600009
Alwins Gate	Parcel 2/186	C00900000000018600002
Grootvlei	Parcel 193	C00900000000019300000
Alwynsgat	Parcel R/187	C00900000000018700000
Farm 437	Parcel RE/437	C00900000000043700000

Name	Erf No	SG Code
Matjes Valie	Parcel 1/103	C00900000000010300001
Wittehart	Parcel 96	C00900000000009600000
Waterval	Parcel 2/97	C00900000000009700002
Waterval	Parcel RE/97	C00900000000009700000
Waterval	Parcel RE/101	C00900000000010100000
Middle Kraal	Parcel RE/98	C00900000000009800000
Quaggafontein	Parcel 82	C00900000000008200000
Kaffers Kraal	Parcel 42	C00900000000004200000
Aangrensende Lapfontein	Parcel 41	C00900000000004100000
Lapfontein	Parcel 1/40	C00900000000004000001
Leeuw Kloof	Parcel 43	C00900000000004300000
Snydersfontein	Parcel RE/21	C00900000000002100000
Snydersfontein	Parcel 1/21	C00900000000002100001
Gert Adriaans Kraal	Parcel RE/18	C00900000000001800000
Gert Adriaans Kraal	Parcel 2/18	C00900000000001800002
Farm 7	Parcel 1/7	C00900000000000700001
Slangefontein	Parcel 1/6	C00900000000000600001
Duikerfontein	Parcel 1/5	C00900000000000500001
Duikerfontein	Parcel 3/5	C00900000000000500003
Duikerfontein	Parcel RE/5	C00900000000000500000

Northern Cape: The roads followed by the proposed fibre optic cable traverses thirty-eight (38) land portions in the Northern Cape Province.

Name	Erf No	SG Code
Muranda	Parcel RE/144	C08000000000014400000
Jackalls Dance	Parcel RE/143	C08000000000014300000
Loxton Town Allotment	Parcel RE/377	C08000010000037700000
Loxton Town Allotment	Parcel RE/374	C08000010000037400000
Loxton Town Allotment	Parcel RE/371	C08000010000037100000
Loxton Town Allotment	Parcel Uitspan Berg RE/359	C08000010000035900000
Loxton Town Allotment	Parcel RE/261	C08000010000026100000
Loxton Town Allotment	Parcel RE/250	C08000010000025000000
Loxton Town Allotment	Parcel RE/249	C08000010000024900000
Loxton Town Allotment	Parcel RE/241	C08000010000024100000
Loxton Town Allotment	Parcel RE/233	C08000010000023300000
Loxton Town Allotment	Parcel RE/240	C08000010000024000000
Uitspan Berg	Parcel RE/142	C08000000000014200000
Farm 570	Parcel 1/570	C01700000000057000001
Farm 570	Parcel 2/570	C01700000000057000002
Weltevreden	Parcel 1/571	C01700000000057100001
Farm 570	Parcel RE/582	C01700000000058200000
Rondom	Parcel RE/540	C01700000000054000000
Nieuwe Uitvlugt	Parcel 3/539	C01700000000053900003
Nieuwe Uitvlugt	Parcel 6/539	C01700000000053900006
Nieuwe Uitvlugt	Parcel RE/539	C01700000000053900000
Blaauw Krantz	Parcel 4/485	C01700000000048500004
Blaauw Krantz	Parcel 3/485	C01700000000048500003
Klipbanks Fontein	Parcel RE/533	C01700000000053300000

Name	Erf No	SG Code
Blaauw Krantz	Parcel 16/485	C01700000000048500016
Vrye Laagte	Parcel RE/530	C01700000000053000000
Blaauw Krantz	Parcel 29/485	C01700000000048500029
Blaauw Krantz	Parcel 13/485	C01700000000048500013
Blaauw Krantz	Parcel 33/485	C01700000000048500033
Carnarvon Town Allotment	Parcel Blaauw Krantz RE/353	C01700020000035300000
Farm 578	Parcel RE/311	C01700010000031100000
Carnarvon Town Allotment	Parcel RE/859	C01700010000085900000
Blaauw Krantz	Parcel RE/312	C01700010000031200000
Carnarvon Town Allotment	Parcel RE/810	C01700010000081000000
Carnarvon Town Allotment	Parcel RE/867	C01700010000086700000
Carnarvon Town Allotment	Parcel RE/452	C01700010000045200000
Carnarvon Town Allotment	Parcel RE/890	C01700010000089000000
Carnarvon Town Allotment	Parcel RE/353	C01700010000035300000

Appendix B: Draft I&AP Database Summary

Contacts for the following key organisations are included in the Draft I&AP Database. The list below is a summary of the entities / organisations that are currently included in the Draft I&AP Database and does not divulge the contact details of representatives of these entities / organisations.

- Agri Northern Cape
- Agri Western Cape
- Agricarnarvon farmer's association
- AgriSA
- Beaufort West Municipality (Beaufort West)
- BirdLife South Africa
- Breede-Gouritz Catchment Management Agency
- CapeNature
- Cell C
- Central Karoo District Municipality
- Civil Aviation Authority (CAA)
- Department of Agriculture, Forestry and Fisheries (DAFF)
- Department of Environment, Forestry and Fisheries (DEFF / DEA)
- Department of Environment, Forestry and Fisheries (DEFF / DEA) - Biodiversity Unit
- Department of Rural Development and Land Reform (DRDLR)
- Department of Transport
- Department of Water and Sanitation (Northern Cape)
- Department of Water and Sanitation (Western Cape)
- Earthlife Africa
- Endangered Wildlife Trust (EWT)
- Eskom
- Heritage Western Cape (HWC)
- Independent Communications Authority of South Africa (ICASA)
- Kareeberg Municipality (Carnarvon)
- MTN
- National Department of Agriculture, Forestry and Fisheries (DAFF)
- National Department of Economic Development
- National Department of Water and Sanitation (DWS / DHSWS)
- Northern Cape Chamber of Commerce and Industry

- Northern Cape Department of Agriculture, Land Reform & Rural Development
- Northern Cape Department of Economic Development and Tourism
- Northern Cape Department of Environment and Nature Conservation (DENC)
- Northern Cape Department of Roads and Public Works
- Northern Cape Department of Roads and Public Works (Roads)
- Northern Cape Department of Transport, Safety and Liaison (Transport Operations)
- Northern Cape Economic Development, Trade and Investment Promotion Agency (NCEDA)
- Northern Cape Roads and Public Works
- Nuveld Boerevereniging farmer's association
- Pixley ka Seme District Municipality
- SALT (The Southern African Large Telescope)
- SANParks
- Sentech
- South African Astronomical Observatory (SAAO)
- South African Bat Assessment Association (SABAA)
- South African Environmental Observation Network (SAEON)
- South African Heritage Resource Agency (SAHRA)
- South African Local Government Association (SALGA) (Northern Cape)
- South African Local Government Association (SALGA) (Western Cape)
- South African National Research Network (SANReN)
- South African National Roads Agency (SANRAL)
- Southern African Large Telescope (SALT)
- Square Kilometre Array South Africa (SKA) / South African Radio Astronomy Observatory (SARAO)
- Telkom
- Transnet
- Ubuntu Municipality (Loxton)
- Vodacom
- Visual Impact Assessment Specialist (BOLA)
- Western Cape Department of Agriculture
- Western Cape Department of Economic Development and Tourism
- Western Cape Department of Environmental Affairs and Development Planning (DEA&DP)
- Western Cape Department of Transport and Public Works
- Western Cape Roads Department
- Wildlife and Environmental Society of South Africa (WESSA) (Environmental Governance Programme)
- World Wide Fund South Africa (WWF-sa)

Appendix 16 Public Participation Process proof

Contents

Site notice

(Text and layout only, photographs and coordinates of site notice placement will be included in the final report. Site notice is comprised of 2 x A3 pages)

Environmental Authorisation Reference Number: To be assigned
Water Use General Authorisation Reference Number: WU18079

NOTIFICATION: APPLICATION FOR ENVIRONMENTAL AUTHORISATION, WATER USE AUTHORISATION AND ASSOCIATED PUBLIC PARTICIPATION PROCESS FOR THE PROPOSED SQUARE KILOMETRE ARRAY (SKA) FIBRE OPTIC CABLE BETWEEN BEAUFORT WEST AND CARNARVON, IN THE NORTHERN CAPE AND WESTERN CAPE PROVINCES.

The South African National Research Network (SANReN), the Project Applicant, is proposing to install a high-speed fibre optic internet cable between Beaufort West and Carnarvon. The proposed fibre optic cable is required to facilitate a connection between the Square Kilometre Array (SKA) radio telescope core site in the Northern Cape (NC) and an existing data processing facility in Cape Town in the Western Cape (WC).

The fibre optic cable route will follow the N1, R381 and R63 roads for a length of approximately 183 km, from Beaufort West, via Loxton, to Carnarvon. The proposed project spans the WC and NC Provinces, and is located within the Beaufort West Local Municipality (Central Karoo District, WC), and the Ubuntu and Kareeberg Local Municipalities (Pixley ka Seme District, NC). The fibre optic cabling will predominantly be installed underground in the road reserves of the N1, R381 and R63 roads. Where underground installation of the cable is unfeasible (i.e. Molteno, Blounek and Rosedene passes) the cabling will be installed overhead on poles, in some sections just outside the road reserve.

The proposed project triggers Listed Activities that require a **Basic Assessment (BA) process** in terms of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) and the 2014 NEMA Environmental Impact Assessment (EIA) Regulations (as amended). An Application for Environmental Authorisation (EA) will be submitted to the Competent Authority for the EA, the National Department of Environment, Forestry and Fisheries (DEFF).

Furthermore, the proposed fibre optic cable may cross multiple watercourses (including rivers and drainage lines) which require water use authorization in terms of the National Water Act (Act 36 of 1998, as amended). A **water use General Authorisation (GA)**, as per GN 509 of the NWA, has been issued by the Competent Authority for the water use authorisation, Regional Department of Water and Sanitation (DWS) of the Lower Orange Water Management Area (WMA).

Part of the fibre optic cabling is proposed within the eastern section of the Karoo National Park next to the R381 road, specifically to traverse the difficult terrain associated with the Molteno Pass. In terms of the **National Environmental Management: Protected Areas Act (NEM:PAA), prior written approval of the Park management authority** is required for any development, construction or farming in a national park. South African National Parks (SANParks) and the Karoo National Park management have approved the proposed Fibre Optic Protect in line with the NEM:PAA requirements.

The Council for Scientific and Industrial Research (CSIR) Environmental Management Services has been appointed as the independent Environmental Assessment Practitioner (EAP) to undertake and manage the BA and GA processes for the proposed project on behalf of the Project Applicant.

An integrated Public Participation Process (PPP) is being undertaken for the BA and water use GA processes. Interested and Affected Parties (I&APs) are notified of the availability of and opportunity to comment on the Draft BA Report (including water use GA aspects).

Project information and reports are available online at: https://www.csir.co.za/environmental-impact-assessment and http://bit.ly/SKAfibre-PPP. Hard copy BA report summaries are available at: Beaufort West: Klein Karoo Agri (80 Donkin Street); Loxton: Loxton Library / Municipality (Corner of Margaretha Prinsloo Street and Probart Street); Carnarvon: SARAO Visitors Centre (Corner of Victoria and Hanau Street).

Should you have any questions, wish to register as an I&AP and / or to provide comments on the proposed project, you are kindly requested to e-mail, fax or post your details and comments to:

Attention: Luanita Snyman-Van der Walt.
Reference: SKA fibre.
Email: ems@csir.co.za (preferred).
PO Box 320, Stellenbosch, 7599.
Tel: 021 888 2400; Fax: 021 888 2693.

I&APs can also complete an online Registration and Comment form here: http://bit.ly/SKAfibre-IAP.

Commenting period closes 30 September 2021.

Public participation is conducted in accordance with the NEMA and the Protection of Personal Information Act (https://www.csir.co.za/csir-privacy-notice).

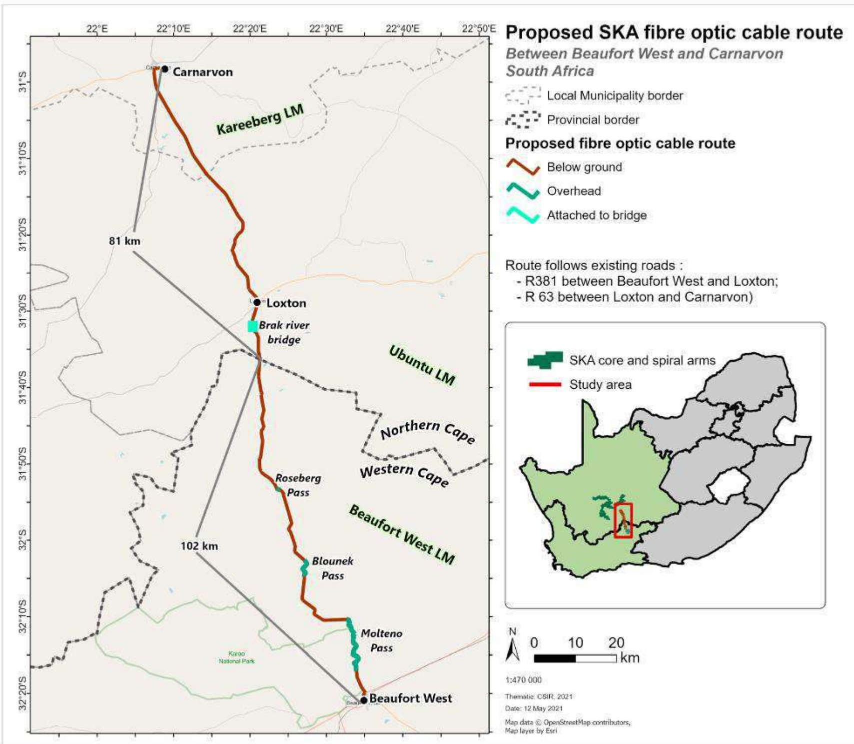


Figure i: The proposed SKA fibre optic cable route starts in Beaufort West, follows the existing R381 and R63 roads via Loxton and terminates in Carnarvon.

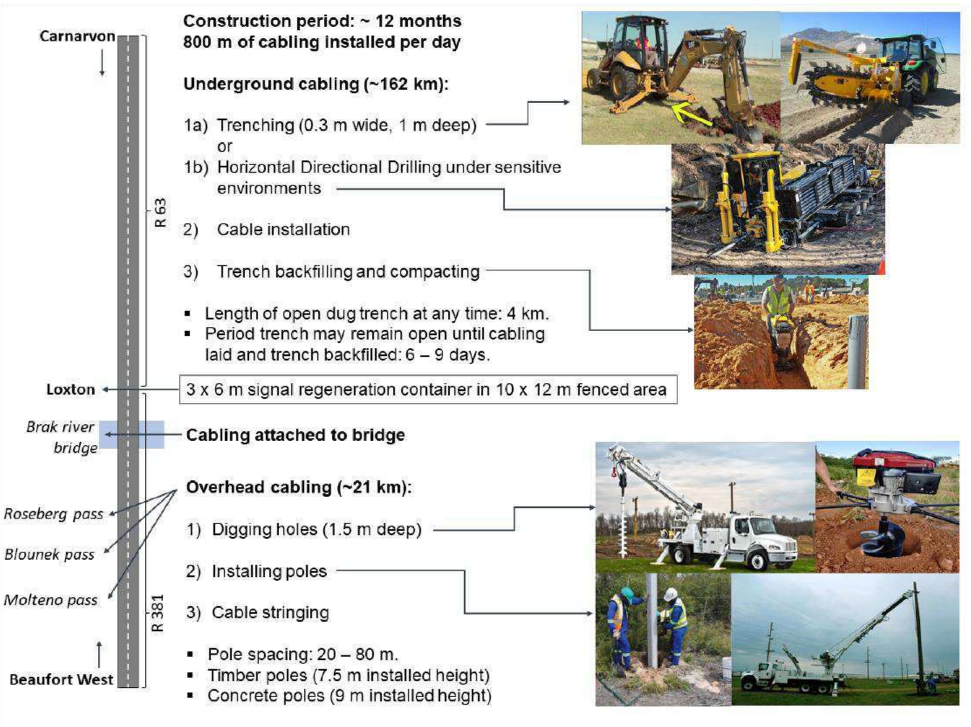


Figure ii: Schematic summary of the main activities to install the fibre optic cable between Beaufort West and Carnarvon.

Newspaper advertisements

(Text and layout only, tear sheets will be included in the final report. Newspapers targeted are City Press (English) and Oewernuus (Afr)).

NOTIFICATION: APPLICATION FOR ENVIRONMENTAL AUTHORISATION, WATER USE AUTHORISATION, AND ASSOCIATED PUBLIC PARTICIPATION PROCESS FOR THE PROPOSED SQUARE KILOMETRE ARRAY (SKA) FIBRE OPTIC CABLE BETWEEN BEAUFORT WEST AND CARNARVON

The South African National Research Network (SANReN) is proposing to install a high-speed fibre optic internet cable between Beaufort West and Carnarvon. The proposed fibre optic cable is required to facilitate a connection between the Square Kilometre Array (SKA) core site in the Northern Cape (NC) and an existing data processing facility in Cape Town in the Western Cape (WC).

The proposed route for the new fibre optic cable will follow the N1, R381 and R63 roads from Beaufort West, via Loxton, to Carnarvon. The project is located within the Beaufort West Local Municipality (Central Karoo District, WC), and the Ubuntu and Kareeberg Local Municipalities (Pixley ka Seme District, NC). The fibre optic cabling will predominantly be installed underground in the road reserves of the N1, R381 and R63 roads, and overhead at the Molteno, Blounek and Rosedene passes.

The proposed project requires a **Basic Assessment (BA)** process in terms of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) Environmental Impact Assessment (EIA) Regulations (2014 as amended, 2017, 2021); as well as a **water use General Authorisation** for multiple watercourses crossings along the route. The fibre optic cabling is partly proposed within the eastern section of the Karoo National Park next to the R381 road, specifically to traverse the difficult terrain associated with the Molteno Pass. The South African National Parks (SANParks) and the Karoo National Park management have approved the project in line with the National Environmental Management: Protected Areas Act (NEM:PAA) requirements.

Interested and Affected Parties (I&APs) are hereby notified of the release of the Draft BA Report for the proposed project for a 30-day review period from **XX xxx to XX.**

Register as an I&AP and submit comments on the draft report to: Luanita Snyman-van der Walt. Ref: SKA fibre. Email: **ems@csir.co.za.** PO Box 320, Stellenbosch, 7599. Tel: 021 888 2400; Fax: 021 888 2693.

The draft BA Report is available online at: **https://www.csir.co.za/environmental-impact-assessment or http://bit.ly/SKAfibre-PPP.** I&APs can also complete an online Registration and Comment form at: **http://bit.ly/SKAfibre-IAP.**

CSIR

Touching lives through innovation

KENNISGEWING: AANSOEK VIR OMGEWINGSMAGTIGING, WATERVERBUIK MAGTIGING EN VERWANTE PUBLIEKE DEELNAME PROSES VIR DIE VOORGESTELDE "SQUARE KILOMETRE ARRAY" (SKA) OPTIESE VESEL KABEL TUSSEN BEAUFORT WES EN CARNARVON

Die "South African National Research Network" (SANReN) beplan om 'n hoë-spoed optiese vesel internet kabel tussen Beaufort West en Carnarvon te installeer. Die optiese vesel kabel word benodig om die konneksie tussen die "Square Kilometre Array" (SKA) radioteleskoop in die Noordkaap en 'n bestaande dataverwerkingsfasiliteit in Kaapstad, in the Weskaap, te voltooi.

Die voorgestelde roete vir die nuwe optiese vesel kable sal die N1, R381 en R63 paaie vanaf Beaufort Wes, via Loxton, tot in Carnarvon volg. Die projek is dus geleë in die Beaufort Wes munisipaliteit (Sentrale Karoo Distrik, Weskaap), en die Ubuntu en Kareeberg munisipaliteite (Pixley ka Seme Distrik, Noodkaap). The kabel sal hoosaaklik ondergrond en binne die pad reserwes van die N1, R381 and R63 paaie installeer word, en oorhoofs by die Molteno, Blounek en Rosedene passe.

Die voorgestelde projek benodig 'n **Basiese Assessering (BA)** proses in terme van die "National Environmental Management Act" (Wet 107 van 1998, soos gewysig) (NEMA) 2014 NEMA "Environmental Impact Assessment" (EIA) Regulasies (soos gewysig, 2017, 2021); asook 'n **waterverbruik Algemene Magtiging** vir rivierkruisings. 'n Gedeelte van die optiese vesel kabel word beplan in die oostelike gedeelte van die Karoo Nasionale Park, langs die R381 pad, om die komplekse topografie van die Molteno Pas te deurkruis. Die Suid-Afrikaanse Parkeraad (SANParke) en die bestuur van die Karoo Nasionale Park het die optiese vesel kabel goedgekeur.

Geintereseerde en Belanghebbende Partye (G&BPs) word hiermee in kennis gestel van die vrystelling van die konsep BA Verslag vir die voorgestelde projek vir 'n 30-dae hersieningsperiode vanaf **xxx tot en met xxx.**

Registreer as 'n G&BP en stuur kommentaar op die konsep verslag aan: Luanita Snyman-Van der Walt via epos, faks of pos. Verwysing: SKA fibre. Epos: **ems@csir.co.za.** Posbus 320, Stellenbosch, 7599. Tel: 021 888 2400. Faks: 021 888 2693.

Die konsep BA Verslag is aanlyn beskikbaar by: **https://www.csir.co.za/environmental-impact-assessment** of **http://bit.ly/SKAfibre-PPP.** G&BPs kan ook 'n aanlyn Registrasie en Kommentaar form hier voltooi: **http://bit.ly/SKAfibre-IAP.**

CSIR
Touching lives through innovation

Letter - Notification 1: I&AP registration and draft Report commenting period

(Text and layout only, will be sent to I&APs (incl. adjacent landowners) via email. Several adjacent landowners do not have email addresses – their letters are hand-delivered. Proof of transmittal (hard copy and email) will be included in the final report).

CSIR
Touching lives through innovation

SANReN
South African National Research Network

SKA
SKA AFRICA

CSIR Environmental Management Services
11 Jan Celliers Street, Stellenbosch, 7600
Tel: +27 (0) 21 888 2400
Email: ems@csir.co.za

23 August 2021

Dear Interested and Affected Party

NOTIFICATION: APPLICATION FOR ENVIRONMENTAL AUTHORISATION, WATER USE AUTHORISATION AND ASSOCIATED PUBLIC PARTICIPATION PROCESS FOR THE PROPOSED SQUARE KILOMETRE ARRAY (SKA) FIBRE OPTIC CABLE BETWEEN BEAUFORT WEST AND CARNARVON, IN THE NORTHERN CAPE AND WESTERN CAPE PROVINCES

Environmental Authorisation Reference Number: To be assigned.
Water Use General Authorisation Reference Number: WU18079.

Notice is hereby given that the South African National Research Network (SANReN), the Project Applicant, is proposing to install a high-speed fibre optic internet cable between Beaufort West and Carnarvon. The proposed fibre optic cable is required in order to facilitate a connection between the Square Kilometre Array (SKA) core site in the Northern Cape (NC) and an existing data processing facility in Cape Town in the Western Cape (WC). Fibre optic infrastructure already exists between the SKA core site and Carnarvon, and between Beaufort West and the existing data processing facility in Cape Town.

The proposed route for the new fibre optic cable will follow the N1, R381 and R63 roads for a length of approximately 183 km, from Beaufort West, via Loxton, to Carnarvon. The proposed project spans the WC and NC Provinces, and is located within the Beaufort West Local Municipality (Central Karoo District, WC), and the Ubuntu and Kareeberg Local Municipalities (Pixley ka Seme District, NC).

The fibre optic cabling will predominantly be installed underground in the road reserves of the N1, R381 and R63 roads:

Beaufort West:	2nd Ave. → Park Ave. → Kerk Str. →New Str. → Donkin Str. (N1 / N12) →
Beaufort West to Loxton:	R381 →
Loxton:	Fraserburg Str. → Auret Str. / R381 →
Loxton to Carnarvon:	R63 →
Carnarvon:	Biblioteek Str. → Zahn Str. → Van Riebeeck Str. → Stasieweg Str.

23 Augustus 2021

Geagte Belanghebbende en Geaffekteerde Party

KENNISGEWING: AANSOEK VIR OMGEWINGSMAGTIGING, WATERVERBUIK MAGTIGING EN VERWANTE PUBLIEKE DEELNAME PROSES VIR DIE VOORGESTELDE "SQUARE KILOMETRE ARRAY" (SKA) OPTIESE VESEL KABEL TUSSEN BEAUFORT WES EN CARNARVON, IN DIE WESKAAP EN NOORDKAAP PROVINSIES.

Omgewingsmagtiging Verwysings Nommer: Moet steeds toegewys word.
Waterverbuik-magtiging Verwysings Nommer: WU18079.

U word hiermee in kennis gestel dat die "South African National Research Network" (SANReN), die Aansoeker, voorstel om 'n hoë-spoed optiese vesel internet kabel tussen Beaufort West en Carnarvon te installeer. Die optiese vesel kabel word benodig om die konneksie tussen die "Square Kilometre Array" (SKA) radioteleskoop in die Noordkaap en 'n bestaande dataverwerkingsfasiliteit in Kaapstad, in the Weskaap, te voltooi. Optiese vesel infrastruktuur bestaan reeds tussen die SKA en Carnarvon, en tussen Beauort Wes en Kaapstad.

Die voorgestelde roete vir die nuwe optiese vesel kable sal die N1, R381 en R63 paaie volg vir 'n afstand van ongeveer 183 km vanaf Beaufort Wes, via Loxton, tot in Carnarvon. Die projek is dus geleë in die Beaufort Wes munisipaliteit (Sentrale Karoo Distrik, Weskaap), en die Ubuntu en Kareeberg munisipaliteite (Pixley ka Seme Distrik, Noodkaap).

The kabel sal hoosaaklik ondergrond en binne die pad reserwes van die N1, R381 and R63 paaie installeer word:

Beaufort West:	2nd Ave. → Park Ave. → Kerk Str. →New Str. → Donkin Str. (N1 / N12) →
Beaufort West na Loxton:	R381 →
Loxton:	Fraserburg Str. → Auret Str. / R381 →
Loxton na Carnarvon:	R63 →
Carnarvon:	Biblioteek Str. → Zahn Str. → Van Riebeeck Str. → Stasieweg Str.

Where underground installation of the cable is unfeasible (i.e. Molteno, Blounek and Rosedene passes) the cabling will be installed on poles 7.5 – 9 m tall, potentially just outside the road reserve on the following properties:

Molteno Pass:

- Erf 3545, Beaufort West region [C00900010000354500000] (Karoo National Park).
- Erf 1707, Beaufort West region [C00900010000170700000] (Karoo National Park).
- Portion 9 of the Farm Alwins Gate 186 [C00900000000018600009] (Karoo National Park).
- Portion 1 of the farm Matjes Valie 103 [C00900000000010300001].
- Road reserve of R 381, as far as possible.

Blounek Pass:

- Remainder of the Farm Waterval 97 [C00900000000009700000].
- Remainder of the Farm Middle Kraal 98 [C00900000000009800000].
- Road reserve of R 381, as far as possible.

Roseberg Pass:

- Within road reserve of the R381.

The proposed project triggers Listed Activities that require a **Basic Assessment (BA) process** in terms of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) and the 2014 NEMA Environmental Impact Assessment (EIA) Regulations (as amended, 2017). An Application for Environmental Authorisation (EA) will be submitted to the Competent Authority for the EA, the National Department of Environment, Forestry and Fisheries (DEFF).

Furthermore, the proposed fibre optic cable may cross multiple watercourses (including rivers and drainage lines) which require water use authorization in terms of the National Water Act (Act 36 of 1998, as amended). A **water use General Authorisation (GA)**, as per GN 509 of the NWA, has been issued by the Competent Authority for the water use authorisation, Regional Department of, Water and Sanitation (DWS) of the Lower Orange Water Management Area (WMA).

Council for Scientific and Industrial Research (CSIR) Environmental Management Services has been appointed as the independent Environmental Assessment Practitioner (EAP) to undertake and manage the BA and GA processes for the proposed project on behalf of the Project Applicant. However, since CSIR is the parent organisation of SANReN (i.e. the Applicant and the EAP are both associated with the CSIR), an independent peer review EAP (from SLR Consulting SA) has been appointed.

Interested and Affected Parties (I&APs) are hereby notified of the release of the draft BA Report for the proposed project for a 30-day review period from 30 August to 30 September 2021.

Waar dit onprakties is om die kabel te begrawe (bv. die Molteno, Blounek en Rosedene passe) sal die kabel op pale, tussen 7.5 – 9 m hoog, installeer word, moontlik nét buite die padreserwe op die volgende eiendomme:

Molteno Pas:

- Erf 3545, Beaufort West steek [C00900010000354500000] (Karoo Nasionale Park).
- Erf 1707, Beaufort West streek [C00900010000170700000] (Karoo Nasionale Park).
- Porsie 9 van Alwins Gate 186 [C00900000000018600009] (Karoo Nasionale Park).
- Porsie 1 van Matjes Valie 103 [C00900000000010300001].
- Padreserwe van die R 381, sover moontlik.

Blounek Pas:

- Restant van Waterval 97 [C00900000000009700000].
- Restant van Middle Kraal 98 [C00900000000009800000].
- Padreserwe van die R381, sover moontlik.

Roseberg Pas:

- Padreserwe van die R381.

Die voorgestelde projek sluit aktiwiteite in wat 'n **Basiese Assessering (BA)** proses in terme van die "National Environmental Management Act" (Wet 107 van 1998, soos gewysig) (NEMA) en die 2014 NEMA "Environmental Impact Assessment" (EIA) Regulasies (soos gewysig, 2017) benodig. 'n Aansoek vir Omgwingsmagtiging (OM / "EA") sal aan die Bevoegde Owerheid – die Nasionale Departement van Omgeweing, Bosbou en Visserye – ingedien word.

Verder, die voorgestelde kabel gaan verskeie riviere en dreineringslyne deurkruis. Hierdie riverkruisings vereis watervebruik-magtigting in terme van die "National Water Act" (Wet 36 of 1998, soos gewysig). 'n **Algemene Magtiging** (AM / "GA") vir watervebruik is uitgereik deur die Bevoegde Owerheid – die Streeksdepartement vir Water en Sanisasie in beheer vir die Laer Oranje waterbestuursarea.

Die Wetenskaplike en Nywerheid Navorsingsraad (WNNR / "CSIR") se "Environmental Management Services" is aangestel as die onafhanklike Omgewingsassessering Praktisyn (OAP / "EAP") om die BA en AM prossesse te ondemeem. Die WNNR is egter die voog-organisasie van SANReN, en dus is 'n addisionele onafhanklike en eksterne hersiener (van "SLR Consulitng SA") aangestel.

'Belanghebbende en Geaffekteerde Partye (B&GPs) word hiermee in kennis gestel van die vrystelling van die konsep BA Verslag) vir die voorgestelde projek vir 30 dae vanaf 30 Augustus tot 30 September 2021.

The draft BA Report is available online at: https://www.csir.co.za/environmental-impact-assessment or http://bit.ly/SKAfibre-PPP.

Hard copies of the BAR summary are available at the following locations during the 30-day commenting period on the draft BAR:

- Beaufort West: Klein Karoo Agri (80 Donkin Str.).
- Loxton: Loxton Library / Municipality (Corner of Margaretha Prinsloo Str. and Probart Str.).
- Carnarvon: SARAO Visitors Centre (Corner of Victoria and Hanau Street).

All comments received from I&APs and stakeholders during the review of the draft BA Report will be considered and included in the final BA Reports. The final BA report will then be submitted to the Competent Authority, the Department of Forestry, Fisheries and the Environment (DFFE) for decision-making in line with Regulation 19 (1) (a) of the National Environmental Management Act (NEMA) Environmental Impact Assessment (EIA) Regulations (2014, as amended).

Should you have any questions, wish to register as an I&AP and / or to provide comments on the proposed project, you are kindly requested to e-mail, fax or post your details and comments to:

Attention: Luanita Snyman-Van der Walt.
Reference: SKA fibre.
Email: ems@csir.co.za (preferred).
PO Box 320, Stellenbosch, 7599.
Tel: 021 888 2400.
Fax: 021 888 2693.

I&APs can also complete an online Registration and Comment form here: http://bit.ly/SKAfibre-IAP.

Public participation is conducted in accordance with the NEMA and the Protection of Personal Information Act (https://www.csir.co.za/csir-privacy-notice).

Thank you in advance for your participation in this project. Should you have any queries or require additional information please do not hesitate to contact the undersigned using the contact details provided above.

Kind regards,

Die konsep BA Verslag is aanlyn beskikbaar by: https://www.csir.co.za/environmental-impact-assessment of http://bit.ly/SKAfibre-PPP.

Harde kopieë van die BA Verslag opsomming is beskikbaar gedurende die 30-dae kommentaar tydperk by die volgende liggings:

- Beaufort West: Klein Karoo Agri (80 Donkin Str.).
- Loxton: Loxton Biblioteek / Munisipale gebou) (hoek van Margaretha Prinsloo Str. en Probart Str.)
- Carnarvon: SARAO Besoekersentrum (hoek van Victoria and Hanau Str.).

Kommentaar ontvang van G&BPs gedurende die hersieningsperiode sal in ag geneem word, en in die finale BA Verslag ingesluit word. Die finale BA Verslag sal dan aan die Bevoegde Owerheid, die Departement van Omgewingsake / "Department of Forestry, Fisheries and the Environment" (DFFE)), ingedien word vir besluitneming volgens Regulasie 19 (1) (a) van die "NAtional Environmental Management Act" (NEMA) "Environmental Impact Assessment (EIA) Regulasies (2014, soos gewysig).

Indien u enige vrae het, wil registreer as 'n G&BP, en / of will kommentaar op die voorgestelde optiese vesel kabel projek will lewer, kan u gerus 'n epos, fax, of pos stuur aan:

Aandag: Luanita Snyman-Van der Walt.
Verwysing: SKA fibre.
Epos: ems@csir.co.za (verkies).
Posbus 320, Stellenbosch, 7599.
Tel: 021 888 2400.
Faks: 021 888 2693.

G&BPs kan ook 'n aanlyn Registrasie en Kommentaar form hier voltooi: http://bit.ly/SKAfibre-IAP.

Publieke deelname word uitgevoer per die vereistes van die NEMA en die "Protection of Personal Information Act" (https://www.csir.co.za/csir-privacy-notice).

Byvoorbaat dankie vir u deelname in hierdie projek. Indien u enige navrae het of addisionele inligting benodig, kontak gerus die ondergetekende by die bogenoemde besonderhede.

Vriendelike groete,

Luanita Snyman-Van der Walt (Pr.Sci.Nat. 400128/16)
Project Manager and EAP | Projekbestuurder en EAP
CSIR | WNNR Environmental Management Services

Appendix 17 Authority consultation and comments

Contents

Basic Assessment for the proposed Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon

PRE-APPLICATION MEETING 2 NOTES

Final, 12 May 2021

DFFE meeting reference: 2020-10-0001

Date: 22 April 2021, 10:00-12:00

Compiled by: Luanita Snyman-van der Walt (CSIR EMS)
Reviewed by: Rohaida Abed (CSIR EMS) (draft v1) and Edward Perry (SLR Consulting South Africa) (draft v2)

Participants

Competent Authority

- Herman Alberts, chair (Department of Forestry, Fisheries and the Environment (DFFE) – the Competent Authority / "the Department") - *HA*
- Muhammad Essop (DFFE) - *ME*
- Coenrad Agenbach (DFFE) – *CA*

Environmental Assessment Practitioner (EAP)

- Luanita Snyman-van der Walt (Council for Scientific and Industrial Research (CSIR) Environmental Management Services (EMS)) - *LSvdW*
- Paul Lochner (CSIR EMS) - *PL*
- Rohaida Abed (CSIR EMS) - *RA*

Peer review EAP

- Edward Perry (SLR Consulting South Africa) – *EP*

Applicant

- Zuki Makalima (CSIR South African National Research Network (SANReN)) - *ZM*
- Mlungisi Majola (CSIR SANReN) - *MM*
- Leon Staphorst (CSIR SANReN) - *LS*
- Tracy Cheetham (South African Radio Astronomy Observatory (SARAO) / Square Kilometre Array (SKA)) - *TC*

Apologies:

- Milicent Solomons (DFFE)

1. **Key discussion points**

1.1 Project description: Description of the proposed Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon.

1.2 Listed Activities & other approvals / permits: Discussion on the applicable listed activities identified, and other permits / approvals required

1.3 Specialist assessments: Discussion on the specialist studies identified and taken forward in the Basic Assessment (BA) process.

1.4 Public Participation Process (PPP): Discussion on the approach to the PPP (i.e. PPP plan).

1.5 Query: micro-siting during construction: Discussion on micro-siting during construction within the conditions of an Environmental Authorisation (EA).

1.6 Way Forward and Closure.

2. **Project description (presentation by LSvdW – see Appendix A)**

2.1 No specific comments or questions raised.

3. **Listed Activities and other permits / approvals (presentation by LSvdW – see Appendix A)**

3.1 The following Listed Activities were confirmed by the Competent Authority to <u>not apply:</u>

3.1.1 Listing Notice (LN) 1 Activity 12: *The development of —*

*(ii) infrastructure or structures with a **physical footprint of 100 square metres** or more; where such development occurs—*

*(a) **within a watercourse;***

*(c) if no development setback exists, **within 32 metres of a watercourse**, measured from the edge of a watercourse*

Excluding –

***(ee) where such development occurs within existing roads**, or road reserves or railway line reserves; ...*

3.1.1.1 <u>Outcome</u>: The cabling installed underground in the road reserve is excluded from this Listed Activity. If it can be confirmed that where poles are placed within a watercourse / 32 m of a watercourse the clearance will not exceed the threshold, Listed Activity 1 (12) will not apply (ME).

3.1.2 LN 1 Activity 27: *The **clearance of an area of 1 hectares** or more, but less than 20 hectares of **indigenous vegetation, except where such clearance of indigenous vegetation is required for—***

(i) the undertaking of a linear activity;...

3.1.2.1 The proposed SKA fibre optic cable is considered a linear development (HA).

3.1.2.2 <u>Outcome</u>: It was confirmed that Listed Activity 1 (27) does not apply (HA).

3.1.3 LN 1 Activity 34: *The **expansion or changes to of existing facilities** or infrastructure for any process or activity where such expansion or changes will result in the need for a permit or license or an amended permit or license in terms of national or provincial legislation governing the release of emissions, effluent or pollution...*

3.1.3.1 The proposed SKA fibre optic cable is considered a new development and not an extension of the SKA-mid and spiral arms which forms part of the radio-telescope (HA).

3.1.3.2 Outcome: It was confirmed that Listed Activity 1 (34) does not apply (HA).

3.1.4 LN 3 Activity 3: *The development of **masts or towers** of any material or type used for **telecommunication broadcasting or radio transmission** purposes where the mast or tower—*
*(b) will **exceed 15 metres** in height—...*

3.1.4.1 The maximum height of the installed overhead fibre optic cable (7.5 – 9 m) does not exceed the threshold (ME).

3.1.4.2 Outcome: It was confirmed that Listed Activity 3 (3) does not apply (ME).

3.2 National Environmental Management Protected Areas Act (NEM:PAA) Section 50(5) approval:

3.2.1 Current status of approval: The Karoo National Park management have been consulted (including a site visit in November 2020) and communicated 'in principle' agreement for the fibre optic cable to traverse Park land in the corridor where current Eskom infrastructure and telephone poles are located (LSvdW).

3.2.2 NEM:PAA approval must be obtained before an Application for Environmental Authorisation (EA) is lodged (ME).

3.2.3 Additionally, proposed development may only be in line with current Park Management Plans, or else the Plans must be amended first to accommodate new development (CA).

3.2.3.1 SANParks will presumably consider the alignment of the fibre optic cable installation with the Karoo National Park Management Plan when deciding on NEM:PAA Section 50 (5) approval (EP).

3.2.4 This is stipulated in Section 19 of the NEM:PAA regulations for the proper administration of special nature reserves, national parks and world heritage sites (Government Notice R1061 in Government Gazette 28181, dated 28 October 2005; and as amended in Government Notice R622 in Government Gazette 37904, dated 15 August 2014):

19 (1) No development contemplated in section 50 (5) of the Act shall be implemented—

(a) in any area other than an area specifically designated for such development in a management plan; and

(b) before a management authority has indicated in writing the nature and extent of the strategic or environmental impact assessment required for the development.

19 (2) No commercial activity or activity contemplated in section 50 of the Act, which requires an environmental impact assessment to be undertaken, either in terms of subregulation (1)(b) or under any other law, may be implemented before a management authority has approved, with or without conditions, the environmental impact assessment before it is submitted to the relevant authority for approval.

3.2.5 Suggested contact for further clarification in Dr. Kallie Naudé from DFFE Protected Areas Department (CA).

3.2.6 Action: The DFFE to kindly provide contact details for Dr. Naudé (*note: this has been obtained by the EAP in the interim)*.

3.2.7 Action: The Applicant and EAP to liaise further with Karoo National Park and Dr. Naudé to ensure that NEM:PAA Section 50 (5) approval is in place before submitting an Application for EA, and to clarify matters relating to the Park Management Plan.

3.3 Provincial protected flora removal permits:

3.3.1 Current status of approval: In the EAP's experience the flora permits are often only considered and issued after EA has been obtained. The relevant Departments at the Provinces have been approached to ascertain whether the permit may be obtained in parallel to EA, but stating that both EA and flora permits must be in place before construction starts. Feedback from the Provinces have been slow (LSvdW).

4. Specialist assessments (presentation by LSvdW – see Appendix A)

4.1 No specific comments or questions raised.

5. Public Participation Plan (presentation by LSvdW – see Appendix A)

5.1 No specific comments or questions raised.

6. Query: micro-siting during construction / spatial extent of EA (presentation by LSvdW – see Appendix A)

6.1 Where the fibre optic cabling is installed underground within the road reserve, unforeseen technical difficulties may result in the routing being adjusted. The aim is to be able to account for these changes, whilst still adhering to the Environmental Management Programme (EMPr), but without having to amend the EA (LSvdW).

6.2 The area where the cabling is installed must have been assessed during the BA Process, any activities outside the assessed area cannot be allowed without the necessary approvals in terms of the EIA Regulations (CA).

6.3 The area between the road and adjacent property fence line has been assessed. No trenching will occur on private land - here the cable will be installed above ground to traverse technically difficult terrain (LSvdW).

6.4 The Provincial Departments responsible for roads who are issuing approval for construction in the road reserve has indicated that the road reserve is 15 m on either side of the centre line of the road. This is not necessarily consistent across the entire route (e.g. may be 10 m on the left and 20 m on the right). Trenching will also occur no closer than 1 m from the fence of adjacent private land (MM).

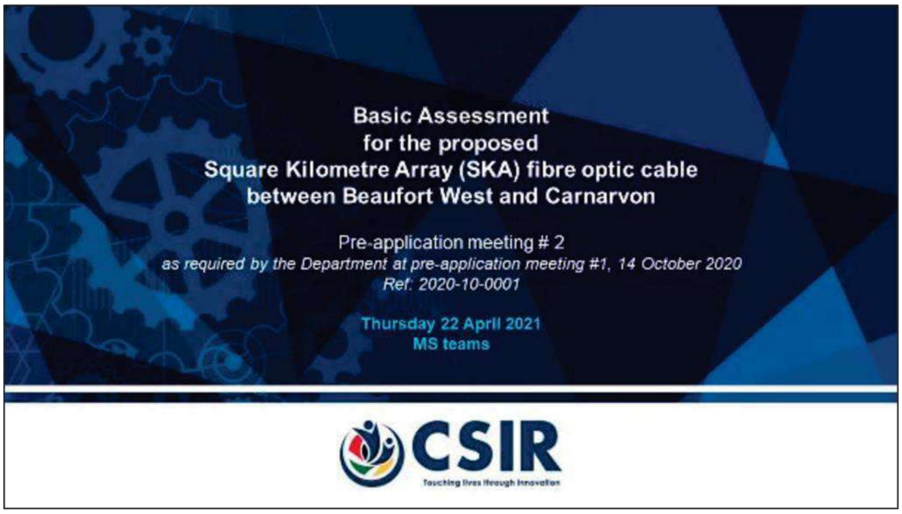
6.5 Although the statutory road reserve width is indicated as 15 m on either side of the centre line of the road, the fencing of adjacent properties are often closer or further away from the road than 15 m (LSvdW).

6.6 Outcome: The proposed extent of EA for the underground cabling sections in the road reserve will be defined as a 30 m wide corridor around the centre line of the road. Any deviations to the route within the 30 m wide assessed corridor would not result in an Amendment to the EA (should it be granted). However, any amendments to the route that would result in encroachment outside of the corridor would require an amendment process.

7.	**Closure, way forward and final comments (presentation by LSvdW – see Appendix A)**
7.1	This pre-application meeting (22 April 2021) was held as per the outcome of pre-application meeting 1 (14 October 2020) where the Department required the peer review EAP to be present at the meeting in order for the meeting to be valid.
7.1.1	Outcome: The Department acknowledges that Ed Perry (SLR Consulting SA) acting as peer review EAP on the proposed SKA fibre optic project is present, and that the pre-application meeting may be deemed official and valid (ME).
7.2	Final word of thanks from LSvdW and HA.
7.3	Closure by HA.

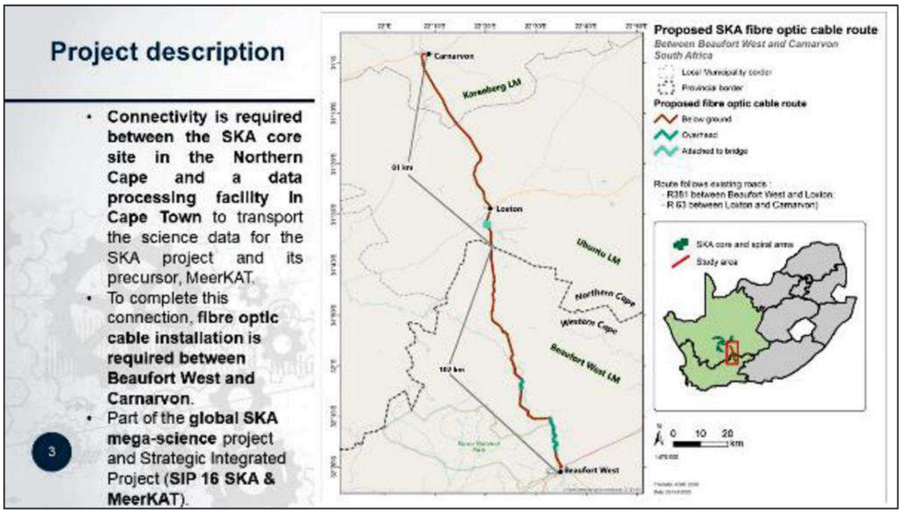
Meeting ends.

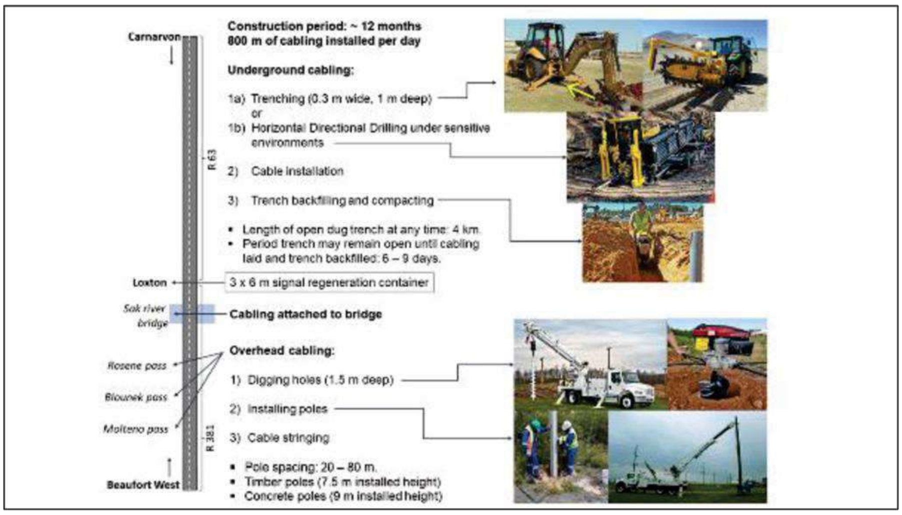
Appendix A: Pre-application meeting 2 PowerPoint presentation



Agenda

Item	Description	Time	Presenter
1	Welcome, Apologies, Introductions and Outline of Meeting Proceedings. Housekeeping for the MS Teams call.	10H00 – 10H05	CSIR EMS
2	PROJECT DESCRIPTION Description of the proposed SKA fibre optic cable between Beaufort West and Carnarvon.	10H05 – 10H15	CSIR EMS
3	LISTED ACTIVITIES & OTHER APPROVALS / PERMITS Discussion on the applicable listed activities identified, and other permits / approvals required	10H15 – 10H45	CSIR EMS (discussion all)
4	SPECIALIST ASSESSMENTS Discussion on the specialist studies identified and taken forward in the BA process.	10H45 – 11H00	CSIR EMS (discussion all)
5	PUBLIC PARTICIPATION PROCESS Discussion on the approach to the PPP (i.e. PPP plan)	11H00 – 11H15	CSIR EMS (discussion all)
6	QUERY: MICRO-SITING DURING CONSTRUCTION Discussion on micro-siting during construction within the conditions of an EA	11H15 – 11H45	CSIR EMS (discussion all)
7	Way Forward and Closure	11H45– 12H00	CSIR EMS & DFFE


Project description
Connectivity is required between the SKA core site in the Northern Cape and a data processing facility in Cape Town to transport the science data for the SKA project and its precursor, MeerKAT.
To complete this connection, fibre optic cable installation is required between Beaufort West and Carnarvon.
Part of the global SKA mega-science project and Strategic Integrated Project (SIP 16 SKA & MeerKAT).
3
Proposed SKA fibre optic cable route
Between Beaufort West and Carnarvon South Africa
Proposed fibre optic cable route
Carnarvon
Kareeberg LM
Loxton
Ubuntu LM
Northern Cape
Western Cape
Beaufort West LM
Beaufort West
0 10 20 km


Construction period: ~ 12 months
800 m of cabling installed per day
Underground cabling:
1a) Trenching (0.3 m wide, 1 m deep)
or
1b) Horizontal Directional Drilling under sensitive environments
2) Cable installation
3) Trench backfilling and compacting
Length of open dug trench at any time: 4 km.
Period trench may remain open until cabling laid and trench backfilled: 6 – 9 days.
3 x 6 m signal regeneration container
Cabling attached to bridge
Overhead cabling:
1) Digging holes (1.5 m deep)
2) Installing poles
3) Cable stringing
Pole spacing: 20 – 80 m.
Timber poles (7.5 m installed height)
Concrete poles (9 m installed height)
Carnarvon
Loxton
Sak river bridge
Rosene pass
Blouvek pass
Molteno pass
Beaufort West
R 63
R 381

Listed Activities
Listing Notice 1, Activity 19

The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse.

The proposed approach to avoid sensitive areas, particularly watercourses, are via Horizontal Directional Drilling 2 m below the riverbed starting 32 m from river banks. In some areas, dry watercourses may be trenched and backfilled, in accordance with measures identified and included in the Environmental Management Programme (EMPr).

5

Listed Activities
Listing Notice 3, Activity 12

The clearance of an area of 300 square metres or more of indigenous vegetation:

*(a) Northern Cape (ii) within critical biodiversity areas identified in bioregional plans; and [[**(iv) On land, where, at the time of the coming into effect of this Notice or thereafter such land was zoned open space, conservation or had an equivalent zoning**]].*

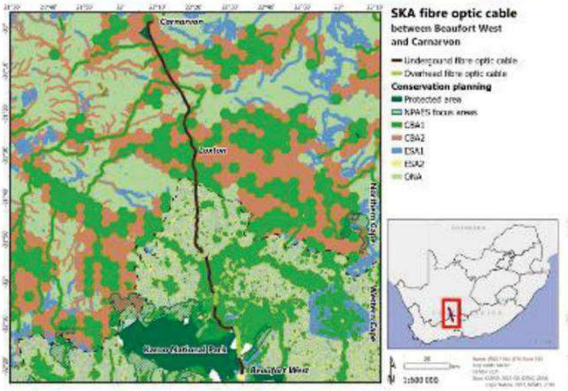
*(i) Western Cape (ii) within critical biodiversity areas identified in bioregional plans; and **(v) On land designated for protection or conservation purposes in an Environmental Management Framework adopted in the prescribed manner, or a Spatial Development Framework adopted by the MEC or Minister**; and [[**Iv. On land, where, at the time of the coming into effect of this Notice or thereafter such land was zoned open space, conservation or had an equivalent zoning**]].*

Although the development is predominantly proposed within the road reserves of the R381 and R63, Listing Notice 3 Activity 12 applies since the total cumulative approximate construction footprint of the proposed fibre optic cable, within Critical Biodiversity Areas (CBAs) in the Northern Cape (37 803 m^2) and Western Cape (19 814 m^2) Provinces, exceeds the 300 m^2 clearance threshold.

6

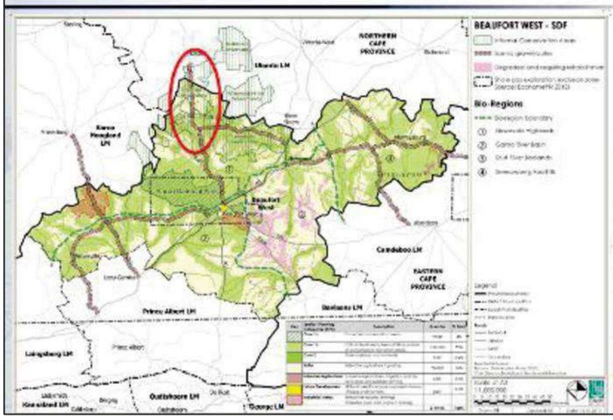
Additionally, the Beaufort West SDF (2013, adopted 2017 for 2017-22) recognises the Sakrivier and Kromrivier Conservancies between Beaufort West and Loxton (in the Northern Cape and Western Cape provinces), in addition to the Karoo National Park.

Listed Activities
Listing Notice 3, Activity 12



Critical Biodiversity Areas, Protected Areas, Expansion Strategy Areas.

Listed Activities
Listing Notice 3, Activity 12



Conservancies recognised in the Beaufort West Spatial Development Framework (2013, adopted 2017 for 2017-22)

Listed Activities
Considered but found to not apply

Description	Time
LN 1 Activity 12 ***The development of—*** ... ***(ii) infrastructure or structures with a physical footprint of 100 square metres or more;*** ***where such development occurs—*** ***(a) within a watercourse;*** *(b) in front of a development setback; or* ***(c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse*** ***Excluding –*** ***…(ee) where such development occurs within existing roads, or road reserves or railway line reserves; …***	LN 1 (12) <u>does not apply</u> since the fibre route will predominantly be installed within road reserves and 1 m from the fence of the private land. Where outside of the road reserve (e.g. overhead sections) the holes dug for poles will not result in clearance exceeding 100 m^2.
LN 1 Activity 27 ***The clearance of an area of 1 hectares or more, but less than 20 hectares of indigenous vegetation, except where such clearance of indigenous vegetation is required for—*** ***(i) the undertaking of a linear activity;…***	LN 1 (27) <u>does not apply</u> since the fibre optic cable is a linear activity.
LN 1 Activity 34 ***The expansion or changes to of existing facilities or infrastructure for any process or activity where such expansion [or changes] will result in the need for a permit or license or an amended permit or license in terms of national or provincial legislation governing the release of emissions, effluent or pollution…***	LN 1 (34) <u>does not apply</u> since the proposed fibre optic cable is a new development (unless considered as part of the larger SKA?). However, permits for emissions, effluent or pollution are not required (Protected flora permit + SANParks approval).
LN 3 Activity 3 ***The development of masts or towers of any material or type used for telecommunication broadcasting or radio transmission purposes where the mast or tower—*** *(a) is to be placed on a site not previously used for this purpose; and* ***(b) will exceed 15 metres in height—…***	LN 3 (3) does not apply since the total pole height for overhead cable installation is 9 m, buried 1.5 m deep, with a resultant above-ground height of 7.5 m. Furthermore, the poles on which the cable is mounted does not qualify as a mast or tower that sends / receives telecommunication signals.

Other approvals and permits
SANParks

Part of the fibre optic cabling is proposed within the **eastern section of the Karoo National Park next to the R381** road so as to traverse the **difficult terrain associated with the Molteno Pass**. Before any development, construction or farming may be permitted in a national park, nature reserve or world heritage site, prior written approval of the Park management authority is required in order to go ahead (**NEM:PAA S 50(5)**). This approval is thus required and is being sought for the proposed Fibre Optic Project, separate to the BA Process.

<u>Recommendation in BA and EMPr:</u>
*NEM:PAA Section 50(5) approval from SANParks (Karoo National Park) must be obtained (**this may be obtained in parallel / after EA, but must be in place prior to construction**).*

10

Other approvals and permits
Protected flora removal permits

75 YEAR ANNIVERSARY

Western Cape Nature and Environmental Conservation Ordinance:
Section 63 the WCNECO no person may pick endangered or protected plants (listed in Schedules 3 and 4) without a permit.
95 relevant plant species recorded during field survey.
Northern Cape Nature Conservation Act:
Sections 49 to 51 of the NCNCA stipulates that no person may pick specially protected or protected plants (listed in Schedules 1 and 2) without a permit.
58 relevant plant species recorded during field survey.

Recommendation in BA and EMPr:
*Permits for the removal of protected flora in terms of Sections 49 to 51 of the NCNCA (Northern Cape) and Section 63 of the WCNECO (Western Cape) must be obtained **(this may be obtained in parallel / after EA, but must be in place prior to construction)**.*

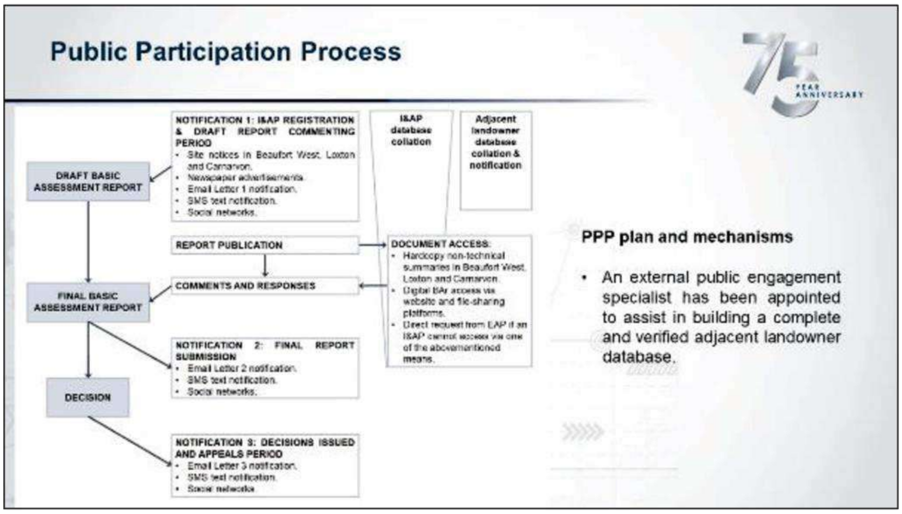
11

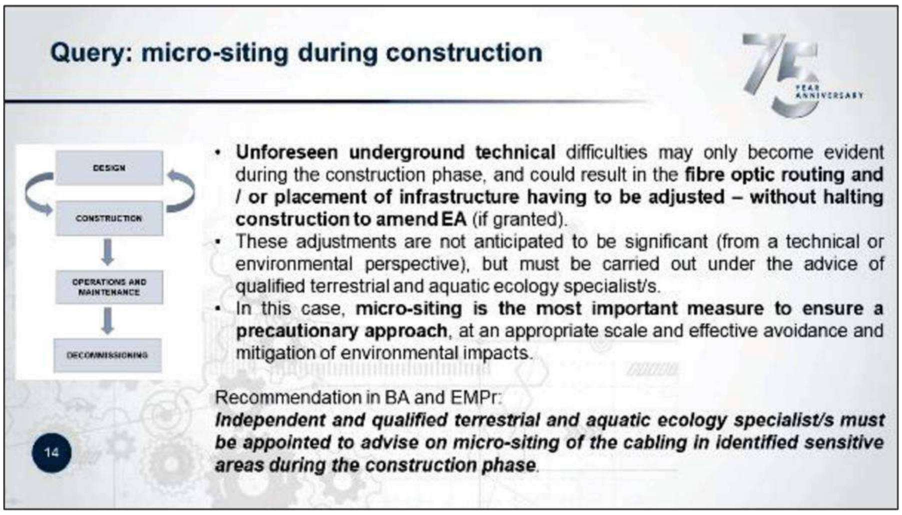
Specialist assessments
(complete)

75 YEAR ANNIVERSARY

Screening tool classification: *Any activities within or close to a watercourse*

Specialist Assessment	DEA Screening Tool?	Taken forward in BA?	Rationale
Archaeological and Cultural Heritage	Yes	**Yes**	• HIA required - S38(1)(a) NHRA (linear development > 300 m).
Palaeontology	Yes	**Yes**	• Field assessment and protocols for finds required – Very High SAHRIS 'Palaeosensitivity'.
Terrestrial Biodiversity + Animal Species + Plant Species	Yes	**Yes**	• Sensitive fauna and flora present, notably Riverine rabbit. • Sensitive areas (incl. Riverine rabbit habitat) have been highlighted based on specialist field assessment.
Aquatic Biodiversity + Hydrology	Yes	**Yes**	• Multiple river / watercourse / wetland crossings. • Watercourse / wetland delineation has been done.
Landscape/Visual	Yes	**Yes**	• Undertaken for overhead sections, as per DFFE recommendation during pre-app meeting #1.
Socio-economic	Yes	**No**	• Exclusion motivated for in BA report. • Direct socio-economic opportunities will be short-term and limited • Negative socio-economic impacts not expected / negligible. • Generic management actions will be included in the EMPr.


Public Participation Process
NOTIFICATION 1: I&AP REGISTRATION & DRAFT REPORT COMMENTING PERIOD
• Site notices in Beaufort West, Loxton and Carnarvon.
• Newspaper advertisements.
• Email Letter 1 notification.
• SMS text notification.
• Social networks.
I&AP database collation
Adjacent landowner database collation & notification
DRAFT BASIC ASSESSMENT REPORT
REPORT PUBLICATION
DOCUMENT ACCESS:
• Hardcopy non-technical summaries in Beaufort West, Loxton and Carnarvon.
• Digital BAr access via website and file-sharing platforms.
• Direct request from EAP if an I&AP cannot access via one of the abovementioned means.
COMMENTS AND RESPONSES
FINAL BASIC ASSESSMENT REPORT
NOTIFICATION 2: FINAL REPORT SUBMISSION
• Email Letter 2 notification.
• SMS text notification.
• Social networks.
DECISION
NOTIFICATION 3: DECISIONS ISSUED AND APPEALS PERIOD
• Email Letter 3 notification.
• SMS text notification.
• Social networks.
PPP plan and mechanisms
• An external public engagement specialist has been appointed to assist in building a complete and verified adjacent landowner database.


Query: micro-siting during construction
DESIGN
CONSTRUCTION
OPERATIONS AND MAINTENANCE
DECOMMISSIONING
• **Unforeseen underground technical** difficulties may only become evident during the construction phase, and could result in the **fibre optic routing and / or placement of infrastructure having to be adjusted – without halting construction to amend EA** (if granted).
• These adjustments are not anticipated to be significant (from a technical or environmental perspective), but must be carried out under the advice of qualified terrestrial and aquatic ecology specialist/s.
• In this case, **micro-siting is the most important measure to ensure a precautionary approach**, at an appropriate scale and effective avoidance and mitigation of environmental impacts.
Recommendation in BA and EMPr:
Independent and qualified terrestrial and aquatic ecology specialist/s must be appointed to advise on micro-siting of the cabling in identified sensitive areas during the construction phase.
14

Way forward and closure

Confirmation / agreement on:

- **Validity of the pre-application meeting** -- peer review EAP present.
- **Listed Activities:**
  - **LN1(19)** - infilling or depositing…dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock from a watercourse.
  - **LN3(12)** - clearance of an area of 300 m² or more of indigenous vegetation in CBAs and areas designated for protection / conservation in SDF (zoning to be confirmed).
- **Other approvals and permits:**
  - **NEM:PAA Section 50(5)** approval from SANParks (Karoo National Park) and Provincial **protected flora removal permits** – this may be obtained **in parallel / after EA**, **but must be in place prior to construction.**
- **Broad PPP plan and mechanisms.**
- **Micro-siting during construction** (without the need to amend EA).

Next steps:

- **Meeting minutes / notes to be prepared by CSIR and submitted to the Department for Approval.**
- **PPP plan to be submitted to the Department for Approval.**
- **EA application and BA report submission in May 2021.**

15

Thank you

EAP - CSIR EMS contact person:
Luanita Snyman-van der Walt
(Lvdwalt1@csir.co.za)

Applicant - CSIR SANReN contact person:
Mlungisi Majola
(Mlungisi@sanren.ac.za)

Peer review EAP – SLR Consulting SA contact person:
Edward Perry
(Eperry@slrconsulting.com)

CSIR
Touching lives through innovation

Pre-application meeting #2 notes and PP plan acceptance

Luanita Snyman-Van der Walt - RE: 2020-10-0001 PPP PLAN (email 2/2) - Re: Square Kilometre Array(SKA) fibre optic cable between Beaufort West and Carnarvon.

From:	Luanita Snyman-Van der Walt
To:	Halberts@environment.gov.za
Date:	12 May 2021 13:25
Subject:	RE: 2020-10-0001 PPP PLAN (email 2/2) - Re: Square Kilometre Array(SKA) fibre optic cable between Beaufort West and Carnarvon.
Cc:	Rohaida Abed; Mlungisi Majola; Paul Lochner; Coenrad Agenbach; Ephro...
Attachments:	SKAfibre_PPP plan_final_accepted_12May2021.pdf; 2020-10-0001_SKAfibre_BA_Pre-app meeting 2 notes_final_12May2021.pdf

Thank you, Herman.

For your records, kindly find attached the finalised versions of the pre-application meeting notes and PP plan. These will also be included in the EA application, as requested.

Kind regards
Luanita

>>> Herman Alberts <HAlberts@environment.gov.za> 12 May 2021 12:11 >>>
The minutes are also approved

Sent from my Galaxy

-------- Original message --------
From: Luanita Snyman-Van der Walt <LvdWalt1@csir.co.za>
Date: 12/05/2021 11:56 (GMT+02:00)
To: Herman Alberts <HAlberts@environment.gov.za>
Cc: Mlungisi Majola <MMajola1@csir.co.za>, Paul Lochner <PLochner@csir.co.za>, Rohaida Abed <RAbed@csir.co.za>, Coenrad Agenbach <Cagenbach@environment.gov.za>, Ephron Maradwa <EMaradwa@environment.gov.za>, Muhammad Essop <MEssop@environment.gov.za>, ajay@sanren.ac.za, Leon Staphorst <leon@sanren.ac.za>, zuki@sanren.ac.za, Tracy Cheetham <tcheetham@ska.ac.za>
Subject: RE: 2020-10-0001 PPP PLAN (email 2/2) - Re: Square Kilometre Array(SKA) fibre optic cable between Beaufort West and Carnarvon.

Dear Herman

Thank you for notifying us that the PP plan has been accepted by the Department. All requirements in this regard is noted.

We are also looking forward to any edits / comments on and the acceptance of the draft pre-application meeting notes.

Kind regards
Luanita

>>> Herman Alberts <HAlberts@environment.gov.za> 12 May 2021 11:39 >>>
Dear Luanita,

The PP Plan is hereby approved.

Please note that this approval do not negate your responsibility to ensure that the PP process for the abovementioned development meets the minimum requirements of the EIA Regulations. Also ensure that a copy of the PP plan, this approval and the minutes from the pre-application meetings are submitted as part of your application for Environmental Authorisation.

Regards

From: Luanita Snyman-Van der Walt <LvdWalt1@csir.co.za>
Sent: Wednesday, 05 May 2021 17:32
To: Coenrad Agenbach <Cagenbach@environment.gov.za>; Herman Alberts <HAlberts@environment.gov.za>; Muhammad Essop <MEssop@environment.gov.za>
Cc: Mlungisi Majola <MMajola1@csir.co.za>; Paul Lochner <PLochner@csir.co.za>; Rohaida Abed <RAbed@csir.co.za>; ajay@sanren.ac.za; Leon Staphorst <leon@sanren.ac.za>; zuki@sanren.ac.za; Tracy Cheetham <tcheetham@ska.ac.za>
Subject: 2020-10-0001 PPP PLAN (email 2/2) - Re: Square Kilometre Array(SKA) fibre optic cable between Beaufort West and Carnarvon.

(Email 2 of 2)

Dear Muhammad, Herman and Coenrad

Due to email size constraints, the draft Public Participation plan, as outlined during the pre-application meeting, is attached here for the Department's consideration and approval.

Thank you in advance, I look forward to your feedback.

Kind regards
Luanita

Touching lives through innovation

Luanita Snyman-van der Walt
| Pr Sci Nat | MSc Env Sci | PgD GISc |
| Environmental Management Services |
Scientist and Assessment Practitioner
Tel: +27 (0) 21 888 2490
Cell: +27 (0) 72 182 9718
Email: Lvdwalt1@csir.co.za
www.csir.co.za

Disclaimer
This message and any attachments transmitted with it are intended solely for the addressee(s) and may be legally privileged and/or confidential. If you have received this message in error please destroy it and notify the sender. Any unauthorized usage, disclosure, alteration or dissemination is prohibited. The Department of Environmental Affairs accepts no responsibility for any loss whether it be direct, indirect or consequential, arising from information made available and actions resulting there from. The views and opinions expressed in this e-mail message may not necessarily be those of Management..

DFFE pre-application meeting (14 October 2020)

Basic Assessment for the proposed Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon

PRE-APPLICATION MEETING NOTES
Final, 19 October 2020

DEFF meeting reference: 2020-10-0001

Date: 14 October 2020, 10:30-12:00

Participants

- Muhammad Essop (Department of Environment, Forestry and Fisheries (DEFF) - *ME*
- Coenrad Agenbach (DEFF) - *CA*
- Millicent Solomons (DEFF) - *MS*
- Herman Alberts (DEFF) - *HA*
- Luanita Snyman-van der Walt (Council for Scientific and Industrial Research (CSIR) Environmental Management Services (EMS) - *LSvdW*
- Zuki Makalima (CSIR South African National Research Network (SANReN)) - *ZM*
- Mlungisi Majola (CSIR SANReN) - *MM*
- Leon Staphorst (CSIR SANReN) - *LS*
- Tracy Cheetham (South African Radio Astronomy Observatory (SARAO) / Square Kilometre Array (SKA) - *TC*

Apologies:

- Paul Lochner (CSIR EMS)

1. Welcome, introductions and apologies

1.1 All participants introduce themselves.

1.2 MS: Confirmation that the [Strategic Infrastructure Projects (SIP) Directorate] team is comfortable to deal with the application and that it will go through this unit within DEFF (the Department).

2. Absence of external peer review EAP at pre-application meeting

2.1 ME: Seeing that the Environmental Assessment Practitioner (EAP) does not fully comply with Regulation 31(a) in terms of independence the pre-application meeting cannot technically be conducted as an 'official' pre-application meeting in the absence of an independent reviewer (peer review EAP), since the reviewer cannot confirm or deny the contents of the meeting notes are correct.

2.1.1 ME: If this meeting does continue, another meeting must be held with the reviewer present, otherwise the procedure will be considered flawed.

2.1.2 LSvdW: The independent reviewer will be in receipt of the meeting notes [these notes] as a record of the proceedings and discussions.

2.1.3 LSvdW: Pre-application meetings are not 'official' or mandatory processes, and there is no basis for setting the requirement that the peer review EAP must be present in the pre-application meeting.

2.1.4 LSvdW: The EAP was notified at 08:47 on 14 October 2020 via that the independent reviewer must attend the meeting (Appendix A). Given the short notice, is was not a reasonable request to have the independent reviewer present.

2.1.5 LS: Suggests that the meeting proceeds. When the peer review EAP is appointed, a follow-up meeting can be scheduled to address any specific issues.

2.2 ZM: How difficult would it be to set up a follow-up meeting with the Department and the peer reviewer?

2.2.1 ME: Once the CSIR has appoint a peer-review meeting, a short meeting can be held with to finalise any issues.

2.3 MS: Focus the advice that the Department is providing. The independence issue has been identified as a potential risk for the application, and comes from experience with other applications. The peer review EAP will review the complete EIA process and all documents, and it's reiterated as such that the peer review EAP needs to be part of the complete process.

Outcome: Due to the EAP not complying fully with Regulation 31(a) of the National Environmental Management Act (NEMA) Environmental Impact Assessment (EIA) Regulations, an external independent peer review EAP will be appointed. A second pre-application meeting must be convened, with the peer review EAP present.

3. Project description (presentation by LSvdW – see Appendix B)

3.1 ME: Is it known exactly which sections are overhead, underground and attached to a bridge?

3.1.1 LSvdW: Yes, the sections that are unfeasible to trench (e.g. Molteno Pass and a section after the Molteno Pass) will be installed overhead. Close to Loxton, there is a river with hard bedrock, here the cabling will be attached to the road bridge.

3.1.2 ZM: Detailed route design is available. A significant amount of work has already gone into the technical design of the route, from a telecommunications and technical perspective.

4. Listed Activities (presentation by LSvdW– see Appendix B)

4.1 No comments or questions raised.

5. Specialist assessments (presentation by LSvdW– see Appendix B)

5.1 CA: Agreed that large sections of the cable route is underground and not particularly a visual/landscape issue. However, for certain sections specialist input may have to be provided, specifically for the section next to the Karoo National Park. South African National Parks (SANParks) should be consulted in this regard or get a Visual Impact Assessment (VIA) specialist to look at that section in particular.

5.1.1 LSvdW: There will be engagement with SANParks and the manager of the Karoo National Park. The only reservation to proceed with a full VIA, is that the outcomes and recommendations from the assessment is unlikely to change the technical design of the route and overhead cable poles.

5.1.2 ZM: In the section where overhead cabling is proposed, there already exists many Eskom powerlines and Telkom routes for fibre optic. As such the overhead fibre optic installation will not be an entirely new types of infrastructure in those areas.

5.1.3 LSvdW: The existing Eskom powerlines and other linear overhead infrastructure existing in these sections will also be considered from a cumulative impact assessment perspective.

6. Public Participation Plan (Presentation by LSvdW– see Appendix B)

6.1 ME: The Regulations do not make provision for deviations. If an Applicant want to deviate or not comply with any of the regulations, an application for exemption in terms of the Exemption Regulations must be made. The 2010 EIA Regulations contained deviation requests, which were removed from the 2014 EIA Regulations and replaced this with separate Exemption Regulations.

6.1.1 LSvdW: Is an exemption application entirely separate from an Environmental Authorisation (EA) application, or can it be integrated? Who is the decision-maker?

6.1.2 ME: It is a completely separate application. An Applicant must apply for exception before being able to apply for EA. The Department, the same person who will make a decision on the application for EA will also make a decision on the application for Exemption.

6.1.3 ME: Exemption provisions follow a Basic Assessment (BA) process, which includes Public Participation Process (PPP). I.e. you need to undertake PPP to ask for exemption from undertaking certain aspects of PPP. An Applicant would lodge an application for Exemption, provide a motivation report and undertake PPP. If the Department decides favourably on the Application for Exemption, the Applicant can then apply for EA and follow the amended PPP that was approved.

6.1.4 ME: The Exemption Regulations refers back to Chapter 6 of the EIA Regulations in terms of PPP requirements.

6.1.5 MS: Going through an Exemption Application is not advisable.

6.1.6 LSvdW: Direct written notification of potentially more than 98 individuals who are adjacent landowners to a road reserve seems like an overly onerous and time-consuming process.

6.2 MS: There is no provision in the regulations, apart from the Exemption Regulations, to not fully comply with PPP requirements in the regulations.

6.2.1 ME: This is being flagged as a risk to the project. There has been experience with other applications where this [written adjacent land owner notification] was not done correctly, those projects where appealed by Interested and Affected Parties (I&AP), and the appeals were upheld.

6.2.2 ME: The placement of site notice boards within the town vs intervals along the route is not a deviation / exemption issue, it is a motivation of where site notices will be placed. This will be approved in the PPP plan if found acceptable.

6.3 CA: Notice boards may also be placed at farms stalls or smaller establishments along the proposed route.

6.4 CA: The PPP plan places significant emphasis on electronic media. It must be taken into account that not all people have access to cell phones or computers and data. It is recommended that hard copies be placed at accessible areas for I&APs to consider.

6.4.1 MM: Hard copies can also be placed where farmer's associations, for example, are meeting in person.

6.4.2 TC: SKA's experience is that there are currently face-to-face engagements with the unions currently.

Outcome: The draft PPP Plan will be updated and finalised in accordance with the Department's suggestions and resubmitted for consideration.

7. Strategic importance of the project

7.1 LSvdW: What is the potential for expedited decision-making on SIPs?

7.1.1 MS: The decision-making timeframe on the Final BA Report is 57 days instead of 107 days.

8. Closure, way forward and final comments

8.1 MS: It is important that the minimum regulatory requirements are complied with by all parties in the EIA process. The SIP Directorate has been alerted to the project from Presidential Infrastructure Coordinating Commission (PICC) office.

8.2 LSvdW: With regards to **EAP independence** and the absence of the independent peer review EAP, the outcome is that a follow-up pre-application meeting will be scheduled with the peer reviewer present to ensure the reviewer involvement from the pre-application phase through the entire project. All relevant documentation (*inter alia* the pre-application meeting presentation and notes) will be shared with the independent reviewer once appointed.

8.3 LSvdW: Is there broad agreement on the identified applicable **Listed Activities**?

8.3.1 ME: The Department is agreement with the two main Listed Activities identified. However, the EAP needs to verify and confirm that all potentially applicable activities have been considered and are applied for. Furthermore, additional Listed Activities may become apparent during the EIA process.

8.4 LSvdW: Heritage, Palaeontology, Aquatic ecology and Terrestrial ecology are the key **specialist assessments** that need to be taken forward in the BA process. It was discussed that a visual impact specialist may need to be included to specifically assessment the overhead Molteno Pass section next to the Karoo National Park.

8.4.1 LSvdW: What is the Department's perspective on potentially not including a full socio-economic impact assessment in the BA?

8.4.2 MS: This will depend on the motivation included in the draft BA report which supports whether a socio-economic assessment is necessary.

8.4.3 ME: The specialist assessments also need to comply with the Assessment Protocols. The first step of the assessment protocols stipulate verification of sensitivity which would further inform whether an assessment is required.

8.5 ME: Will it be possible in the report to **clearly distinguish between the underground, overhead and bridge sections**? Some conditions may be applicable to the overhead sections or underground sections.

8.5.1 LSvdW: Yes, this will be clearly indicated.

8.6 ME: Is the **road going through the Karoo National Park** technically inside or outside the Park?

8.6.1 LSvdW: According to the Karoo National Park Management Plan, the park is entirely to the west of the road and the road is not within the park itself.

8.6.2 ME: Confirmation and clarification is required from SANParks that the road and the proposed fibre optic cable is not within the Park boundary, else Section 50(5) approval in terms of the National Environmental Management Protected Areas Act (NEM:PAA) is required. This must clarified and / or approval obtained before lodging EA application.

8.7 ME: In the Northern Cape, if you clear vegetation in Critical Biodiversity Area (CBA1) area, **biodiversity offsets** are required.

8.7.1 LSvdW: This has been the experience with large-scale wind energy development. It will need to be clarified with Northern Cape Department of Nature Conservation (DENC) whether biodiversity offsets would be required for development in road reserves.

8.7.2 ME: The terrestrial ecology specialist should also be able to provide more guidance in this regards.

8.8 LSvdW: Regarding the **PPP**. The PPP plan will need to be updated, finalised and resubmitted based on the discussions emanating from the pre-application meeting. The issue around direct written notification of adjacent landowners will have to be investigated and planned well to ensure full compliance with the Regulations.

8.9 LSvdW: CSIR EMS to prepare **meeting notes** and submit to the Department for review and approval.

8.9.1 ME: The Department can provide input into the meeting notes and the turnaround time on meeting notes review and approval is typically 48 hours.

8.9.2 ME: The Department can't provide input to the PPP plan since there still needs to be a follow-up pre-application meeting with the appointed peer review EAP. The peer review EAP also need to veto the PPP plan before the Department can approve it.

8.10 CA: With regards to **adjacent land owner notification** - there is an opportunity use the farmer's association meetings to determine a register of adjacent land owners.

8.10.1 TC: When SKA engaged around the Central Karoo Astronomy Advantage Area (CKAAA) an I&AP register was developed for almost the entire Northern Cape. This can assist in identifying and obtaining details for adjacent land owners.

8.11 ME: For the follow-up pre-application meeting a new meeting request form does not have to be submitted to the Department. The meeting can be arranged directly via email.

Final word of thanks from LSvdW and CA.

Meeting ends ~11:45.

Appendix A: DEFF request that the external independent EAP be present at the pre-application meeting.

Page 1 of 3

Luanita Snyman-Van der Walt - RE: 2020-10-0001 PRE-APP MEETING FOR THE Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon.

From: Luanita Snyman-Van der Walt
To: Leon Staphorst; Mlungisi Majola; Coenrad Agenbach; Halberts@environme...
Date: 14 Oct 2020 08:49
Subject: RE: 2020-10-0001 PRE-APP MEETING FOR THE Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon.

Good morning Muhammad

The independent reviewer EAP has been identified and approached, but not yet formally appointed. It will not be possible to get them to join the meeting at such short notice.

Kind regards
Luanita

>>> Muhammad Essop <MEssop@environment.gov.za> 14 Oct 2020 08:47 >>>
Dear Luanita.

Please ensure that your peer review EAP is also part of the meeting.

Regards
Muhammad Essop
Sent from my Samsung Galaxy smartphone.

-------- Original message --------
From: Luanita Snyman-Van der Walt <LvdWalt1@csir.co.za>
Date: 2020/10/14 08:43 (GMT+02:00)
To: Leon Staphorst <LStaphorst@csir.co.za>, Mlungisi Majola <MMajola1@csir.co.za>, Coenrad Agenbach <Cagenbach@environment.gov.za>, Herman Alberts <HAlberts@environment.gov.za>, Muhammad Essop <MEssop@environment.gov.za>, ajay@sanren.ac.za, zuki@sanren.ac.za, Tracy Cheetham <tcheetham@ska.ac.za>
Subject: Re: 2020-10-0001 PRE-APP MEETING FOR THE Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon.

Good morning Colleagues

Herewith the final PowerPoint presentation for the SKA Fibre Optic Cable pre-application meeting today @ 10:30.

Looking forward to the discussions.

Kind regards
Luanita

>>> Luanita Snyman-Van der Walt 08 Oct 2020 16:59 >>>

file:///C:/Users/LVDWALT1/AppData/Local/Temp/XPgrpwise/5F86BB9DSTELLBOS... 15 Oct 2020

Dear Muhammad, Coenrad and Herman

Thank you very much for assigning us a meeting slot so soon. I have forwarded the appointment and link to the other attendees (also cc'd here).

You'll notice in the pre-application form we made a special request that Milicent Solomons, Director: SIPs, join since she has been close to the SKA project. I just want to confirm whether I should still approach her directly to join, or whether Coenrad has specifically been included as representative of the SIP Directorate?

I will also be sharing with you early next week draft presentation, PPP plan, Environmental Screening Study incl. Screening Tool Report, and Background Information Document for the project.

Looking forward to the engagement, and thank you in advance for your time.

Kind regards
Luanita

Luanita Snyman - van der Walt
| MSc Env Sci | PgD GISc |
Pr. Sci. Nat. Environmental Science

Senior Environmental Scientist and -Assessment Practitioner
CSIR, SMART Places, Environmental Management Services
Stellenbosch, South Africa

CSIR

Email: lvdwalt1@csir.co.za | Tel: +27 (0) 21 888 2490 | Cell: +27 (0) 72 182 9718 | Fax: +27 (0) 21 888 2473 | Web: https://www.csir.co.za/environmental-impact-assessment
Researchgate: https://www.researchgate.net/profile/Luanita_Snyman_Van_Der_Walt
LinkedIn: https://www.linkedin.com/in/luanita-snyman-van-der-walt-41800260/

>>> Muhammad Essop 08 Oct 2020 14:19 >>>
Dear Colleagues.

Please find pre-app meeting invitation.

Joining the meeting
When you are ready to join, just click on the link below and you will be able to join the meeting. If you lose connection, just re-enter the meeting by re-clicking on the link. When joining the meeting please mute your microphone and only unmute when you want to make an input. There is also a function to raise your hand. The Chair will be able to see that you want to make an input and will acknowledge you. In this way there will only be one speaker at a time, also please put off your video camera as this will slow down the session and use unnecessary data.

Join Microsoft Teams Meeting

Learn more about Teams | Meeting options

Join with a video conferencing device

94863853@t.plcm.vc VTC Conference ID: 1266771554

Alternate VTC dialing instructions

'Please consider the environment before you print this email'

'Please consider the environment before you print this email'
'Please consider the environment before you print this email'

Disclaimer
This message and any attachments transmitted with it are intended solely for the addressee(s) and may be legally
privileged and/or confidential. If you have received this message in error please destroy it and notify the sender. Any
unauthorized usage, disclosure, alteration or dissemination is prohibited. The Department of Environmental Affairs accepts
no responsibility for any loss whether it be direct, indirect or consequential, arising from information made available and
actions resulting there from. The views and opinions expressed in this e-mail message may not necessarily be those of
Management..

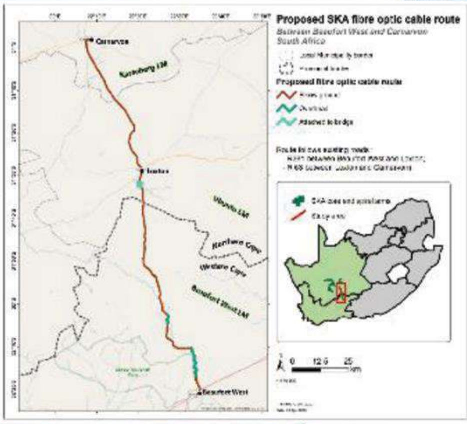
Appendix B: Pre-application meeting PowerPoint presentation

Agenda

Item	Description	Time	Presenter
1	Welcome, Apologies, Introductions and Outline of Meeting Proceedings. Housekeeping for the MS Teams call.	10H30 – 10H35	CSIR EMS
2	PROJECT DESCRIPTION Description of the proposed SKA fibre optic cable between Beaufort West and Carnarvon.	10H35 – 10H45	CSIR EMS
3	LISTED ACTIVITIES Discussion on the applicable listed activities identified	10H45 – 11H00	CSIR EMS (discussion all)
4	SPECIALIST ASSESSMENTS Discussion on the specialist studies identified and taken forward in the BA process.	11H00 – 11H25	CSIR EMS (discussion all)
5	PUBLIC PARTICIPATION PROCESS Discussion on the approach to the PPP (i.e. PPP plan), incl. request for deviation of direct notification of adjacent land owners (98 properties).	11H25– 11H40	CSIR EMS (discussion all)
6	STRATEGIC IMPORTANCE OF THE PROJECT Discussion on the importance of the project as a SIP and the criticality of concluding the assessment and Environmental Authorisation decision-making processes as effectively as possible.	11H40 – 11H50	SANReN, SKA / SARAO, CSIR EMS (discussion all)
7	Way Forward and Closure	11H50 – 12H00	DEFF

Project description

- **Connectivity is required between the SKA core site in the Northern Cape and a data processing facility in Cape Town** to transport the science data for the SKA project and its precursor, MeerKAT.
- To complete this connection, **fibre optic cable installation is required between Beaufort West and Carnarvon**.
- Part of the **global SKA mega-science** project and Strategic Integrated Project (**SIP 16 SKA & MeerKAT**).



3

Project description

- **The Applicant**
    - The **South African National Research Network (SANReN)** managed and implemented by the **Council for Scientific and Industrial Research (CSIR)**, has been appointed by the South African Radio Astronomy Observatory (SARAO) with installing the fibre optic cable.
- **The Environmental Assessment Practitioner (EAP)**
    - **CSIR Environmental Management Services (EMS).**
- **CSIR EMS is an independent EAP and has no vested interest** (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for the work performed.
- **However, as best practice, an independent reviewer will be appointed** to review the Basic Assessment Report as per **S13(2) of the NEMA EIA Regulations.**

4

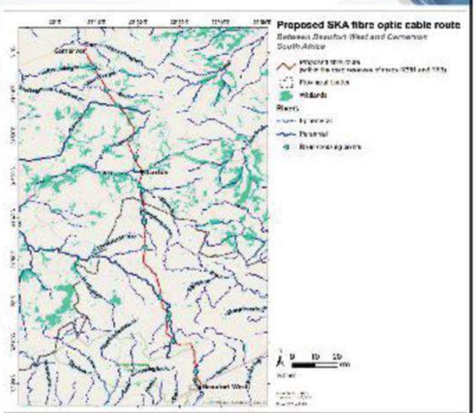
Project description

- **Beaufort West Transnet** building → **Loxton** where a 3 m x 6 m container for regeneration of signal will be established → existing **Carnarvon** SKA Point of Presence (PoP) site (total **185 km**).
- Full fibre route will be installed within the **road reserves of roads R381 and R63** (and other roads within the towns of Beaufort West, Loxton and Carnarvon), and at least **1 m from the fence of adjacent private land**.
- Fibre duct and cable will be laid in a **1 m deep and 300 mm wide trench** and be buried by backfilling and compacting the trench.
- Some sections (notably the Molteno pass) are **unfeasible to trench** – here cabling will be **installed overhead** (pole length = 9 m, buried 1.5 m deep, resultant aboveground height of 7.5 m)

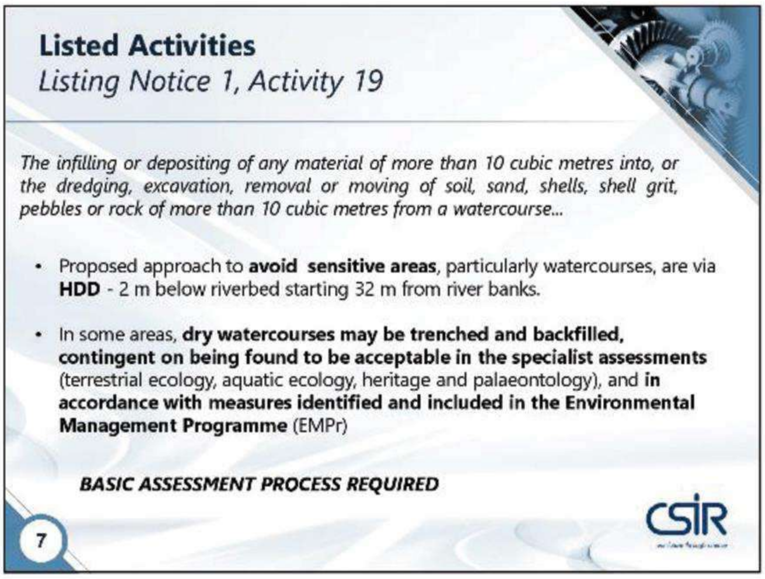
5

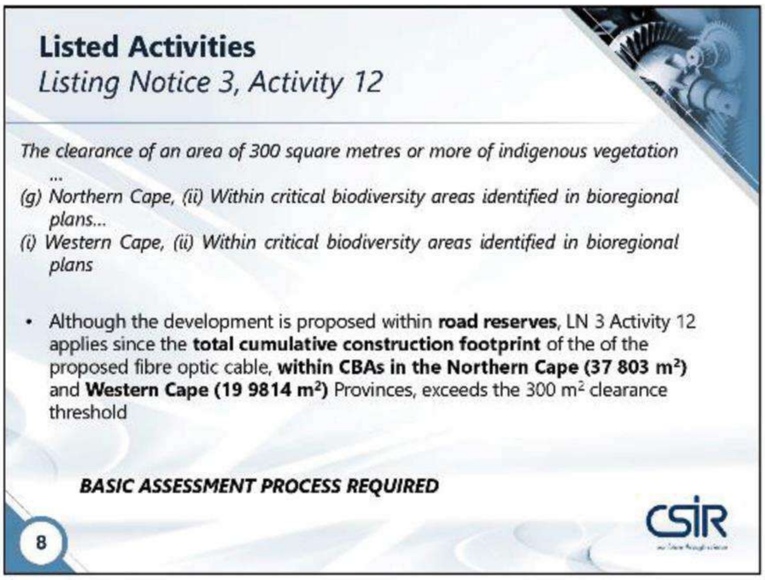
Project description

- **Stream / river and associated wetland crossings**. Rivers will be crossed using **horizontal directional drilling (HDD), 2 m below riverbed, and starting 32 m away from river banks**.
    - Application for a **Section 21 (c) and (i) Water Use License** (National Water Act)
- There is one river with **solid bedrock** where HDD is not feasible - **attach to the existing road bridge**.

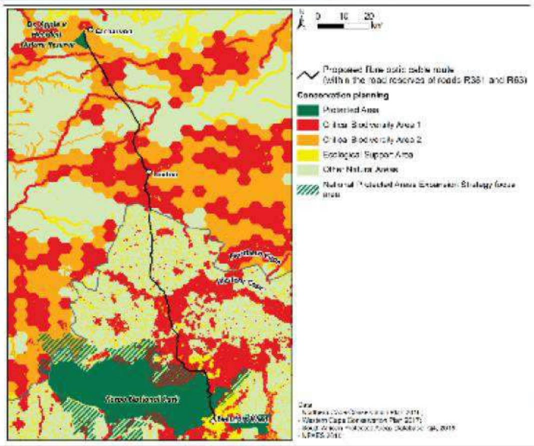


6


Listed Activities
Listing Notice 1, Activity 19
The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse...
• Proposed approach to avoid sensitive areas, particularly watercourses, are via HDD - 2 m below riverbed starting 32 m from river banks.
• In some areas, dry watercourses may be trenched and backfilled, contingent on being found to be acceptable in the specialist assessments (terrestrial ecology, aquatic ecology, heritage and palaeontology), and in accordance with measures identified and included in the Environmental Management Programme (EMPr)
BASIC ASSESSMENT PROCESS REQUIRED
7
CSIR


Listed Activities
Listing Notice 3, Activity 12
The clearance of an area of 300 square metres or more of indigenous vegetation ...
(g) Northern Cape, (ii) Within critical biodiversity areas identified in bioregional plans...
(i) Western Cape, (ii) Within critical biodiversity areas identified in bioregional plans
• Although the development is proposed within road reserves, LN 3 Activity 12 applies since the total cumulative construction footprint of the of the proposed fibre optic cable, within CBAs in the Northern Cape (37 803 m²) and Western Cape (19 9814 m²) Provinces, exceeds the 300 m² clearance threshold
BASIC ASSESSMENT PROCESS REQUIRED
8
CSIR

Listed Activities
Listing Notice 3, Activity 12



9

CSIR

Listed Activities
Considered but found to not apply

Description	Time
LN 1 Activity 12 ***The development of—*** ... ***(ii) infrastructure or structures with a physical footprint of 100 square metres or more; where such development occurs—*** ***(a) within a watercourse;*** *(b) in front of a development setback; or* ***(c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse*** ***Excluding –*** ***...(ee) where such development occurs within existing roads, or road reserves or railway line reserves; ...***	LN 1 (12) <u>does not apply</u> since the full fibre route will be installed within road reserves and 1 m from the fence of the private land.
LN 1 Activity 27 ***The clearance of an area of 1 hectares or more, but less than 20 hectares of indigenous vegetation, except where such clearance of indigenous vegetation is required for—*** ***(i) the undertaking of a linear activity;...***	LN 1 (27) <u>does not apply</u> since the fibre optic cable is a linear activity.
LN 3 Activity 3 ***The development of masts or towers of any material or type used for telecommunication broadcasting or radio transmission purposes where the mast or tower—*** *(a) is to be placed on a site not previously used for this purpose; and* ***(b) will exceed 15 metres in height—...***	LN 3 (3) <u>does not apply</u> since the total pole height for overhead cable installation is 9 m, buried 1.5 m deep, with a resultant above-ground height of 7.5 m. Furthermore, the poles on which the cable is mounted does not qualify as a mast or tower that sends / receives telecommunication signals.

Specialist assessments

Screening tool classification: *Any activities within or close to a watercourse*

Specialist Assessment	DEA Screening Tool?	Taken forward in BA?	Rationale
Archaeological and Cultural Heritage	Yes	**Yes**	• HIA required - S38(1)(a) NHRA (linear development > 300 m).
Palaeontology	Yes	**Yes**	• Field assessment and protocols for finds required – Very High SAHRIS 'Palaeosensitivity'.
Terrestrial Biodiversity + Animal Species + Plant Species	Yes	**Yes**	• Sensitive fauna and flora present, notably Riverine rabbit
Aquatic Biodiversity + Hydrology	Yes	**Yes**	• Multiple river / watercourse / wetland crossings
Socio-economic	Yes	**No**	• Direct socio-economic opportunities will be short-term and limited • Negative socio-economic impacts not expected / negligible.
Landscape/Visual	Yes	**No**	• Trenches – temporary visual impact along roads. • Overhead cabling section - sensitive visual receptors limited drivers on Molteno pass. • Nature of the overhead sections are not outrageous - resemble telephone poles. • Confirmed by Visual Specialist, included as I&AP for Level 1 Comment.

Public Participation Process

- Public Participation Plan has been developed (submitted together with Pre-application meeting request).
- Integrated PPP for the BA, WUL and HIA aspects,
- Mechanisms to achieve the purpose of PPP:
  - Email notifications;
  - SMS text notifications;
  - Information sharing via broader social networks;
  - Newspaper advertisements;
  - Site notices; and
  - Digital document access.

CSIR

12

Public Participation Process

- **Deviation requests:**
  - Regulation 41 (2) (a) (i) [placement of site notice boards]:
    - It is proposed that site **notice boards be concentrated along the roads within the towns of Beaufort West, Loxton and Carnarvon,** instead of placement in intervals along the 185 km road reserve corridor in which the fibre optic cable is proposed.
  - Regulation 41 (2) (b) (ii) [written notification to adjacent land owners]:
    - Request that the requirement for **direct notification of adjacent land owners be stayed** as the number of adjacent land owners / occupiers will potentially exceed **ninety-eight (98) individuals** - judging from the number of land portions traversed by the road reserves in which the fibre optic cable is proposed.
    - **Site notice boards, newspaper advertisements** (one local and one national), as well as broader outreach via farmer's associations and ward councillors / municipal managers to their constituents (**social networks**), will be sufficient to reasonably notify potential land owners adjacent to the 185 km road reserve corridor.

13

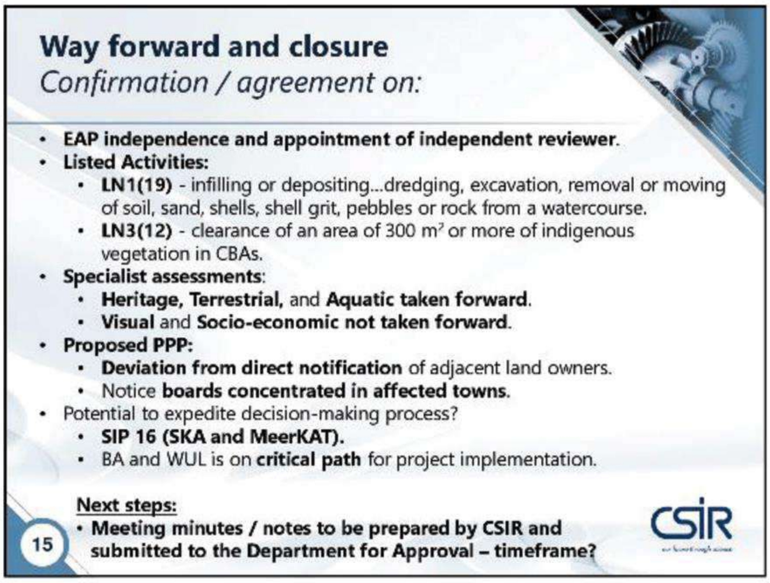
CSIR

Strategic Importance of the Project

- *"South Africa's ratification of the Convention confirms South Africa's strong commitment to the global SKA partnership. We are determined to ensure the success of what will be the first ever large global research infrastructure hosted in Africa"*
  - Dr Blade Nzimande, South Africa's Minister of Higher Education, Science and Innovation.
  June 2020 - https://www.skatelescope.org/news/south-africa-ratifies-ska-convention/
- Forms part of the **SKA and MeerKAT Strategic Infrastructure Project (SIP 16).**
- Environmental Authorisation is on a **critical path** for construction of the fibre optic cable.
- Potential to **expedite decision-making process**?
- Estimated submission of Final BA Report – early January 2021.

14

CSIR


Way forward and closure
Confirmation / agreement on:
• EAP independence and appointment of independent reviewer.
• Listed Activities:
• LN1(19) - infilling or depositing...dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock from a watercourse.
• LN3(12) - clearance of an area of 300 m² or more of indigenous vegetation in CBAs.
• Specialist assessments:
• Heritage, Terrestrial, and Aquatic taken forward.
• Visual and Socio-economic not taken forward.
• Proposed PPP:
• Deviation from direct notification of adjacent land owners.
• Notice boards concentrated in affected towns.
• Potential to expedite decision-making process?
• SIP 16 (SKA and MeerKAT).
• BA and WUL is on critical path for project implementation.
Next steps:
• Meeting minutes / notes to be prepared by CSIR and submitted to the Department for Approval – timeframe?
15
CSIR


Thank you
CSIR EMS contact person:
Luanita Snyman-van der Walt
(Lvdwalt1@csir.co.za)
CSIR SANReN contact person:
Mlungisi Majola
(Mlungisi@sanren.ac.za)
CSIR

Pre-application meeting #1 notes acceptance

Luanita Snyman-Van der Walt - RE: 2020-10-0001 PRE-APP MEETING NOTES - Re: Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon.

From:	Luanita Snyman-Van der Walt
To:	Coenrad Agenbach; Halberts@environment.gov.za; messop@environment.gov....
Date:	19 Oct 2020 15:03
Subject:	RE: 2020-10-0001 PRE-APP MEETING NOTES - Re: Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon.
Cc:	Leon Staphorst; Mlungisi Majola; ajay@sanren.ac.za; zuki@sanren.ac.za...
Attachments:	2020-10-0001_SKAfibre_BA_Pre-app meeting notes_final_19Oct2020.pdf

Dear Muhammad

Thanks you for picking up the typo. I have corrected it. Kindly find attached the final notes.

I will be in touch with regards to setting up a follow-up pre-application meeting once we have appointed the external reviewer and are ready to move forward.

Kind regards
Luanita

>>> Muhammad Essop <MEssop@environment.gov.za> 19 Oct 2020 13:56 >>>
Dear Luanita.

The minutes are fine with one correction as outlined in the attached document.

Regards

Muhammad Essop
Assistant Director – Priority Infrastructure Projects
Integrated Environmental Authorisations
Department of Environment, Forestry and Fisheries
Private Bag X447
Pretoria
0001
(012) 399 9406
MEssop@environment.gov.za

From: Luanita Snyman-Van der Walt <LvdWalt1@csir.co.za>
Sent: Monday, October 19, 2020 10:38
To: Coenrad Agenbach <Cagenbach@environment.gov.za>; Herman Alberts <HAlberts@environment.gov.za>; Muhammad Essop <MEssop@environment.gov.za>; Milicent Solomons <MSolomons@environment.gov.za>
Cc: Leon Staphorst <LStaphorst@csir.co.za>; Mlungisi Majola <MMajola1@csir.co.za>; ajay@sanren.ac.za; zuki@sanren.ac.za; Tracy Cheetham <tcheetham@ska.ac.za>
Subject: 2020-10-0001 PRE-APP MEETING NOTES - Re: Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon.

Dear Muhammad, Herman, Milicent and Coenrad

Thank you for the pre-application meeting discussion on the proposed SKA fibre optic cable between Beaufort West and Carnarvon last week 14 Oct. The Department's advice and input on this project is greatly appreciated.

Kindly find attached hereto, for your consideration, review and input, draft notes capturing the discussion and key outcomes.

Thank you in advance, I look forward to the Department's feedback.

Kind regards
Luanita

Luanita Snyman - van der Walt

| MSc Env Sci | PgD GISc |

Pr. Sci. Nat. Environmental Science

Senior Environmental Scientist and -Assessment Practitioner

CSIR, SMART Places, Environmental Management Services

Stellenbosch, South Africa

CSIR

Email: lvdwalt1@csir.co.za | Tel: +27 (0) 21 888 2490 | Cell: +27 (0) 72 182 9718 | Skype: Luts.vd.w | Fax: +27 (0) 21 888 2473 | Web: https://www.csir.co.za/environmental-impact-assessment

Researchgate: https://www.researchgate.net/profile/Luanita_Snyman_Van_Der_Walt

Linkedin: https://www.linkedin.com/in/luanita-snyman-van-der-walt-41800260/

'Please consider the environment before you print this email'
'Please consider the environment before you print this email'

eWULAAS General Authorisation approach confirmation

water & sanitation
Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

Private Bag X5912, UPINGTON, 8800, Street Addres Louisvale Rd, UPINGTON, 8801, www.dwa.gov.za

Enquiries: Ms AK Mthintelwa
Email: MthintelwaA@dws.gov.za

Tel: 0543385854
Fax: AssessorFax
Ref. No: WU18079

ACKNOWLEDGEMENT RECEIPT

APPLICATION FOR REGISTRATION OF WATER USE(S) WITHIN THE AMBIT OF A GENERAL AUTHORISATION IN TERMS OF SECTION 40 OF THE NATIONAL WATER ACT, 1998 (ACT 36 OF 1998), Orange - Upington

The Department of Water and Sanitation hereby acknowledges receipt of your application for registration of water uses(s) authorized in terms of General Authorization.

The Department will process your request and reverts back to you with response within 30 days of receipt of this letter.

Contact the author hereto should you require any information regarding your application.

Yours faithfully,

Recommend
Comments:

I, Mr Khutjo Kwena Sekwaila (WUL Manager) herewith electronically sign this document.
Electronic Signature Key : 4904566078680642545
WULA Manager
Date: Jul 21 2021 8:50AM

Letter 1: Acknowledgement of Receipt

Luanita Snyman-Van der Walt - Application have been returned to you (WU18079)

From: <Ewulaas_Do_Not_Reply@dws.gov.za>
To: <lvdwalt1@csir.co.za>
Date: 19 Nov 2020 10:33
Subject: Application have been returned to you (WU18079)

Dear Ms Luanita Snyman-van der Walt

The following application have been returned to you:

Council for Scientific and Industrial Research (CSIR) - South African National Research Network (SANReN) SKA fibre optic cable between Beaufort West and Carnarvon - watercourse crossings (WU18079)

The reason for the return is as follows :

APPLICATION FOR REGISTRATION OF WATER USE(S) WITHIN THE AMBIT OF A GENERAL AUTHORISATION IN TERMS OF SECTION 40 OF THE NATIONAL WATER ACT, 1998 (ACT 36 OF 1998)

The Department of Water and Sanitation has assessed your Pre Water Use Licence application enquiry. Please continue to apply for registration of water uses(s) authorized in terms of General Authorization.

You received this email from :

Name : Mr Khutjo Kwena Sekwaila (WUL Manager)
e-Mail : sekwailak@dws.gov.za
Tel : 0538367609

Thank you,
The e-WULAAS Team

e-WULAAS

Heritage Western Cape acknowledgement of Notice of Intent to Develop

ILifa leMveli leNtshona Koloni
Erfenis Wes-Kaap
Heritage Western Cape

Our Ref: HM/CENTRAL KAROO/BEAUFORT WEST/ SKA PROJECT
Case No.: 20200206SB1006E
Enquiries: Stephanie-Anne Barnardt
E-mail: stephanie.barnardt@westerncape.gov.za
Tel: 021 483 5959
Date: 27 October 2020

Jenna Lavin
34 Harries Street, Plumstead
jenna.lavin@ctsheritage.com, Evan.Burger@westerncape.gov.za

RESPONSE TO NOTIFICATION OF INTENT TO DEVELOP: HIA REQUIRED
In terms of Section 38(8) of the National Heritage Resources Act (Act 25 of 1999) and the Western Cape Provincial Gazette 6061, Notice 298 of 2003

NOTIFICATION OF INTENT TO DEVELOP: PROPOSED SQUARE KILOMETER ARRAY (SKA) FIBER OPTIC CABLE, BEAUFORT WEST, SUBMITTED IN TERMS OF SECTION 38(1) OF THE NATIONAL HERITAGE RESOURCES ACT (ACT 25 OF 1999)

CASE NUMBER: 20200206SB1006E

The matter above has reference.

Heritage Western Cape is in receipt of your application for the above matter received on 7 October 2020. This matter was discussed at the Heritage Officers meeting held on 19 October 2020.

You are hereby notified that, since there is reason to believe that the proposed Square Kilometer Array (SKA) fiber optic cable, Beaufort West will impact on heritage resources, HWC requires that a Heritage Impact Assessment (HIA) that satisfies the provisions of section 38(3) of the NHRA be submitted. This HIA must have specific reference to the following:

- Impacts to palaeontological heritage resources
- Impacts to archaeological heritage resources

The required HIA must have an integrated set of recommendations.
Please note, should you require the HIA to be submitted as a Phased HIA, a written request must be submitted to HWC prior to submission. HWC reserves the right to determine whether a phased HIA is acceptable on a case by case Basis.

The comments of relevant registered conservation bodies; all Interested and Affected parties; and the relevant Municipality must be requested and included in the HIA where provided. Proof of these requests must be supplied.

HWC reserves the right to request additional information as required.

Applicants are strongly advised to review and adhere to the time limits contained the Standard Operational Procedure (SOP) between DEADP and HWC. The SOP can be found using the following link http://www.hwc.org.za/node/293

Should you have any further queries, please contact the official above and quote the case number.

Yours faithfully

pp.
....
Dr. Mxolisi Dlamuka
Chief Executive Officer, Heritage Western Cape

www.westerncape.gov.za/cas

Street Address: Protea Assurance Building, Green Market Square, Cape Town, 8000 • **Postal Address:** P.O. Box 1665, Cape Town, 8000 • **Tel:** +27 (0)21 483 5959 • **E-mail:** ceoheritage@westerncape.gov.za

Straatadres: Protea Assuransie-gebou, Groentemarkplein, Kaapstad, 8000 • **Posadres:** Posbus 1665, Kaapstad, 8000 • **Tel:** +27 (0)21 483 5959 • **E-pos:** ceoheritage@westerncape.gov.za

Idilesi yendawo: kumgangatho 3, kwisakhiwo iprotea Assurance, Greenmarket Square, ekapa, 8000 • **Idilesi yeposi:** Inombolo yebhokisi yeposi 1665, eKapa, 8000 • **Iinombolo zomnxeba:** +27 (0)21 483 5959 • **Idilesi ye-imeyile:** ceoheritage@westerncape.gov.za

Email to Beaufort West Municipality, inviting comments on the draft Heritage Impact Assessment

Luanita Snyman-Van der Walt - Heritage Impact Assessment: Proposed development of the SKA Fibre Optic Line between Beaufort West and Carnarvon

From:	Jenna Lavin <jenna.lavin@ctsheritage.com>
To:	<buildingcontrol@beaufortwestmun.co.za>
Date:	26 Jan 2021 15:17
Subject:	Heritage Impact Assessment: Proposed development of the SKA Fibre Optic Line between Beaufort West and Carnarvon
Cc:	Luanita Snyman-Van der Walt <LvdWalt1@csir.co.za>
Attachments:	SKAfibre_Construction method statement_12Nov2020.pdf; SKAfibre_BID_summary_draft_Jan2021.pdf; CTS20_098_CSIR_SKA Fibre_HIA_PPP-compressed.pdf

To whom it may concern;

CTS Heritage has been requested to assist with undertaking the heritage compliance process in terms of section 38(8) of the NHRA for the proposed development of a Fibre Optic Line between Beaufort West and Carnarvon for the SKA. Please find attached the Heritage Impact Assessment completed for this proposed development as well as additional supporting documentation.

As part of this process, Heritage Western Cape requires that all registered Conservation Bodies and relevant Municipalities are provided with 30 days in which to comment on the Heritage Impact Assessment. According to the HWC website, there are no registered Conservation Bodies for the area proposed for development.

As the relevant official from the Beaufort West Municipality, you are hereby invited to comment on the attached Heritage Impact Assessment. Please send any questions or concerns that you may have regarding impacts to heritage resources resulting from the proposed development.

Please ensure that any comments are sent to me at the address above by no later than **Sunday, 28 February 2021.**

Please feel free to circulate the attached documentation to any persons that may be interested.

Many thanks and kind regards

Jenna

Jenna Lavin
Director
CTS Heritage
16 Edison Way, Century City

Message Id:	83374C1C.67C : 216 : 26236
Subject:	Heritage Impact Assessment: Proposed development of the SKA Fibre Optic Line between Beaufort West and Carnarvon
Created By:	**jenna.lavin@ctsheritage.com**
Scheduled Date:	
Creation Date:	26 Jan 2021 14:55
From:	Jenna Lavin <jenna.lavin@ctsheritage.com>

Recipients:

Recipient	Action	Date & Time	Comment
beaufortwestmun.co.za			
To: buildingcontrol@beaufortwestmun.co.za(buildingcontrol@beaufortwestmun.co.za)			
POBOX1.STELLBOS			
CC: Luanita Snyman-Van der Walt(LvdWalt1@csir.co.za)			

Post Offices

Post Office	Delivered	Route
beaufortwestmun.co.za		beaufortwestmun.co.za
POBOX1.STELLBOS		csir.co.za

Files

File	Size	Date & Time
CTS20_098_CSIR_SKA Fibre_HIA_PPP-compressed.pdf	12.6 MB (13191633 Bytes)	
MESSAGE	1 KB (1485 Bytes)	26 Jan 2021 14:55
Mime.822	20.5 MB (21475237 Bytes)	
SKAfibre_BID_summary_draft_Jan2021.pdf	1.07 MB (1121067 Bytes)	
SKAfibre_Construction method statement_12Nov2020.pdf	1.31 MB (1371226 Bytes)	
TEXT.htm	5 KB (5499 Bytes)	

Options

Concealed Subject:	No
Expiration Date:	None
Priority:	Standard
Reply Requested By:	None
Security:	Standard
To Be Delivered:	Immediate

Junk Mail Handling Evaluation Results

Message is eligible for Junk Mail handling
Sender e-mail address is in recipient's personal address book

Junk Mail settings when this message was delivered

Junk List is enabled
Junk Mail using personal address books is not enabled
Junk iCal Mail using personal address books is not enabled
Block List is enabled

Record Id

Record Id:	6010327D.STELLBOS.POBOX1.100.1703639.1.1E0A0.1
Common Record Id:	60101633.PTA-GWIA1.GWIA.200.20000D8.1.4106686.1

South African Heritage Resources Agency interim comment

Proposed Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon, Northern and Western Cape

Our Ref: 15577

an agency of the
Department of Arts and Culture

T: +27 21 462 4502 | F: +27 21 462 4509 | E: info@sahra.org.za
South African Heritage Resources Agency | 111 Harrington Street | Cape Town
P.O. Box 4637 | Cape Town | 8001
www.sahra.org.za

Enquiries: Natasha Higgitt
Tel: 021 462 4502
Email: nhiggitt@sahra.org.za
CaseID: 15577

Date: Friday October 23, 2020
Page No: 1

Interim Comment

In terms of Section 38(3), 38(8) of the National Heritage Resources Act (Act 25 of 1999)

Attention: CSIR

The South African Radio Astronomy Observatory (SARAO) spearheads South Africa's activities in the SKA Radio Telescope through engineering, science and construction. SARAO is a National Facility, managed by the National Research Foundation, which incorporates radio astronomy instruments and programmes such as the MeerKAT and KAT-7 telescopes in the Karoo, the Hartebeesthoek Radio Astronomy Observatory (HartRAO) in Gauteng, the African Very Long Baseline Interferometry (AVN) programme in nine African countries, as well as the associated human capital development and commercialisation endeavours. Connectivity is required between the SKA core site in the Northern Cape and a data processing facility in Cape Town to transport the science data for the SKA project and its precursor, MeerKAT. Access to dark fibre is required to transport this data due to the expected data throughputs for the SKA project. SARAO has built an overhead fibre route between Carnarvon and the SKA core site. Additionally, the South African National Research Network (SANReN) has procured access to fibre between Beaufort West area and Cape Town. A fibre optic cable connection must, therefore, be built between Carnarvon and Beaufort West. The details of the preferred and selected SKA fibre route (Route A) is as follows: The fibre route starts from Beaufort West Transnet building, to a 3 m x 6 m signal repeater station at Loxton, and then on to the Carnarvon SKA Point of Presence (PoP) site (location where networking equipment may be accessed). The fibre duct and cable will be laid in a 1 m deep and 300 mm wide trench and be buried by backfilling and compacting the trench. The full fibre route will be installed within the road reserves of roads R381 and R63, and 1 m from the fence of the private land. 155 km will be underground and 25 km will be overhead due to it not being technically or financially feasible to trench on the Molteno Pass section. The total pole length is 9 m, buried 1.5 m deep, with a resultant above-ground height of 7.5 m There are several streams / rivers and associated wetlands to cross. Rivers will be crossed using directional drilling 2 m below the riverbed starting 32 m away from river banks. There is only one river with solid bedrock (the Brak River near Loxton) where directional drilling is not technically or financially feasible. Here the fibre cable will be attached to the existing road bridge.

Thank you for notifying SAHRA of the Proposed Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon, Northern and Western Cape. It must be noted that SAHRA is only providing comments for the Northern Cape portion of the proposed development.

Proposed Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon, Northern and Western Cape

Our Ref: 15577

an agency of the
Department of Arts and Culture

T: +27 21 462 4502 | F: +27 21 462 4509 | E: info@sahra.org.za
South African Heritage Resources Agency | 111 Harrington Street | Cape Town
P.O. Box 4637 | Cape Town | 8001
www.sahra.org.za

Enquiries: Natasha Higgitt
Tel: 021 462 4502
Email: nhiggitt@sahra.org.za
CaseID: 15577

Date: Friday October 23, 2020
Page No: 2

If the proposed development is undergoing an Environmental Authorisation (EA) Application process in terms of the National Environmental Management Act, 107 of 1998 (NEMA), NEMA Environmental Impact Assessment (EIA) Regulations as amended, it is incumbent on the developer to ensure that a **Heritage Impact Assessment** (HIA) is done as per section 38(3) and 38(8) of the National Heritage Resources Act, Act 25 of 1999 (NHRA) as required by section 24(4)b(iii) of NEMA. This must include an archaeological component, palaeontological component and any other applicable heritage components. The HIA must be conducted **as part of the** EA Application in terms of NEMA and the NEMA EIA Regulations.

If the proposed development is not undergoing an EA application, section 38(1) of the NHRA will apply, and an assessment of heritage resources is required to be conducted as a stand-alone assessment.

The assessment must include an assessment of the impact to archaeological and palaeontological resources. The assessment of archaeological resources (inclusive of a field assessment) must be conducted by a qualified archaeologist and the report comply with the SAHRA 2007 Minimum Standards: Archaeological and Palaeontological Components of Impact Assessment Reports (see www.asapa.co.za or www.aphp.org.za for a list of qualified archaeologists).

The proposed development is located within an area of very high and moderate palaeontological sensitivity as per the SAHRIS PalaeoSensitivity map. As such, a field-based Palaeontological Impact Assessment (PIA) must be undertaken by a qualified palaeontologist. (See https://www.palaeosa.org/heritage-practitioners.html for a list of qualified palaeontologists). The report must comply with the 2012 Minimum Standards: Palaeontological Components of Heritage Impact Assessments.

Any other heritage resources as defined in section 3 of the NHRA that may be impacted, such as built structures over 60 years old, sites of cultural significance associated with oral histories, burial grounds and graves, graves of victims of conflict, and cultural landscapes or viewscapes must also be assessed.

Further comments will be issued upon receipt of the draft EIA documents inclusive of appendices.

Should you have any further queries, please contact the designated official using the case number quoted above in the case header.

Yours faithfully

Proposed Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon, Northern and Western Cape

Our Ref: 15577

an agency of the
Department of Arts and Culture

T: +27 21 462 4502 | F: +27 21 462 4509 | E: info@sahra.org.za
South African Heritage Resources Agency | 111 Harrington Street | Cape Town
P.O. Box 4637 | Cape Town | 8001
www.sahra.org.za

Enquiries: Natasha Higgitt
Tel: 021 462 4502
Email: nhiggitt@sahra.org.za
CaseID: 15577

Date: Friday October 23, 2020
Page No: 3

Natasha Higgitt
Heritage Officer
South African Heritage Resources Agency

Phillip Hine
Manager: Archaeology, Palaeontology and Meteorites Unit
South African Heritage Resources Agency

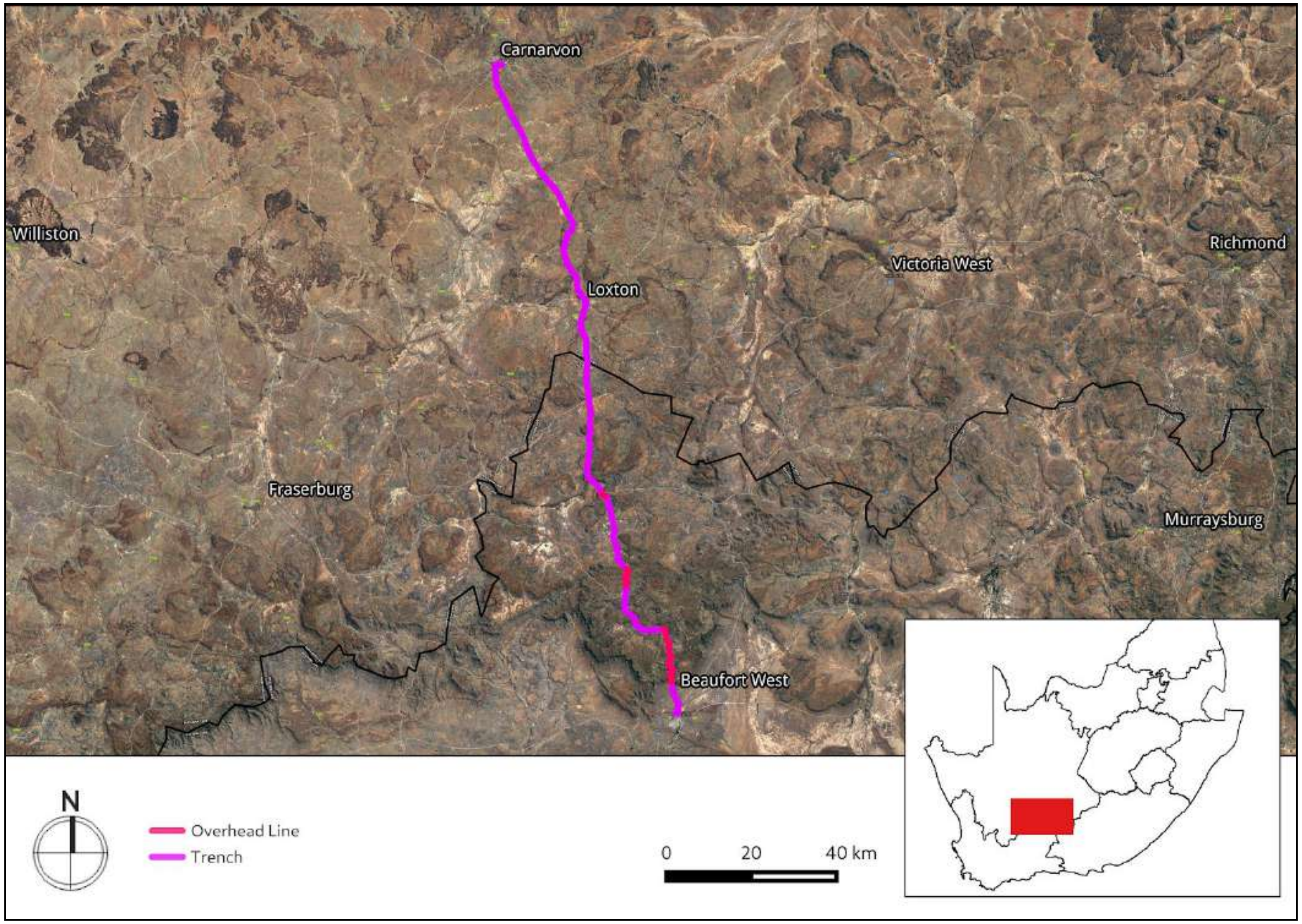
ADMIN:
Direct URL to case: http://www.sahra.org.za/node/541368

.

Appendix 18 Heritage Screener

CTS HERITAGE

HERITAGE SCREENER

CTS Reference Number:	**CTS20_098**	 **Figure 1a.** Satellite map indicating the location of the proposed development in the Western and Northern Cape Province
HWC Ref:	**20100206**	
SAHRIS Case No.	**15577**	
Client:	**CSIR**	
Date:	**September 2020**	
Title:	**Proposed Square Kilometre Array (SKA) fibre optic cable between Beaufort West and Carnarvon, Northern and Western Cape**	
Recommendation by CTS Heritage Specialists	**RECOMMENDATION:** **As the proposed development may negatively impact on significant archaeological and palaeontological heritage and as such, it is recommended that an HIA is required in order to assess the nature of these impacts and proposed methods for mitigating this impact.**	

CTS HERITAGE

1. Proposed Development Summary

The South African Radio Astronomy Observatory (SARAO) spearheads South Africa's activities in the SKA Radio Telescope through engineering, science and construction. SARAO is a National Facility, managed by the National Research Foundation, which incorporates radio astronomy instruments and programmes such as the MeerKAT and KAT-7 telescopes in the Karoo, the Hartebeesthoek Radio Astronomy Observatory (HartRAO) in Gauteng, the African Very Long Baseline Interferometry (AVN) programme in nine African countries, as well as the associated human capital development and commercialisation endeavours.

Connectivity is required between the SKA core site in the Northern Cape and a data processing facility in Cape Town to transport the science data for the SKA project and its precursor, MeerKAT. Access to dark fibre is required to transport this data due to the expected data throughputs for the SKA project. SARAO has built an overhead fibre route between Carnarvon and the SKA core site. Additionally, the South African National Research Network (SANReN) has procured access to fibre between Beaufort West area and Cape Town. A fibre optic cable connection must, therefore, be built between Carnarvon and Beaufort West.

The details of the preferred and selected SKA fibre route (Route A) is as follows:

1. The fibre route starts from Beaufort West Transnet building, to a 3 m x 6 m signal repeater station at Loxton, and then on to the Carnarvon SKA Point of Presence (PoP) site (location where networking equipment may be accessed).
2. The fibre duct and cable will be laid in a 1 m deep and 300 mm wide trench and be buried by backfilling and compacting the trench.
3. The full fibre route will be installed within the road reserves of roads R381 and R63, and 1 m from the fence of the private land.
4. 155 km will be underground and 25 km will be overhead due to it not being technically or financially feasible to trench on the Molteno Pass section. The total pole length is 9 m, buried 1.5 m deep, with a resultant above-ground height of 7.5 m
5. There are several streams / rivers and associated wetlands to cross. Rivers will be crossed using directional drilling 2 m below the riverbed starting 32 m away from river banks.
6. There is only one river with solid bedrock (the Brak River near Loxton) where directional drilling is not technically or financially feasible. Here the fibre cable will be attached to the existing road bridge.

NB It may seem like the cabling ventures into private land. However, it has been confirmed that the cabling will be installed in road reserves only and will not impede on private land. As such, please consider the study area as the section between the road and the fence of private land - which in some instances may be quite wide, especially in topographically complex area such as the Molteno pass.

2. Application References

Name of relevant heritage authority(s)	Heritage Western Cape and SAHRA
Name of decision making authority(s)	Department of Environment, Forest and Fisheries (DEFF)

3. Property Information

Latitude / Longitude	From 30°58'13.31"S 22° 8'29.23"E to 32°21'3.13"S 22°34'35.21"E
Erf number / Farm number	***Western Cape*** Park Avenue, Beaufort West; New Street, Beaufort West; Donkin Steet (N1 / N12), Beaufort West; R381, Beaufort West to Loxton; ***Northern Cape*** R381, Beaufort West to Loxton; Fraserburg Street, Loxton; Auret Street / R381, Loxton; R63, Loxton to Carnarvon; South Street, Carnarvon; Margaretha Prinsloo Street, Carnarvon; Biblioteek Street, Carnarvon; Zahn Street, Carnarvon; Van Riebeeck Street, Carnarvon; Stasieweg Street, Carnarvon.
Province	Northern Cape and Western Cape
Current Use	Road Reserve or Private land
Current Zoning	Road Reserve or Agriculture

4. Nature of the Proposed Development

Total Surface Area of development	Total 183 km (102 km in the Western Cape, and 81 km in the Northern Cape) x 300mm
Depth of excavation (m)	1m for cable duct, 1.5m for poles and 2m below rivers
Height of development (m)	7.5m

5. Category of Development

x	**Triggers: Section 38(8) of the National Heritage Resources Act**
	Triggers: Section 38(1) of the National Heritage Resources Act
x	1. Construction of a road, wall, powerline, pipeline, canal or other similar form of linear development or barrier over 300m in length.
	2. Construction of a bridge or similar structure exceeding 50m in length.
	3. Any development or activity that will change the character of a site-
	a) exceeding 5 000m^2 in extent
	b) involving three or more existing erven or subdivisions thereof
	c) involving three or more erven or divisions thereof which have been consolidated within the past five years
	4. Rezoning of a site exceeding 10 000m^2
	5. Other (state):

6. Additional Infrastructure Required for this Development

3 m x 6 m signal repeater station at Loxton

7. Mapping (please see Appendix 3 and 4 for a full description of our methodology and map legends)

Figure 1b Overview Map. Satellite image (2017) indicating the proposed development area at closer range in the Northern Cape

CTS HERITAGE

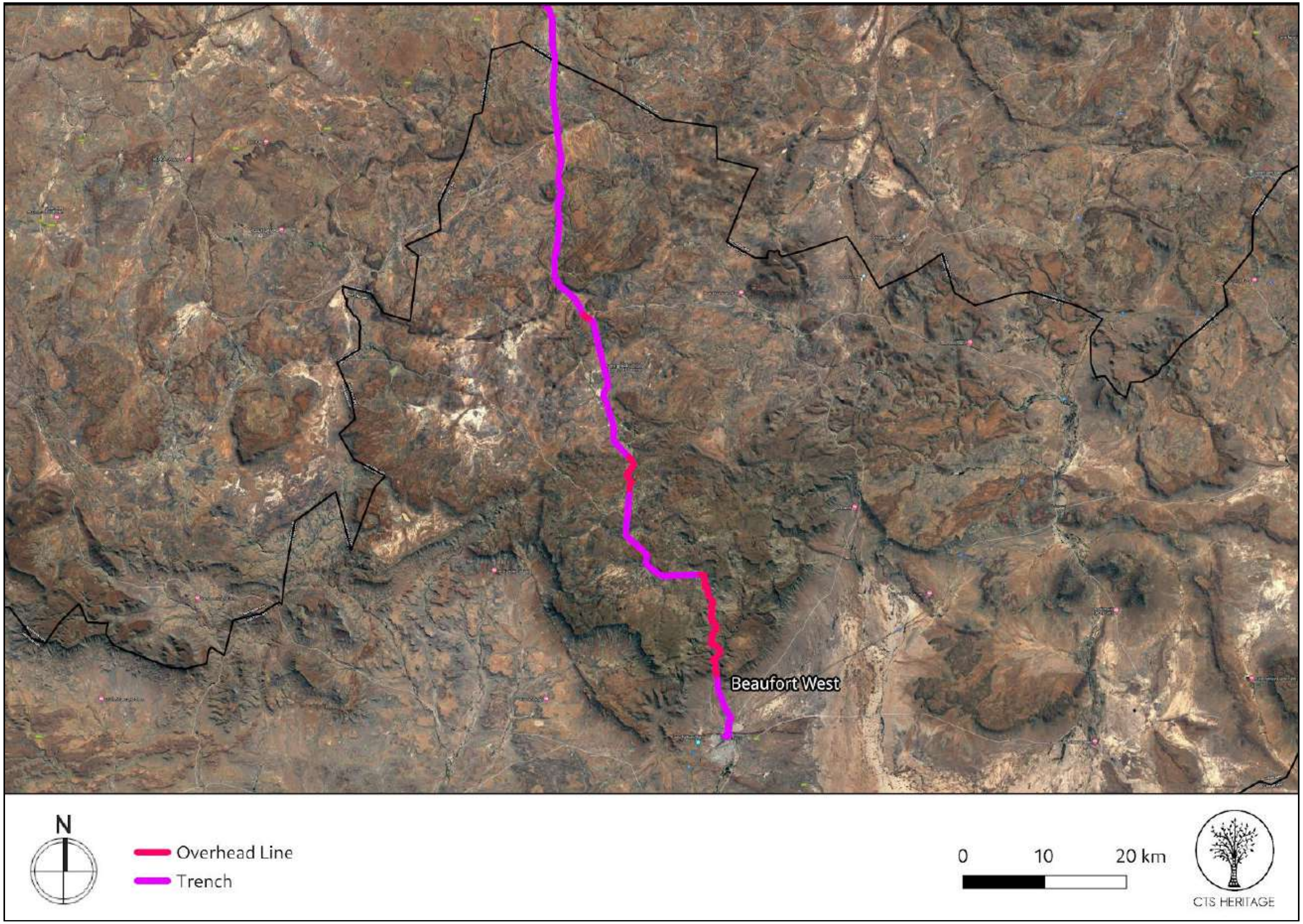


Figure 1c. Overview Map. Satellite image (2017) indicating the proposed development area at closer range in the Western Cape.

CTS HERITAGE

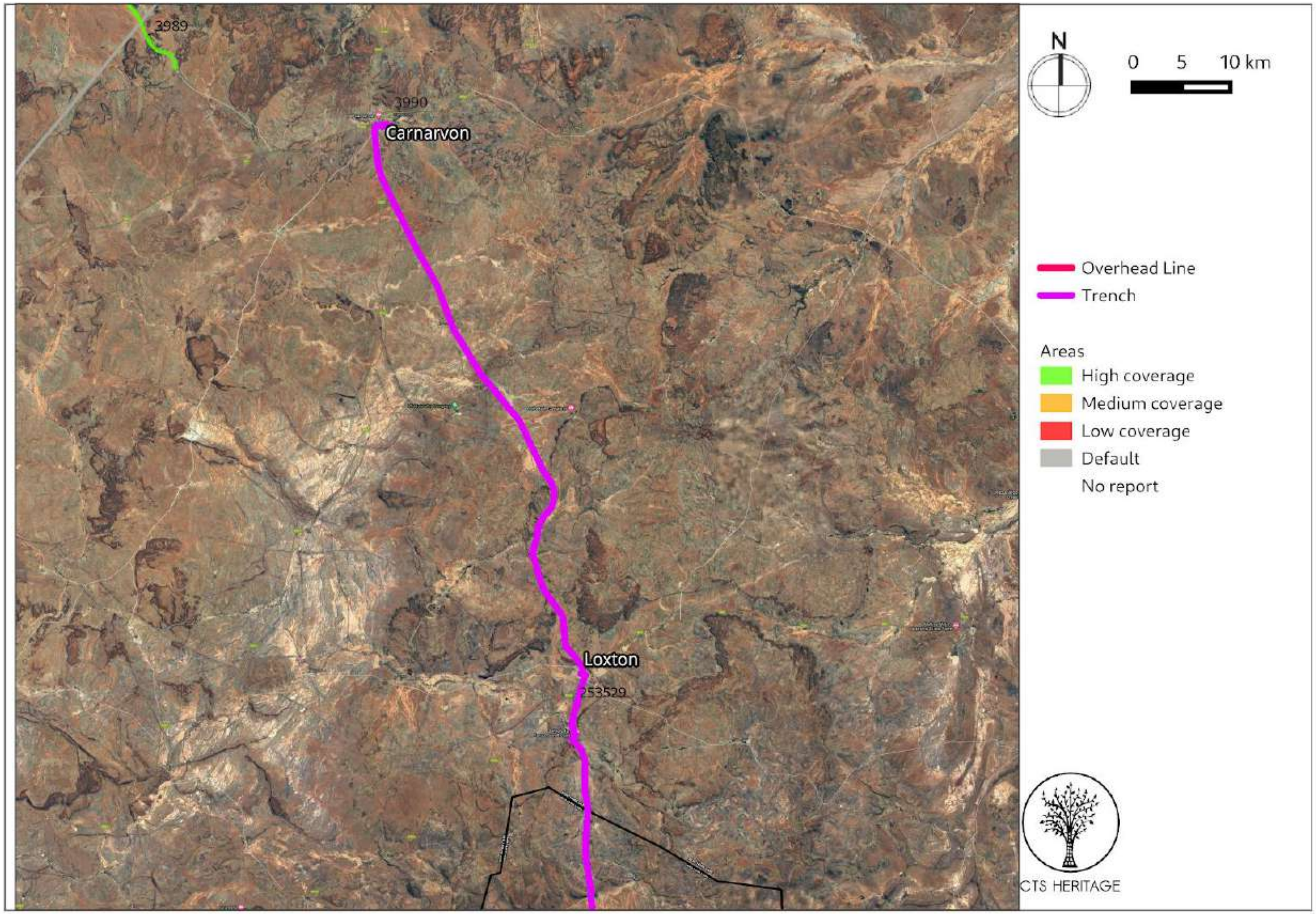


Figure 2a. Previous HIAs Map. Previous Heritage Impact Assessments surrounding the proposed development area in the Northern Cape, with SAHRIS NIDS indicated. Please see Appendix 2 for a full reference list.

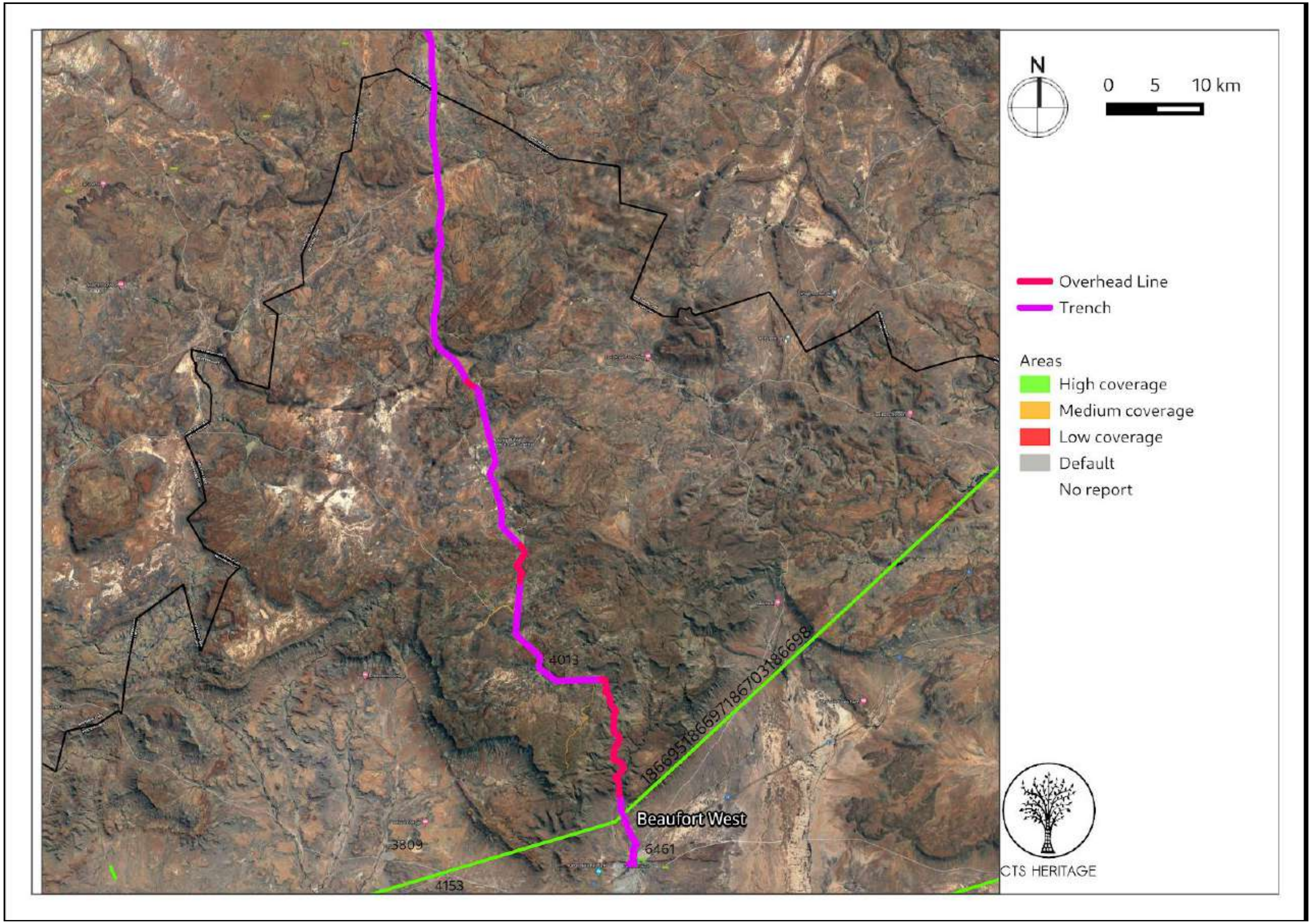


Figure 2b. Previous HIAs Map. Previous Heritage Impact Assessments surrounding the proposed development area in the Western Cape, with SAHRIS NIDS indicated. Please see Appendix 2 for a full reference list.

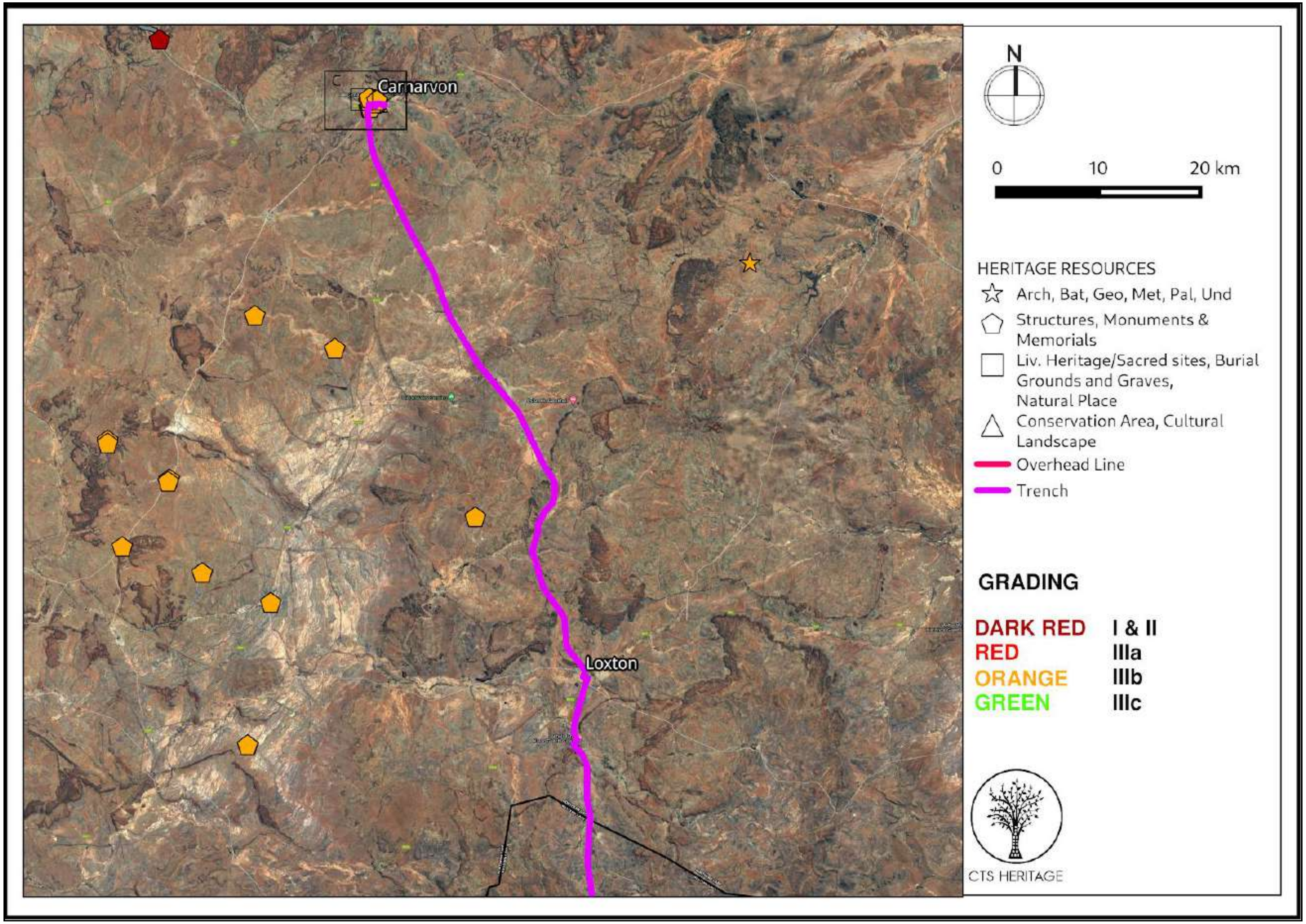


Figure 3a. Heritage Resources Map. Heritage Resources previously identified in and near the study area in the Northern Cape. Please See Appendix 4 for full description of heritage resource types.

CTS HERITAGE

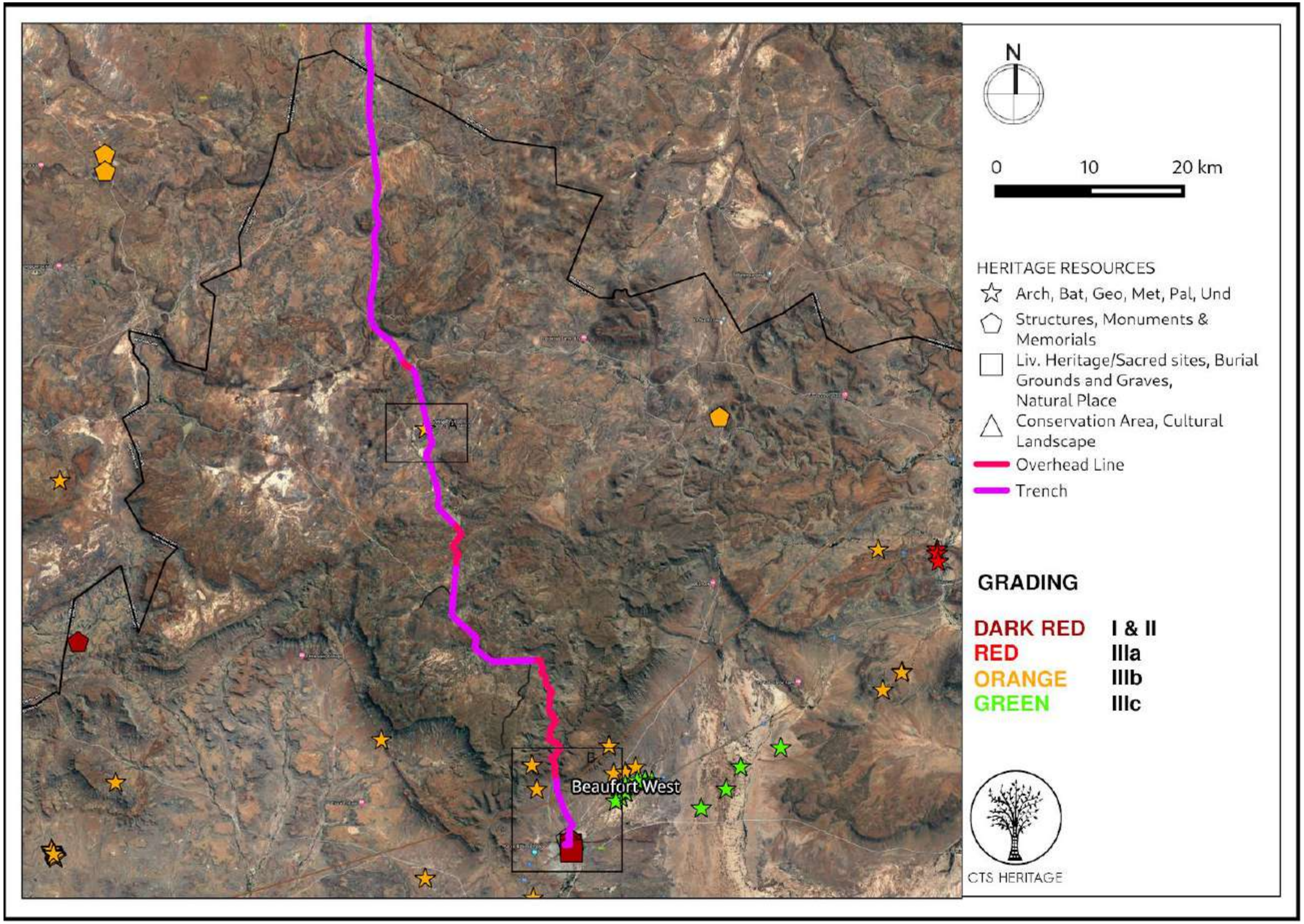


Figure 3b. Heritage Resources Map. Heritage Resources previously identified in and near the study area in the Western Cape. Please See Appendix 4 for full description of heritage resource types.

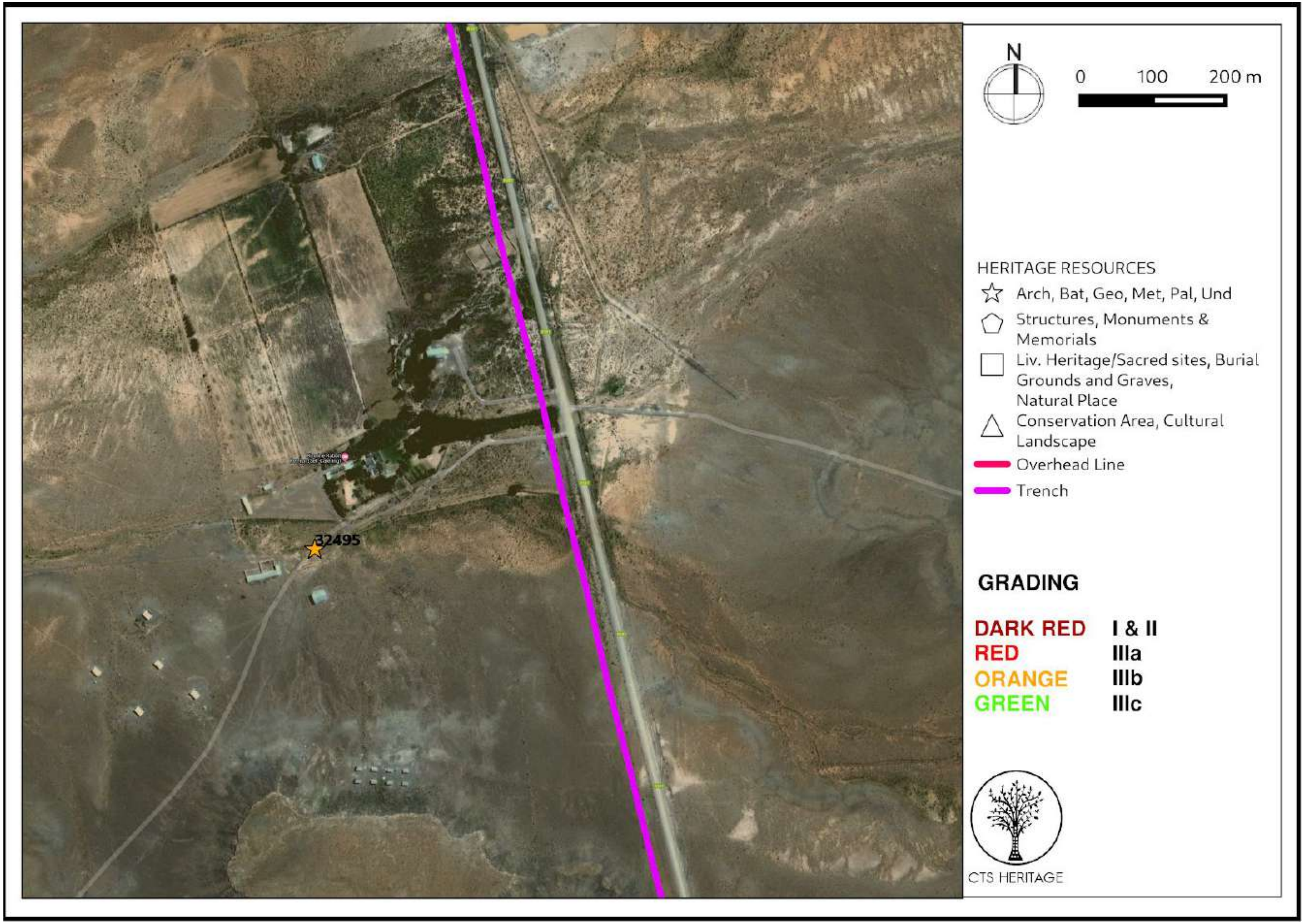


Figure 3c. Heritage Resources Map. Inset A

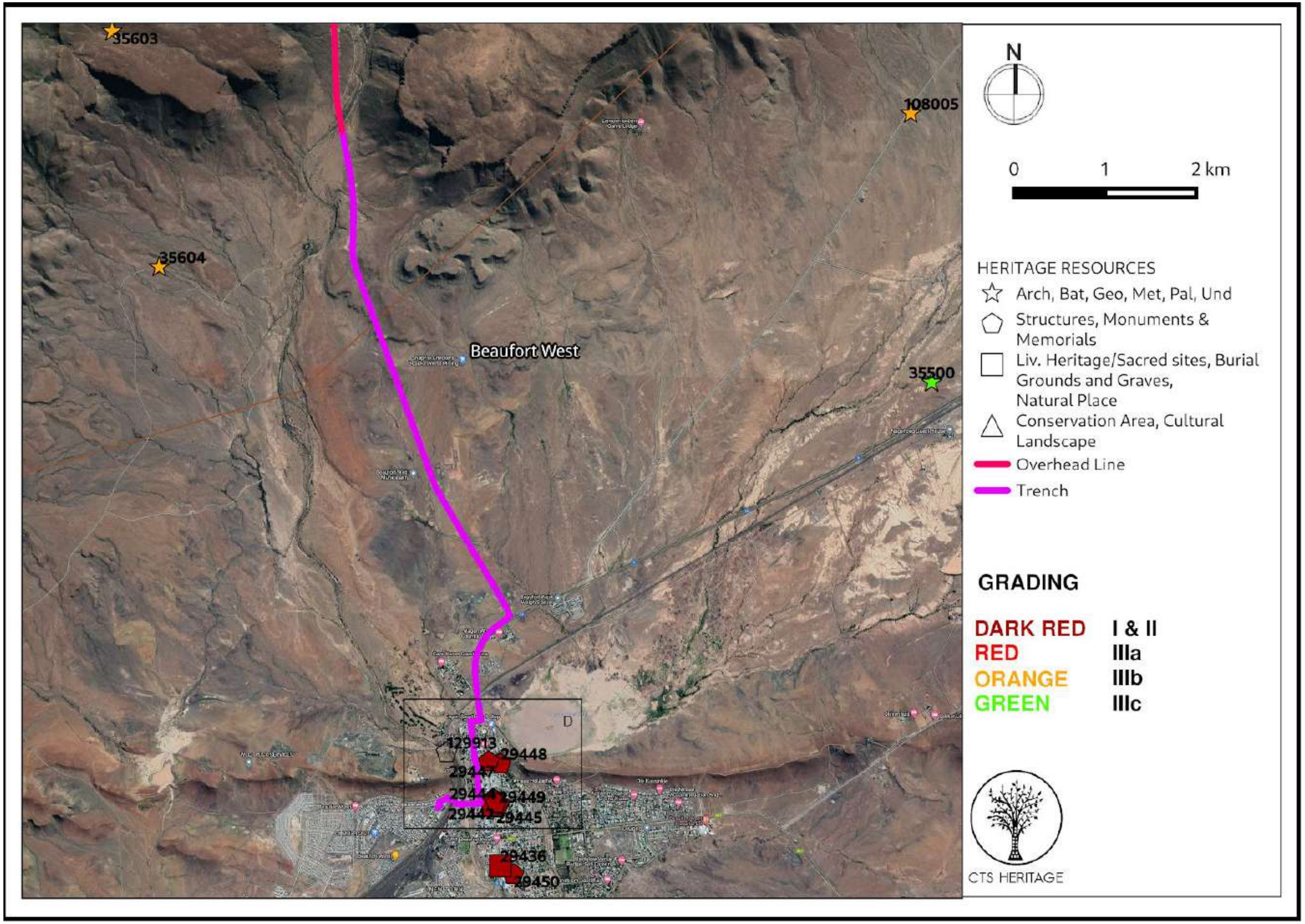


Figure 3d. Heritage Resources Map. Inset B

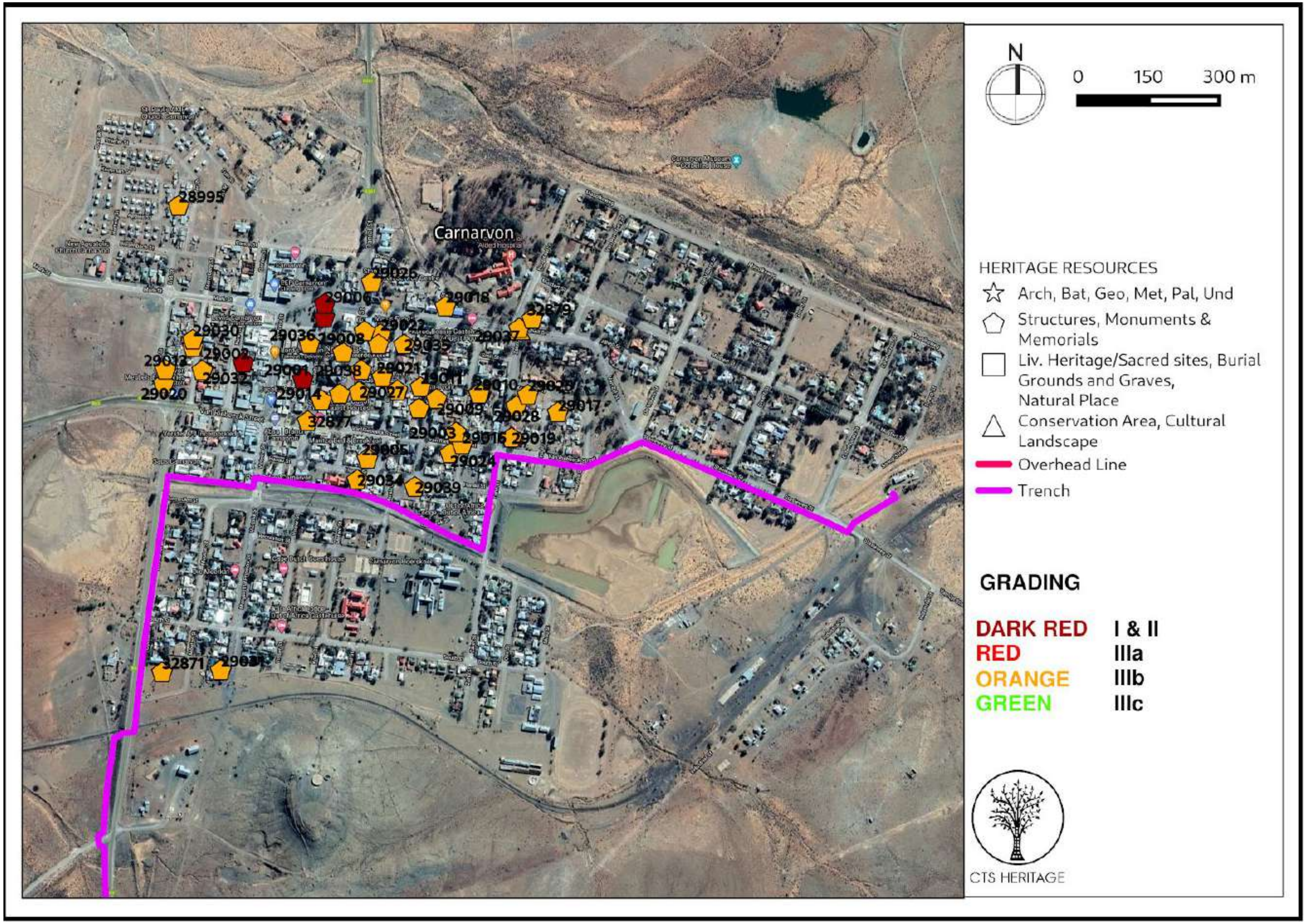


Figure 3e. Heritage Resources Map. Inset C

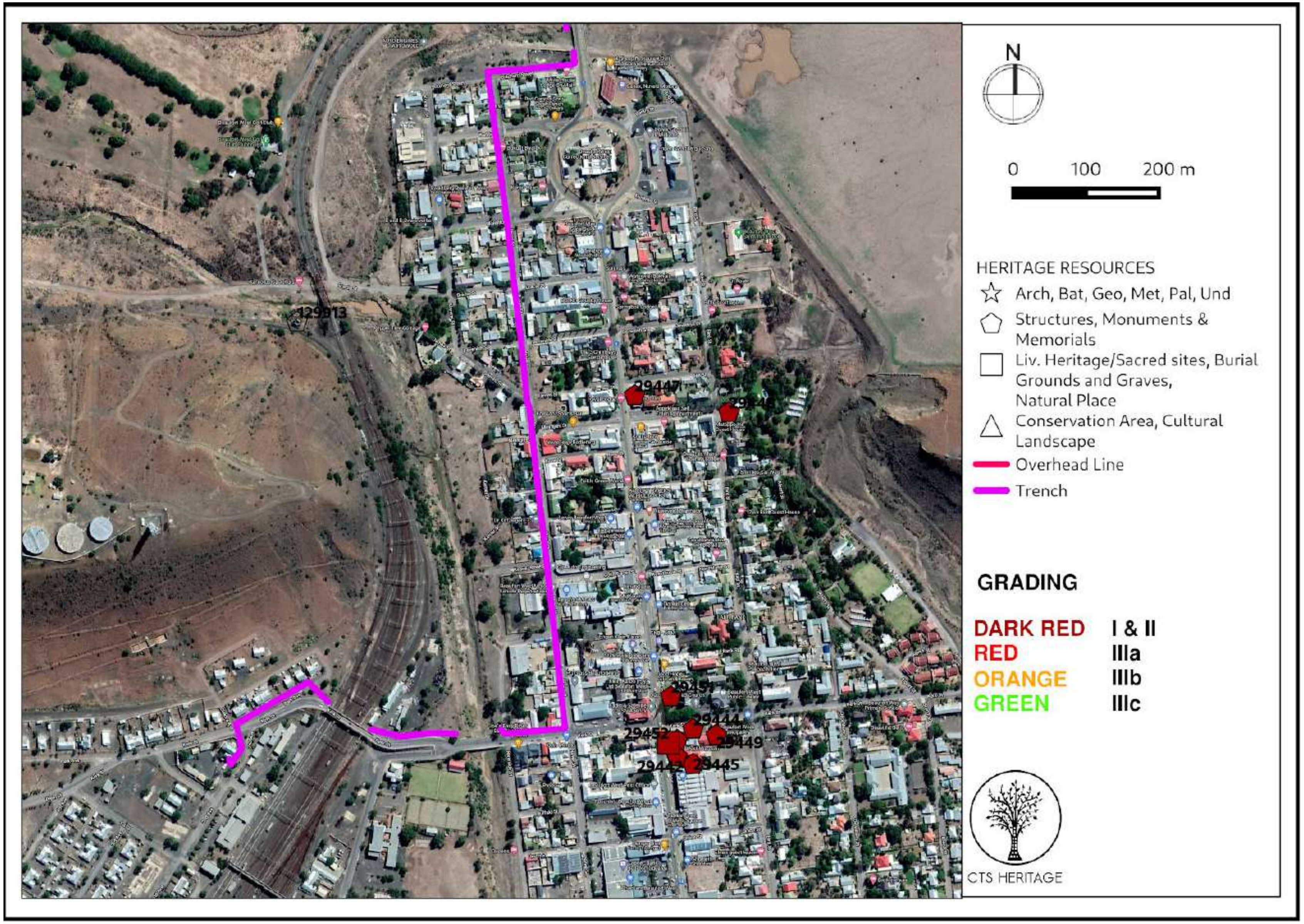


Figure 3f. Heritage Resources Map. Inset D

CTS HERITAGE

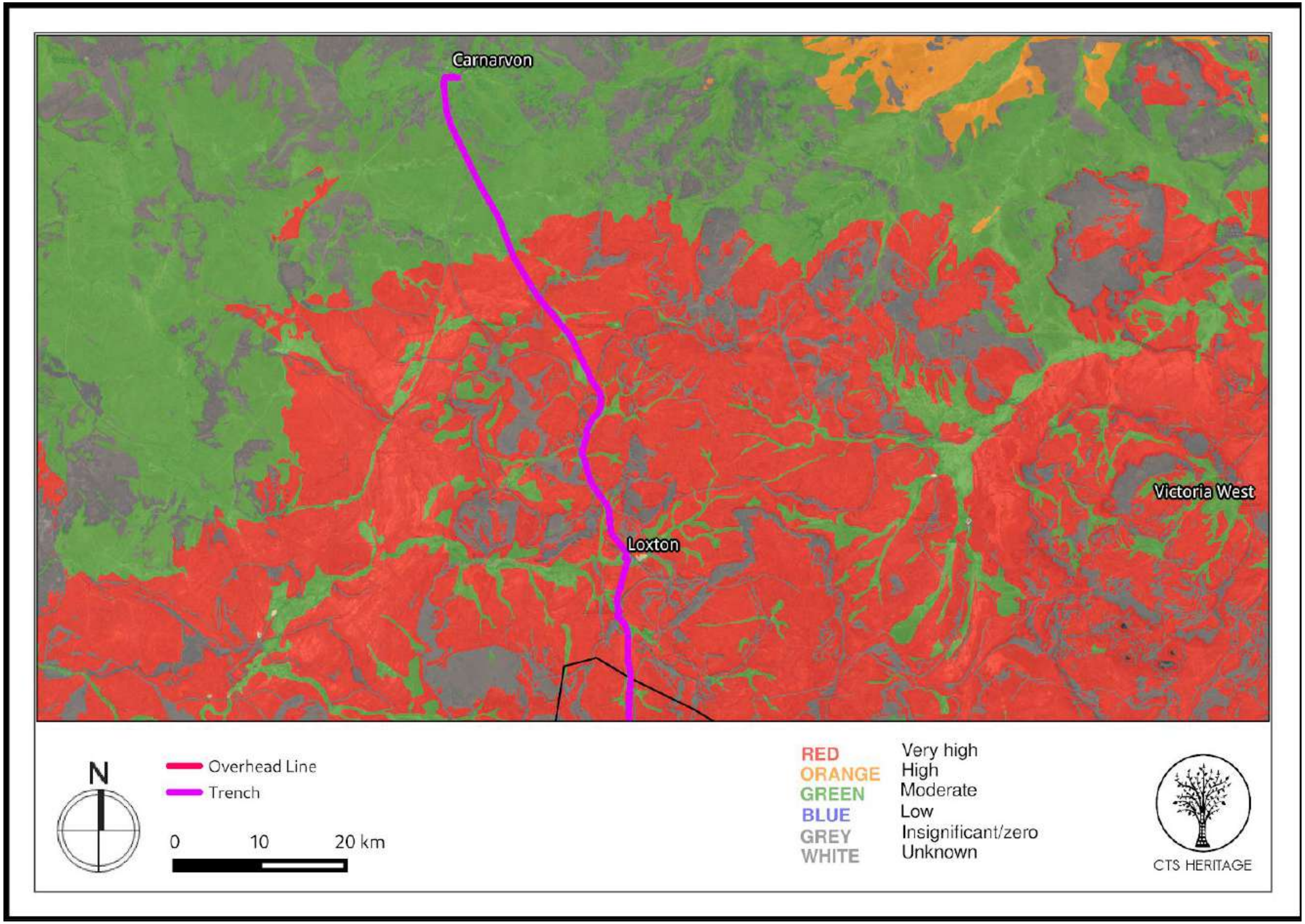


Figure 4a. Palaeosensitivity Map. Indicating fossil sensitivity underlying the study area in the Northern Cape. Please See Appendix 3 for a full guide to the legend.

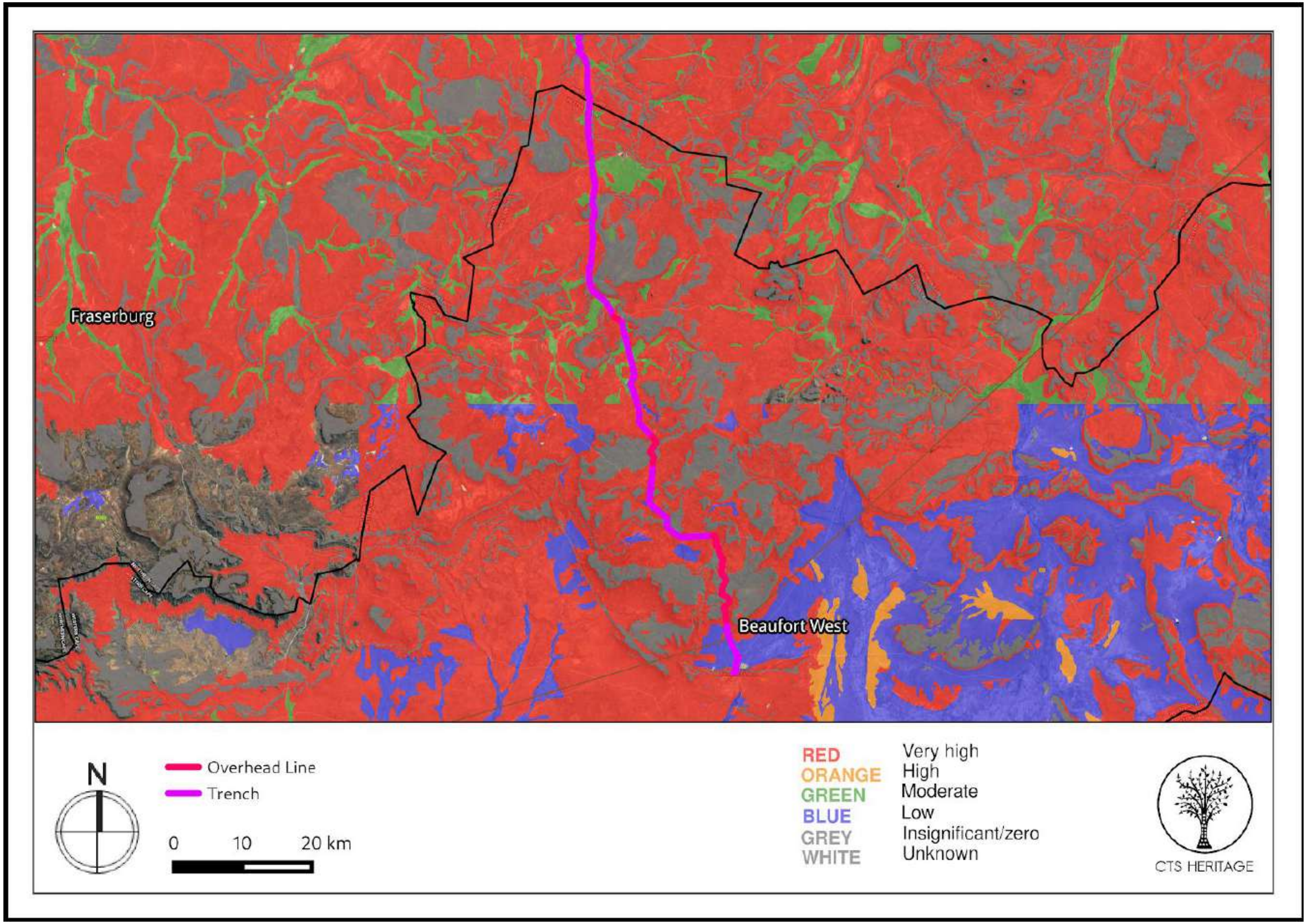


Figure 4b. Palaeosensitivity Map. Indicating fossil sensitivity underlying the study area in the Western Cape. Please See Appendix 3 for a full guide to the legend.

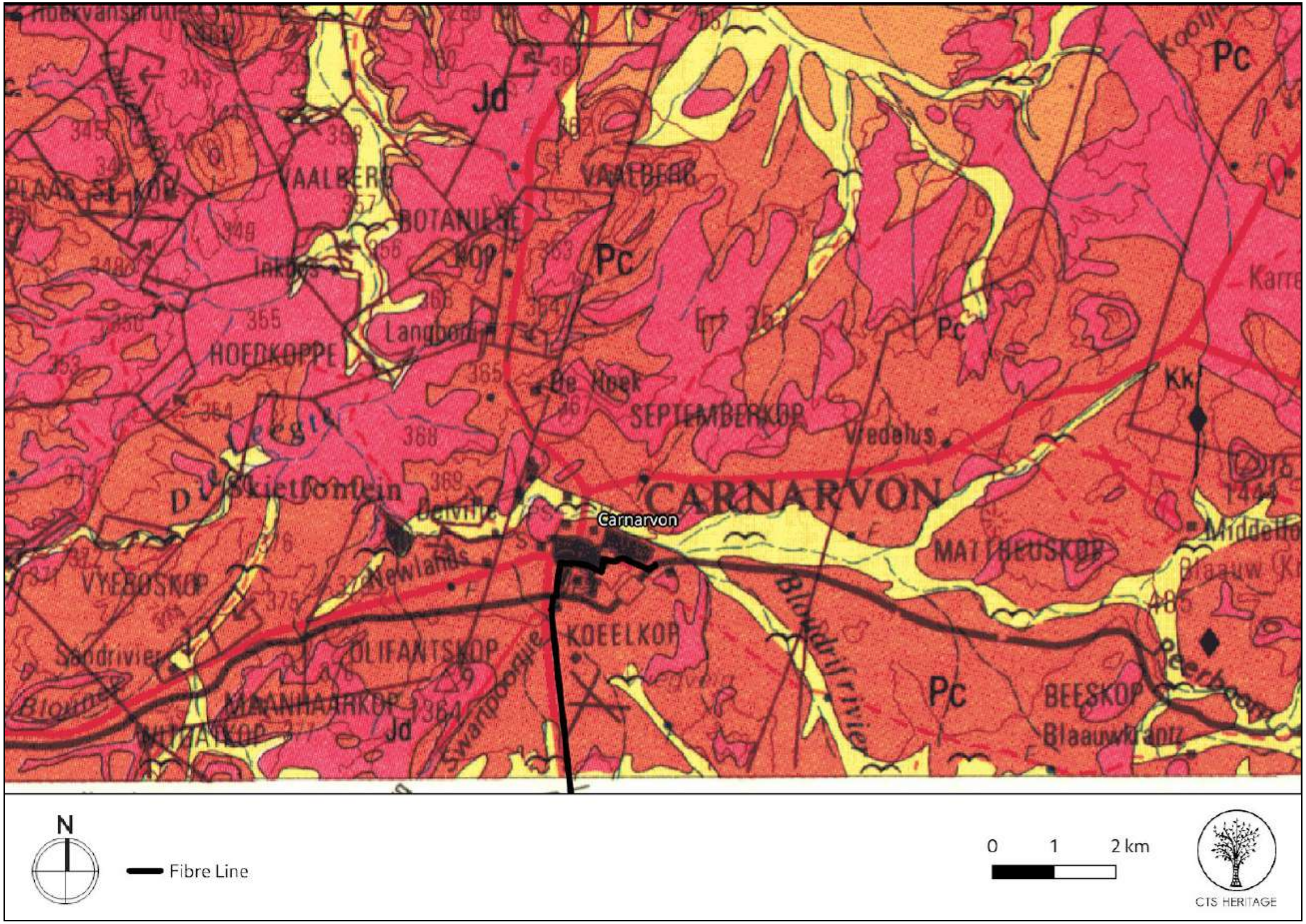


Figure 5a. Geology Map. Extract from the CGS 3022 Britstown Map indicating that the development area is underlain by Pc: Carnavon Formation of the Ecca Group, Quaternary Sands and Jd: Jurassic Dolerite

CTS HERITAGE

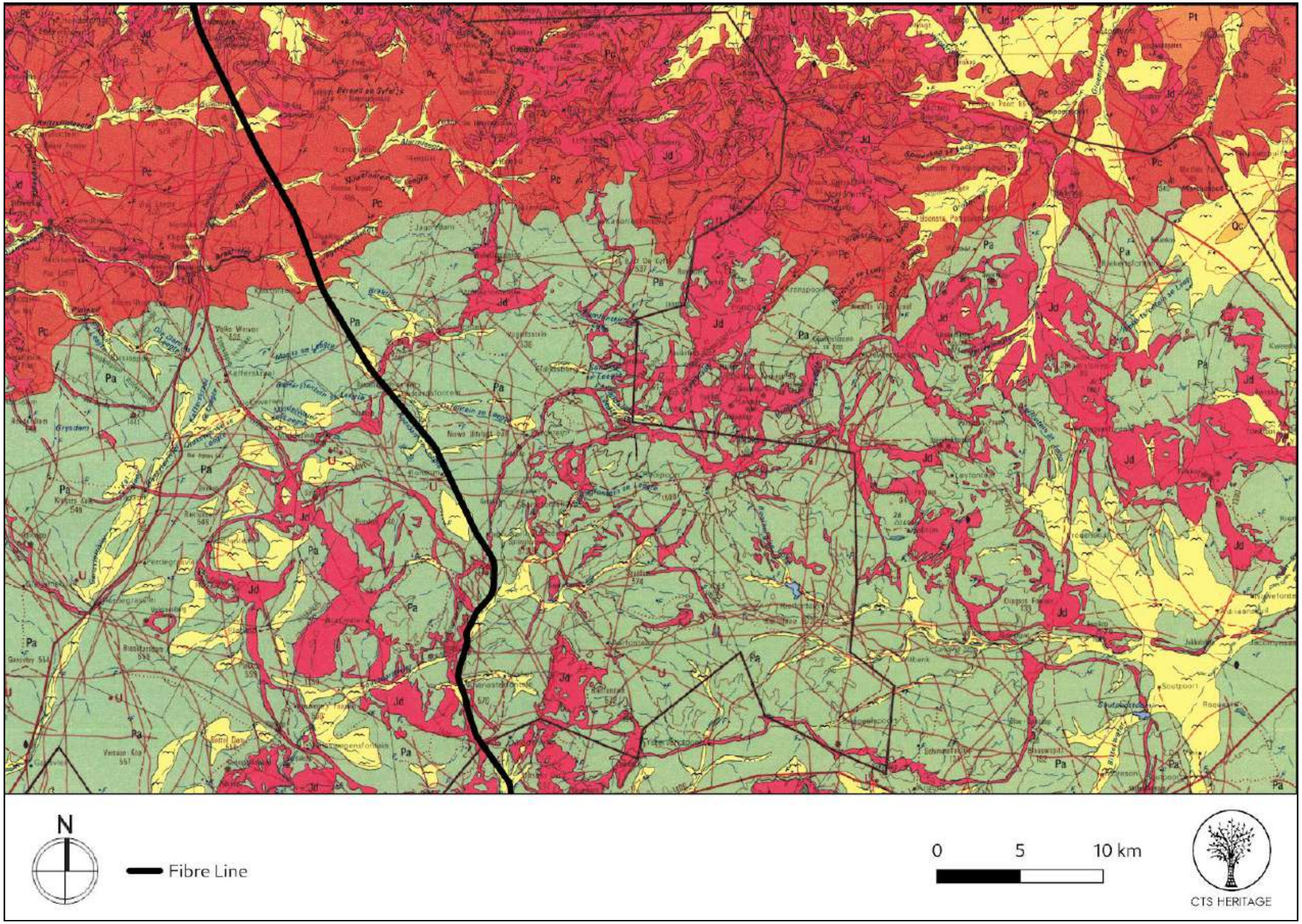


Figure 5b. Geology Map. Extract from the CGS 3122 Victoria West Map indicating that the development area is underlain by Pa: Abramskraal Formation of the Beaufort Group, Pc: Carnavon Formation of the Ecca Group, Quaternary Sands and Jd: Jurassic Dolerite

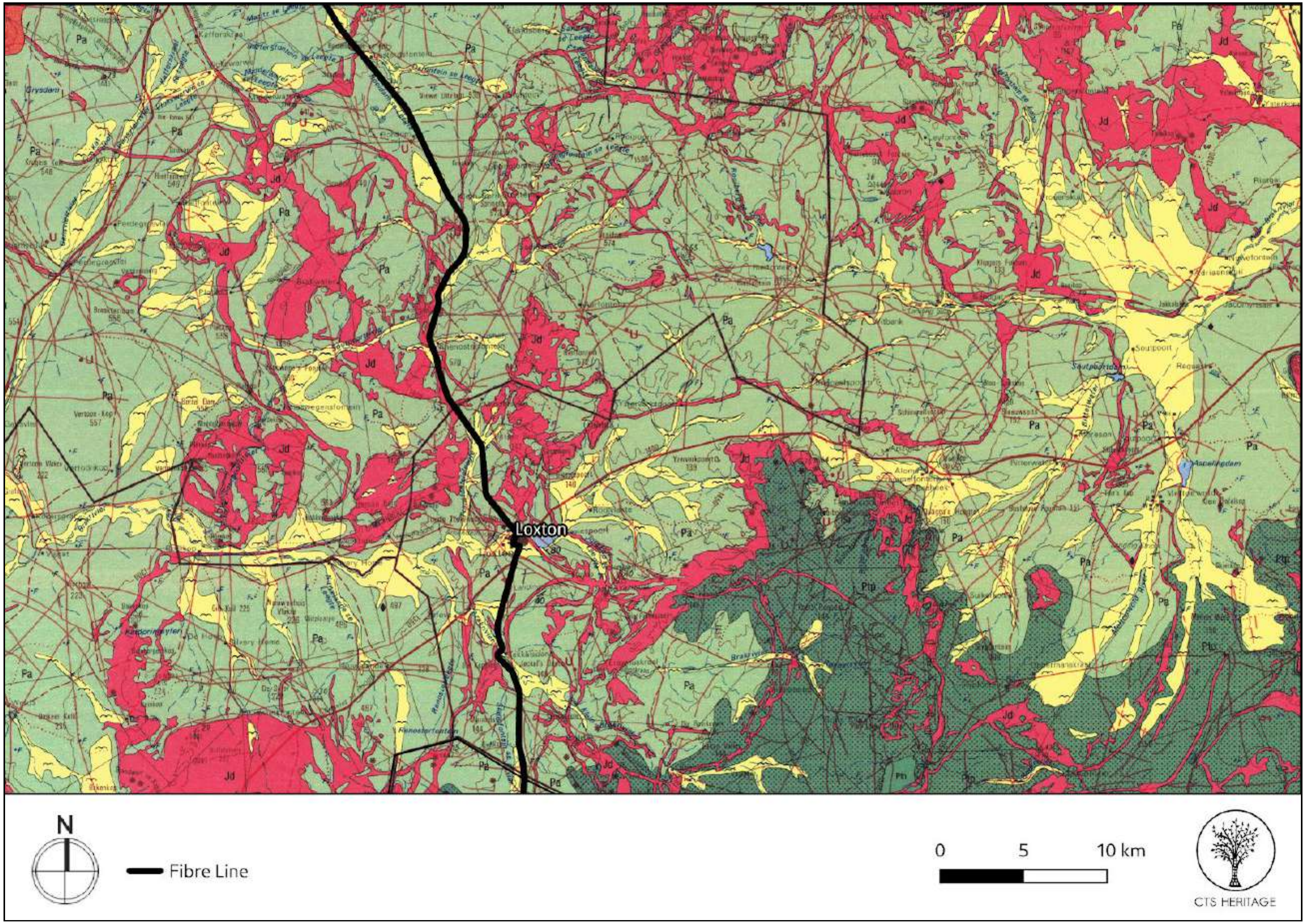


Figure 5c. Geology Map. Extract from the CGS 3122 Victoria West Map indicating that the development area is underlain by Pa: Abramskraal Formation of the Beaufort Group, Pc: Carnavon Formation of the Ecca Group, Quaternary Sands and Jd: Jurassic Dolerite

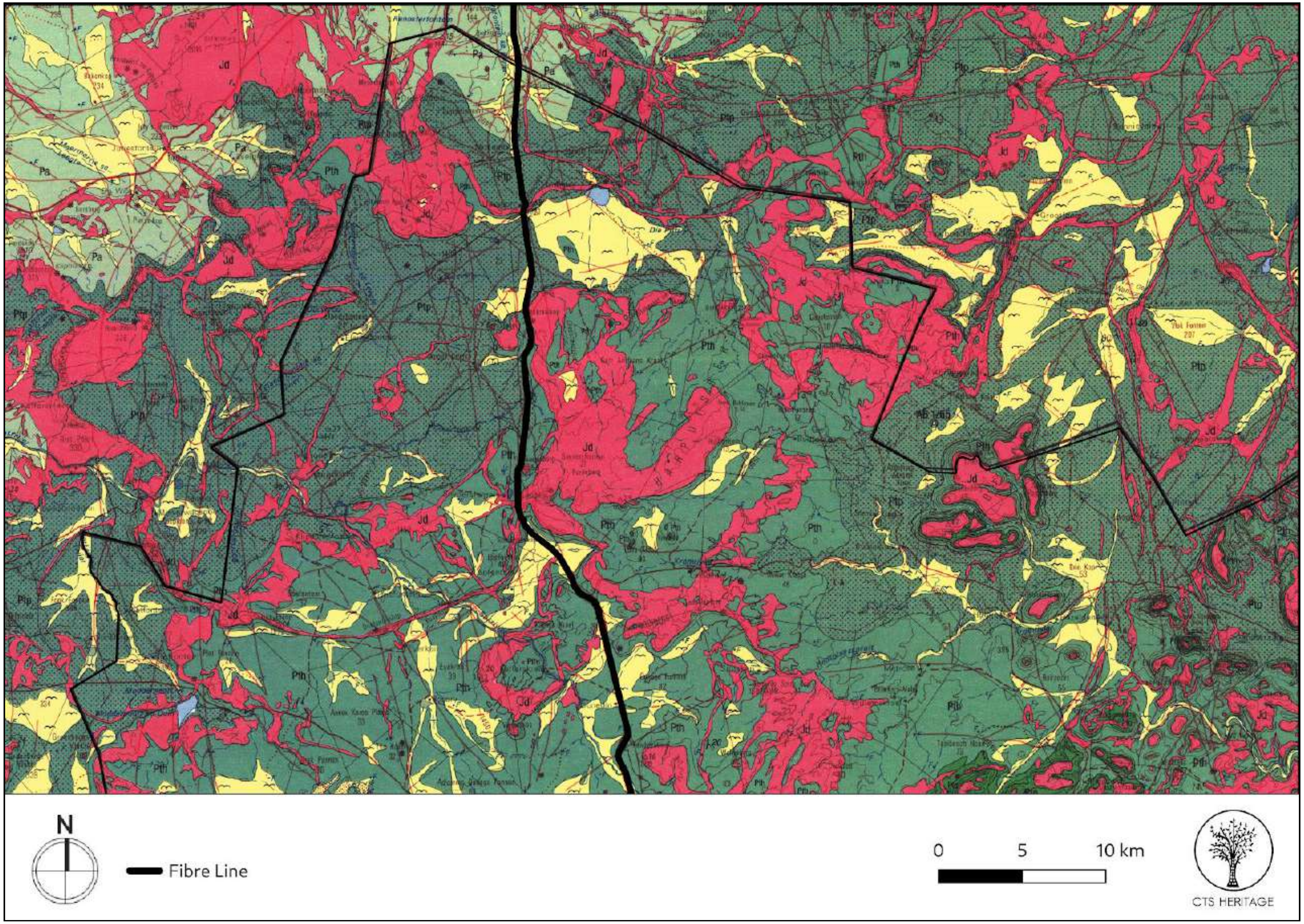


Figure 5d. Geology Map. Extract from the CGS 3122 Victoria West Map indicating that the development area is underlain by Ptp: Poortjie Member and Pth: Hoedemaker Member of the Teekloof Formation, Pa: Abramskraal Formation of the Beaufort Group, Pc: Carnavon Formation of the Ecca Group, Quaternary Sands and Jd: Jurassic Dolerite

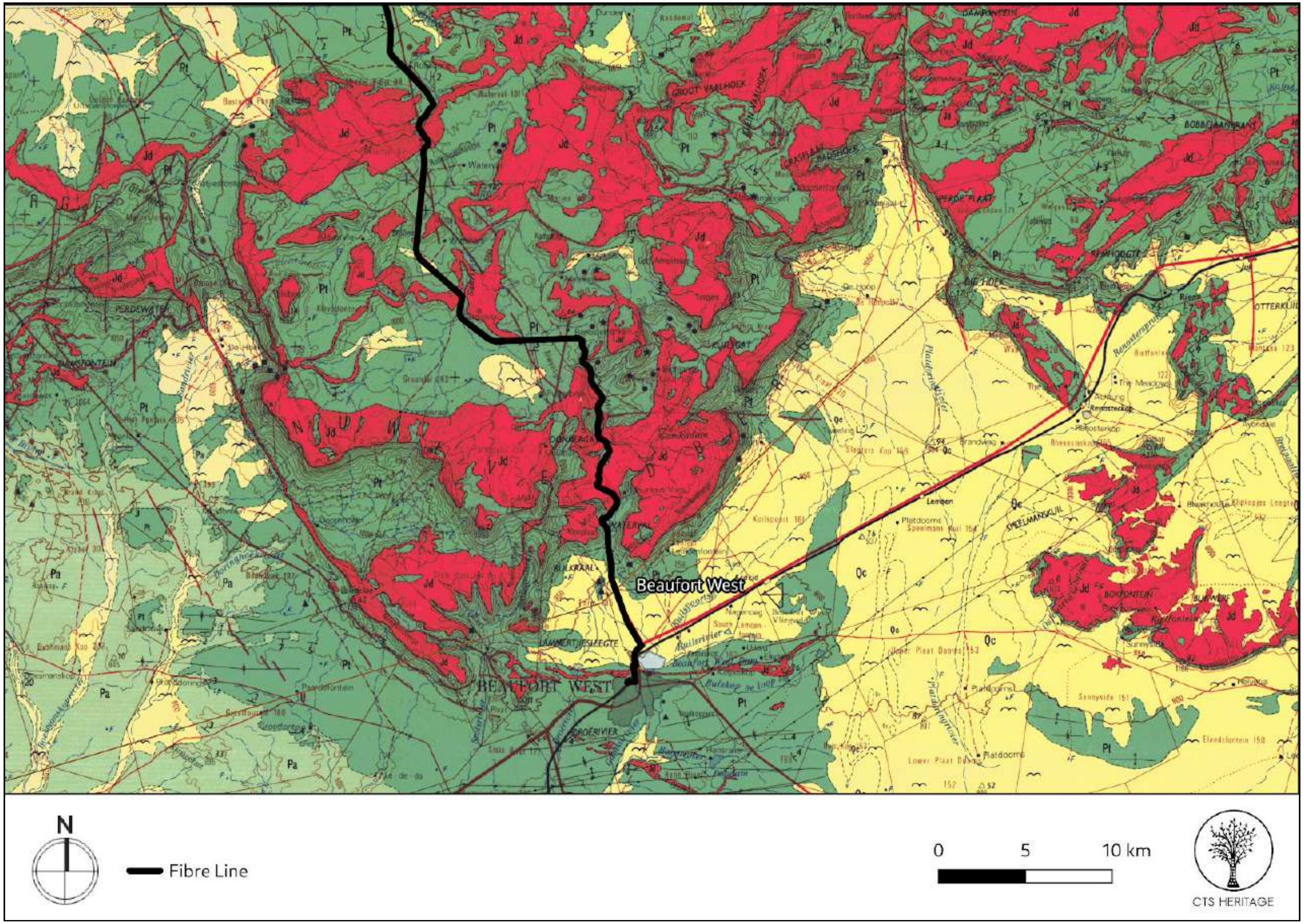


Figure 5e. Geology Map. Extract from the CGS 3222 Beaufort West Map indicating that the development area is underlain by Ptp: Poortjie Member and Pth: Hoedemaker Member of the Teekloof Formation, Pa: Abramskraal Formation of the Beaufort Group, Pc: Carnavon Formation of the Ecca Group, Quaternary Sands and Jd: Jurassic Dolerite

Figure 6.1. Contextual Images. From Beaufort West, facing north along the R381- Google Street View

Figure 6.2. Contextual Images. Facing north along the R381 - Google Street View

Figure 6.3. Contextual Images. Facing north along the R63 - Google Street View

CTS HERITAGE

Figure 6.4 Contextual Images. Facing north along the R63 - Google Street View

Figure 6.5 Contextual Images. Facing north towards Carnavon along the R63 - Google Street View


Figure 7.1 and 7.2 Infrastructure. Photos showing typical underground and overhead fibre optic cable installation

8. Heritage statement and character of the area

This application is for the proposed installation of a fibre line from Carnavon to Loxton in the Northern Cape, and from Loxton to Beaufort West in the Western Cape in order to connect the Square Kilometer Array (SKA) to the internet for the purposes of sending and receiving data. The proposed Fibre Line will be allocated within the existing road reserve for the majority of the route and will supplement existing overhead lines where trenching is not possible.

Carnarvon was established in 1853 on a route between Cape Town and Botswana that was followed by early explorers and traders. It was originally established as a mission station of the Rhenish Missionary Society and named Harmsfontein. Loxton's first church building and schoolhouse was built in 1900. Tree-lined streets and flood irrigation channels that run alongside the town's main roads were completed in the same year. The town became a municipality in 1905 as it developed to serve the region's sheep-farming community. The church that stands in the town's centre was constructed in 1924. Beaufort West was the first town to be established in the central Karoo. The town was founded in 1818 and became the first municipality in South Africa on 3 February 1837 and had the country's first town hall. When the railroad reached the town in 1880 it became a marshalling yard and locomotive depot and today it is the largest town in the Karoo. All of these towns have significant historic town centres with a unique sense of place. It is not anticipated that the proposed trenching for the SKA Fibre Line will negatively impact on any historic fabric or on this unique sense of place. However, care must be taken to ensure that historic features such as leiwater systems are not negatively impacted by the proposed trenches.

According to Tusenius (2012, SAHRIS NID 503050), "with the notable exception of the research done by Sampson in the Seacow Valley (1985), the rich archaeological heritage of the Karoo has not been systematically studied… Sites and scatters of Early, Middle and Late Stone Age (ESA, MSA and LSA) material have been recorded, as well as pastoralist occurences, historical sites, rock paintings and engravings." According to a concise summary of the heritage of the area provided by Rossouw (2019, SAHRIS NID 521590), Rock engravings located to the southeast of Loxton, suggest the possibility that a giant long-horned buffalo (*Syncerus antiquus)*, which became extinct more than 10 000 years ago, previously occurred in the area. Furthermore, "multiple rock engraving sites have been recorded in the region and are mainly attributed to San hunter-gatherers who inhabited the area and had done so for thousands of years (Smith et at., 2000: 4) while the pastoralist Khoekhoe had been present in the Karoo for at least 2 000 years (Smith, 2002) The historical footprint is largely represented by the vernacular architecture of the well-known corbelled houses in the region, which is related to 19th century trekboers who occupied these buildings, and whose cultural history dates back to their 18th century movement onto the VOC Cape frontier that resulted in ongoing interaction with indigenous people in the Karoo." As the proposed development is anticipated to be restricted to existing road reserve, it is not anticipated that the proposed development will have a negative impact on significant archaeological heritage. However, it is well established that ESA, MSA and LSA archaeological occurrences are prevalent throughout the broader Karoo landscape and these resources may be impacted by the proposed development.

Based on the SAHRIS Palaeosensitivity Map (Figure 4a and 4b), most of the area proposed for development is underlain by sediments that have very high palaeontological sensitivity. According to geology maps from the CGS, these sediments include the Poortjie Member and Hoedemaker Member of the Teekloof Formation, and the Abrahamskraal Formation of the Beaufort Group. According to Rossouw (2019), the study area is located within "early Permian Abrahamskraal Formation rocks of the Adelaide Subgroup (Karoo Supergroup) that is capped by severely degraded, superficial sheet wash and channel related (Quaternary) deposits bounded by Jurassic age dolerite intrusions to the north. The Loxton area lies within the outcrop area of the Tapinocephalus Assemblage Zone (AZ) which spans the middle part of the Abrahamskraal Formation. Vertebrate fossils of the Tapinocephalus AZ are not as common as in succeeding biozones and are usually found as individual specimens in the mudrock sequences in association with, and often enveloped by, brown-weathering calcareous nodular material. This faunal assemblage is mainly represented by small dicynodonts, large dinocephalians, pareiasaurs and pristerognathid therocephalians." It is therefore likely that any excavation conducted within this palaeontologically sensitive area is likely to negatively impact on significant palaeontological heritage.

RECOMMENDATION:
As the proposed development may negatively impact on significant archaeological and palaeontological heritage and as such, it is recommended that an HIA is required in order to assess the nature of these impacts and proposed methods for mitigating this impact.

CTS HERITAGE

APPENDIX 1

List of heritage resources within close proximity to the proposed development

Site ID	Site no	Full Site Name	Site Type	Grading
29018	9/2/019/0002-143	14 Alheit Street, Carnarvon	Building	Grade IIIb
29019	9/2/019/0002-144	16 Zahn Street, Carnarvon	Building	Grade IIIb
29020	9/2/019/0002-145	1 End Street, Carnarvon	Building	Grade IIIb
29037	9/2/019/0002-077	Standard Bank, Alheit Street, Carnarvon	Building	Grade IIIb
29038	9/2/019/0002-080	10 Daniel Street, Carnarvon	Building	Grade IIIb
29039	9/2/019/0002-085	Erf 330, Hanau Street, Carnarvon	Building	Grade IIIb
29033	9/2/019/0002-086	17 Daniel Street, Carnarvon	Building	Grade IIIb
29034	9/2/019/0002-087	Erf 328, Hanau Street, Carnarvon	Building	Grade IIIb
29035	9/2/019/0002-125	22 Grey Street, Carnarvon	Building	Grade IIIb
29036	9/2/019/0002-128	19 Church Street, Carnarvon	Building	Grade IIIb
29028	9/2/019/0002-129	22 Zahn Street, Carnarvon	Building	Grade IIIb
29029	9/2/019/0002-130	11 Sterrenberg Street, Carnarvon	Building	Grade IIIb
29030	9/2/019/0002-131	7 Sterrenberg Street, Carnarvon	Building	Grade IIIb
29031	9/2/019/0002-134	2 Victoria Street, Carnarvon	Building	Grade IIIb
29032	9/2/019/0002-135	8 Sterrenberg Street, Carnarvon	Building	Grade IIIb
29026	9/2/019/0002-136	24 Daniel Street, Carnarvon	Building	Grade IIIb

29027	9/2/019/0002-137	4 Daniel Street, Carnarvon	Building	Grade IIIb
29022	9/2/019/0002-138	19 Grey Street, Carnarvon	Building	Grade IIIb
29023	9/2/019/0002-139	17 Grey Street, Carnarvon	Building	Grade IIIb
29024	9/2/019/0002-140	13 Van Riebeeck Street, Carnarvon	Building	Grade IIIb
29025	9/2/019/0002-141	9 Kronkel Road, Carnarvon	Building	Grade IIIb
29017	9/2/019/0002-142	5 Kronkel Road, Carnarvon	Building	Grade IIIb
29021	9/2/019/0002-146	9-11 Grey Street, Carnarvon	Building	Grade IIIb
29013	9/2/019/0002-147	5 End Street, Carnarvon	Building	Grade IIIb
29014	9/2/019/0002-148	10 Church Street, Carnarvon	Building	Grade IIIb
29015	9/2/019/0002-149	12 Grey Street, Carnarvon	Building	Grade IIIb
29016	9/2/019/0002-150	Johanna Street, Carnarvon	Building	Grade IIIb
29010	9/2/019/0002-151	14 Johanna Street, Carnarvon	Building	Grade IIIb
29011	9/2/019/0002-152	9 River Street, Carnarvon	Building	Grade IIIb
29012	9/2/019/0002-153	5 River Street, Carnarvon	Building	Grade IIIb
29008	9/2/019/0002-154	20 Daniel Street, Carnarvon	Building	Grade IIIb
29009	9/2/019/0002-155	6 River Street, Carnarvon	Building	Grade IIIb
29003	9/2/019/0002-156	7 Johanna Street, Carnarvon	Building	Grade IIIb
29004	9/2/019/0002-157	5 Daniel Street, Carnarvon	Building	Grade IIIb
29005	9/2/019/0002-158	1 Grey Street, Carnarvon	Building	Grade IIIb

28995	9/2/019/0014	De Bult, Carnarvon	Building	Grade IIIb
29453	9/2/010/0003	Old Town Hall, Donkin Street, Beaufort West	Building	Grade II
29452	9/2/010/0002/001	Cypress tree, Bird Street, Beaufort West	Natural	Grade II
29445	9/2/010/0017/001	Old Dutch Reformed Mission Church Parsonage, 91 Donkin Street, Beaufort West	Building	Grade II
29442	9/2/010/0017/002	Old Dutch Reformed Mission Church, 89 Donkin Street, Beaufort West	Building	Grade II
29448	9/2/010/0004	Matoppo House, 7 Bird Street, Beaufort West	Building	Grade II
29449	9/2/010/0007	Old Girls' Public School, Church Street, Beaufort West	Building	Grade II
29450	9/2/010/0008	Historic Ring-Wall of the Old Cemetery, Bird Street, Beaufort West	Structures	Grade II
29447	9/2/010/0012	Clyde House, 25 Donkin Street, Beaufort West	Building	Grade II
29444	9/2/010/0016	Old Public Library, 15 Church Street, Beaufort West	Building	Grade II
29436	9/2/010/0018	Pear trees, Donkin Street, Beaufort West	Natural	Grade II
29041	9/2/019/0002-023	Old Parsonage, Union Square, Carnarvon	Building	Grade II
29006	9/2/019/0003	Dutch Reformed Mission Church Complex, Union Square, Carnarvon	Building	Grade II
29001	9/2/019/0005	Svenskbo, 11 Church Street, Carnarvon	Building	Grade II
29002	9/2/019/0007	14 New Street, Carnarvon	Building	Grade II
32871	9/2/019/3	Sendingkerk complex	Building	Grade IIIb

32877	9/2/019/5	House at 11 Church Street	Building	Grade IIIb
32879	9/2/019/7	14 Nuwe Street Carnarvon	Building	Grade IIIb
32495	Dunedin	Quagga Fontein 82	Palaeontological	Grade IIIb
32880	9/2/019/8	Horsemill Groot Kareebosfontein Farm	Building	Grade IIIb
35500	GK003	Gamma Kappa 003	Artefacts	Grade IIIc
35601	GK066	Gamma Kappa 066	Artefacts	Grade IIIb
35603	GK068	Gamma Kappa 068	Artefacts	Grade IIIb
35604	GK069	Gamma Kappa 069	Rock Art	Grade IIIb
32953	9/2/019/15	Buildings entered into Register Carnarvon	Conservation Area	Grade IIIb
108004	BEAUF03	Beaufort West 03	Artefacts	Grade IIIb
108005	BEAUF04	Beaufort West 04	Artefacts	Grade IIIb
108008	BEAUF07	Beaufort West 07	Artefacts	Grade IIIb
89874	Carnarvon	Carnarvon	Place	
129913	9/2/010/0010	Anglo-Boer War Blockhouse, Beaufort West	Structures	
29451	9/2/010/0002	Dutch Reformed Church, 85 Donkin Street, Beaufort West	Building	Grade II

APPENDIX 2

Reference List from SAHRIS

Heritage Impact Assessments				
Nid	**Report Type**	**Author/s**	**Date**	**Title**
3989	AIA Phase 1	Cobus Dreyer	19/04/2007	First Phase Archaeological and Cultural Heritage Assessment of the Proposed Borrow Pit Sites Along the P02996 Road Between Carnarvon & the Ska Site, Northern Cape
3990	AIA Phase 1	Cobus Dreyer	17/09/2007	First Phase Archaeological and Cultural Heritage Investigation of the Proposed Upgrading of the Oxidation Pond System at Carnarvon, Northern Cape
4013	AIA Phase 1	Jonathan Kaplan	01/02/2006	Phase 1 Archaeological Impact Assessment Proposed Klavervlei Powerline Karoo National Park
6461	AIA Phase 1	Jonathan Kaplan	01/02/2008	Phase 1 Archaeological Impact Assessment: Proposed Development Remainder of Farm 185 (Now Called Plot 8419) Beaufort West, Western Cape Province
253529	HIA Phase 1	Cobus Dreyer	20/12/2014	First phase archaeological and heritage assessment of the proposed solid waste disposal site at Loxton, Northern Cape
186695	HIA Phase 1	McEdward Murimbika	01/08/2014	Proposed Gamma-Kappa 2nd 765kV Eskom Transmission Powerline and Substations Upgrade Development in Western Cape PHASE 1 HERITAGE IMPACT ASSESSMENT STUDY REPORT
186697	AIA Desktop	Foreman Bandama, Shadreck Chirikure	01/08/2014	An Archaeological Scoping and Assessment report for the proposed Gamma (Victoria West, Northern Cape) - Kappa (Ceres â€“ Western Cape) 765Kv (2) Eskom power transmission line
186698	PIA Desktop	JF Durand	09/06/2013	GAMMA-KAPPA 765kV Transmission Line, Western Cape Province SCOPING REPORT PALAEONTOLOGY
186703	Visual Impact Assessment		01/01/2014	THE PROPOSED GAMMA KAPPA 2ND 765KV TRANSMISSION POWERLINE AND SUBSTATIONS UPGRADE, NORTHERN AND WESTERN CAPE (NEAS REFERENCE DEA/EIA/0001267/2012 DEA REFERENCE14/12/16/3/3/2/353) VISUAL IMPACT ASSESSMENT

CTS HERITAGE

APPENDIX 3 - Keys/Guides

Key/Guide to Acronyms

AIA	Archaeological Impact Assessment
DARD	Department of Agriculture and Rural Development (KwaZulu-Natal)
DEA	Department of Environmental Affairs (National)
DEADP	Department of Environmental Affairs and Development Planning (Western Cape)
DEDEAT	Department of Economic Development, Environmental Affairs and Tourism (Eastern Cape)
DEDECT	Department of Economic Development, Environment, Conservation and Tourism (North West)
DEDT	Department of Economic Development and Tourism (Mpumalanga)
DEDTEA	Department of economic Development, Tourism and Environmental Affairs (Free State)
DENC	Department of Environment and Nature Conservation (Northern Cape)
DMR	Department of Mineral Resources (National)
GDARD	Gauteng Department of Agriculture and Rural Development (Gauteng)
HIA	Heritage Impact Assessment
LEDET	Department of Economic Development, Environment and Tourism (Limpopo)
MPRDA	Mineral and Petroleum Resources Development Act, no 28 of 2002
NEMA	National Environmental Management Act, no 107 of 1998
NHRA	National Heritage Resources Act, no 25 of 1999
PIA	Palaeontological Impact Assessment
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System
VIA	Visual Impact Assessment

Full guide to Palaeosensitivity Map legend

	RED:	VERY HIGH - field assessment and protocol for finds is required
	ORANGE/YELLOW:	HIGH - desktop study is required and based on the outcome of the desktop study, a field assessment is likely
	GREEN:	MODERATE - desktop study is required
	BLUE/PURPLE:	LOW - no palaeontological studies are required however a protocol for chance finds is required
	GREY:	INSIGNIFICANT/ZERO - no palaeontological studies are required
	WHITE/CLEAR:	UNKNOWN - these areas will require a minimum of a desktop study.

CTS HERITAGE

APPENDIX 4 - Methodology

The Heritage Screener summarises the heritage impact assessments and studies previously undertaken within the area of the proposed development and its surroundings. Heritage resources identified in these reports are assessed by our team during the screening process.

The heritage resources will be described both in terms of **type**:

- Group 1: Archaeological, Underwater, Palaeontological and Geological sites, Meteorites, and Battlefields
- Group 2: Structures, Monuments and Memorials
- Group 3: Burial Grounds and Graves, Living Heritage, Sacred and Natural sites
- Group 4: Cultural Landscapes, Conservation Areas and Scenic routes

and **significance** (Grade I, II, IIIa, b or c, ungraded), as determined by the author of the original heritage impact assessment report or by formal grading and/or protection by the heritage authorities.

Sites identified and mapped during research projects will also be considered.

DETERMINATION OF THE EXTENT OF THE INCLUSION ZONE TO BE TAKEN INTO CONSIDERATION

The extent of the inclusion zone to be considered for the Heritage Screener will be determined by CTS based on:

- the size of the development,
- the number and outcome of previous surveys existing in the area
- the potential cumulative impact of the application.

The inclusion zone will be considered as the region within a maximum distance of 50 km from the boundary of the proposed development.

DETERMINATION OF THE PALAEONTOLOGICAL SENSITIVITY

The possible impact of the proposed development on palaeontological resources is gauged by:

- reviewing the fossil sensitivity maps available on the South African Heritage Resources Information System (SAHRIS)
- considering the nature of the proposed development
- when available, taking information provided by the applicant related to the geological background of the area into account

DETERMINATION OF THE COVERAGE RATING ASCRIBED TO A REPORT POLYGON

Each report assessed for the compilation of the Heritage Screener is colour-coded according to the level of coverage accomplished. The extent of the surveyed coverage is labeled in three categories, namely low, medium and high. In most instances the extent of the map corresponds to the extent of the development for which the specific report was undertaken.

Low coverage will be used for:

- desktop studies where no field assessment of the area was undertaken;
- reports where the sites are listed and described but no GPS coordinates were provided.
- older reports with GPS coordinates with low accuracy ratings;
- reports where the entire property was mapped, but only a small/limited area was surveyed.
- uploads on the National Inventory which are not properly mapped.

Medium coverage will be used for

- reports for which a field survey was undertaken but the area was not extensively covered. This may apply to instances where some impediments did not allow for full coverage such as thick vegetation, etc.
- reports for which the entire property was mapped, but only a specific area was surveyed thoroughly. This is differentiated from low ratings listed above when these surveys cover up to around 50% of the property.

High coverage will be used for

- reports where the area highlighted in the map was extensively surveyed as shown by the GPS track coordinates. This category will also apply to permit reports.

RECOMMENDATION GUIDE

The Heritage Screener includes a set of recommendations to the applicant based on whether an impact on heritage resources is anticipated. One of three possible recommendations is formulated:

(1) The heritage resources in the area proposed for development are sufficiently recorded - The surveys undertaken in the area adequately captured the heritage resources. There are no known sites which require mitigation or management plans. No further heritage work is recommended for the proposed development.

This recommendation is made when:

- enough work has been undertaken in the area
- it is the professional opinion of CTS that the area has already been assessed adequately from a heritage perspective for the type of development proposed

(2) The heritage resources and the area proposed for development are only partially recorded - The surveys undertaken in the area have not adequately captured the heritage resources and/or there are sites which require mitigation or management plans. Further specific heritage work is recommended for the proposed development.

This recommendation is made in instances in which there are already some studies undertaken in the area and/or in the adjacent area for the proposed development. Further studies in a limited HIA may include:

- improvement on some components of the heritage assessments already undertaken, for instance with a renewed field survey and/or with a specific specialist for the type of heritage resources expected in the area
- compilation of a report for a component of a heritage impact assessment not already undertaken in the area
- undertaking mitigation measures requested in previous assessments/records of decision.

(3) The heritage resources within the area proposed for the development have not been adequately surveyed yet - Few or no surveys have been undertaken in the area proposed for development. A full Heritage Impact Assessment with a detailed field component is recommended for the proposed development.

Note:
The responsibility for generating a response detailing the requirements for the development lies with the heritage authority. However, since the methodology utilised for the compilation of the Heritage Screeners is thorough and consistent, contradictory outcomes to the recommendations made by CTS should rarely occur. Should a discrepancy arise, CTS will immediately take up the matter with the heritage authority to clarify the dispute.

Appendix 19 General Authorisation in terms of the National Water Act 36 of 1998

water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

Northern Cape Region, Private Bag X6101, Kimberley, 8301, 28 Central Road, Beaconsfield, Kimberley, 8301
Tel.: 053-836 7600, Fax: 053-842 3258

F	053 842 3258		KK Sekwaila
E	SekwailaK@dws.gov.za		053 836 7600
			27/2/2/D155/2/1

South African National Research Network
Council for Scientific and Industrial Research
Meiring Naude Road
Scientia
Pretoria
0002

Dear Mr. M Majola

REGISTRATION OF WATER USE IN TERMS OF SECTION 39 OF THE NATIONAL WATER ACT, NO 36 OF 1998: TO BE UNDER TAKEN BY COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH (CSIR) FOR THE SOUTH AFRICAN NATIONAL RESEARCH NETWORK (SANREN) SKA FIBRE OPTIC CABLE BETWEEN BEAUFORT WEST AND CARNARVON ON VARIOUS PROPERTIES, BETWEEN BEAUFORT WEST AND CARNARVON IN THE ORANGE WATER MANAGEMENT AREA (LOWER), D55F, NORTHERN CAPE

Your request dated 15 June 2021 to be registered to use water in terms of General Authorisation Government Notice. 509 dated 26 August 2016 refers.

The Department is pleased to confirm that the intended water use falls within the ambit of the General Authorisations. Therefore, you may continue with the water uses as permissible in terms of Section 22 (1) (a) (iii) of the NWA. You are therefore requested to adhere to the conditions stipulated in the said General Authorisations.

Water use(s) registered:

Sub Sec	Description as per the Act	Existing Authorizations	Applied for	Authorisation Recommended or Not Recommended
(c)	Impeding or diverting the flow of water in a watercourse		X	Recommended
(i)	Altering the bed, banks, course or characteristics of a watercourse		X	Recommended

REGISTRATION OF WATER USE IN TERMS OF SECTION 39 OF THE NATIONAL WATER ACT, NO 36 OF 1998: TO BE UNDER TAKEN BY COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH (CSIR) FOR THE SOUTH AFRICAN NATIONAL RESEARCH NETWORK (SANREN) SKA FIBRE OPTIC CABLE BETWEEN BEAUFORT WEST AND CARNARVON ON VARIOUS PROPERTIES, BETWEEN BEAUFORT WEST AND CARNARVON IN THE ORANGE WATER MANAGEMENT AREA (LOWER), D55F, NORTHERN CAPE

Table 1: Details of the registered water use(s)

<table>
<tr><th rowspan="2">Purpose</th><th rowspan="2">Property description</th><th colspan="2">Coordinates</th></tr>
<tr><th>Lat.</th><th>Long</th></tr>
<tr><td colspan="2">Section 21 (c) and (i):</td><td colspan="2"></td></tr>
<tr><td>SKA fibre optic cable across Gamka River</td><td>Land Parcel 36 of the Minor Region BEAUFORT WEST</td><td>-32,35041315</td><td>22,58019825</td></tr>
<tr><td>SKA fibre optic cable across Gamka River</td><td>Land Parcel 3545 of the Minor Region BEAUFORT WEST</td><td>-32,28344373</td><td>22,56514822</td></tr>
<tr><td rowspan="2">SKA fibre optic cable across delineated riverine system (unnamed watercourse)</td><td rowspan="2">Land Parcel 430 of the Major Region BEAUFORT WEST</td><td>-32,22574793</td><td>22,56210118</td></tr>
<tr><td>-32,20711646</td><td>22,55919889</td></tr>
<tr><td>SKA fibre optic cable across delineated riverine system (unnamed watercourse)</td><td>Portion 1 of Land Parcel 103 of the Major Region BEAUFORT WEST</td><td>-32,1734204</td><td>22,54788862</td></tr>
<tr><td>SKA fibre optic cable across delineated riverine system (unnamed watercourse)</td><td>Land Parcel 187 of the Major Region BEAUFORT WEST</td><td>-32,1734118</td><td>22,52275107</td></tr>
<tr><td>SKA fibre optic cable across delineated riverine system (unnamed watercourse)</td><td>Land Parcel 193 of the Major Region BEAUFORT WEST</td><td>-32,16192412</td><td>22,47441069</td></tr>
<tr><td rowspan="2">SKA fibre optic cable across delineated riverine system (unnamed watercourse)</td><td rowspan="2">Land Parcel 96 of the Major Region BEAUFORT WEST</td><td>-32,13688753</td><td>22,45631798</td></tr>
<tr><td>-32,11348836</td><td>22,44889388</td></tr>
<tr><td>SKA fibre optic cable across delineated riverine system (Sak river)</td><td>Land Parcel 97 of the Major Region BEAUFORT WEST</td><td>-32,07089224</td><td>22,45410336</td></tr>
<tr><td>SKA fibre optic cable across delineated valley bottom wetland (Sak river)</td><td>Land Parcel 98 of the Major Region BEAUFORT WEST</td><td>-32,0513348</td><td>22,45709816</td></tr>
<tr><td rowspan="3">SKA fibre optic cable across delineated riverine system (Sak river)</td><td rowspan="3">Land Parcel 82 of the Major Region BEAUFORT WEST</td><td>-31,9884844</td><td>22,42401966</td></tr>
<tr><td>-31,96357548</td><td>22,42424135</td></tr>
<tr><td>-31,9452307</td><td>22,41916752</td></tr>
<tr><td>SKA fibre optic cable across delineated valley bottom wetland (unnamed watercourse)</td><td>Land Parcel 43 of the Major Region BEAUFORT WEST</td><td>-31,89012904</td><td>22,39846813</td></tr>
<tr><td rowspan="6">SKA fibre optic cable across delineated riverine system (unnamed watercourse)</td><td rowspan="6">Land Parcel 21 of the Major Region BEAUFORT WEST</td><td>-31,86649984</td><td>22,37892309</td></tr>
<tr><td>-31,85685799</td><td>22,36536345</td></tr>
<tr><td>-31,83922639</td><td>22,35443607</td></tr>
<tr><td>-31,82899462</td><td>22,35460003</td></tr>
<tr><td>-31,8117013</td><td>22,35778219</td></tr>
<tr><td>-31,80487857</td><td>22,35823485</td></tr>
<tr><td>SKA fibre optic cable across</td><td>Portion 1 of Land Parcel 21 of the</td><td>-31,79865348</td><td>22,35943061</td></tr>
</table>

J.

REGISTRATION OF WATER USE IN TERMS OF SECTION 39 OF THE NATIONAL WATER ACT, NO 36 OF 1998: TO BE UNDER TAKEN BY COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH (CSIR) FOR THE SOUTH AFRICAN NATIONAL RESEARCH NETWORK (SANREN) SKA FIBRE OPTIC CABLE BETWEEN BEAUFORT WEST AND CARNARVON ON VARIOUS PROPERTIES, BETWEEN BEAUFORT WEST AND CARNARVON IN THE ORANGE WATER MANAGEMENT AREA (LOWER), D55F, NORTHERN CAPE

Purpose	Property description	Coordinates	
		Lat.	Long
delineated riverine system (unnamed watercourse)	Major Region BEAUFORT WEST	-31,78537607	22,36086399
		-31,76068953	22,35839774
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Portion 1 of Land Parcel 7 of the Major Region BEAUFORT WEST	-31,70284271	22,36098254
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Portion 1 of Land Parcel 6 of the Major Region BEAUFORT WEST	-31,67647805	22,3579492
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Portion 1 of Land Parcel 5 of the Major Region BEAUFORT WEST	-31,64969956	22,3531577
SKA fibre optic cable across delineated valley bottom wetland (Slanfontein se river)		-31,64182563	22,35244112
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Land Parcel 5 of the Major Region BEAUFORT WEST	-31,62745547	22,35309316
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Land Parcel 144 of the Major Region VICTORIA WEST	-31,58337816	22,35163392
SKA fibre optic cable across Slangfontein se river	Land Parcel 143 of the Major Region VICTORIA WEST	-31,5564022	22,35094749
SKA fibre optic cable across Brak river	Land Parcel 143 of the Major Region VICTORIA WEST	-31,53659374	22,3395647
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Land Parcel 143 of the Major Region VICTORIA WEST	-31,52625351	22,33816434
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Land Parcel 359 of the Minor Region VICTORIA WEST-LOXTON	-31,50782658	22,34244906
		-31,49356796	22,34707419
		-31,4827042	22,35099943
		-31,4578298	22,33589914
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Land Parcel 142 of the Major Region VICTORIA WEST	-31,44049889	22,32952228
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Land Parcel 142 of the Major Region VICTORIA WEST	-31,42147397	22,32455294
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Portion 2 of Land Parcel 570 of the Major Region CARNARVON	-31,35421768	22,2991751
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Portion 1 of Land Parcel 571 of the Major Region CARNARVON	-31,34875837	22,30086385
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Land Parcel 540 of the Major Region CARNARVON	-31,27640358	22,29874785
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Portion 6 of Land Parcel 539 of the Major Region CARNARVON	-31,2332426	22,27003958

REGISTRATION OF WATER USE IN TERMS OF SECTION 39 OF THE NATIONAL WATER ACT, NO 36 OF 1998: TO BE UNDER TAKEN BY COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH (CSIR) FOR THE SOUTH AFRICAN NATIONAL RESEARCH NETWORK (SANREN) SKA FIBRE OPTIC CABLE BETWEEN BEAUFORT WEST AND CARNARVON ON VARIOUS PROPERTIES, BETWEEN BEAUFORT WEST AND CARNARVON IN THE ORANGE WATER MANAGEMENT AREA (LOWER), D55F, NORTHERN CAPE

Purpose	Property description	Coordinates	
		Lat.	Long
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Land Parcel 539 of the Major Region CARNARVON	-31,21281004	22,25022928
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Portion 4 of Land Parcel 485 of the Major Region CARNARVON	-31,184839	22,227482
SKA fibre optic cable across delineated riverine system (Brak river)	Portion 3 of Land Parcel 485 of the Major Region CARNARVON	-31,15500975	22,20749182
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Portion 3 of Land Parcel 485 of the Major Region CARNARVON	-31,1388829	22,20044458
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Portion 16 of Land Parcel 485 of the Major Region CARNARVON	-31,13064756	22,19689841
SKA fibre optic cable across delineated riverine system (Alarmleegte river)	Land Parcel 533 of the Major Region CARNARVON	-31,09619129	22,17673568
SKA fibre optic cable across delineated riverine system (Reitzvilleleegte river)	Portion 13 of Land Parcel 485 of the Major Region CARNARVON	-31,06661389	22,158721
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Portion 13 of Land Parcel 485 of the Major Region CARNARVON	-31,0524351	22,15065329
SKA fibre optic cable across delineated riverine system (unnamed watercourse)	Portion 33 of Land Parcel 485 of the Major Region CARNARVON	-31,0449275	22,14640449

Attached herewith are the Registration Certificate and a copy of the general authorisation for ease of reference.

You are required to comply with the conditions of the General Authorisation.

Yours faithfully,

Tekalake?.

PROVINCIAL HEAD: NORTHERN CAPE
DATE: 26/07/2021