Baseline Botanical Assessment for the proposed Augrabies Photovoltaic Power Project at Farm Rooipad 15 Portion 9, Augrabies, Northern Cape Province

Aptosimum marlothii

Report by Dr David J. McDonald
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Report prepared for Rosenthal Environmental

February 2012; updated 8 December 2013

National Legislation and Regulations governing this report

This is a 'specialist report' and is compiled in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended, and the Environmental Impact Assessment Regulations, 2010.

Appointment of Specialist

David J. McDonald of Bergwind Botanical Surveys & Tours CC was appointed by Rosenthal Environmental to provide specialist botanical consulting services for the Environmental Impact Assessment for the proposed Augrabies Photovoltaic Power Project in the Northern Cape Province. The consulting services comprise an assessment of potential impacts on the flora and vegetation in the designated study area by the proposed project for a Basic Assessment process.

Details of Specialist

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Expertise

Dr David J. McDonald:

- Qualifications: BSc. Hons. (Botany), MSc (Botany) and PhD (Botany)
- Botanical ecologist with over 30 years' experience in the field of Vegetation Science.
- Founded Bergwind Botanical Surveys & Tours CC in 2006
- Has conducted over 300 specialist botanical / ecological studies.
- Has published numerous scientific papers and attended numerous conferences both nationally and internationally (details available on request)

Independence

The views expressed in the document are the objective, independent views of Dr McDonald and the survey was carried out under the aegis of, Bergwind Botanical Surveys and Tours CC. Neither Dr McDonald nor Bergwind Botanical Surveys and Tours CC have any business, personal, financial or other interest in the proposed development apart from fair remuneration for the work performed.

Conditions relating to this report

The content of this report is based on the author's best scientific and professional knowledge as well as available information. Bergwind Botanical Surveys & Tours CC, its staff and appointed associates, reserve the right to modify the report in any way deemed fit should new, relevant or previously unavailable or undisclosed information become known to the author from on-going research or further work in this field, or pertaining to this investigation

This report must not be altered or added to without the prior written consent of the author. This also refers to electronic copies of the report which are supplied for the purposes of inclusion as part of other reports, including main reports. Similarly, any recommendations, statements or conclusions drawn from or based on this report must make reference to this report. If these form part of a main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section to the main report.

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/
NEAS Reference Number:	DEAT/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010

PROJECT TITLE

PROPOSED AUGRABIES PHOTOVOLTAIC POWER PROJECT, NORTHERN CAPE

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4.2 The specialist appointed in terms of the Regulations_

I, **David Jury McDonald** , declare that --

General declaration:

- 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 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

Bergwind Botanical Surveys & Tours CC

Name of company (if applicable):

29 February 2012; updated 8 December 2013

Date:

Executive Summary

A botanical assessment was carried out at the farm Rooipad 15 Portion 9, Augrabies Northern Cape Province to determine the constraints that would apply to the construction of a photovoltaic power-generation facility, as well as the impacts such as facility would have on the vegetation and flora.

Two 'focus areas' on the farm were investigated, named PV1 and PV2. Bushmanland Arid Grassland and Blouputs Karroid Thornveld are the two vegetation types found. These vegetation types are widespread, not threatened (Least Threatened conservation status) and no sensitive or threatened species were found in the study area. However, it was determined that the drainage lines should be observed as relatively sensitive habitat and avoided as far as possible by construction of the proposed photovoltaic infrastructure.

It was found that of the two focus areas PV2 would be marginally more suitable from a botanical perspective but that from a visual and engineering viewpoint, PV1 would be preferable. Impacts of the proposed photovoltaic facility in the PV1 area would be locally 'high negative' since some vegetation would have to be removed in the area of the footprint of the facility. However, in the greater context, since the vegetation types are widespread the overall (cumulative) impact would be 'low negative'. Where required, 'on-site mitigation' such as relocation of plant species such as *Aloe claviflora* should be carried out.

The environment of the proposed PV facility is arid and the use of non-native trees (i.e. trees not found on the site) for screening purposes is not advocated but discouraged both on the site and along the R 359 road nearby. The blackthorn trees (*Acacia mellifera* subsp. *detinens*) trees on the site would provide adequate screening of the PV facility.

The preferred site of the proposed photovoltaic facility within the PV1 focus area is endorsed from a botanical perspective as long as the principal mitigation measure, to AVOID the drainage lines, is taken into consideration.

CONTENTS

1. Introduction

Augrabies in the Northern Cape Province is world-famous as a tourist attraction for the spectacular waterfalls on the Orange or Gariep River. The Augrabies District is also known

for the production of raisins and export table grapes. Provision of electrical power to outlying areas such as the Augrabies agricultural area presents many challenges and with the advent of electrical power generation by using photovoltaic installations (solar), some of these local challenges can be addressed. The open spaces at moderate to high altitude in the central part of the country, such as at Augrabies, lend them to photovoltaic (PV) infrastructure. The limitations are mostly due to linking the generated power to the National Grid. However, if such installations can be located near existing sub-stations, they can offer a valuable increase in available power-input to local energy systems.

Mulilo Renewable Energy (Pty) Ltd proposes to develop a 10 MW photovoltaic power plant with associated infrastructure approximately 10 km from Augrabies, Northern Cape Province. Rosenthal Environmental is acting as the environmental assessment lead consultants. Bergwind Botanical Surveys & Tours CC was appointed to conduct a botanical assessment of the proposed site for the required basic assessment process (BAR).

2. Terms of Reference

Terms of reference for baseline botanical assessment:

- Take note of the guideline for involving biodiversity specialists in the EIA process and the requirements of the Botanical Society of South Africa (BotSoc).
- Take note of previous botanical work applicable to the area, including all relevant biodiversity plans compiled in terms of the National Environmental Management of Biodiversity Act (NEMBA).

- Undertake the requisite field work and compile a report that considers the following:
    - The local and regional context of the vegetation communities within the affected areas, taking the relevant biodiversity plans and bioregional planning documents into consideration;
    - The vegetation communities occurring on the proposed site;
    - The status and conservation value of the vegetation communities;
    - Any species of special concern (rare or endangered species), endemic to the area or threatened species encountered or likely to be present;

3. Study Area

3.1 Locality

The study area consists of Portion 9 of Farm Rooipad 15, Augrabies, located in the Kai !Garib Local Municipality, Siyanda District Municipality, Northern Cape Province (Figures 1 & 2). The farm lies approximately 10 km north-west of Augrabies on the R 359 (Figure 2) in the direction of Blouputs. The property is 1 844 ha in extent of which 19.9 ha would be used for development of the proposed PV facility. The Eskom Blouputs Sub-station(S 28°36'44.69" 20°12'58.70"E) is located west of the proposed PV facility site where the road turns to Blouputs.

For purposes of interpreting the landscapes and vegetation the major study area was divided into two sectors, western and eastern sectors. Two smaller areas, referred to as focus areas, within Rooipad 15/9 were identified for specific study within the western (PV1) and eastern (PV2) sectors. The proposed footprint areas of the PV arrays were then located within the 'focus areas' (Figures 3 and 4).

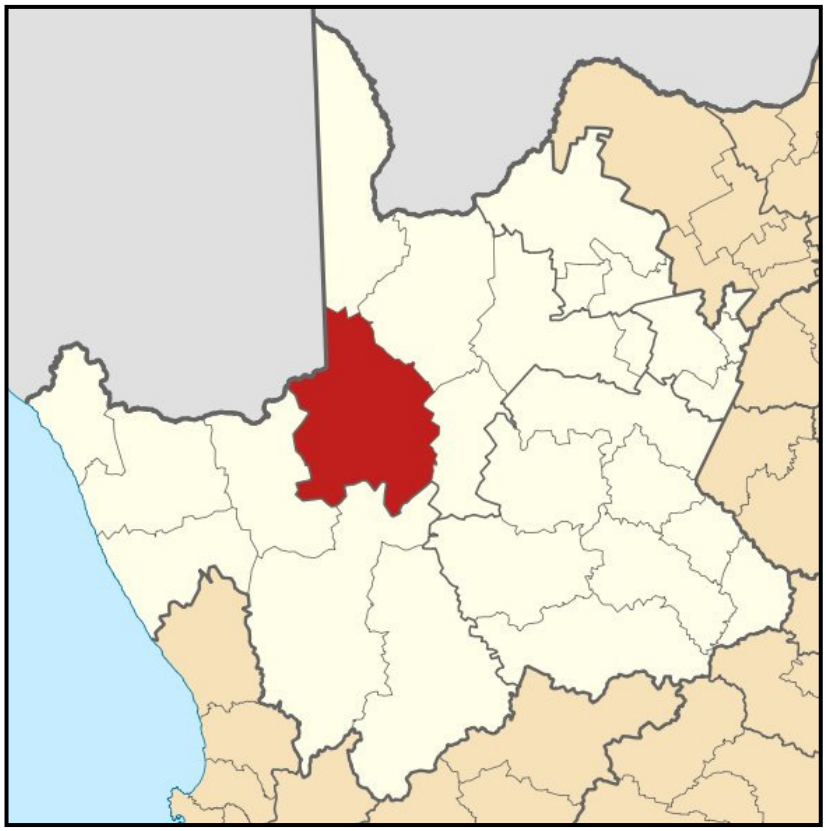


Figure 1. The Northern Cape Province, South Africa (light buff colour) with Kai !Garib Local Municipality (red) within the Siyanda District Municipality. (Source: Wikipedia)

Figure 2. Map of the Augrabies area with the study area (red dot) approximately 10 km NW of the town near Blouputs. (Map modified from: http://www.mapstudio.co.za/locationmap.php?loc=Augrabies)

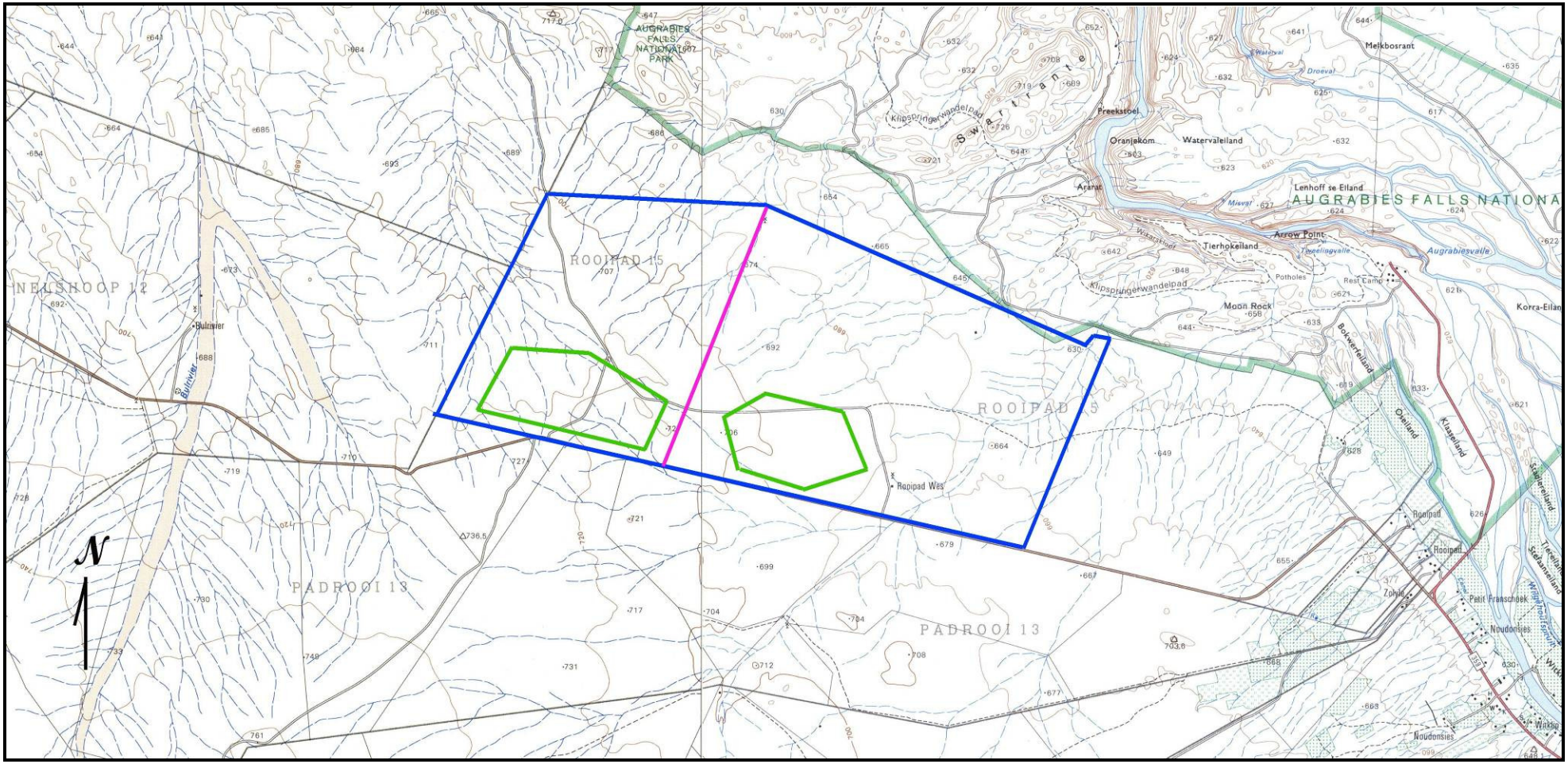


Figure 3. Portion of the 1:50 000 topographic maps 2820 CA & CB, showing the major study area outlined in blue. The major study area is divided into two sectors, western and eastern, by the pink line (Map: Directorate: National Geospatial Information). Note the Augrabies Falls National Park located north and northeast of the site. The focus areas (indicative only – not to scale or accurate) are shown as green outlines.

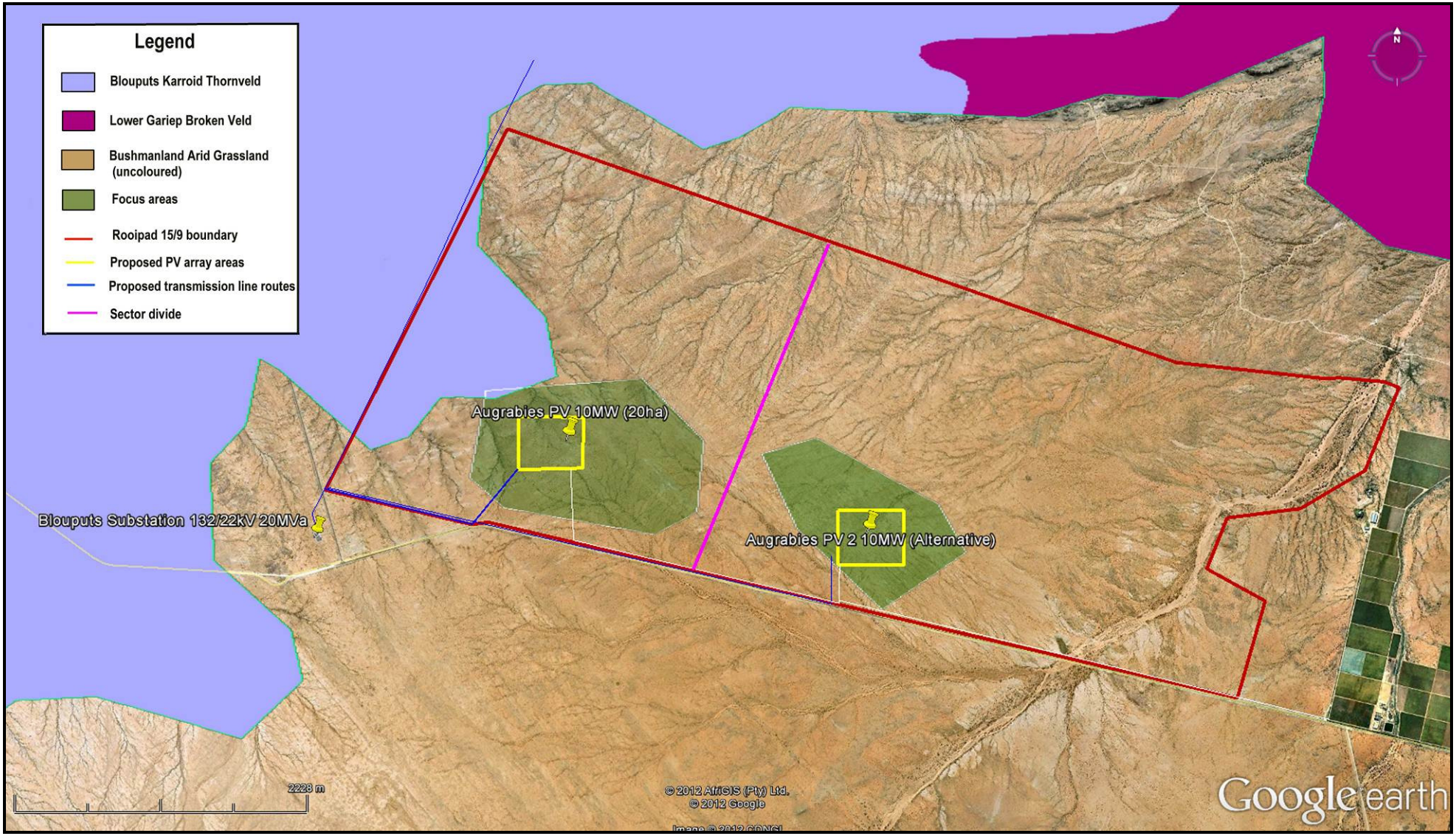


Figure 4. Map of the study area (based on Google Earth ™ imagery), Rooipad 15/9 (red boundary) with the 'focus areas' for the PV project in green. The proposed footprint areas are in yellow. The vegetation units as mapped in the Vegetation Map of South Africa, Lesotho & Swaziland (Mucina *et al.* 2005) are superimposed on the aerial imagery.

3.2 Topography, Geology and Soils

The site can be divided into a western sector and eastern sector separated by a low ridge. The west sector has an undulating plain of altitude ranging between 715 and 718 metres above mean sea level (m. a. m. s. l.) punctuated by shallow seasonal 'sub-dendritic' drainage lines that flow mainly north-westerly towards the Orange River. A low rocky ridge with altitude 720 – 727 m. a. m. s. l. extends from a windmill and reservoir in the western sector, eastwards to a high point at (727 m) that overlooks the eastern sector of the site.

The principal rock type found at the site is granite-gneiss of the Kakamas Terrane of the Namaqua-Natal Province with small outcrops of ultrametamorphic rocks in places (Cornell *et al.* 2006) (Figure 4). The blocky pink migmatite granite is exposed on the ridge described above (Figure 5); this area would not be affected by the PV footprint.

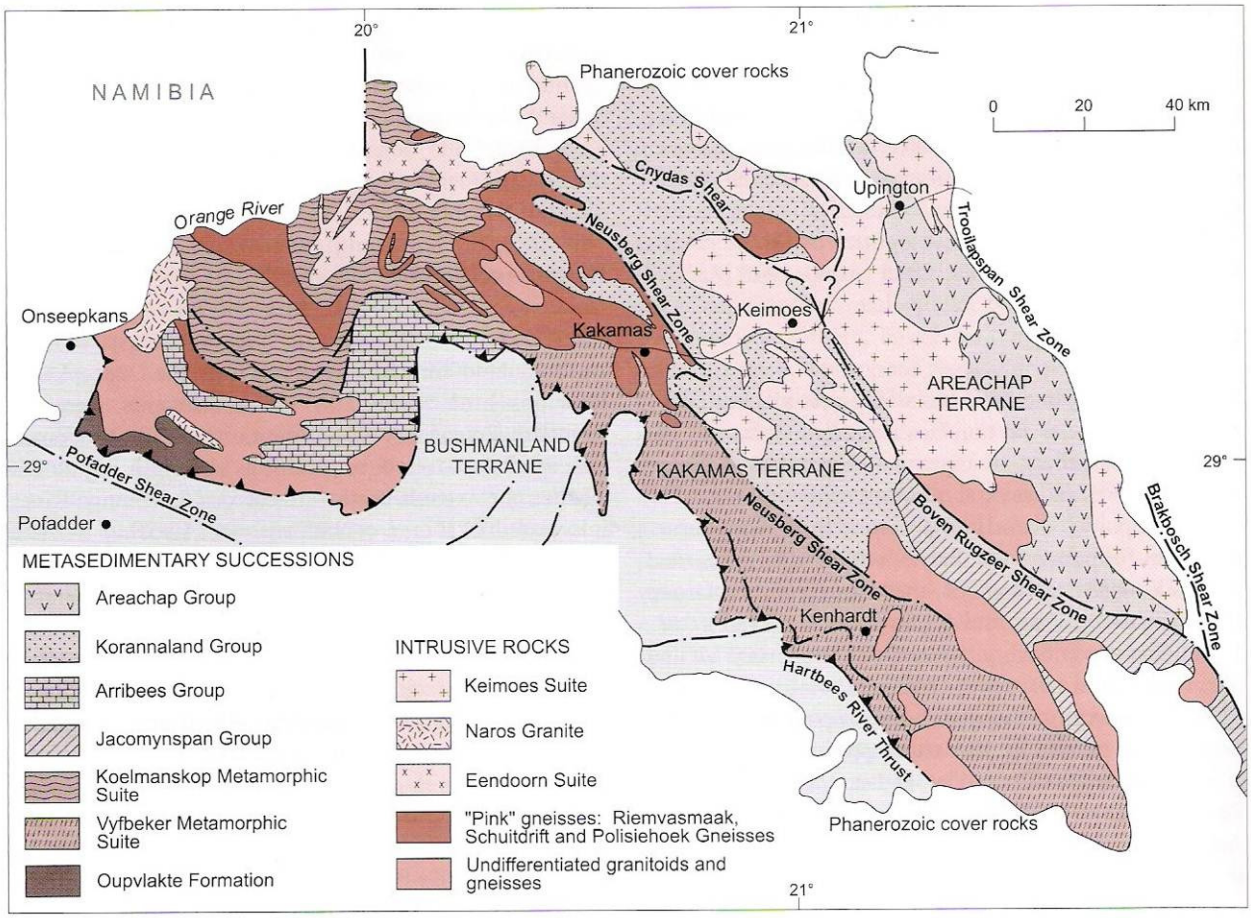


Figure 5. Geological map of

Figure 5. Rocky outcrop of pink granite on the ridge between the western and eastern sectors at Rooipad 15/9

Figure 6. Open area with sparse vegetation and shallow red, sandy soil littered with white quartz pebbles.

According to the land-type classification (Land Type Survey Staff, 1972--2006) the land-type found over the entire study area is the Ag2 land-type ((Figure 7). This land-type consists of red, high base status, < 300 mm deep soils and occasional small seif dunes, dorbank at numerous places and occasional calcrete and lime nodules. It has a dense sub-dendritic drainage and dissection pattern (MacVicar *et al.* 1974). First-hand observations in the study area revealed that the soils in the northwest sector are shallow to skeletal with granite-gneiss and schistose bedrock exposed in places on the plains. The soils have resulted from weathering of the igneous and metamorphic parent rock and are gritty, well-drained red sands. In many places

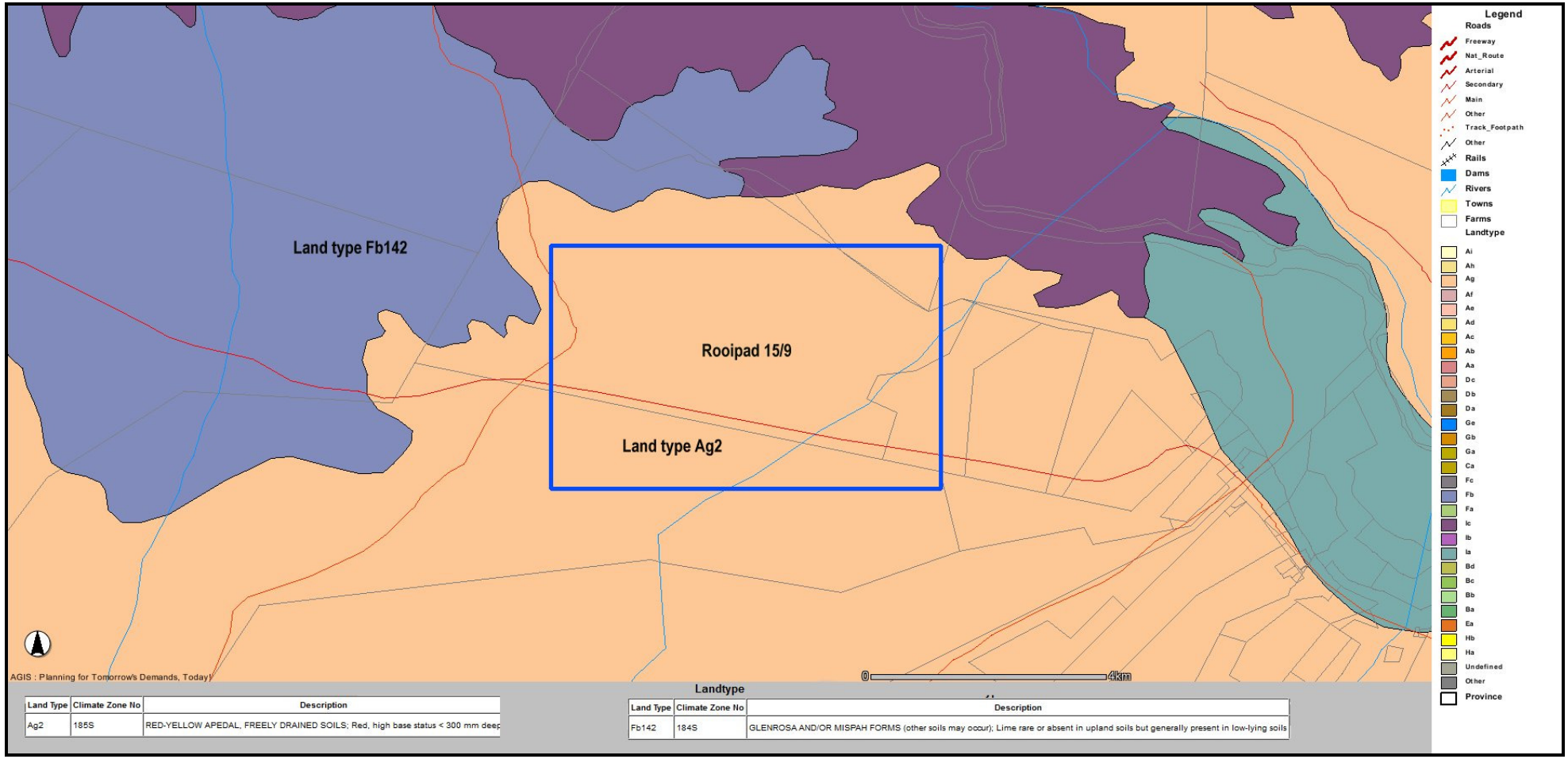
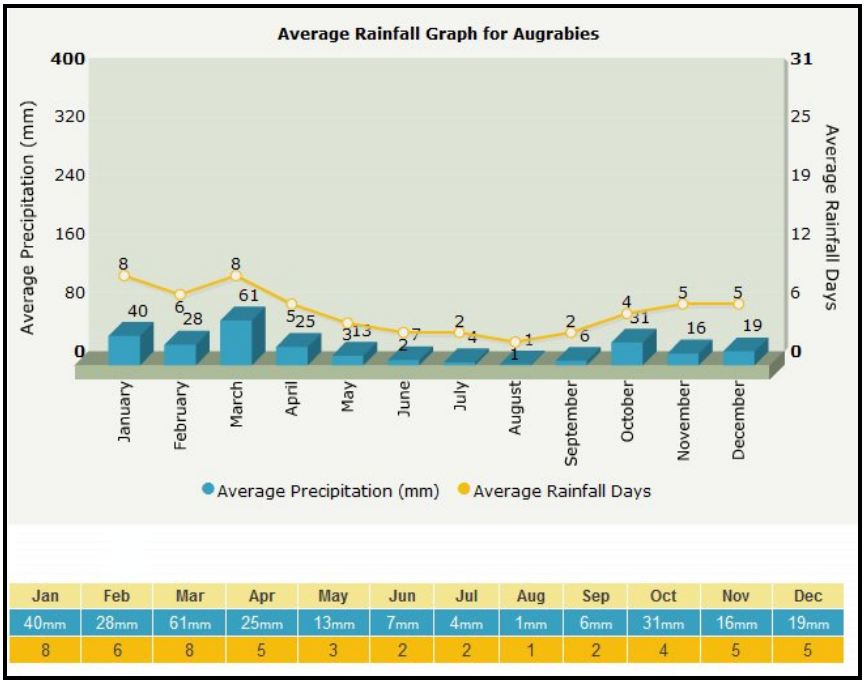


Figure 7. Land-type map of the area west of Augrabies, Northern Cape Province, with Rooipad 15/9 shown as having land-type Ag2. (Source: http://www.agis.agric.za/agisweb/viewer.htm?pn=2015)

the surface of the soil is littered with pebbles and small rocks with a high proportion of quartz pebbles (Figure 6). It is the conclusion of the author that the landscape and soils of the western sector indicate that the land-type is more closely allied to the Fb2 land-type which, according to the map in Figure 7, occurs west and north of the study area, rather than to the Ag2 land-type as given on the map. The shallow Mispah and Glenrosa soil forms, typical of the Fb2 land-type are well represented in the western sector. In contrast the eastern sector has somewhat deeper soils and does not have as many open areas with scattered pebbles and small rocks. From field-observations it was concluded that the eastern sector of the study area is appropriately classified as land-type Ag2. A more detailed study of the soils and landforms at a local scale would be necessary to substantiate these observations. The importance of these distinctions between the land-types is how they are reflected in the vegetation. This is discussed below in section 5

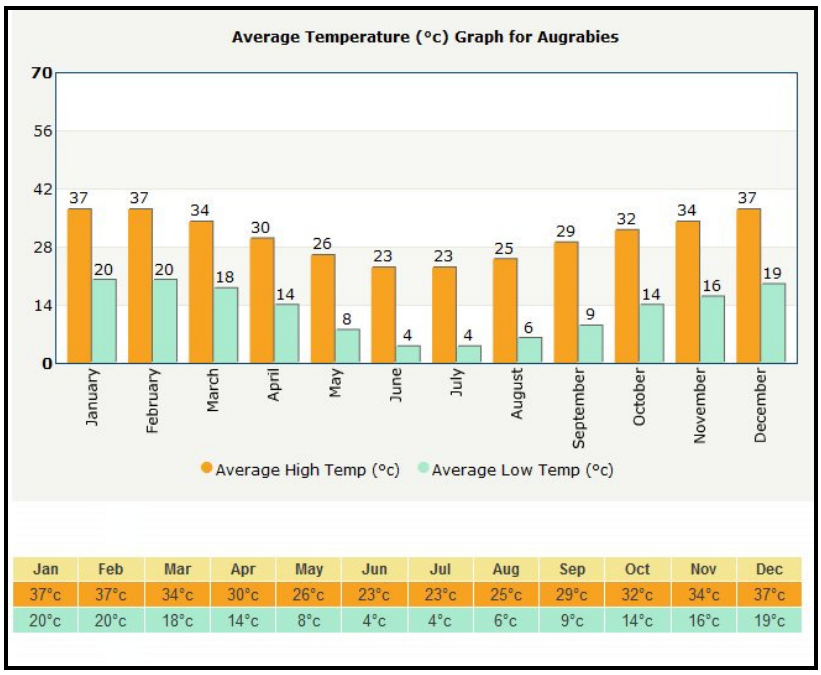
3.3 Climate

Rooipad 15/9 falls within the Nama-Karoo Biome and has an arid climate. Rainfall peaks in March (autumn). Augrabies, the nearest town with measured rainfall and temperatures has a mean annual rainfall of 251 mm (Figure 8), mean summer daytime temperature (October to March) of 35 °C and mean winter night temperature (April to September) of 5 °C. (Figure 9).



Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
40mm	28mm	61mm	25mm	13mm	7mm	4mm	1mm	6mm	31mm	16mm	19mm
8	6	8	5	3	2	2	1	2	4	5	5

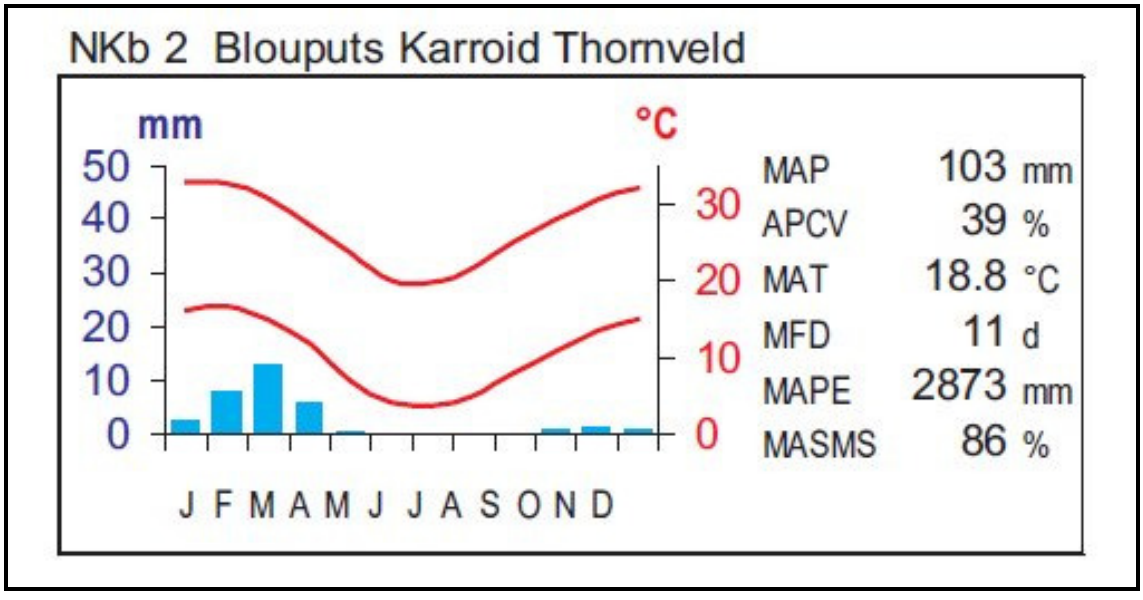
Figure 8. Average rainfall for Augrabies (Source: http://www.worldweatheronline.com/Augrabies-weather-averages/Northern-Cape/ZA.aspx)



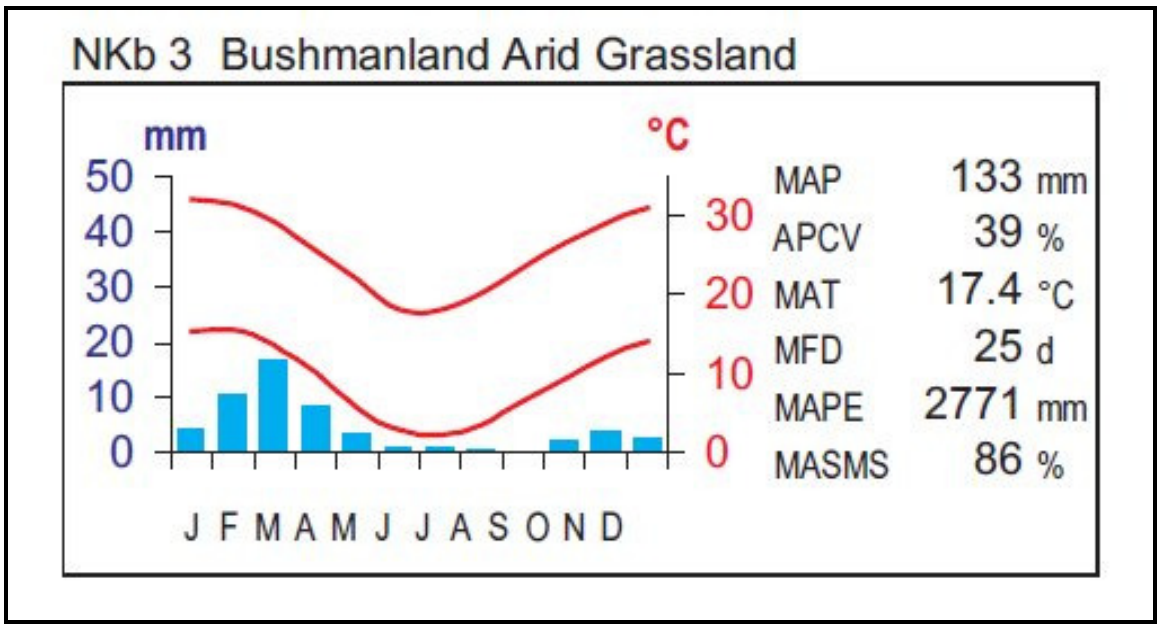
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
37°c	37°c	34°c	30°c	26°c	23°c	23°c	25°c	29°c	32°c	34°c	37°c
20°c	20°c	18°c	14°c	8°c	4°c	4°c	6°c	9°c	14°c	16°c	19°c

Figure 9. Average temperatures for Augrabies (Source: http://www.worldweatheronline.com/Augrabies-weather-averages/Northern-Cape/ZA.aspx).

Climate diagrams for the two vegetation types found in the study area, Blouputs Karroid Thornveld (Figure 10a) and Bushmanland Arid Grassland (Figure 10b) from Mucina *et al.* (2006) show that the mean annual precipitation, as a measure of aridity, is slightly above half to less than half that occurring at Augrabies. This indicates that aridity increases north and west of Augrabies with the study area distinctly more arid than Augrabies.



10a



10b

Figure 10. Climate diagram for Blouputs Arid Grassland (10a) and Bushmanland Arid Grassland (10b) (from *Mucina et al*., 2006) showing MAP – Mean Annual Precipitation; ACPV = Annual Precipitation Coefficient of Variance; MAT = Mean Annual Temperature; MFD = Mean Frost Days; MAPE = Mean Annual Potential Evaporation; MASMA = Mean Annual Soil Moisture Stress.

4. Evaluation Method

The study area at Rooipad 15/9 Augrabies was visited on 23 & 24 February 2012. The site had experienced some recent rain but there was no standing or running water at the time of the field survey. Some parts of the site had also obviously had more rain than others. The site was traversed by vehicles and on foot and a Garmin ® GPSMap 62S was used to track the route and record selected waypoints of which there were 33 recorded in the study area (Figures 18 & 19) (Table 1). Observations were made at the respective waypoints and recorded with a photographic record of the vegetation and selected plant species. Particular attention was given to the possibility of finding endemic and 'Red Data' species.

The recorded information formed the basis for assessing the sensitivity of the study area to inform the optimal placement of the proposed photovoltaic (PV) panels.

5. The Vegetation

5.1 General description

Rooipad 15 and its environs fall within the Nama Karoo Biome, Bushmanland and West Griqualand Bioregion (Rutherford & Westfall, 1994; Mucina *et al*., 2006). Two vegetation

types are found in the study area: Bushmanland Arid Grassland and Blouputs Karroid Thornveld. Lower Gariep Broken Veld and Lower Gariep Alluvial Vegetation occur in the region but do not occur in the study area.

5.2 Blouputs Karroid Thornveld

Blouputs Karroid Thornveld occurs from Augrabies westwards on the plain above Blouputs Valley into southern Namibia. It is characterized by an upper stratum of *Acacia mellifera* subsp. *detinens* (blackthorn; swarthaak) shrubs to small trees which occur as scattered individuals and occasionally in clusters on the undulating rocky plains. An open lower stratum of shrubs occurs which, according to Mucina *et al*. (2006) has the prominent shrubs *Phaeoptilum spinosum*, *Boscia foetida* and *Cadaba aphylla*. Of these *P. spinosum* was not recorded in this survey whereas, *C. aphylla* was found occasionally and *B. foetida* subsp. *foetida* was relatively common and widespread. A stratum of low shrubs, herbs and grasses is found where cover varies from almost no vegetation (bare areas) to areas with more than 80% cover, mainly due to the presence of grasses such as *Stipagrostis* sp. The Blouputs Karroid Thornveld vegetation type was found at all the sample waypoint points in the western sector which includes the PV1 focus area (Figures 11 & 12).

Figure 11. Typical landscape of Blouputs Karroid Thornveld in the PV1 area.

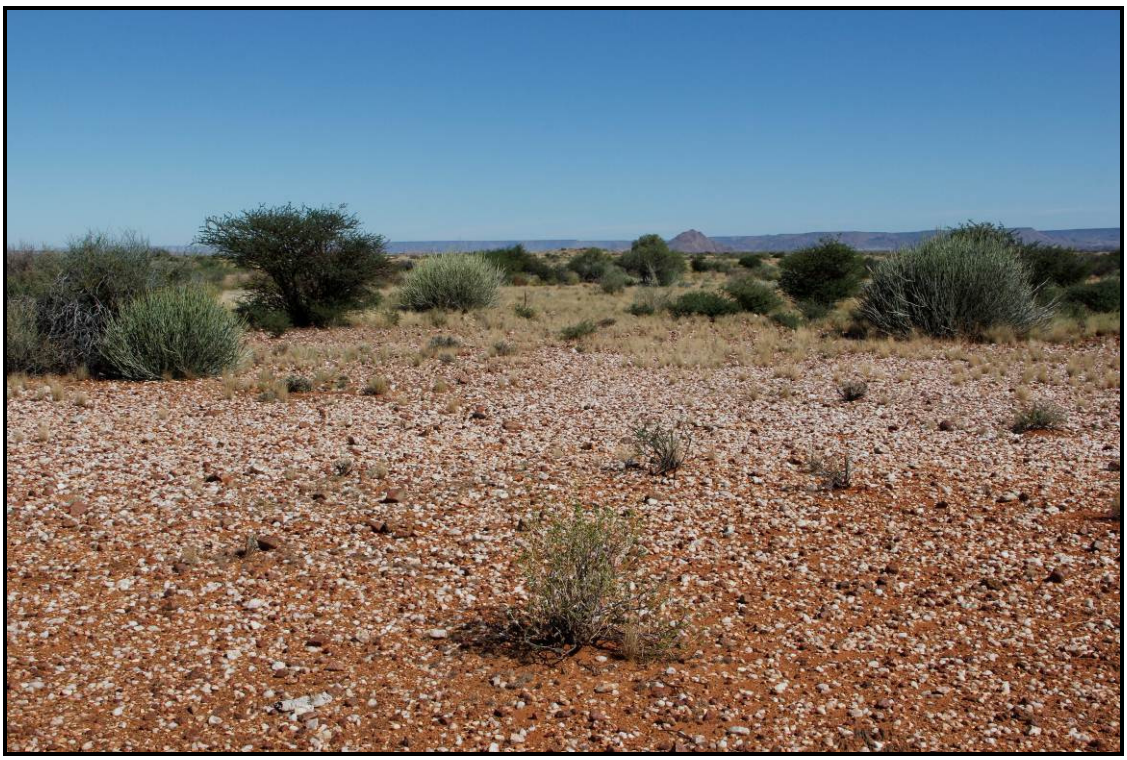


Figure 12. Some parts of the PV1 area have a high cover of pebbles on the soil surface, with sparse vegetation.

Figure 13. Mid-dense to dense vegetation along a seasonal drainage line near the PV1 area.

Species recorded in the survey in the western sector away from the seasonal drainage lines include; *Acacia mellifera* subsp. *detinens* (blackthorn), *Aloe claviflora* (Kraal aloe), *Aptosimum marlothii* (Koffiepit), *Asparagus cooperi, Boscia foetida* subsp. *foetida, Enneapogon scaber* (Rock Nine-awned Grass), *Eriocephalus aspalathoides, Eriocephalus* cf. *microphyllus* var. *pubescens, Euphorbia gregaria, Hermannia modesta*, *Indigofera pechuelii, Leucosphaera bainesii*, perdebossie, silwerbossie), *Lycium bosciifolium* (Slapkriedoring), *Microloma incanum, Monechma genistifolium* subsp. *australe, Monechma* sp. (white flower), *Monsonia* (*Sarcocaulon*) *crassicaule* (Bushman Candle), *Parkinsonia africana* (Wild green-hair tree), *Rhigozum trichotomum* (three thorn), *Sarcostemma viminale, Stipagrostis ciliata* (Tall Bushman Grass), *Stipagrostis obtusa* (Small Bushman Grass) and *Zygophyllum rigidum.*

At waypoint APV6, west of the PV1 focus area is a well-defined seasonal drainage line (Figure 13). The *A. mellifera* subsp. *detinens* trees are taller here and the grasses are taller and more abundant than elsewhere. The species composition of the drainage–line vegetation is similar to that found away from the drainage-lines. Notable exceptions are the presence of *Hibiscus elliottiae*, *Montinia caryophyllaceae* (abundant), *Cenchrus ciliaris* (Foxtail Buffalo Grass) and the tree *Ehretia rigida*. *Aptosimum marlothii* and *Indigofera pechuelii* are also more abundant along the edges of the drainage lines.

Owing to the concentration of plant species and the habitat associated with the seasonal drainage lines are considered more botanically sensitive than the areas away from the drainage lines on the relatively flat, open plains. Therefore, the seasonal drainage lines should be avoided or impacted as little as possible by the proposed PV facility.

From the samples taken in the PV1 area in the western sector, the author is of the opinion that the distribution of Blouputs Karroid Thornveld should be extended eastwards, covering a larger area of Rooipad 15/9 than shown in the vegetation map in Figure 4. A re-interpreted vegetation map is presented in Figure 14 where Blouputs Karroid Thornveld is shown to cover virtually the whole of the western sector of Rooipad 15/9, including PV1, and approximately the north-western quadrant of the eastern sector. Sample waypoints representing Blouputs Karroid Thornveld are given in Table 1 and Figure 19.

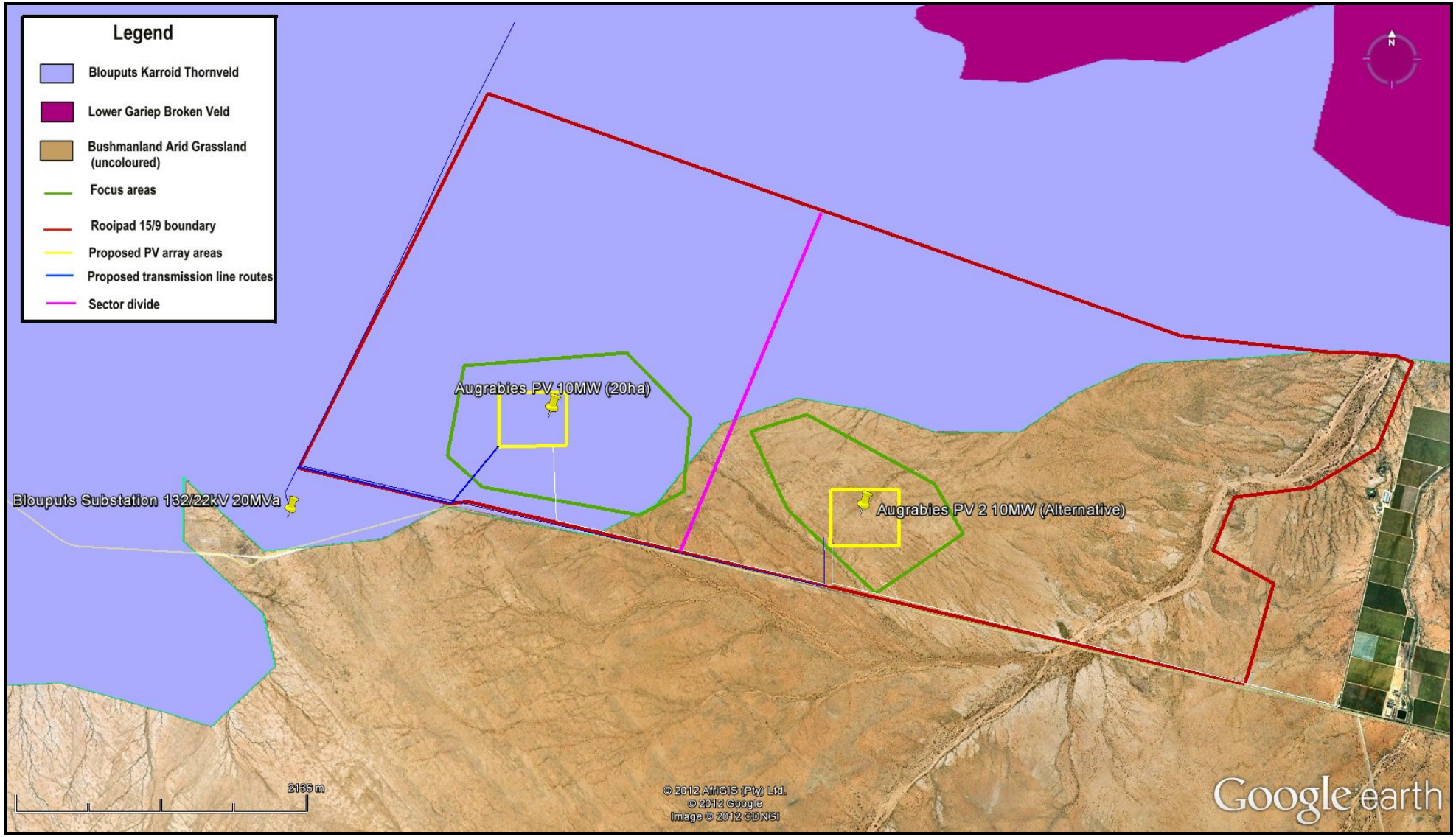


Figure 14. Revised vegetation map of the Rooipad 15/9 area west of Augrabies. Blouputs Karroid Thornveld is considered to be more extensive eastwards than was mapped by Mucina et al. (2005). The whole of the PV1 focus area is within Blouputs Karroid Thornveld and the whole of the PV2 focus area is within Bushmanland Arid Grassland.

Waypoint	Latitude	Longitude	Vegetation Type (as mapped in Figure 14) Blouputs Karroid Thornveld = NKb2; Bushmanland Arid Grassland = NKb3
APV1	S 28 36 41.1	E 20 13 47.5	NKb2
APV2	S 28 36 38.7	E 20 13 49.1	NKb2
APV3	S 28 36 36.5	E 20 13 50.5	NKb2
APV4	S 28 36 34.2	E 20 13 50.6	NKb2
APV5	S 28 36 31.1	E 20 13 48.7	NKb2
APV6	S 28 36 28.9	E 20 13 45.5	NKb2
APV7	S 28 36 26.8	E 20 13 50.1	NKb2
APV8	S 28 36 22.6	E 20 13 51.1	NKb2
APV9	S 28 36 17.9	E 20 13 51.4	NKb2
APV10	S 28 36 13.9	E 20 13 49.9	NKb2
APV11	S 28 36 15.3	E 20 13 55.2	NKb2
APV12	S 28 36 19.5	E 20 13 59.8	NKb2
APV13	S 28 36 24.3	E 20 14 06.5	NKb2
APV14	S 28 36 25.6	E 20 14 07.9	NKb2
APV15	S 28 36 26.6	E 20 14 10.1	NKb2
APV16	S 28 36 28.8	E 20 14 01.2	NKb2
APV17	S 28 36 32.9	E 20 13 53.6	NKb2
APV18	S 28 36 40.2	E 20 13 39.2	NKb2
APV19	S 28 36 44.7	E 20 12 58.7	NKb2
APV20	S 28 36 17.9	E 20 14 14.4	NKb2
APV21	S 28 36 07.2	E 20 14 14.7	NKb2
APV22	S 28 36 24.4	E 20 14 29.9	NKb2
APV23	S 28 36 25.4	E 20 14 35.4	NKb2
APV24	S 28 36 28.0	E 20 14 47.1	NKb3
APV25	S 28 36 30.6	E 20 15 07.5	NKb3
APV26	S 28 36 33.9	E 20 15 20.1	NKb3
APV27	S 28 36 44.8	E 20 15 15.8	NKb3
APV28	S 28 36 49.6	E 20 15 14.1	NKb3
APV29	S 28 36 50.4	E 20 15 34.5	NKb3
APV30	S 28 36 44.3	E 20 15 35.2	NKb3
APV31	S 28 36 35.4	E 20 15 32.5	NKb3
APV32	S 28 36 34.2	E 20 15 34.6	NKb3
APV33	S 28 36 38.7	E 20 14 41.4	NKb3
APV34	S28 36 29.3	E20 14 14.1	NKb3

5.3 Bushmanland Arid Grassland

Bushmanland Arid Grassland is much more widespread than Blouputs Karroid Thornveld. It occurs over a wide expanse in the Northern Cape Province from the Bushmanland Basin in the south to the vicinity of the Orange River in the north and from Prieska in the east to Aggeneys in the west (Mucina *et al.* 2006). At Augrabies it mixes with Lower Gariep Broken Veld and, as at Rooipad 15/9, with Blouputs Karroid Thornveld. It has numerous plant species in common with Blouputs Karroid Thornveld but tends to be grassier with sparse emergent shrubs (Figure 15).

The PV2 (alternative) focus area lies well within Bushmanland Arid Grassland (Figures 15, 16 and 18). The soils are deeper than those found in the western sector, consisting of red sand. Open, bare patches occur occasionally and calcrete was also noted at the surface in places. As mentioned above the species composition of Bushmanland Arid Grassland at Rooipad 15/9 is similar to that of Blouputs Karroid Thornveld. The major difference is in the abundance of the 'white grasses' (*Stipagrostis ciliata* and Stipagrostis *obtusa*) and their cover. *Boscia albitrunca* (Shepherd's Tree) (Figure 17) is also more prevalent in the eastern sector and its related species, *Boscia foetida* subsp. *foetida* is also present. These trees are generally very slow growing and old and where possible should be conserved. *Boscia albitrunca* is a protected tree species under the National Forests Act, Act 84 of 1998 as amended, section 12(1)(d) read with section (15(1) and section 62(2)(c). Any disturbance of Boscia albitrunca would require a license from the Department of Agriculture, Fisheries and Forestry (DAFF). Additional species found in the eastern sector which were not found in the western sector include *Hoodia gordonii* and *Kleinia longiflora*.

Sample waypoints representing Bushmanland Arid Grassland are given in Table 1 and Figure 18.

There are fewer seasonal drainage lines in the eastern sector which includes the PV2 focus area. A well-defined drainage line rises north of the rocky ridge described above and flows in a south-westerly direction. A second drainage line is found in the northeast part of the PV2 focus area. In the upper reaches of these drainage lines *Rhigozum trichotomum* shrubs for open to mid-dense thickets. As the drainage lines become better defined the vegetation is taller with more trees (*A. mellifera* subsp. *detinens*) and mid-high shrubs.

Figure 15. A typical view of the *Stipagrostis*-dominated grassland (Bushmanland Arid Grassland) in the north part of the PV2 focus area.

Figure 16. *Euphorbia gregaria* occurs prominently in the Bushmanland Arid Grassland but is also found in Blouputs Karroid Thornveld.

Figure 17. *Boscia albitrunca* (Shepherd's Tree) found scattered throughout the study area but more prominently in the Bushmanland Arid Grassland.

5.4 Conservation Status

The National Spatial Biodiversity Assessment (NSBA) (Rouget *et al.* 2004) rated both the Blouputs Karroid Thornveld and Bushmanland Arid Grassland as **LEAST THREATENED**. There has been low transformation of these vegetation types by agriculture and infrastructure; the main impact has been grazing. Blouputs Karroid Thornveld is also well conserved within the Augrabies Falls National Park.

The study area also does not fall within a proclaimed threatened ecosystem (Government Gazette No. 34809, 2011).

5.5 Disturbance regime

Rooipad 15/9 has been used for grazing of cattle and sheep but at the time of the survey there were no livestock present. The vegetation is generally in moderate to good condition but there are signs in some areas of overgrazing.

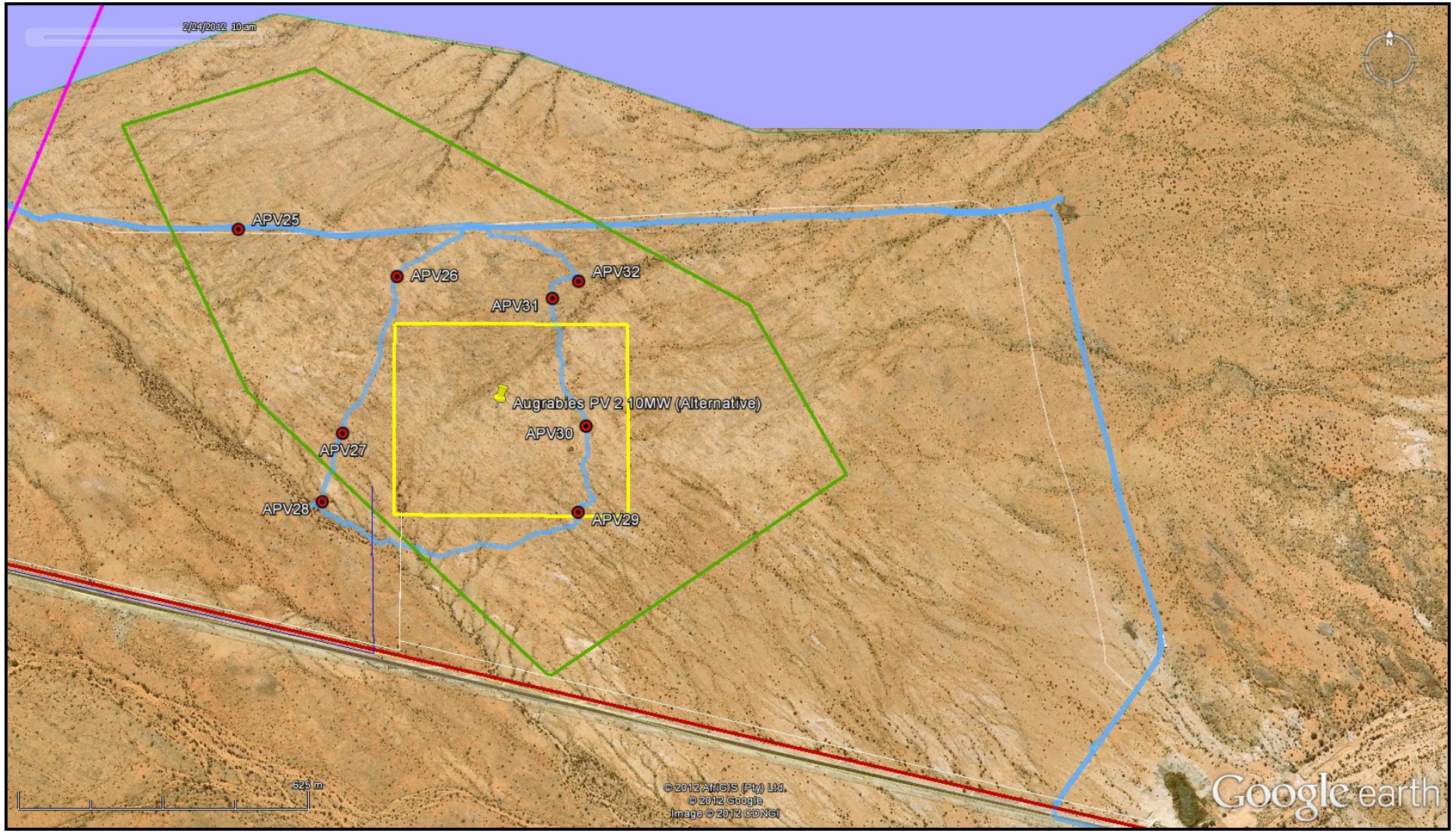


Figure 18. Sample tracks (blue line) and waypoints in the PV2 focus area (green) recorded during the botanical survey. The proposed footprint area is shown with a yellow boundary.

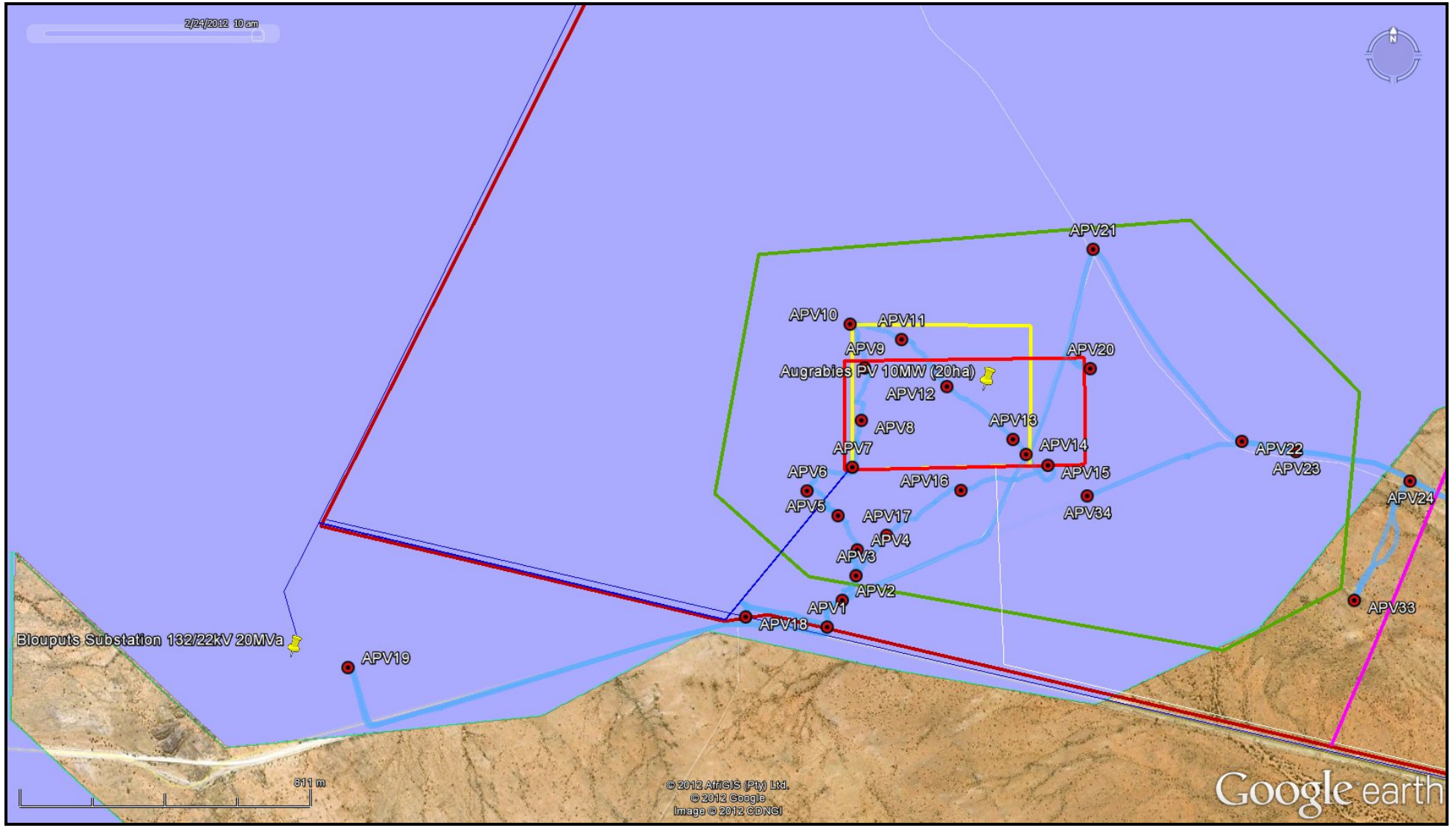


Figure 19. Sample tracks (blue line) and waypoints in the PV1 focus area (green) recorded during the botanical survey. The proposed footprint area is shown with a yellow boundary. The recommended 'variation alternative' footprint to accommodate for botanical constraints is indicated with a red boundary.

6. Proposed Photovoltaic Power Plant and Potential Impacts

6.1 Location of the PV array

The proposed photovoltaic (PV) power would cover an area of marginally less than 20 ha, together with supporting infrastructure. Ideally the PV facility would be built in a rectangular 'block' of 400 x 500 m. The two proposed sites for the PV footprint in PV1 and PV2 were examined in relation to the vegetation found on the sites. The most important consideration from a botanical viewpoint is to avoid the seasonal drainage lines or strongly mitigate for impacts on those areas. They should ideally be buffered by an exclusion zone of at least 30 m from the 'edge' of the drainage line.

Both PV1 and PV2 are not botanically highly sensitive and on balance it would be preferable to place the proposed PV facility in the PV2 area which supports Bushmanland Arid Grassland, a much more widespread vegetation type than Blouputs Karroid Thornveld. However, there are other constraints (e.g. negative visual impacts (A. van der Stok pers. comm.)) with respect to the PV2 area. Consequently the PV1 area (which is the preferred alternative) is favoured on visual and engineering criteria. There would be greater loss of woody plants (mainly *Acacia mellifera* subsp. *detinens*) in the PV1 area than in the PV2 area but since these species are not threatened and are widespread the negative impacts would only be locally high but generally low in the greater context.

The proposed 'rectangular' footprint of the proposed 20 ha PV facility within the PV1 area was thus examined in detail as to how it would affect the vegetation. It was found that it would negatively impact certain drainage lines. It is thus recommended that the footprint layout be so that it would not compromise the PV facility but that would allow the seasonal drainage lines to be avoided and buffered. The proposed layout based on botanical / seasonal drainage line considerations is presented in Figure 19. The yellow footprint area (within the larger PV1 focus area) is the originally proposed PV facility footprint and the proposed variation alternative based on the botanical investigation is shown as a red outline. Co-ordinates of the proposed 'variation alternative' are given in Table 2. (It should be noted that this is not a fixed design but a proposal that should be flexible enough to cause least botanical impacts).

Table 2. Co-ordinates of the corners of the proposed 'variation alternative' area.

Corner	Latitude	Longitude
Northwest	S 28°36'17.31"	E 20°13'49.32"
Southwest	S 28°36'27.08"	E 20°13'49.31"
Northeast	S 28°36'16.98"	E 20°14'13.68"
Southeast	S 28°36'26.50"	E 20°14'13.82"

6.1.1 Mitigation for PV construction

The developer has agreed to a 'light' construction approach as a mitigation measure. This is encouraged but there will still be loss of numerous shrubs and trees, notably old specimens of both *Boscia foetida* subsp. *foetida* and *Boscia albitrunca* which would be unavoidable. It would not be possible to transplant these trees (see above for permit requirement). There are also numerous patches (colonies) of *Aloe claviflora* (Figure 20) in the PV1 area. These plants can be relatively easily relocated. A 'search and rescue' operation should be undertaken prior to construction during which *Aloe claviflora* plants are collected and relocated to other areas of similar habitat on Rooipad 15/9 that would be unaffected by construction. A permit would be required from Northern Cape Department of Environment and Nature Conservation for this purpose since all *Aloe* spp. are protected in the Northern Cape Province.

Figure 20. *Aloe claviflora* (kraal aloe) which grows in small colonies.

6.2 Alignment of water pipeline

A water pipeline will be required to bring water to the PV facility for washing the panels as well as to provide irrigation for indigenous trees used for screening. The proposed alignment would be through Blouputs Karroid Thornveld and is anticipated to have a low negative impact.

6.2.1 Mitigation for water pipeline construction

Where the water pipeline may cross seasonal drainage lines it should be buried so as not to impede water flow. In addition, if the pipeline is to be buried, the smallest possible trench should be made and the surface soil not compacted after replacement to allow vegetation to re-establish. No artificial seeding of the pipeline routes should be carried out since local grass species will recolonize the disturbed soil.

6.3 Overhead transmission lines

Overhead 22 kVA power lines would link the PV plant to the Blouputs Sub-station (Figures 14 &19). The anticipated impact on the natural vegetation is low negative. Care should, however, be taken during construction to avoid unnecessary damage to any trees on the route.

6.4 Access and internal roads

An access road of 400 m is envisaged to connect the PV facility to the R 359 road. This access road is proposed to be 6 m wide and concreted. The internal roads are planned to be 4 m wide and concreted.

The concreting o the access and internal roads is anticipated to have a high negative impact on the hydrology of the site and consequently on the vegetation. The gritty nature of the soil is such that it does not produce a large amount of dust. The soil is also shallow with bedrock close to the surface, providing a stable ‘foundation’. It is therefore recommended that the roads should not be concreted but that where necessary, concreted causeways should be constructed where the roads cross seasonal drainage lines. It is the opinion of the author that this approach would strongly avoid the negative impacts of hard-surfaced roads on the site.

6.5 Visual screening using trees

If visual screening of the PV facility is required, two options can be recommended. Firstly, it would be ideal to use local trees and in this case *Acacia mellifera* subsp. *detinens*. However, this species is very slow growing and would plants would have to be grown from seed since they would not transplant well. The second option is to use *Searsia* (*Rhus*) *pendulina* (White karee) trees. This species is found along the Orange River and is successfully used as a boundary and wind-break tree at vineyards in the Augrabies area e.g. at Vuursteenkop (Figure 21). The latter species is relatively fast-growing but would require irrigation to sustain its growth.

Figure 21. *Searsia* (*Rhus*) *pendulina* grown at Vuursteenkop near the Rooipad 15/9 study area.

I strongly believe that a visual screening intervention using trees that are not native to the site itself (e.g. *Searsia pendulina*) would have a much more negative effect than if the PV facility was simply placed in the landscape and the existing trees and shrubs allowed to provide whatever screening they would. This opinion is applicable to trees on the site itself and along the R 359 road (in the road reserve) near the PV installation. I believe that planting of trees and then the necessary long-term irrigation this would entail would be an 'over-engineered' solution to a problem that is perceived to be greater than it is.

7. Direct Impact: Loss of vegetation type – Blouputs Karroid Thornveld and Bushmanland Arid Grassland

The vegetation present at Rooipad 15/9, Blouputs Karroid Thornveld and Bushmanland Arid Grassland is classified as **Least Threatened**. No threatened species are known to occur in the study area and none are expected to be found. The solar array should be limited to the recommended area (as in Figure 19) which avoids the more sensitive seasonal drainage lines. Mitigation is possible to a certain extent by relocating plant species such as *Aloe claviflora* and by avoiding hard-surfacing of roads.

The significance of impacts on the flora and vegetation at Rooipad15/9 during the construction and operational phases is given in Table 3. In the case of the 'No Go' alternative not much would change and impacts would be **Low Negative.** At a local scale, if the proposed footprint in PV1 is used the impact would be **Moderate Negative** due to impacts on the drainage lines. With mitigation as outlined and implementation of the 'variation alternative' (see Figure 19) the impact would be **Low Negative** (Appendix 1).

The alternative area (PV2) has been rejected but by way of comparison, potential impacts of the PV facility would be **Low Negative** without and with mitigation.

Table 3. Impact and Significance – Loss of natural vegetation and habitat during construction and operational phases of the PV facility, roads and power-lines

Actions	Alternative	Impact	Extent	Duration	Intensity	Significance	Status	Probability of occurrence	Confidence
	"No Go"	Loss of natural vegetation	Local	Long-term	Low	Low	-ve	Probable	High
Without mitigation	Alt 1 (20 ha – preferred)	Loss of natural vegetation	Local	Long- term	Moderate	Moderate	-ve	Probable	High
With mitigation	Alt 1 (20 ha - preferred)	Loss of natural vegetation	Local	Long-term	Low	Low	-ve	Probable	High
Without mitigation	Alt 2 (20 ha)	Loss of natural vegetation	Local	Long- term	Low	Low	-ve	Probable	High
With mitigation	Alt 2 (20 ha)	Loss of natural vegetation	Local	Long-term	Low	Low	-ve	Probable	High

8. Indirect and Cumulative Impacts

No indirect impacts on the flora and vegetation of the study area were noted. As for cumulative impacts, the author is not aware of any other PV facilities implemented or planned for location within Blouputs Karroid Thornveld. Cumulative impacts on this vegetation type from development of solar energy facilities are therefore considered to be very low.

A number of PV facilities are planned in other parts of the Northern Cape Province, and specifically in Bushmanland Arid Grassland, in the Copperton area (Helme, 2010; McDonald 2012 a, b & c). However, the extensive range of Bushmanland Arid Grassland makes the cumulative impact of these facilities negligible.

9. General Assessment and Recommendations

- The vegetation at Rooipad 15/2 Augrabies consists of two types, Blouputs Karroid Thornveld in the north and west and Bushmanland Arid Grassland in the south and east. The vegetation map as drawn by Mucina *et al.* (2005) was re-interpreted based on the field survey in this study. Blouputs Karroid Thornveld is more extensive on Rooipad 15/9 than previously thought. Both vegetation types have a Least Threatened conservation status.

- The PV2 focus area would be the most suitable from a botanical perspective but only marginally so. Visual and engineering constraints strongly favoured the PV1 focus area.

- The preferred site for the photovoltaic facility at Rooipad 15/9 in the PV1 focus area is endorsed from a botanical perspective but with some modifications. The intention of the modification of the PV footprint is to AVOID seasonal drainage lines as much as possible which, as a mitigation measure, will lower the impacts to **Low Negative**.

- No threatened species (Red List) species have been recorded for the area.

- *Boscia albitrunca* trees, a nationally protected species were found as scattered individuals throughout the study area. Only once a firm proposal for the site of the PV installation is determined would it be feasible to locate and mark all B. albitrunca trees that would be affected. That information would be required for application for a permit from DAFF to allow for removal of the trees within the PV footprint.

- *Aloe claviflora* and any other *Aloe* species that may be affected could be transplanted in similar unaffected habitat. It would be necessary to apply for permission for this activity from the Northern Cape Department of Environment and Nature Conservation.

- It is recommended that as part of the Environmental Management Programme for the project that a list of protected plant species according to the Northern Cape Nature Conservation Act, Act 9 of 2009, should be compiled and submitted to the Northern Cape Department of Environment and Nature Conservation for issuing of a license to permit impacting these species.

- The proposed solar energy plant at Rooipad 15/9 Augrabies is supported with no reservations apart from those noted above.

- Planting of trees is not advocated either close to the PV infrastructure or along the R359 road.

10. Conclusions

The proposed construction of a ± 20 ha solar energy facility at Rooipad 15/9 near Augrabies in the Northern Cape Province would be located in an area of relatively low botanical sensitivity with low threats. The direct impacts on the vegetation and flora would be confined to the site and as long as the recommended mitigation measures are implemented, the development can be supported from a botanical viewpoint.

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Appendix 1: Impact Assessment Methodology

The assessment of impacts needs to include the determination of the following:

- The nature of the impact – see Table 1.1
- The magnitude (or severity) of the impact – see Table 1.2
- The likelihood of the impact occurring - see Table 1.2

The degree of confidence in the assessment must also be reflected.

- ***Table 1.1Impact assessment terminology***

Term	Definition
Impact nature	
Positive	An impact that is considered to represent an improvement on the baseline or introduces a positive change.
Negative	An impact that is considered to represent an adverse change from the baseline, or introduces a new undesirable factor.
Direct impact	Impacts that result from a direct interaction between a planned project activity and the receiving environment/receptors (e.g. between occupation of a site and the pre-existing habitats or between an effluent discharge and receiving water quality).
Indirect impact	Impacts that result from other activities that are encouraged to happen as a consequence of the Project (e.g. in-migration for employment placing a demand on resources).
Cumulative impact	Impacts that act together with other impacts (including those from concurrent or planned future third party activities) to affect the same resources and/or receptors as the Project.

Assessing significance

There is no statutory definition of '*significance*' and its determination is, therefore, somewhat subjective. However, it is generally accepted that significance is a function of the magnitude of the impact and the likelihood of the impact occurring. The criteria used to determine significance are summarized in *Table 1.2*

- ***Table 1.2Significance criteria***

Impact magnitude	
Extent	*On-site* – impacts that are limited to the boundaries of the rail reserve, yard or substation site. *Local* – impacts that affect an area in a radius of 20km around the development site. *Regional* – impacts that affect regionally important environmental resources or are experienced at a regional scale as determined by administrative boundaries, habitat type/ecosystem. *National* – impacts that affect nationally important environmental resources or affect an area that is nationally important/ or have macro-economic consequences.
Duration	*Temporary* – impacts are predicted to be of short duration and intermittent/occasional. *Short-term* – impacts that are predicted to last only for the duration of the construction period. *Long-term* – impacts that will continue for the life of the Project, but ceases when the Project stops operating. *Permanent* – impacts that cause a permanent change in the affected receptor or resource (e.g. removal or destruction of ecological habitat) that endures substantially beyond the Project lifetime.
Intensity	BIOPHYSICAL ENVIRONMENT: *Intensity can be considered in terms of the sensitivity of the biodiversity receptor (ie. habitats, species or communities).*

	Negligible – the impact on the environment is not detectable. **Low** – the impact affects the environment in such a way that natural functions and processes are not affected. **Medium** – where the affected environment is altered but natural functions and processes continue, albeit in a modified way. **High** – where natural functions or processes are altered to the extent that it will temporarily or permanently cease. ***Where appropriate, national and/or international standards are to be used as a measure of the impact.*** *Specialist studies should attempt to quantify the magnitude of impacts and outline the rationale used.* SOCIO-ECONOMIC ENVIRONMENT: *Intensity can be considered in terms of the ability of project affected people/communities to adapt to changes brought about by the Project.* **Negligible** – there is no perceptible change to people's livelihood **Low** - People/communities are able to adapt with relative ease and maintain pre-impact livelihoods. **Medium** - Able to adapt with some difficulty and maintain pre-impact livelihoods but only with a degree of support. **High** - Those affected will not be able to adapt to changes and continue to maintain-pre impact livelihoods.
Impact likelihood (Probability)	
Negligible	The impact does not occur.
Low	The impact may possibly occur.
Medium	Impact is likely to occur under most conditions.
High	Impact will definitely occur.

Once a rating is determined for magnitude and likelihood, the following matrix can be used to determine the impact significance.

- ***Table 7.5Example of significance rating matrix***

SIGNIFICANCE RATING					
	LIKELIHOOD	**Negligible**	**Low**	**Medium**	**High**
MAGNITUDE	**Negligible**	**Negligible**	**Negligible**	**Low**	**Low**
	Low	**Negligible**	**Negligible**	**Low**	**Low**
	Medium	**Negligible**	**Low**	**Medium**	**Medium**
	High	**Low**	**Medium**	**High**	**High**

In *Table 7.6*, the various definitions for significance of an impact is given.

- ***Table7.6 Significance definitions***

Significance definitions	
Negligible significance	An impact of negligible significance (or an insignificant impact) is where a resource or receptor (including people) will not be affected in any way by a particular activity, or the predicted effect is deemed to be 'negligible' or 'imperceptible' or is indistinguishable from natural background variations.
Minor significance	An impact of minor significance is one where an effect will be experienced, but the impact magnitude is sufficiently small (with and without mitigation) and well within accepted standards, and/or the receptor is of low sensitivity/value.
	An impact of moderate significance is one within accepted limits and

Moderate significance	standards. The emphasis for moderate impacts is on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that 'moderate' impacts have to be reduced to 'minor' impacts, but that moderate impacts are being managed effectively and efficiently.
Major significance	An impact of major significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. A goal of the EIA process is to get to a position where the Project does not have any major residual impacts, certainly not ones that would endure into the long term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (i.e. ALARP has been applied). An example might be the visual impact of a development. It is then the function of regulators and stakeholders to weigh such negative factors against the positive factors such as employment, in coming to a decision on the Project.

Once the significance of the impact has been determined, it is important to qualify the **degree of confidence** in the assessment. Confidence in the prediction is associated with any uncertainties, for example, where information is insufficient to assess the impact. Degree of confidence can be expressed as low, medium or high.